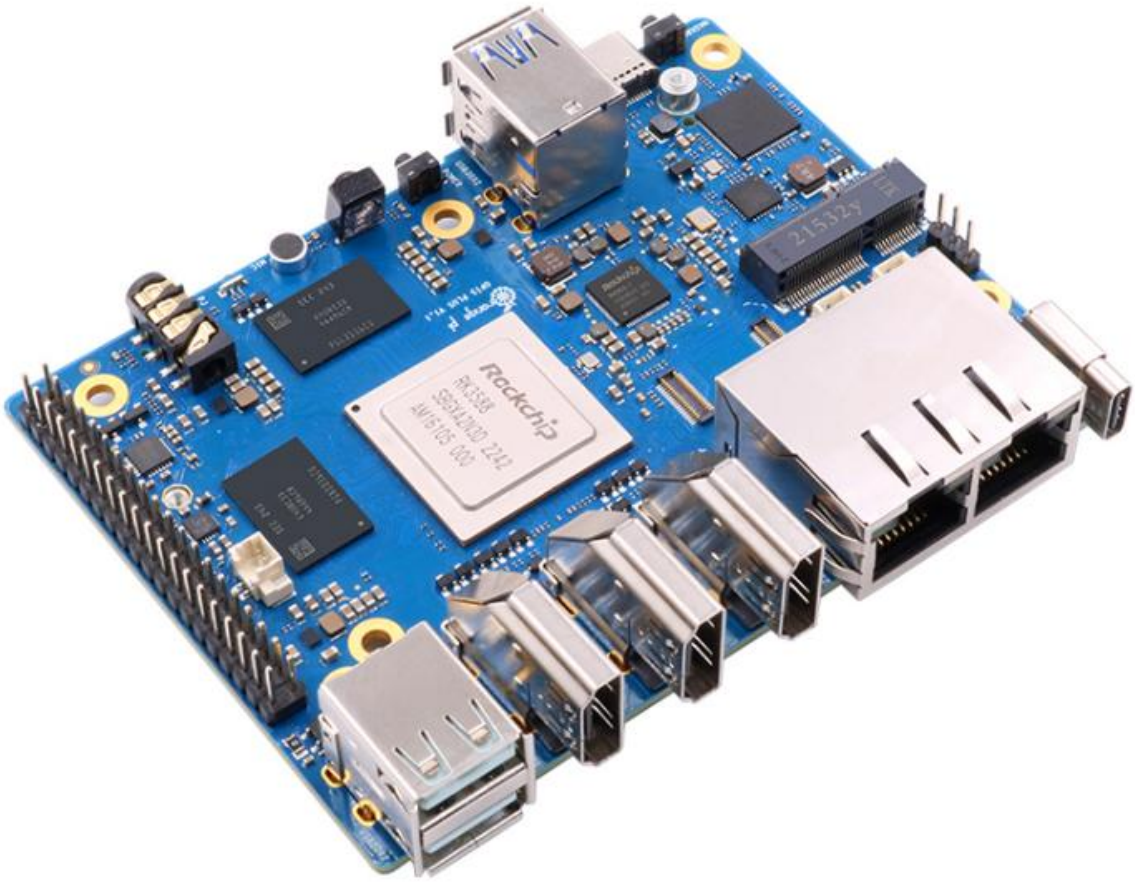
Orange Pi 5 Plus

User Manual



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1. Basic Features of Orange Pi 5 Plus

1.1. What is Orange Pi 5 Plus

Orange Pi 5 Plus adopts Rockchip RK3588 new-generation octa-core 64-bit ARM processor, specifically quad-core A76 and quad-core A55, using Samsung 8nm LP process technology, large-core main frequency up to 2.4GHz, integrated ARM Mali-G610 MP4 GPU, embedded with high-performance 3D and 2D image acceleration modules, built-in AI accelerator NPU with a computing power of up to 6 Tops, optional 4GB, 8GB, 16GB or 32GB memory, with up to 8K display processing capabilities.

Orange Pi 5 Plus introduces quite a lot of interfaces, including 2 HDMI outputs, 1 HDMI input, USB-C/DP interface, M.2 M-key PCIe3.0x4, M.2 E-key PCIe2.0x1, 2 2.5G network port, eMMC expansion interface, USB2.0, USB3.0 interface, infrared, earphone, onboard MIC, speaker, RTC and 40pin expansion pin header, etc. It can be widely used in high-end tablet, edge computing, artificial intelligence, cloud computing, AR/VR, smart security, smart home and other fields, covering various AIoT industries.

Orange Pi 5 Plus supports Orange Pi OS, the official operating system developed by Orange Pi. At the same time, it supports Android 12.1, OpenWRT, Debian11, Debian12, Ubuntu20.04 and Ubuntu22.04 and other operating systems.

1.2. Purpose of Orange Pi 5 Plus

We can use it to achieve：

- A Linux desktop computer
- A Linux web server
- Android tablet
- Android game console, etc.

Of course, there are more functions. Relying on a strong ecosystem and a variety of expansion accessories, OPi 5 Plus can help users easily realize

the delivery from idea to prototype to mass production. It is a maker, dreamer, amateur The ideal creative platform for enthusiasts.

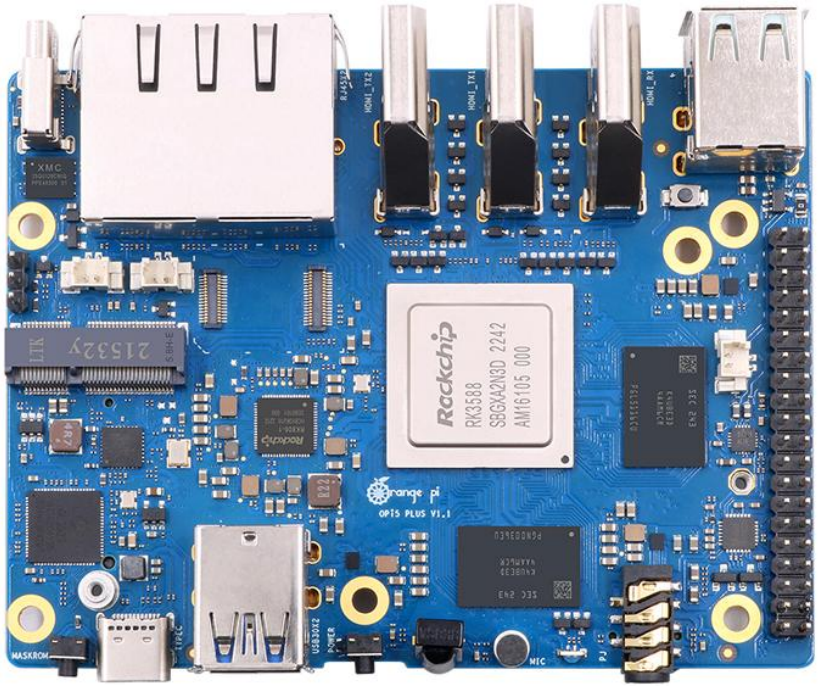
1.3. Hardware Specifications of Orange Pi 5 Plus

Hardware Specifications of Orange Pi 5 Plus	
Master chip	Rockchip RK3588(8nm LP process）
CPU	• 8-core 64-bit processor • 4 Cortex-A76 and 4 Cortex-A55 with independent NEON coprocessor • Cortex-A76 up to 2.4GHz, Cortex-A55 up to 1.8GHz
GPU	• Integrated ARM Mali-G610 • Built-in 3D GPU • Compatible with OpenGL ES1.1/2.0/3.2, OpenCL 2.2 and Vulkan 1.2
NPU	Embedded GPU supports INT4/INT8/INT16/FP16, with computing power up to 6 Tops
PMU	RK806-1
RAM	4GB/8GB/16GB/32GB optional
Storage	• QSPI Nor FLASH: 16MB/32MB • MicroSD card slot • eMMC socket, external eMMC module can be connected • M.2 2280 slot for NVMe SSD (PCIe 3.0 x4)
USB	• 2 x USB3.0 • 2 x USB2.0 • 1 x Type-C
Video	• 2 x HDMI 2.1 output, up to 8K@60FPS • 1 x Type-C (DP 1.4A) output, up to 4K@60FPS • 1 x HDMI input, up to 4K@60FPS • 1 x MIPI DSI 4 Lane output, up to 4K@60Hz
TP interface	1 x 6Pin FPC socket
Camera	1 x MIPI CSI 4 Lane

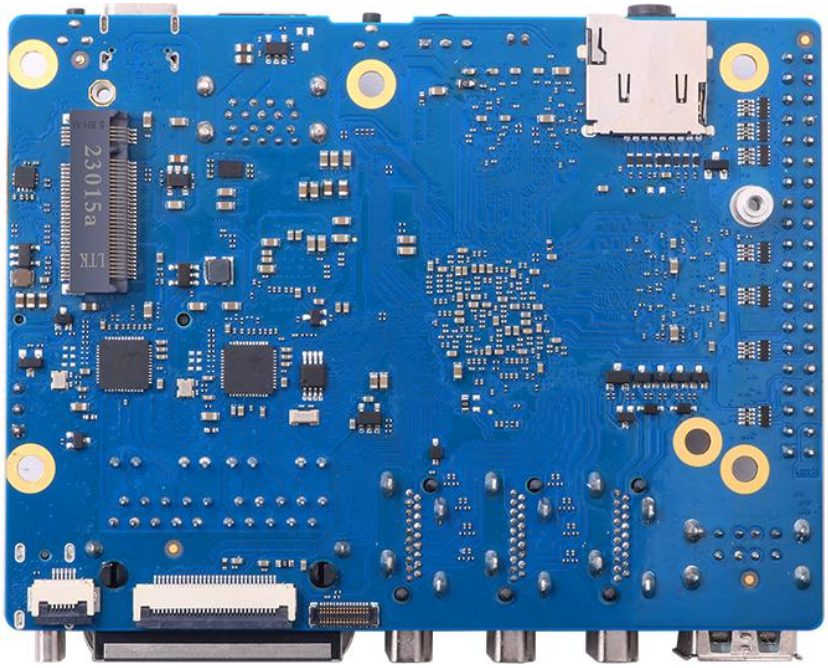
Audio	• 1 x 3.5mm headphone jack audio input/output • 1 x onboard MIC input • 2 x HDMI output • 1 x HDMI input • 1 x DP output • 1 x speaker output (2pin, 1.25mm specification)
Ethernet	2 x PCIe 2.5G Ethernet ports (RTL8125BG)
40pin expansion port	Used to expand UART, I2C, SPI, CAN, PWM, GPIO interfaces
PCIe M.2 M-KEY	PCIe 3.0 x 4 lanes, used to connect 2280 NVMe SSD solid state drive
PCIe M.2 E-KEY	Contains PCIe 2.0 x 1/PCM/UART/USB2.0 interface, supports 2230 Wi-Fi6 /BT module
Button	1 MaskROM key, 1 RECOVERY key, 1 power on/off key
Powered supply	Support Type-C power supply, 5V@4A
Infrared receiver	1 x infrared receiver
LED	RGB LED three-color indicator light
Fan interface	2pin, 1.25mm specification, used to connect 5V fan, support PWM control switch and speed
RTC battery interface	2pin, 1.25mm specification, used to power the RTC module
Debugging	3pin debug serial port (UART)
Supported OS	Orangepi OS(Droid)、Orangepi OS(Arch)、Orangepi OS(OH)、Ubuntu20.04、Ubuntu22.04、Debian11、Debian12、OpenWRT and Android12
Introduction of Appearance Specifications	
Product Size	100mm*75mm
Weight	86.5g
rangePi™ is a registered trademark of Shenzhen Xunlong Software Co., Ltd.	

1.4. Top view and bottom view of Orange Pi 5 Plus

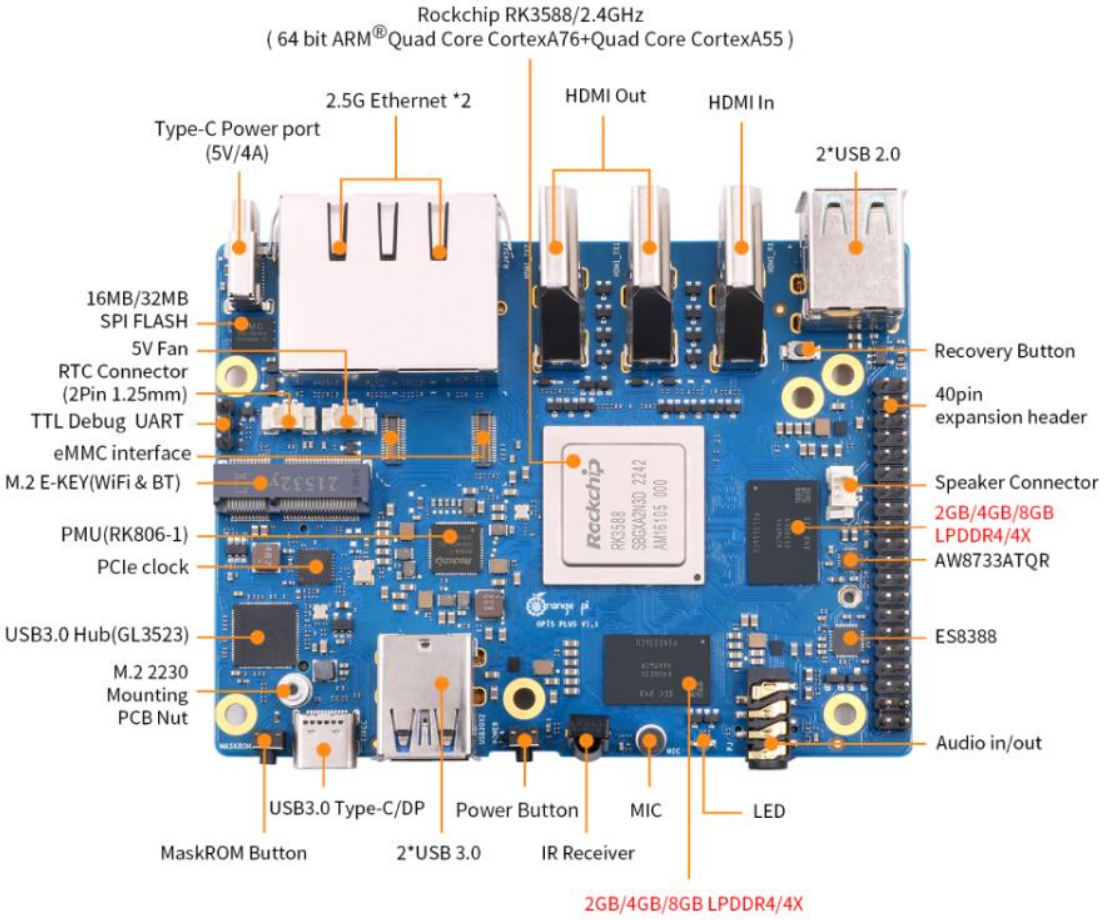
Top view：



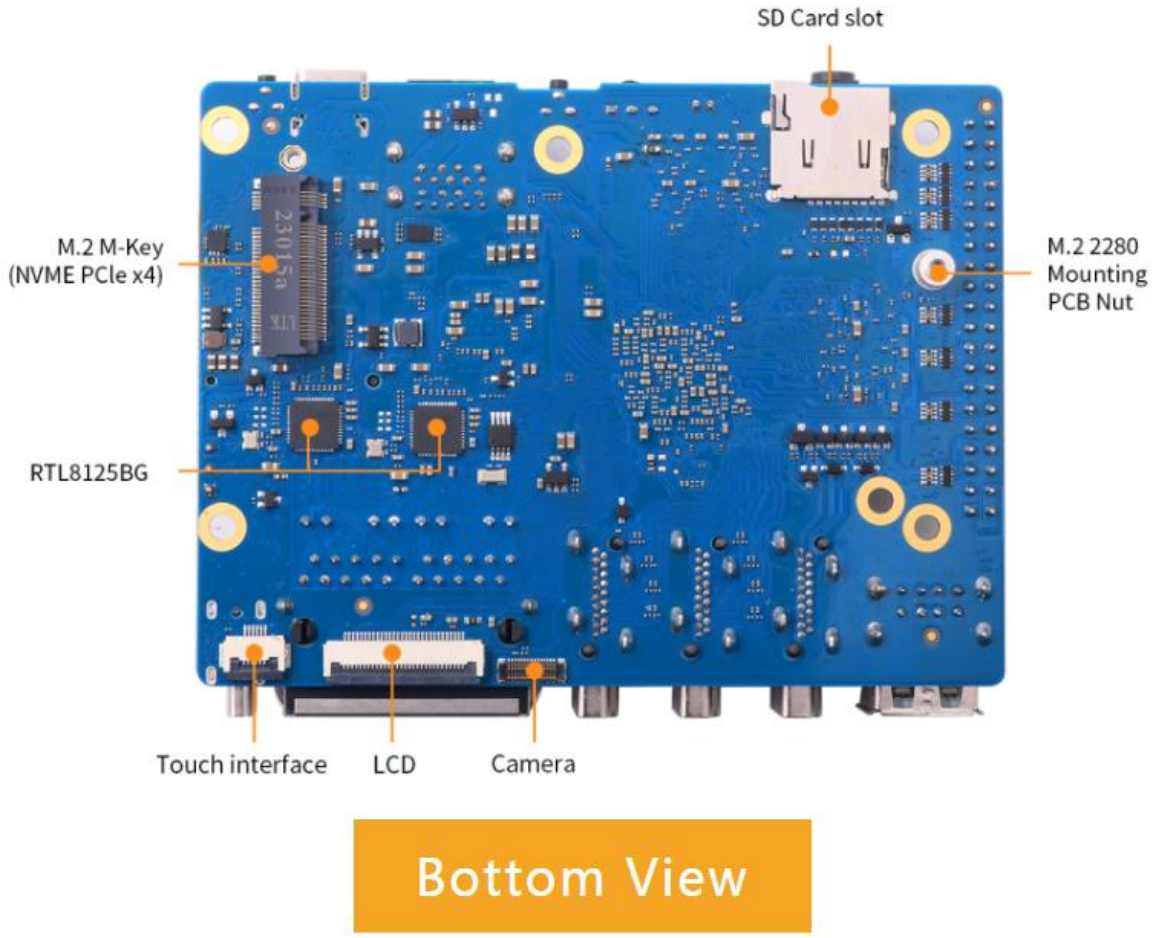
Bottom view：



1. 5. nterface details of Orange Pi 5 Plus



Top View



2. Introduction to the use of the development board

2. 1. Prepare the required accessories

1) TF card, a class 10 or above high-speed SanDisk card with a minimum capacity of 16GB (32GB or above is recommended)

2) TF card reader, used to burn the image into the TF card

3) Display with HDMI interface

4) HDMI to HDMI cable, used to connect the development board to an HDMI monitor or TV for display

Note, if you want to connect a 4K or 8K display, please make sure that the HDMI cable supports 4K or 8K video display.

5) Type-C to HDMI cable, connect the development board to an HDMI monitor or TV for display through the Type-C interface

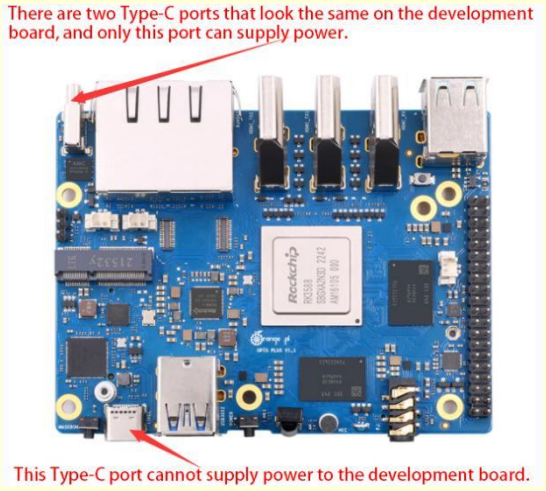
6) Type-C to USB adapter, used to connect USB devices such as USB storage devices or mouse keyboards through the Type-C interface **(there are 2 USB3.0 HOST interfaces and 2 USB2.0 HOST interfaces on the development board, this accessory generally not used)**

7) 10.1-inch MIPI screen, used to display the system interface of the development board (this screen is common to OPi5/OPi5B)

8) Power adapter, Orange Pi 5 Plus is recommended to use 5V/4A Type-C power supply

for power supply

There are two Type-C ports that look the same on the development board. The one next to the network port is the power port, and the other Type-C port has no power supply function. Please don't connect it wrong.



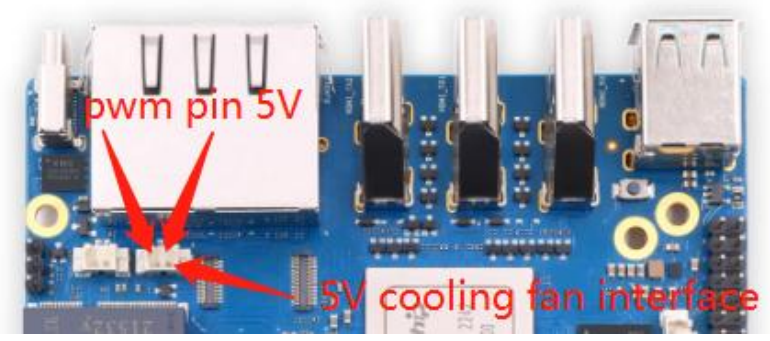
The Type-C power interface of the development board does not support the PD negotiation function, and only supports a fixed 5V voltage input.

9) The mouse and keyboard of the USB interface, as long as the mouse and keyboard of the standard USB interface are acceptable, the mouse and keyboard can be used to control the Orange Pi development board

10) USB camera

11) **5V cooling fan. As shown in the figure below, the development board has an interface for connecting the cooling fan, and the interface specification is** 2pin **1.25mm pitch**

The fan on the development board can adjust the speed and switch through PWM.



12) Network cable, used to connect the development board to the Internet

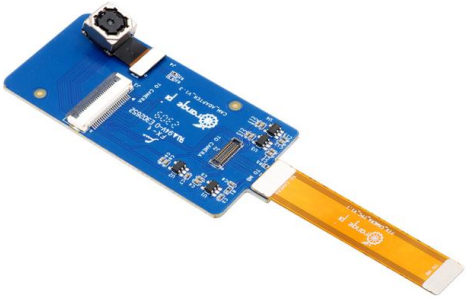
13) The data cable of the Type-C interface, used for burning images, using ADB and other functions

14) Infrared remote control

Note that the remote control of the air conditioner or the TV cannot control the Orange Pi development board. The operating system provided by Orange Pi can only ensure that the remote control provided by Orange Pi can be used by default.

15) OV13850 camera with 13 million MIPI interface (common with OPi5/OPi5B)

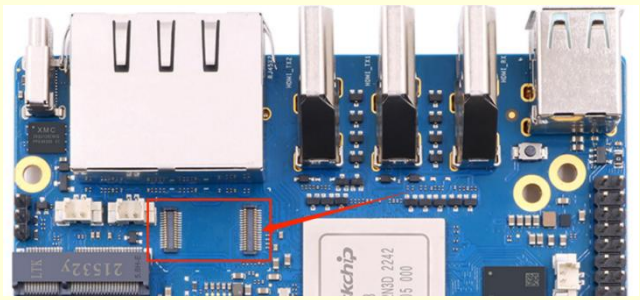
16) OV13855 camera with 13 million MIPI interface (common with OPi5/OPi5B)



17) M.2 M-KEY 2280 specification NVMe SSD solid state drive, PCIe interface specification is PCIe3.0x4

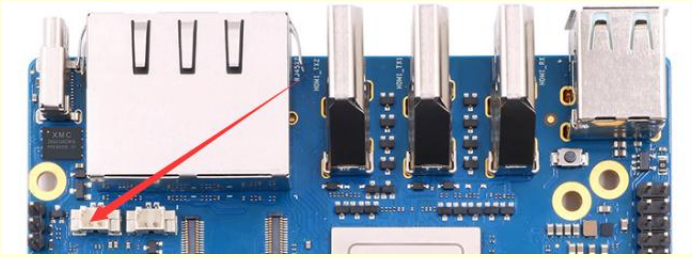
18) eMMC expansion module (to be added physical pictures)

The position where the eMMC module is inserted on the development board is shown in the figure below:

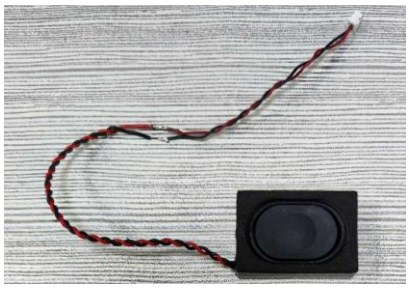


19) RTC battery, the interface is 2pin, 1.25mm pitch

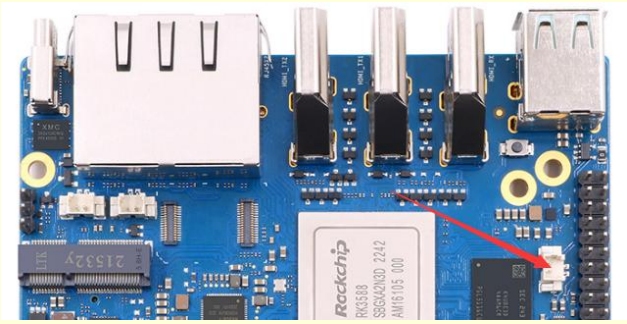
The location of the RTC battery interface on the development board is shown in the figure below:



20) Horn, the interface is 2pin, 1.25mm pitch



The interface position of the speaker on the development board is shown in the figure below:



21) Matching shell (pictures and assembly methods to be added)

22) 3.3V USB to TTL module and DuPont line, when using serial port debugging function, need USB to TTL module and DuPont line to connect the development board and computer

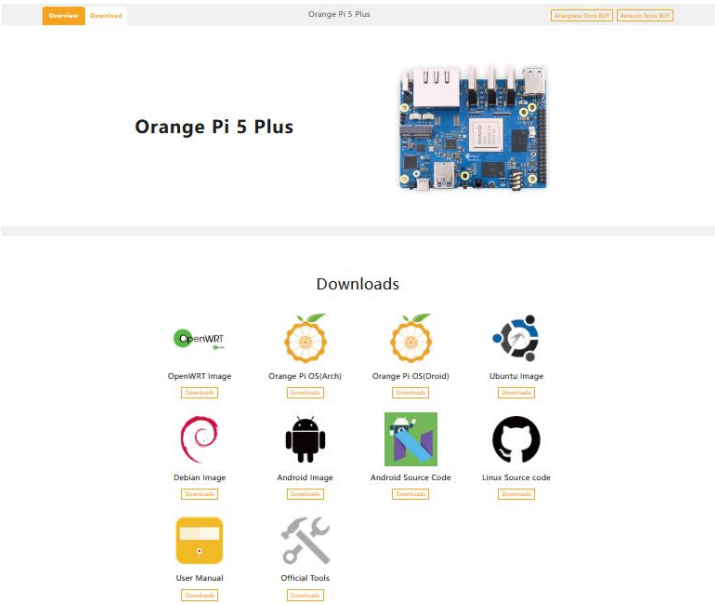
23) Personal computer with Ubuntu and Windows operating systems installed

1	Ubuntu22.04 PC	Optional, used to compile Linux source code
2	Windows PC	For burning Android and Linux images

2.2. Download the image of the development board and related materials

1) The website for downloading the English version of materials is：

http://www.orangepi.org/html/hardWare/computerAndMicrocontrollers/service-and-support/Orange-Pi-5-plus.html



2) The information mainly includes

a. **User Manual and Schematic:** Saved on Google Cloud Disk
b. **Official tools:** mainly include the software that needs to be used during the use of the development board
c. **Android source code**: saved on Google Cloud Disk
d. **Linux source code:** saved on Github
e. **OpenWRT source code:** saved on Github
f. **Android image:** saved on Google Cloud Disk
g. **Ubuntu image**：saved on Google Cloud Disk
h. **Debian image**：saved on Google Cloud Disk
i. **Orange Pi OS image**：saved on Google Cloud Disk
j. **OpenWRT image**：saved on Google Cloud Disk

2.3. Method of burning Linux image to TF card based on Windows PC

Note that the Linux image mentioned here specifically refers to the image of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the **Orange Pi data download page**.

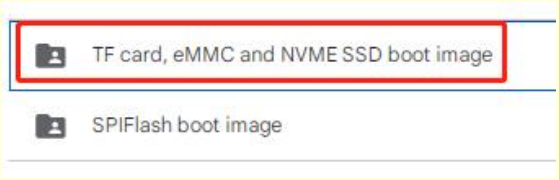
2.3.1. How to use balenaEtcher to burn Linux image

1) First prepare a TF card with a capacity of 16GB or more. The transmission speed of the TF card must be **class 10** or above. It is recommended to use a TF card of SanDisk and other brands

2) Then use the card reader to insert the TF card into the computer

3) Download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system. The size is generally above 2GB.

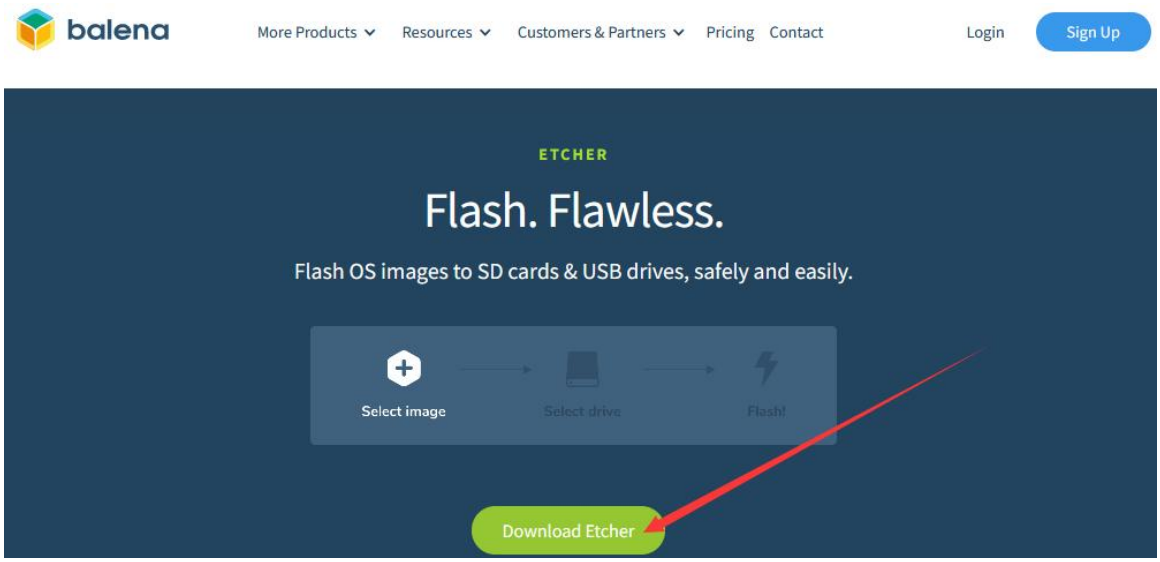
Note, if you download the OpenWRT image, you will see the following two types of images in the download link of the OpenWRT image, please download the image file in the "TF card, eMMC and NVME SSD boot image" folder.



4) Then download the burning software of Linux image——**balenaEtcher,** the download address is:

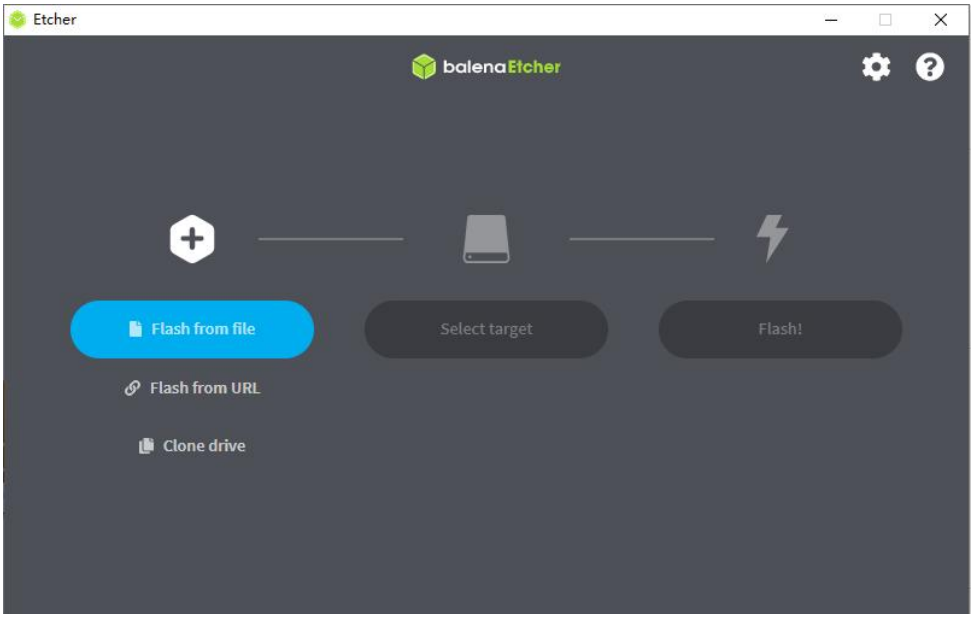
https://www.balena.io/etcher/

5) After entering the balenaEtcher download page, click the green download button to jump to the place where the software is downloaded

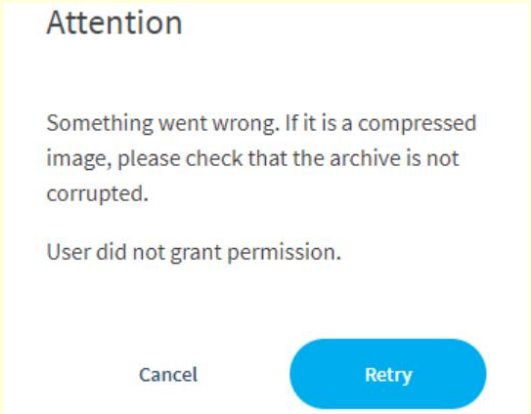


6) Then you can choose to download the Portable version of balenaEtcher software. The Portable version does not need to be installed, and you can use it by double-clicking to open it

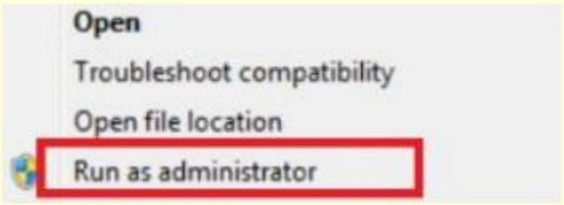
7) If the downloaded version of balenaEtcher needs to be installed, please install it before using it. If you downloaded the Portable version of balenaEtcher, just double-click to open it. The balenaEtcher interface after opening is shown in the figure below:



When opening balenaEtcher, if the following error is prompted:



Please select balenaEtcher, right-click, and select Run as administrator.



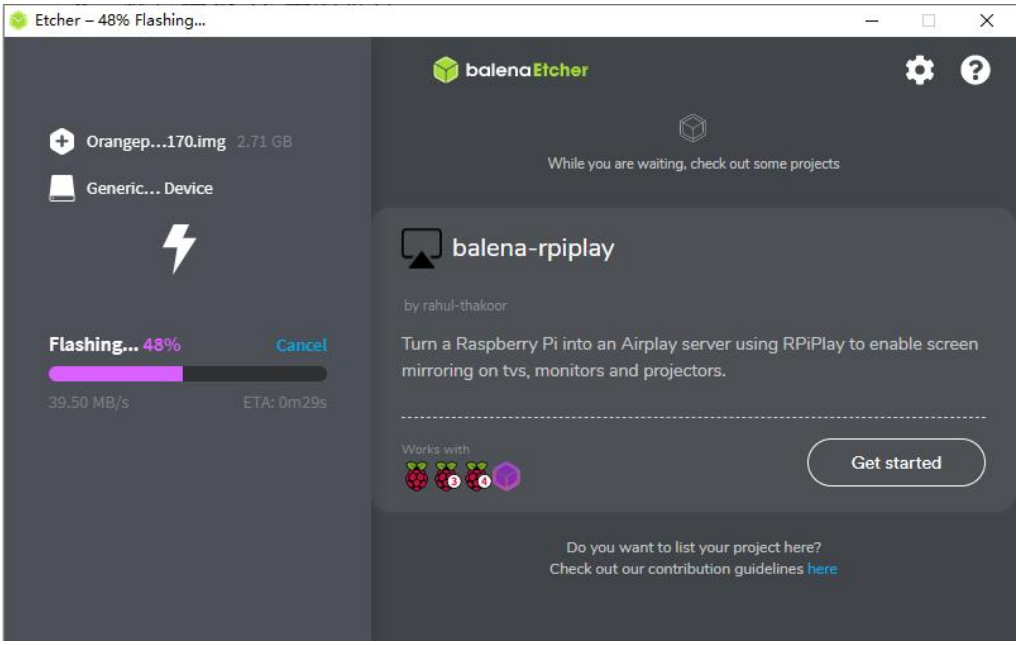
8) The specific steps to use balenaEtcher to burn the Linux image are as follows

a. First select the path of the Linux image file to be burned

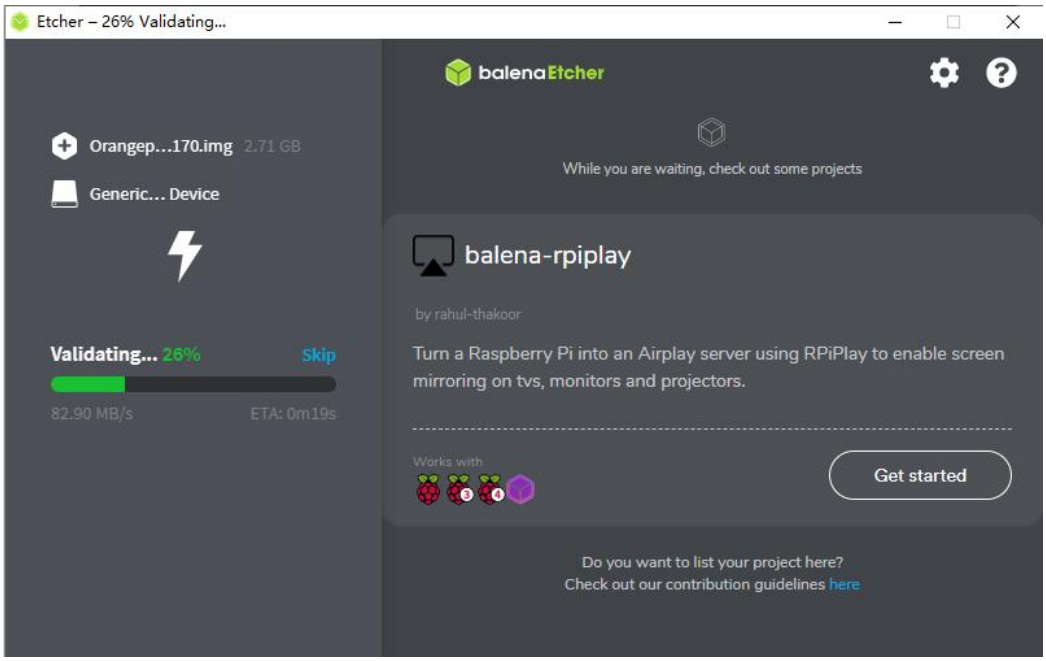
b. Then select the drive letter of the TF card

c. Finally click Flash to start burning the Linux image to the TF card

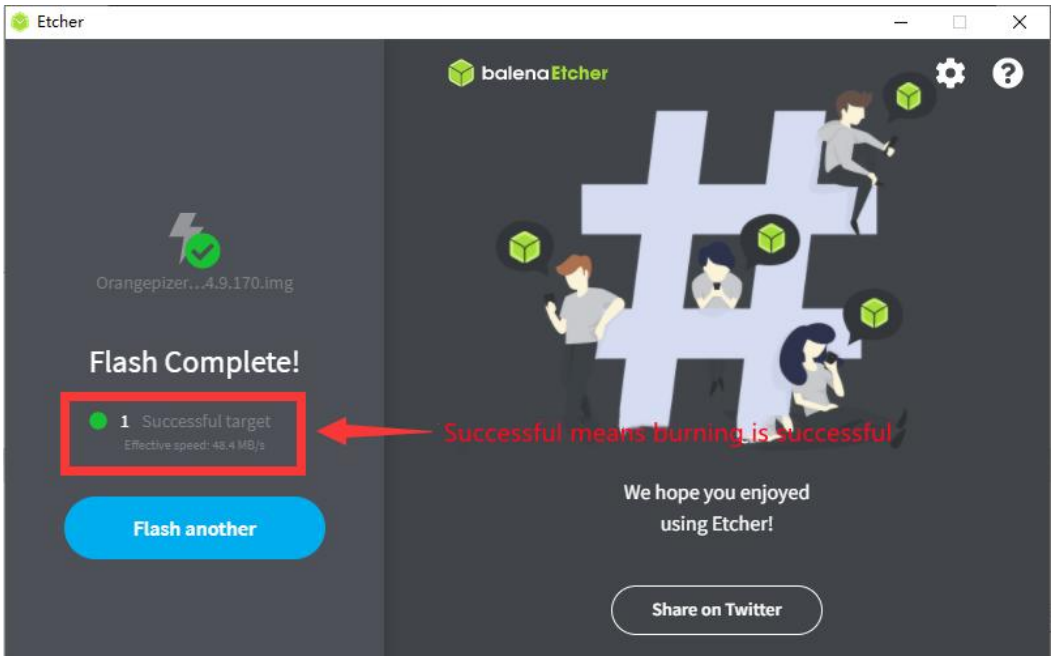
9) The interface displayed in the process of burning the Linux image by balenaEtcher is shown in the figure below, and the progress bar displays purple, indicating that the Linux image is being burned into the TF card.



10) After burning the Linux image, balenaEtcher will also verify the image burned to the TF card by default to ensure that there is no problem in the burning process. As shown in the figure below, a green progress bar indicates that the image has been burnt, and balenaEtcher is verifying the burnt image.



11) After successful burning, the display interface of balenaEtcher is as shown in the figure below. If the green indicator icon is displayed, it means that the image burning is successful. At this time, you can exit balenaEtcher, and then pull out the TF card and insert it into the TF card slot of the development board.

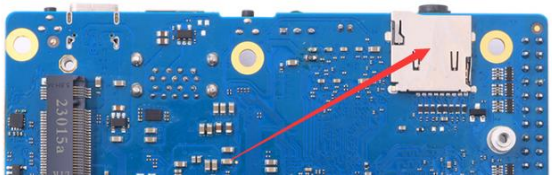


2. 3. 2. How to use RKDevTool to burn Linux image to TF card

1) First, you need to prepare a data cable with a good quality Type-C interface

2) You also need to prepare a 16GB or larger TF card. The transmission speed of the TF card must be class 10 or above. It is recommended to use a TF card of SanDisk and other brands

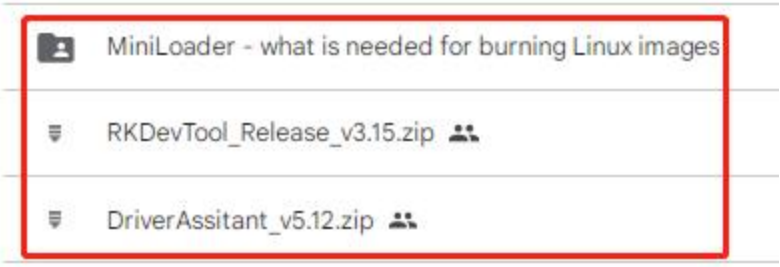
3) Then insert the TF card into the card slot of the development board



4) Then download the Rockchip microdriver **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v3.15.zip** from the Orange Pi data download page

a. On the **Orange Pi data download page**, first select the official tool, and then enter the following folder.

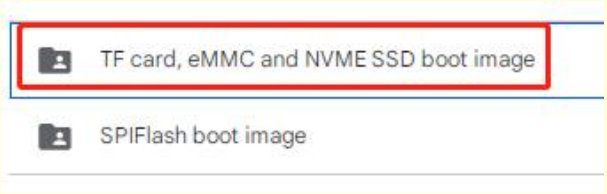
b. Then download all the files below



Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

5) Then download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system , the size is generally more than 2GB

Note, if you download the OpenWRT image, you will see the following two types of images in the download link of the OpenWRT image, please download the image file in the "TF card, eMMC and NVME SSD boot image" folder.

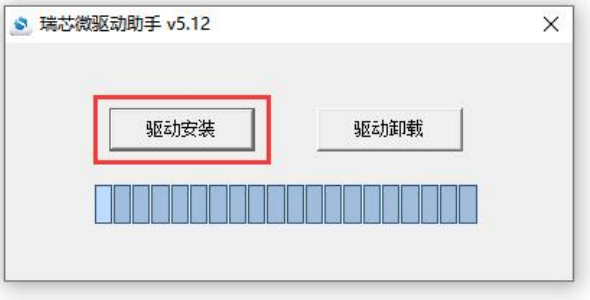


6) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

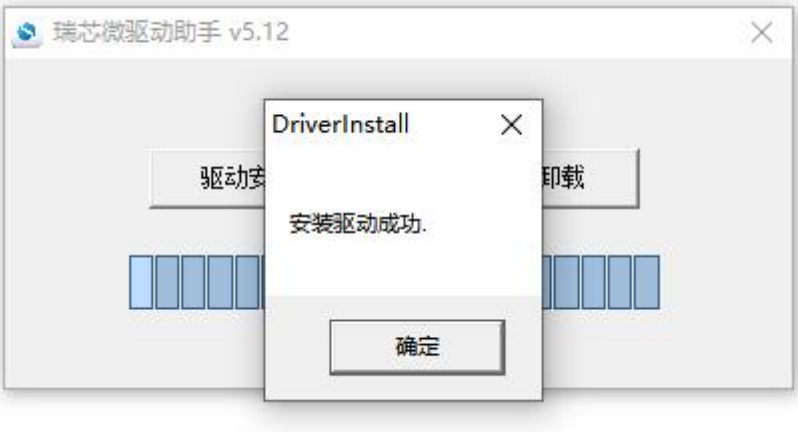
7) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as

follows

a. Click the "**Driver Installation**" button

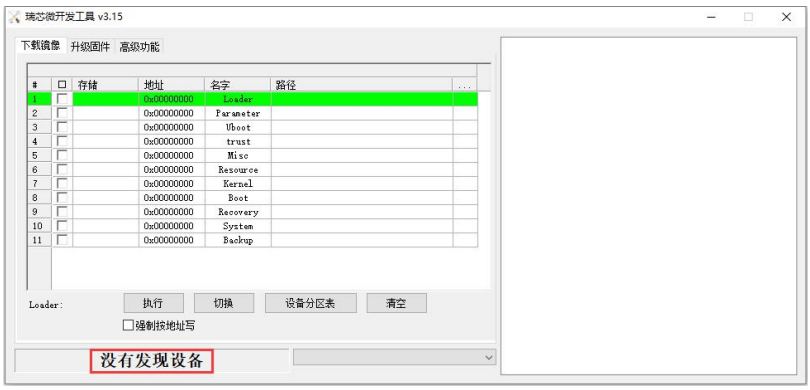


b. After waiting for a period of time, a pop-up window will prompt "**driver installed successfully**", and then click the "**OK**" button.



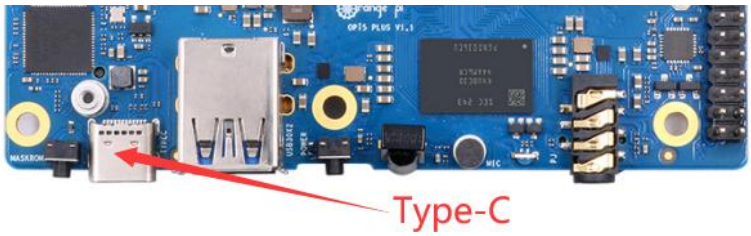
8) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

9) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



10) Then start burning the Linux image to the TF card

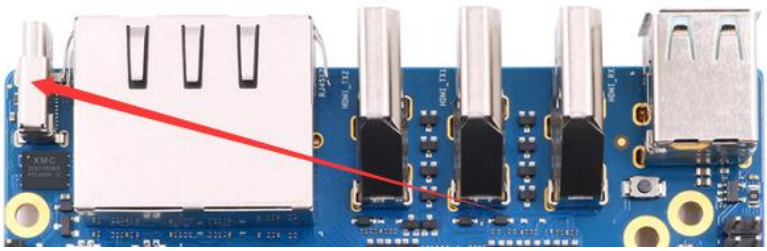
a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



b. Make sure the development board is not connected to the Type-C power supply

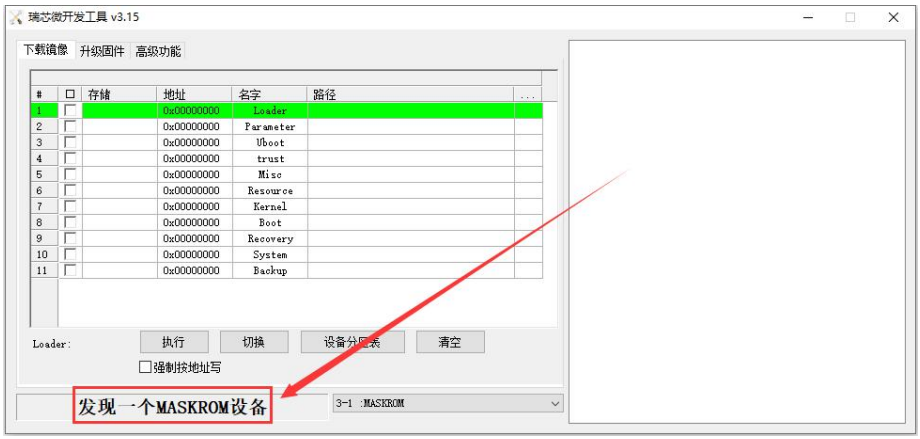
c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below：

d. Finally, connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button. The location of the Type-C power interface is as follows：

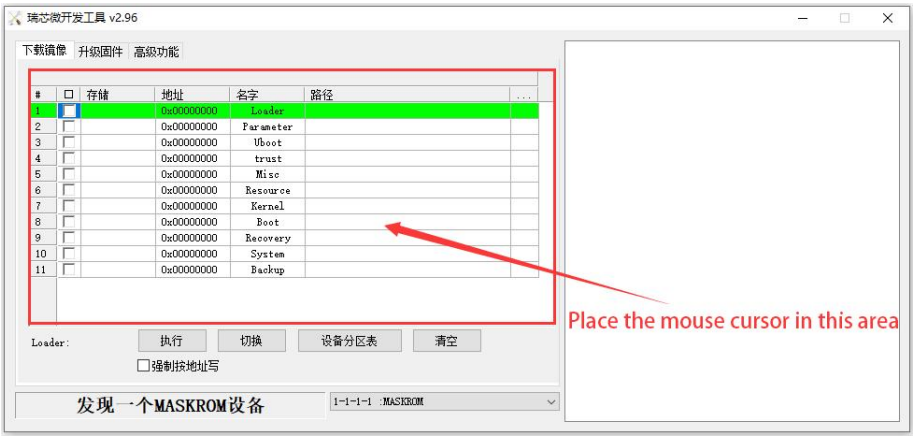


e. If the previous steps are successful, the development board will enter the

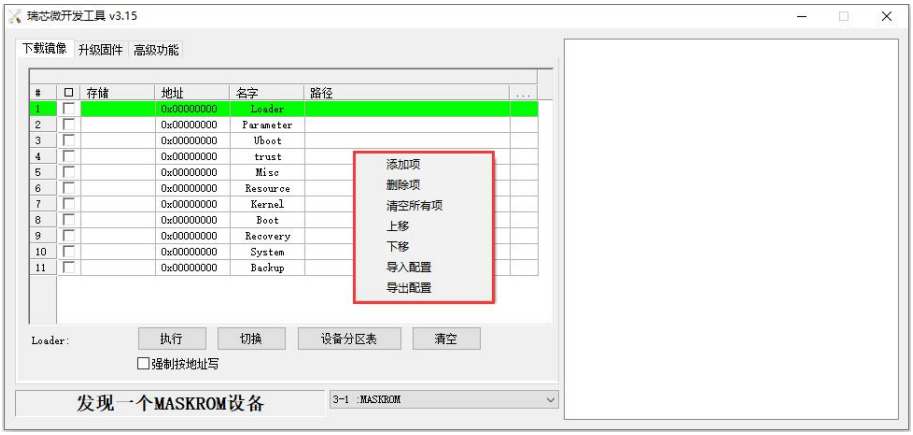
MASKROM mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"



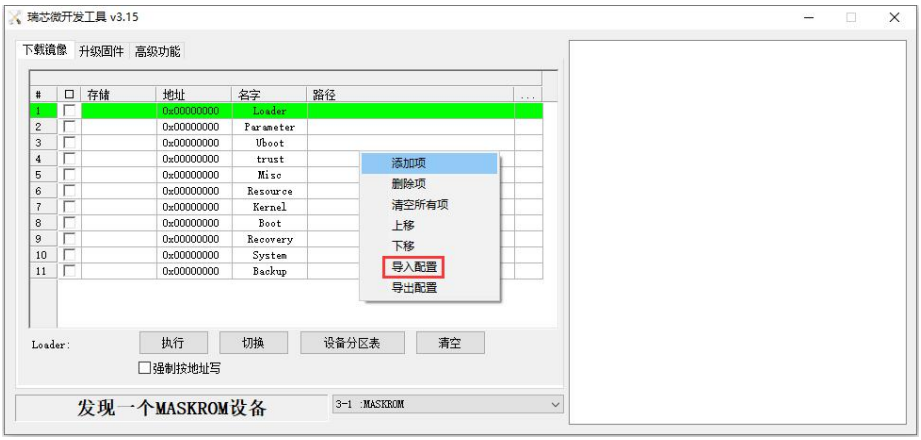
f. Then place the mouse cursor in the area below



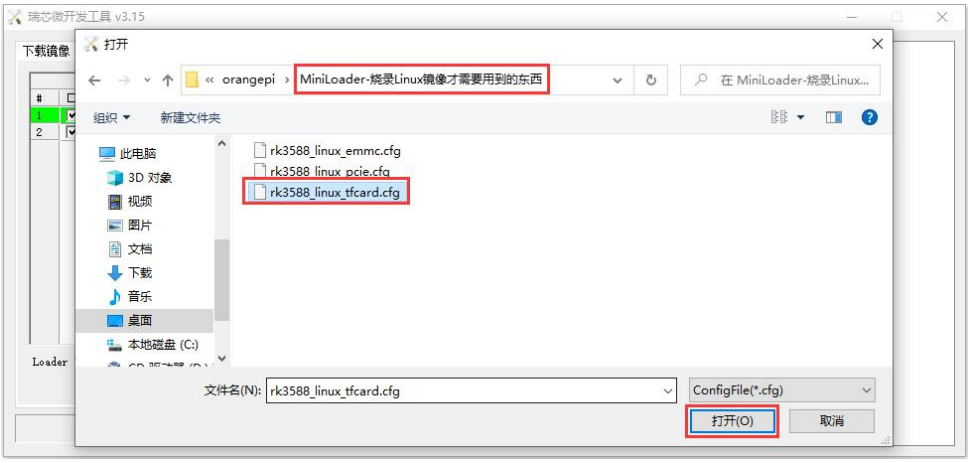
g. Then click the right mouse button and the selection interface shown in the figure below will pop up



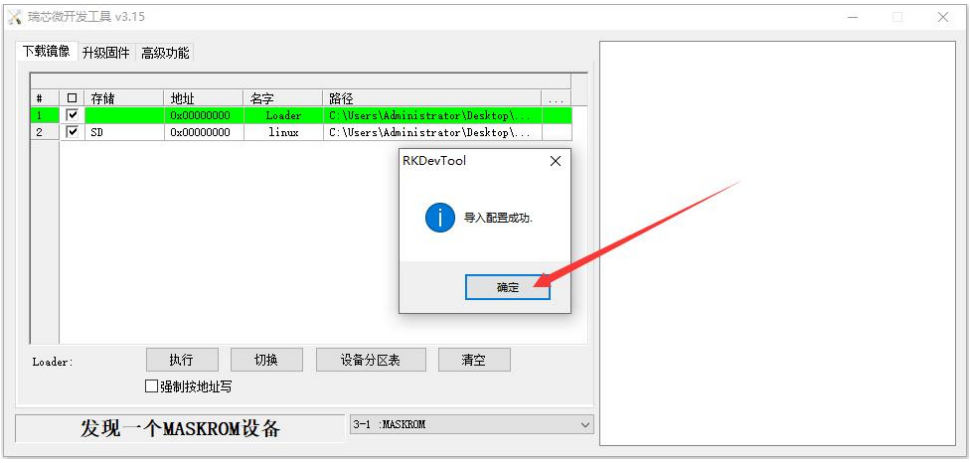
h. Then select the **import configuration** option



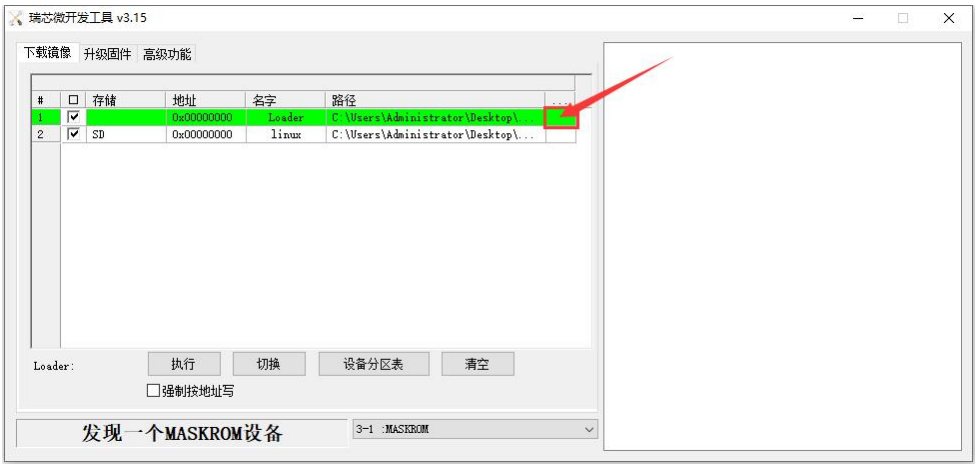
i. Then select the **rk3588_linux_tfcard.cfg** configuration file in the **MiniLoader** folder downloaded earlier, and click **Open**



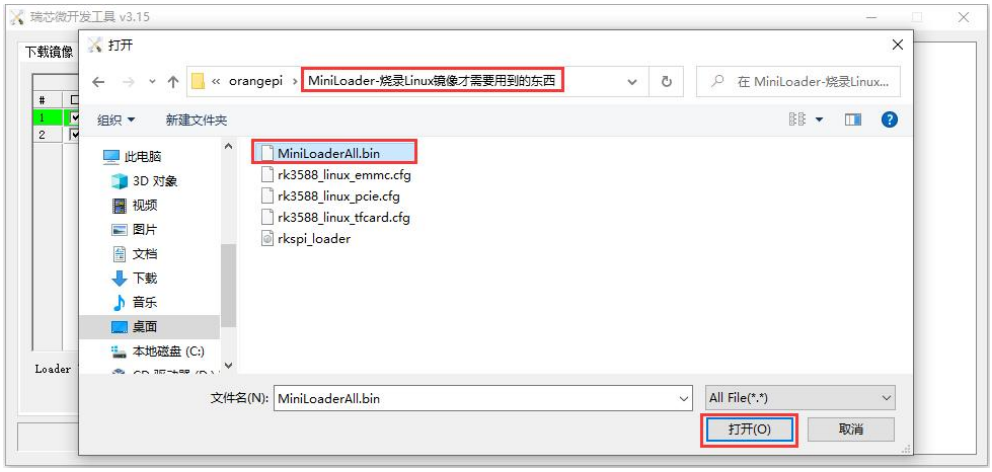
j. Then click **OK**



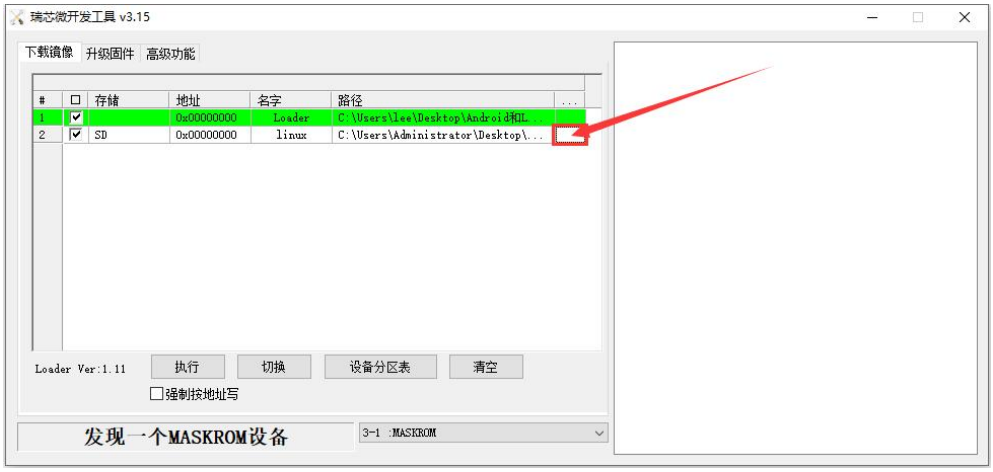
k. Then click the position shown in the figure below



l. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and then click to **open**



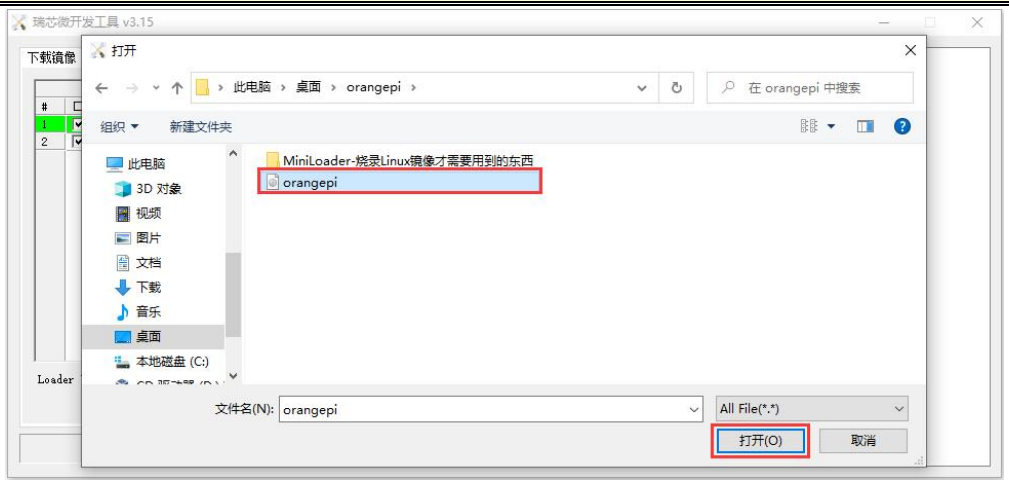
m. Then click the position shown in the figure below



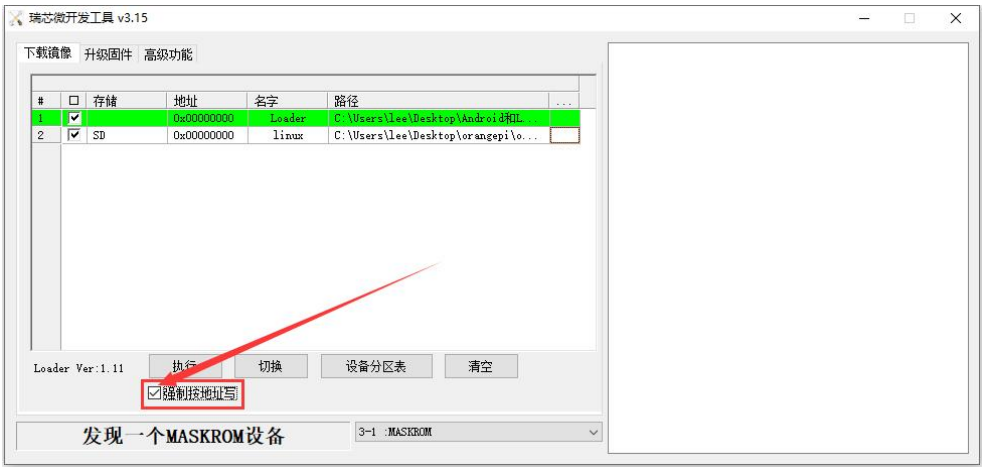
n. Then select the path of the linux image you want to burn, and click **Open**

Before burning the image, it is recommended to rename the linux image to be

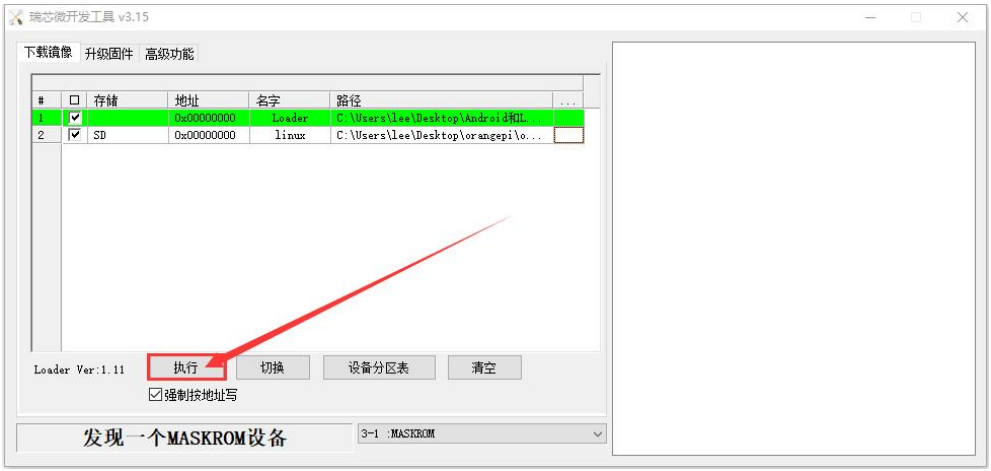
burned to orangepi.img or other shorter names, so that you can see the percentage value of the burning progress when burning the image.



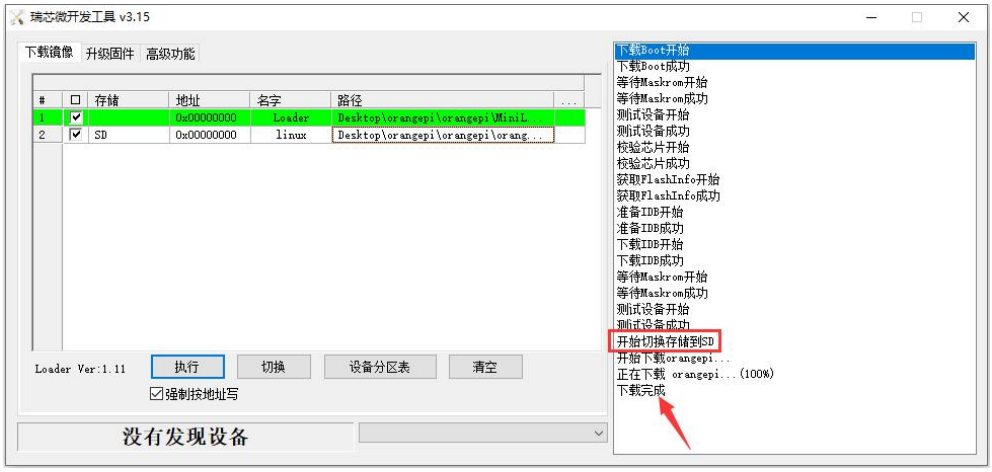
o. Then please check the **option to force writing by address**



p. Then click the execute button to start burning the linux image to the tf card of the development board



q. The log displayed after burning the linux image is shown in the figure below



r. After burning the linux image to the TF card, the linux system will start automatically.

2.3.3. How to use Win32Diskimager to burn Linux image

1) First prepare a TF card with a capacity of 16GB or more. The transmission speed of the TF card must be class 10 or above. It is recommended to use a TF card of SanDisk and other brands

2) Then use the card reader to insert the TF card into the computer

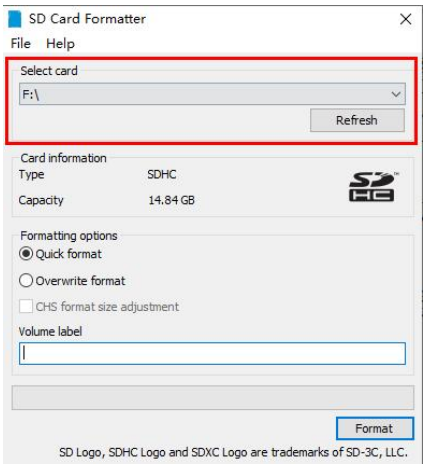
3) Then format the TF card

a. **SD Card Formatter** can be used to format the TF card. The download link is

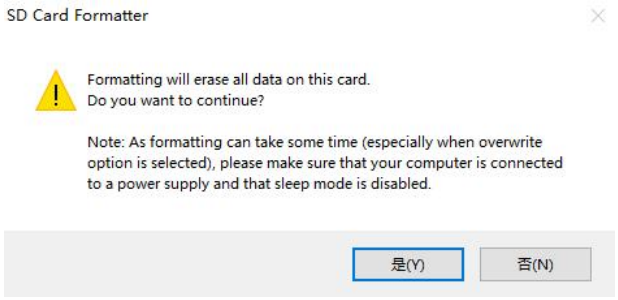
https://www.sdcard.org/downloads/formatter/eula_windows/SDCardFormatterv5_WinEN.zip

b. After downloading, unzip and install directly, and then open the software

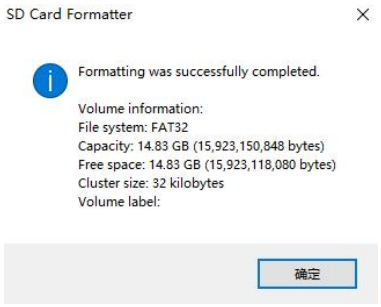
c. If only a TF card is inserted into the computer, the drive letter of the TF card will be displayed in the "**Select card**" column. If multiple USB storage devices are inserted into the computer, you can select the corresponding drive letter of the TF card through the drop-down box



d. Then click "**Format**", a warning box will pop up before formatting, and formatting will start after selecting "**Yes (Y)**"

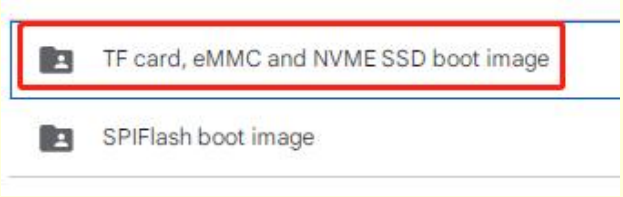


e. After formatting the TF card, the message shown in the figure below will pop up, click OK



4) Download the image file compression package of the Linux operating system that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system. The size is generally more than 2GB

Note, if you download the OpenWRT image, you will see the following two types of images in the download link of the OpenWRT image, please download the image file in the "TF card, eMMC and NVME SSD boot image" folder.



5) Use **Win32Diskimager** to burn the Linux image to the TF card

a. The download page of Win32Diskimager is

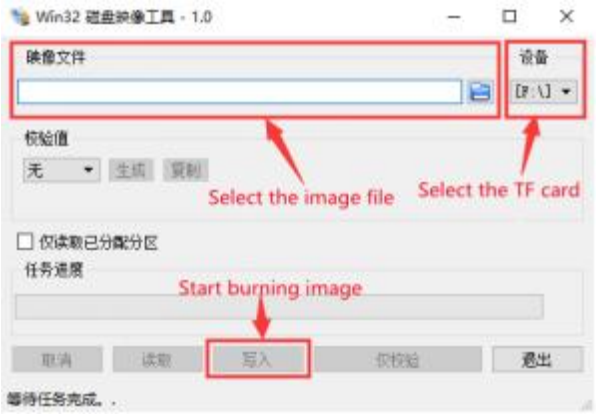
http://sourceforge.net/projects/win32diskimager/files/Archive/

b. After downloading, install it directly. The interface of Win32Diskimager is as follows

a) First select the path of the image file

b) Then confirm that the drive letter of the TF card is consistent with that displayed in the "**Device**" column

c) Finally click "**Write**" to start burning



c. After the image writing is completed, click the "**Exit**" button to exit, and then you can pull out the TF card and insert it into the development board to start

2. 4. Method of burning Linux image to TF card based on Ubuntu PC

Note that the Linux image mentioned here specifically refers to the image of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the Orange Pi data download page, and the Ubuntu PC refers to the personal computer with the Ubuntu system installed.

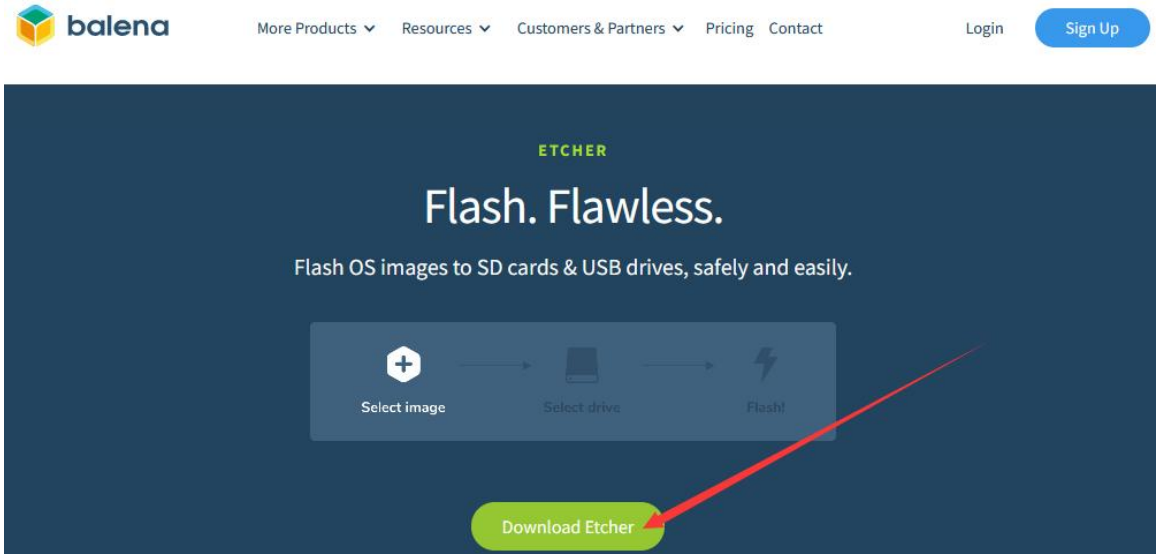
1) First prepare a TF card with a capacity of **16GB** or more. The transmission speed of the TF card must be **class 10** or above. It is recommended to use a TF card of SanDisk and other brands

2) Then use the card reader to insert the TF card into the computer

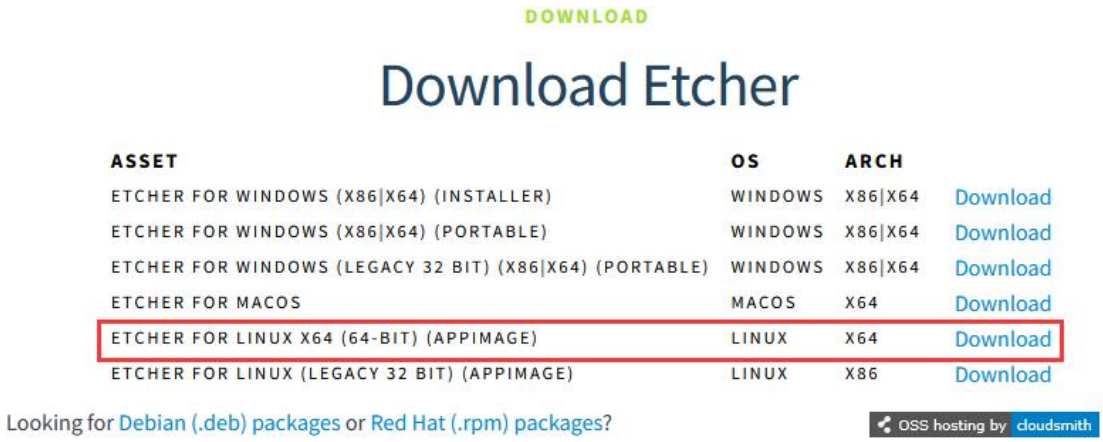
3) Download the balenaEtcher software, the download address is

https://www.balena.io/etcher/

4) After entering the balenaEtcher download page, click the green download button to jump to the place where the software is downloaded

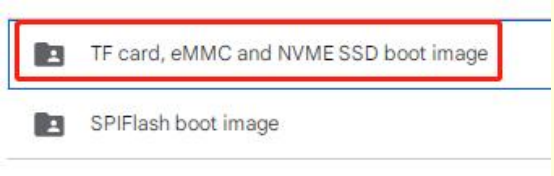


5) Then choose to download the Linux version of the software



6) Download the Linux operating system image file compression package that you want to burn from the Orange Pi data download page, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system. The size is generally more than 2GB

Note, if you download the OpenWRT image, you will see the following two types of images in the download link of the OpenWRT image, please download the image file in the "TF card, eMMC and NVME SSD boot image" folder.



The decompression command for the compressed package ending in 7z is as follows：

```
test@test:~$ 7z x orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.7z
test@test:~$ ls orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.*
orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.7z
orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.sha      # checksum file
orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.img      # mirror file
```

If you download the OpenWRT image, the compressed package ends with gz, and the decompression command is as follows：

```
test@test:~$ gunzip openwrt-aarch64-opi5plus-23.05-linux-5.10.110-ext4.img.gz
```

```
test@test:~$ ls openwrt-aarch64-opi5plus-23.05-linux-5.10.110-ext4.img
openwrt-aarch64-opi5plus-23.05-linux-5.10.110-ext4.img      # mirror file
```

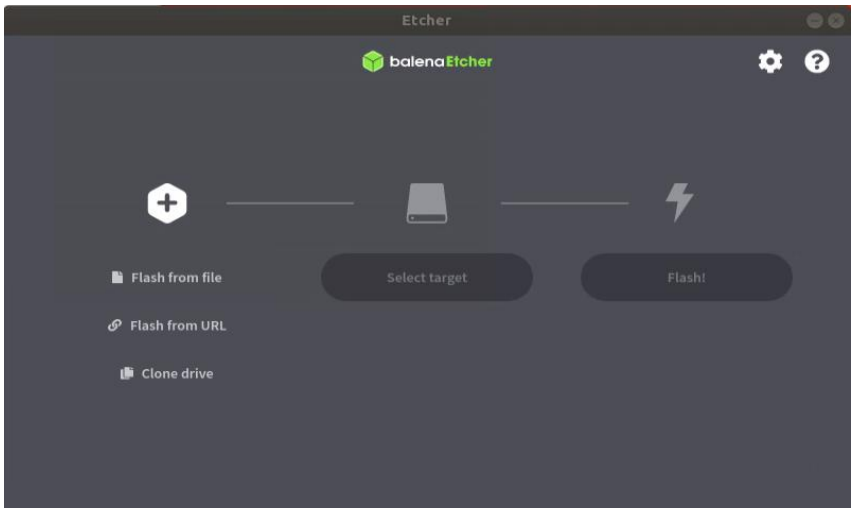
7) After decompressing the image, you can first use the **sha256sum -c *.sha**.sha command to calculate whether the checksum is correct. If the prompt is successful, it means that the downloaded image is correct, and you can safely burn it to the TF card. If it prompts that the **checksum does not match**, it means There is a problem with the downloaded image, please try to download again

```
test@test:~$ sha256sum -c *.sha
orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.img: OK
```

If you download the OpenWRT image, you need to verify the compressed package, do not decompress it and then verify it

```
test@test:~$ sha256sum -c openwrt-aarch64-opi5plus-23.04-linux-5.10.110-ext4.img.gz.sha
openwrt-aarch64-opi5plus-23.04-linux-5.10.110-ext4.img.gz: OK
```

8) Then double-click **balenaEtcher-1.14.3-x64.AppImage** on the graphical interface of Ubuntu PC to open balenaEtcher (no installation required), and the interface after balenaEtcher is opened is shown in the figure below



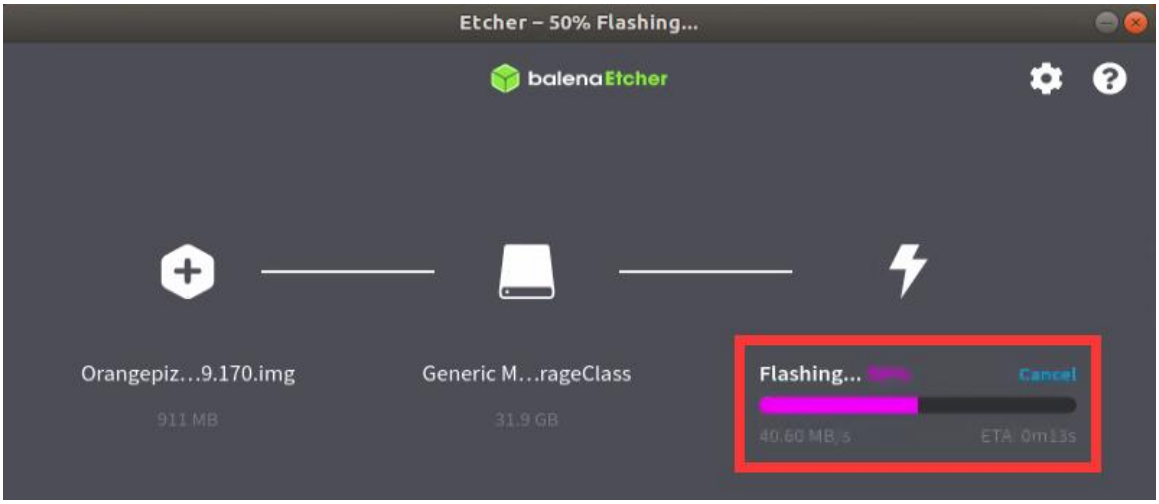
9) The specific steps to use balenaEtcher to burn the Linux image are as follows

a. First select the path of the Linux image file to be burned

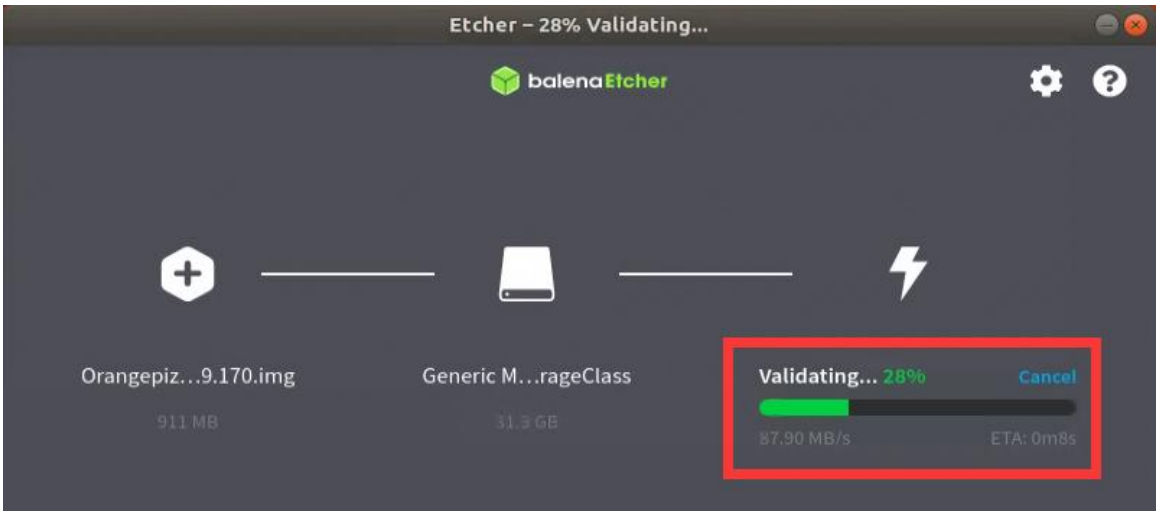
b. Then select the drive letter of the TF card

c. Finally click Flash to start burning the Linux image to the TF card

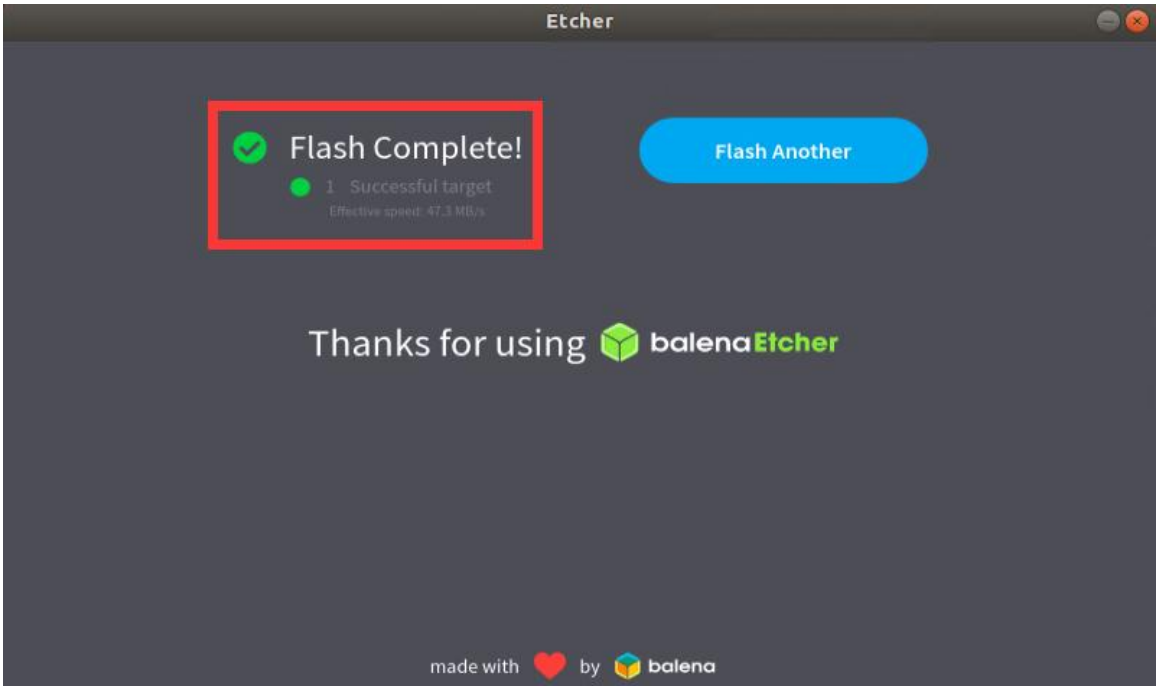
10) The interface displayed in the process of burning the Linux image by balenaEtcher is shown in the figure below, and the progress bar displays purple, indicating that the Linux image is being burned into the TF card



11) After burning the Linux image, balenaEtcher will also verify the image burned into the TF card by default to ensure that there is no problem in the burning process. As shown in the figure below, a green progress bar indicates that the image has been burnt, and balenaEtcher is verifying the burnt image



12) After successful burning, the display interface of balenaEtcher is as shown in the figure below. If a green indicator icon is displayed, it means that the image burning is successful. At this time, you can exit balenaEtcher, and then pull out the TF card and insert it into the TF card slot of the development board for use.



2. 5. How to burn Linux image to eMMC

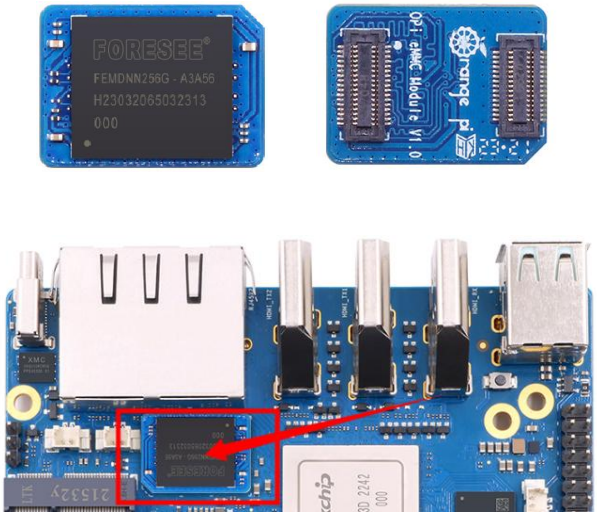
Note, after burning the image into eMMC, if the test finds that it cannot be started, please clear the SPIFlash and try again. For the method of clearing SPIFlash, please refer to the method of using RKDevTool to clear SPIFlash.

2. 5. 1. How to use RKDevTool to burn Linux image into eMMC

Note that all the following operations are performed on a Windows computer.

Note that the Linux image mentioned here specifically refers to the image of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the Orange Pi data download page.

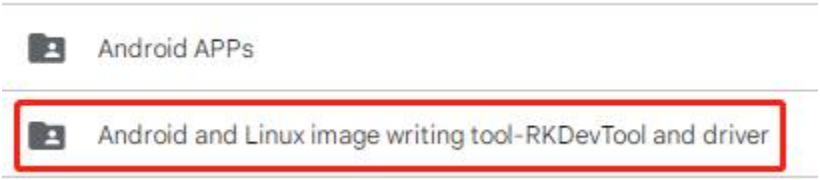
1) The development board reserves the expansion interface of the eMMC module. Before burning the system to the eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of plugging into the development board are as follows:



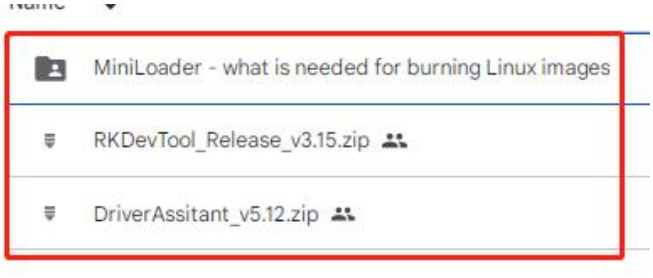
2) It is also necessary to prepare a data cable with a good quality Type-C interface

3) Then download Rockchip **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool RKDevTool_Release_v2.96.zipRKDevTool_Release_v3.15.zip from the Orange Pi data download page, please make sure that the version of the downloaded RKDevTool tool is v2.96.

a. On the download page of Orange Pi, first select the official tool, and then enter the following folder



b. Then download all the files below

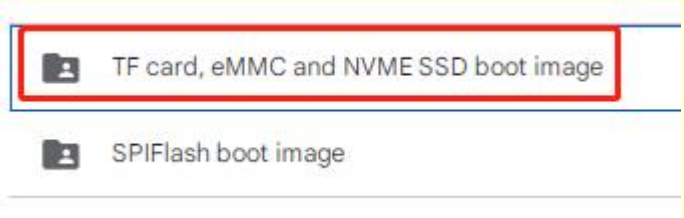


Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

4) Then download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system , the size is generally more than 2GB

Note, if you download the OpenWRT image, you will see the following two types

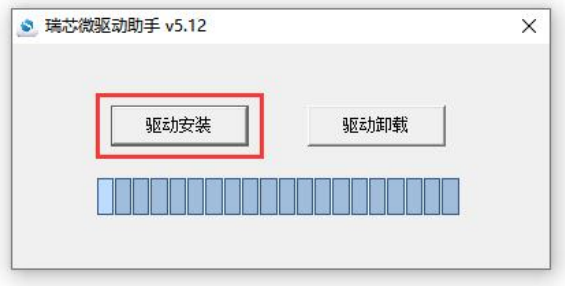
of images in the download link of the OpenWRT image, please download the image file in the "TF card, eMMC and NVME SSD boot image" folder.



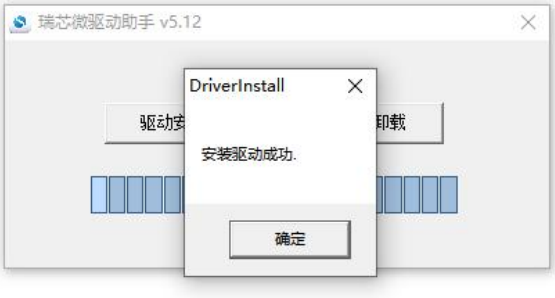
5) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe**executable file in the decompressed folder and open it

6) After opening **DriverInstall.exe,** the steps to install the Rockchip driver are as follows

a. Click the "**Driver Installation**" button

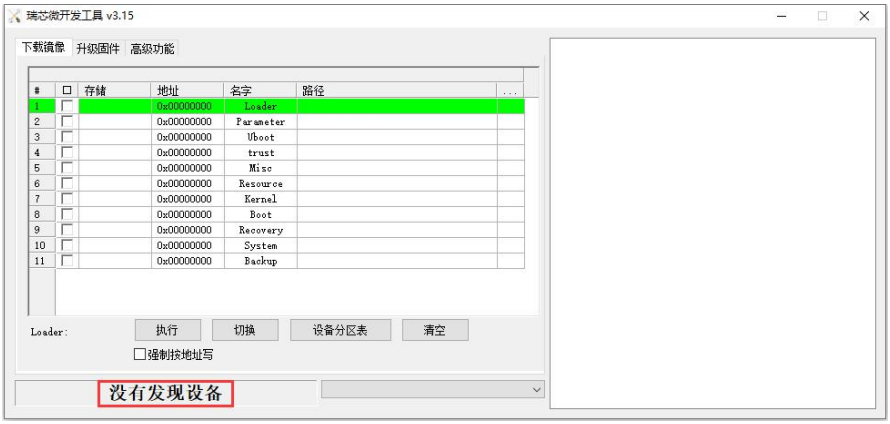


b. After waiting for a period of time, a pop-up window will prompt "**driver installed successfully**", and then click the "**OK**" button.



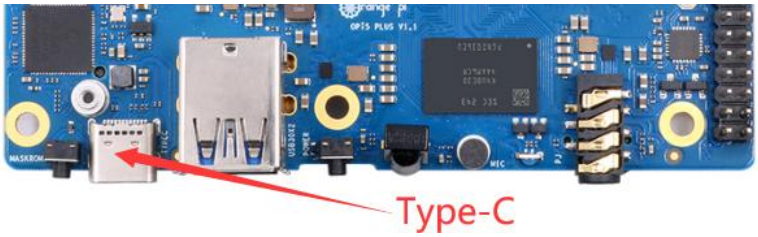
7) Then decompress RKDevTool_Release_v3.15.zip, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

8) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



9) Then start burning the Linux image into eMMC

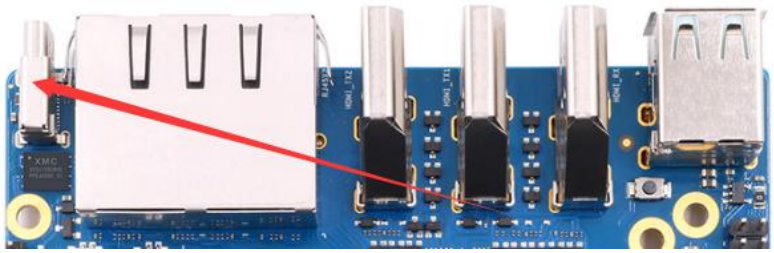
a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



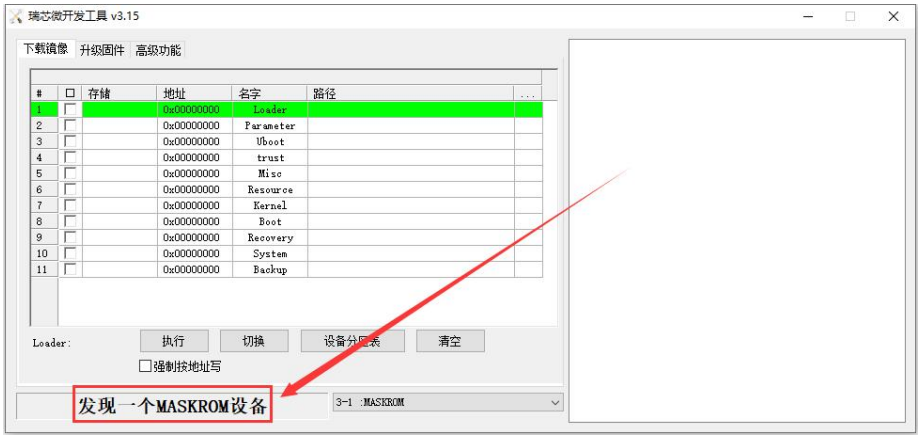
b. Make sure that the development board is not inserted into the TF card and not connected to the power supply

c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below:

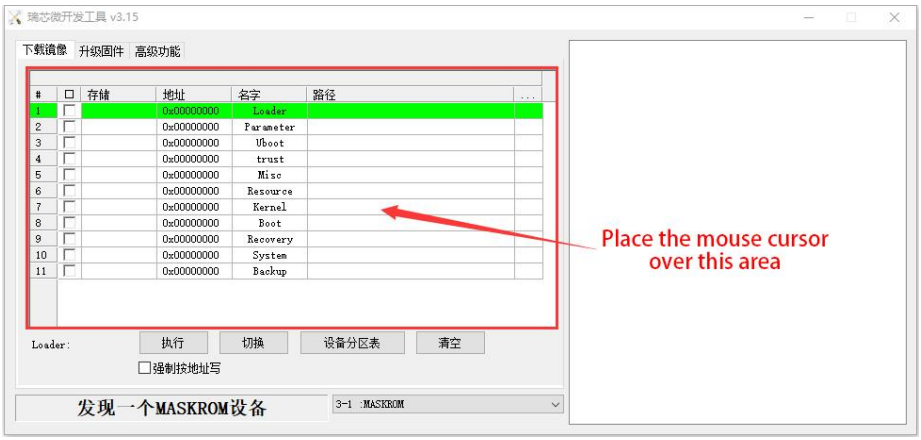
d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



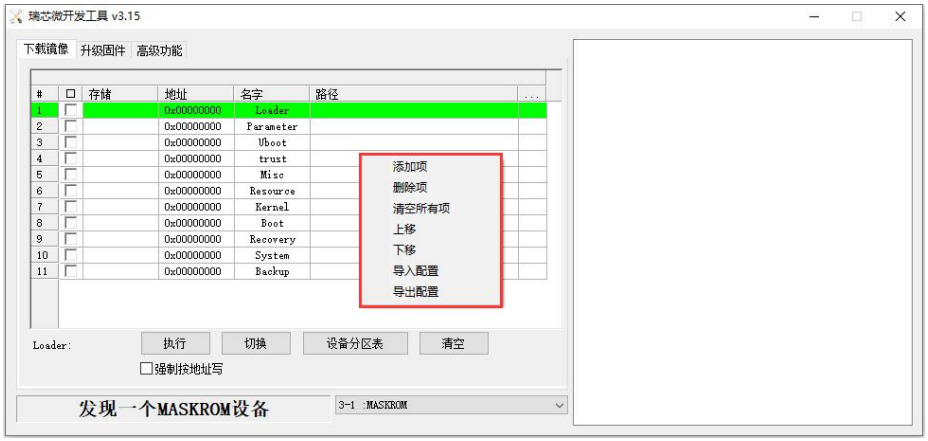
e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"



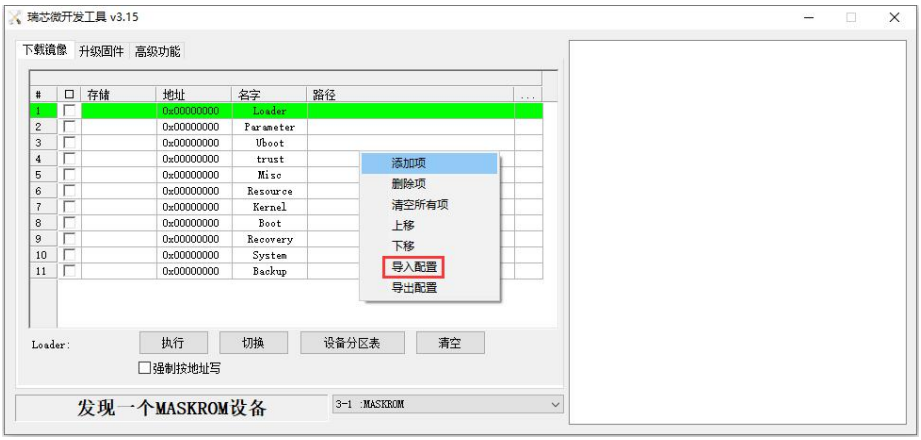
f. Then place the mouse cursor in the area below



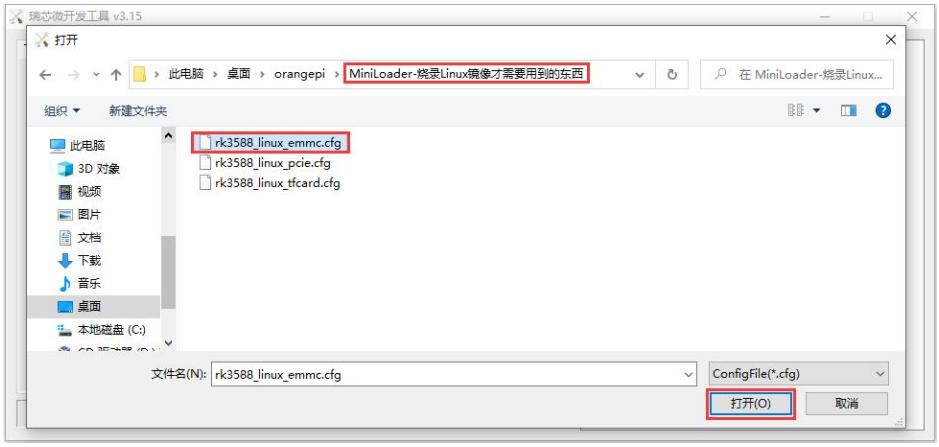
g. Then click the right mouse button and the selection interface shown in the figure below will pop up



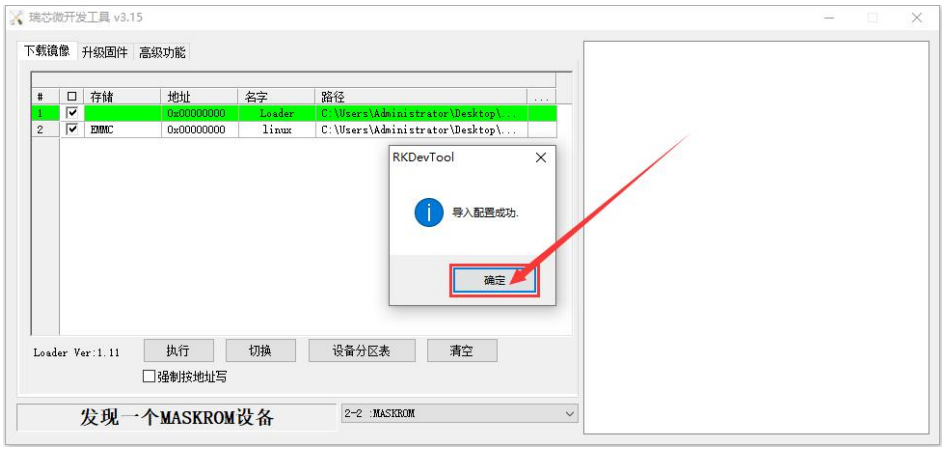
h. Then select the **import configuration** option



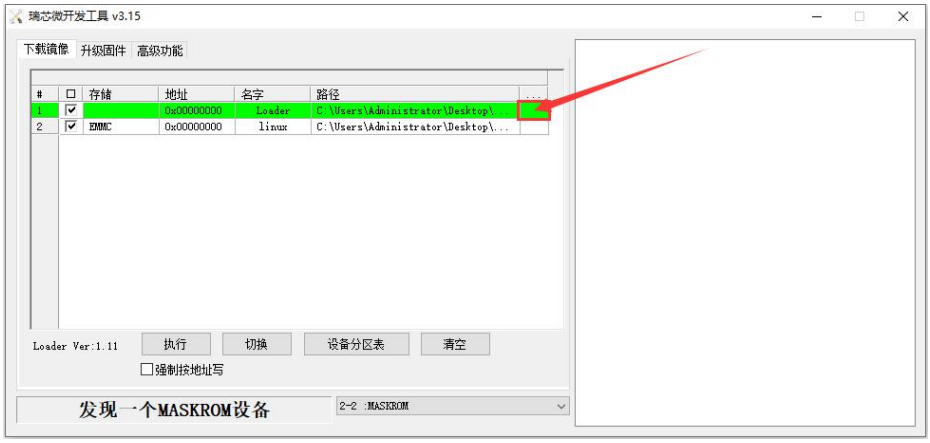
i. Then select the **rk3588_linux_emmc.cfg** configuration file in the **MiniLoader** folder downloaded earlier, and click **Open**



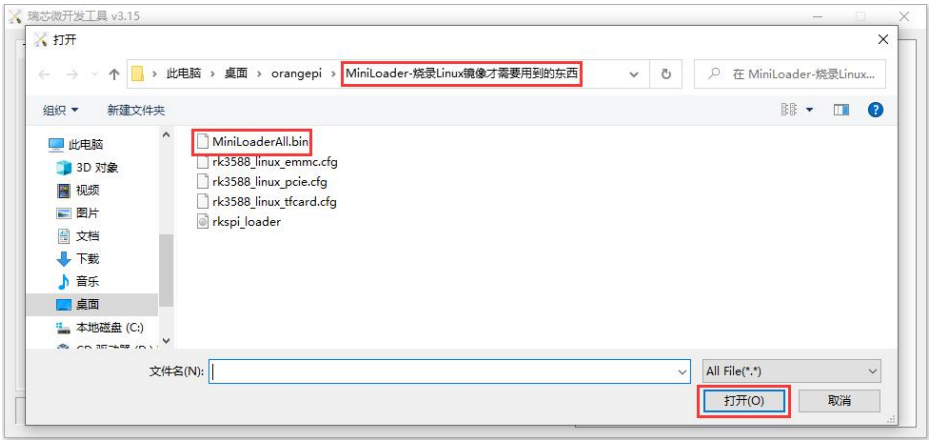
j. Then click **OK**



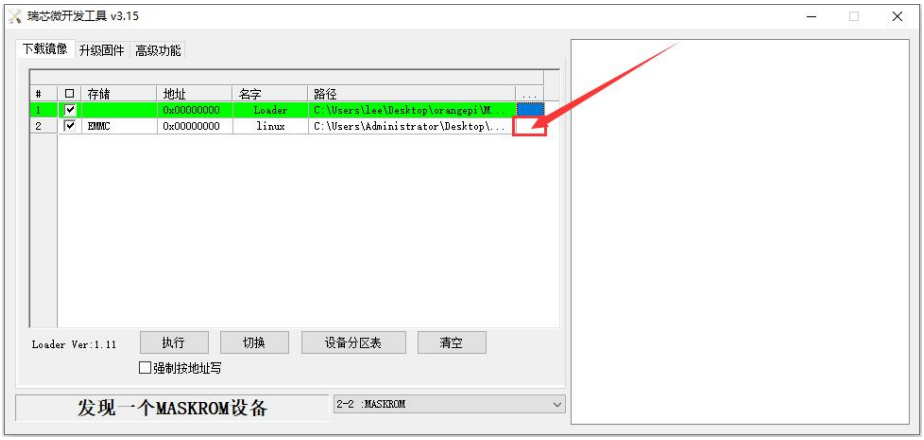
k. Then click the position shown in the figure below



l. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and then click to **open**

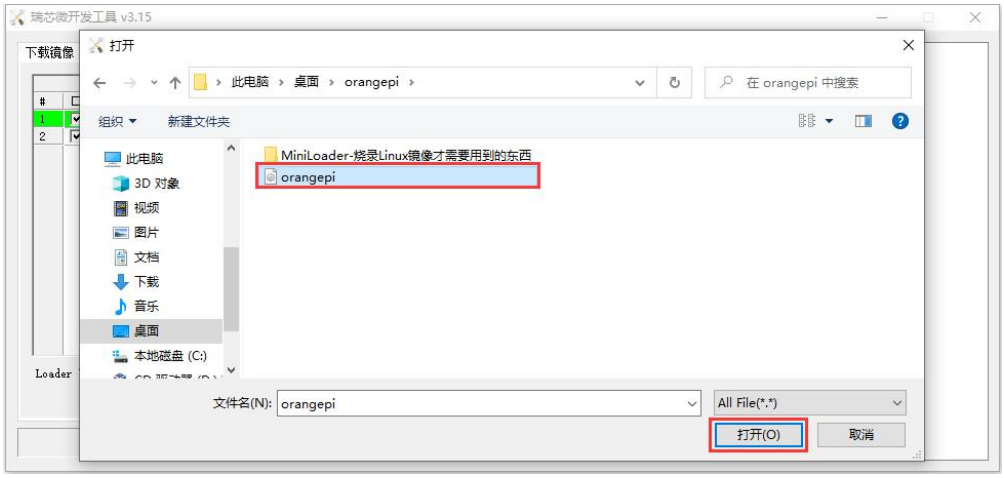


m. Then click the position shown in the figure below

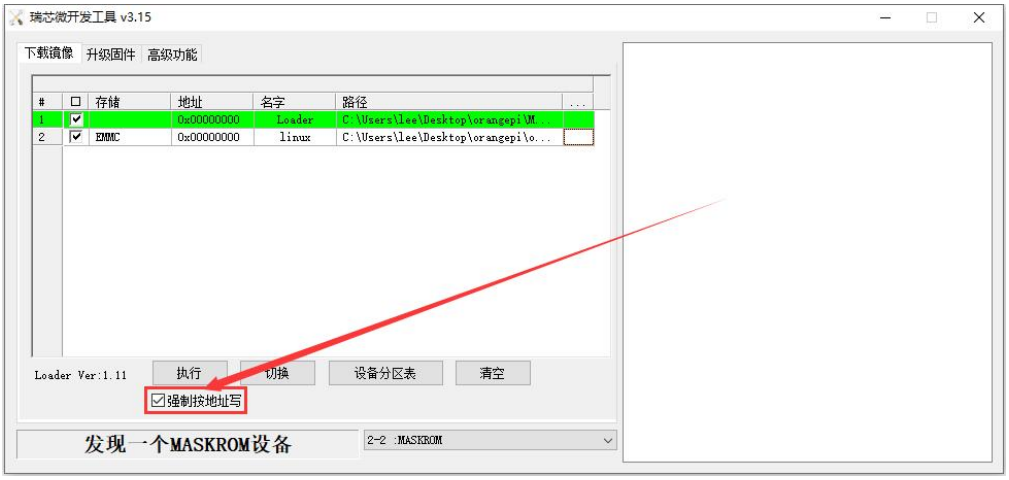


n. . Then select the path of the linux image you want to burn, and click **Open**

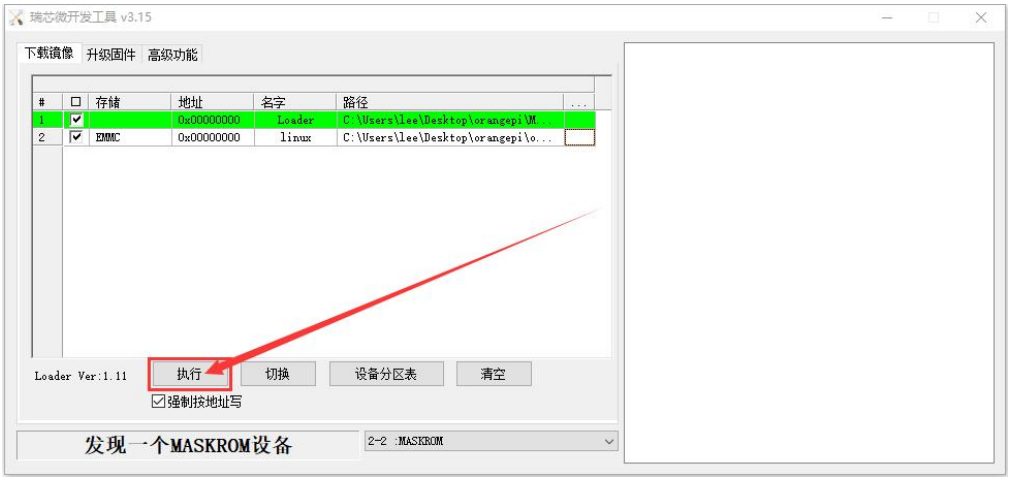
Before burning the image, it is recommended to rename the linux image to be burned to orangepi.img or other shorter names, so that you can see the percentage value of the burning progress when burning the image.



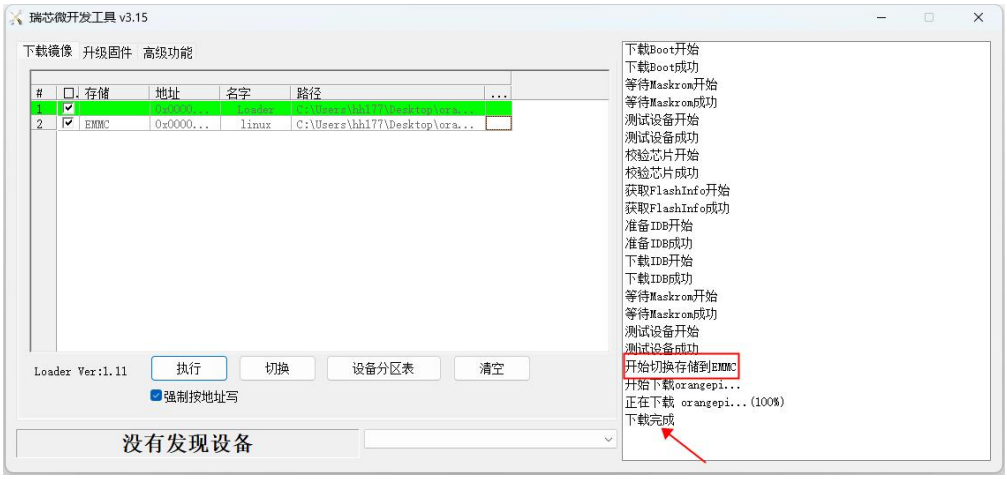
o. Then please check the option to **force writing by address**



p. Then click the execute button to start burning the linux image to the eMMC of the development board



q. The log displayed after burning the linux image is shown in the figure below



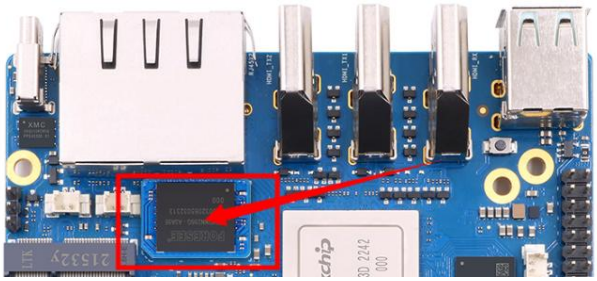
r. After burning the linux image into the eMMC, the linux system will start automatically.

Note, after burning the image into eMMC, if the test finds that it cannot be started, please clear the SPIFlash and try again. For the method of clearing SPIFlash, please refer to the method of using RKDevTool to clear SPIFlash.

2.5.2. Using the dd command to burn the Linux image into eMMC

Note that the Linux image mentioned here specifically refers to the image of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the Orange Pi data download page.

1) The development board reserves the expansion interface of the eMMC module. Before burning the system to the eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of plugging into the development board are as follows:



2) Using the dd command to burn the linux image to eMMC needs to be done with a TF card, so first you need to burn the linux image to the TF card, and then use the TF card to start the development board to enter the linux system. For the method of burning the Linux image to the TF card, please refer to the instructions in the two sections of **the method of burning the Linux image to the TF card based on the Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC.**

3) After using the TF card to start the linux system, we first upload the decompressed linux image file (Debian, Ubuntu image or OPi Arch image downloaded from the official website) to the TF card. For the method of **uploading the linux image file to the development board,** please refer to the description in the section of the method of uploading files to the development board Linux system.

4) After uploading the image to the linux system of the development board, we enter the storage path of the image file in the command line of the linux system of the development board. For example, I store the linux image of the development board in the **/home/orangepi/Desktop** directory Download it, and then enter the **/home/orangepi/Desktop** directory to see the uploaded image file.

```
orangepi@orangepi:~$ cd /home/orangepi/Desktop
orangepi@orangepi:~/Desktop$ ls
Orangepi5plus_x.x.x_debian_bullseye_desktop_xfce_linux5.10.160.img
```

How to enter the command line of the development board linux system?

1. For the method of using the serial port to log in to the terminal, please refer to the instructions in the section on how to use the debugging serial port.

2. Use ssh to remotely log in to the Linux system, please refer to the instructions in the section of SSH remote login to the development board.

3. If a display screen such as HDMI or LCD is connected, you can open a command

line terminal on the desktop.

5) Next, we first use the following command to confirm the device node of eMMC

```
orangepi@orangepi:~/Desktop$ ls /dev/mmcblk*boot0 | cut -c1-12
/dev/mmcblk1
```

6) Then we can use the dd command to clear the eMMC. Note that after the **of=** parameter, please fill in the output result of the above command

```
orangepi@orangepi:~/Desktop$ sudo dd bs=1M if=/dev/zero of=/dev/mmcblk1 count=1000 status=progress
orangepi@orangepi:~/Desktop$ sudo sync
```

7) Then you can use the dd command to burn the linux image of the development board into the eMMC

a. In the following command, the **if=** parameter is followed by the full path where the linux image is stored + the name of the Linux image (such as **the name of /home/orangepi/Desktop/Linux image**). Because we have entered the path of the linux image above, we only need to fill in the name of the Linux image.

b. Please do not copy the linux image name in the following command, but replace it with the actual image name (because the version number of the image may be updated).

```
sudo dd bs=1M if=Orangepi5plus_x.x.x_debian_bullseye_desktop_xfce_linux5.10.160.img of=/dev/mmcblk1 status=progress

sudo sync
```

Note, if you upload a .7z or .xz linux image compressed file, please remember to decompress it before using the dd command to burn.

The detailed description of all parameters of the dd command and more usage can be viewed by executing the man dd command in the linux system.

8) After successfully burning the linux image of the development board to the eMMC, you can use the **poweroff** command to shut down. Then please pull out the TF card, and then short press the power button to turn on, and then the linux system in the eMMC will be started.

2. 6. How to burn Linux image to SPIFlash+NVMe SSD

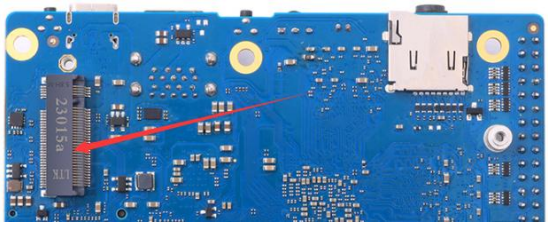
Note that the Linux image mentioned here specifically refers to the image of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the **Orange Pi data download page.**

Note that all the following operations are performed on a Windows computer.

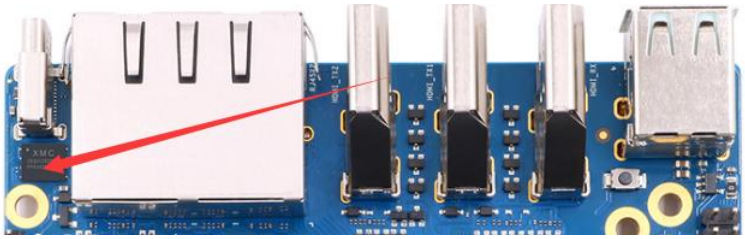
2. 6. 1. The method of using the dd command to burn

1) First, you need to prepare an M-Key 2280 specification NVMe SSD solid state drive, and the specification of the PCIe interface in the M.2 slot of the development board is PCIe3.0x4.

2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board shown in the figure below, and fix it



3) The position of the SPI Flash on the development board is shown in the figure below, no other settings are required before starting the programming



4) Burning the linux image to SPIFlash+NVMe SSD needs to be done with a TF card, so first you need to burn the linux image to the TF card, and then use the TF card to start the

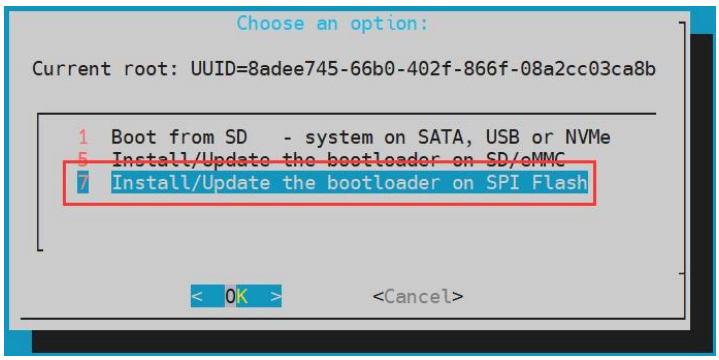
development board to enter the linux system. For the method of burning the Linux image to the TF card, please refer to the instructions in the two sections of **the method of burning the Linux image to the TF card based on the Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC**

5) After using the TF card to start the Linux system, we first burn the u-boot image into the SPI Flash

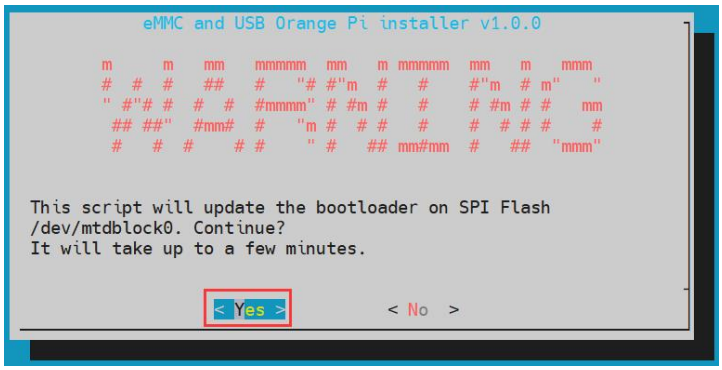
a. Run **nand-sata-install** first, **ordinary users remember to add sudo permission.**

```
orangepi@orangepi:~$ sudo nand-sata-install
```

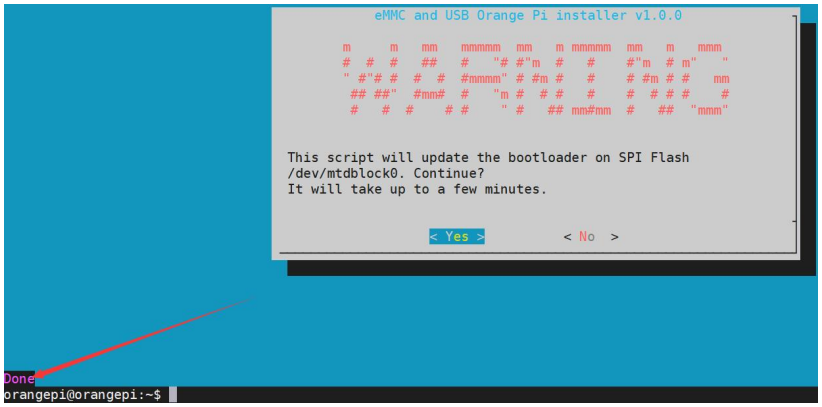
b. Then select **7 Install/Update ther bootloader on SPI Flash**



c. Then select **<Yes>**



d. Then please wait patiently for the burning to complete. After the burning is completed, the display will be as follows (a **Done** will be displayed in the lower left corner):

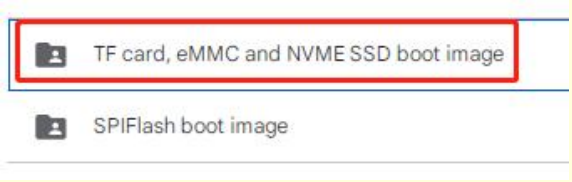


There is no nand-sata-install script in OPi OS Arch system, please use the following command to mirror u-boot to SPI Flash:

[orangepi@orangepi ~]$ **sudo dd if=/boot/rkspi_loader.img of=/dev/mtdblock0**

6) Then upload the linux image file (Debian, Ubuntu or OpenWRT image downloaded from the official website) to the TF card. For the method of **uploading the linux image file to the development board,** please refer to the description in the section of the method of uploading files to the development board Linux system.

Note, if you download the OpenWRT image, you will see the following two types of images in the download link of the OpenWRT image, please download the image file in the "TF card, eMMC and NVME SSD boot image" folder.



7) After uploading the image to the linux system of the development board, we enter the storage path of the image file in the command line of the linux system of the development board. For example, I store the linux image of the development board in the **/home/orangepi/Desktop** directory Download it, and then enter the **/home/orangepi/Desktop** directory to see the uploaded image file.

```
orangepi@orangepi:~$ cd /home/orangepi/Desktop
orangepi@orangepi:~/Desktop$ ls
orangepi5plus_x.x.x_debian_bullseye_desktop_xfce_linux5.10.160.img
```

How to enter the command line of the development board linux system?
4. For the method of using the serial port to log in to the terminal, please refer to the instructions in the section on how to use the debugging serial port.
5. Use ssh to remotely log in to the Linux system, please refer to the instructions in the section of SSH remote login to the development board.
6. If HDMI, LCD and other display screens are connected, you can open a command line terminal on the desktop.

8) Next, let's confirm that the NVMe SSD has been recognized by the development board's linux. If the NVMe SSD is recognized normally, use the **sudo fdisk -l** command to see nvme-related information

```
orangepi@orangepi:~/Desktop$ sudo fdisk -l | grep "nvme0n1"
Disk /dev/nvme0n1: 1.86 TiB, 2048408248320 bytes, 4000797360 sectors
```

Use the lspci command to see an NVMe-related PCI device

```
orangepi@orangepi:~$ lspci
0000:00:00.0 PCI bridge: Rockchip Electronics Co., Ltd Device 3588 (rev 01)
0000:01:00.0 Non-Volatile memory controller: SK hynix BC501 NVMe Solid State Drive
....
```

9) Then we can use the dd command to clear the NVMe SSD (optional)

```
orangepi@orangepi5plus:~/Desktop$ sudo dd bs=1M if=/dev/zero of=/dev/nvme0n1 count=2000 status=progress
orangepi@orangepi5plus:~/Desktop$ sudo sync
```

10) Then you can use the dd command to burn the linux image of the development board to the NVMe SSD

a. In the following command, the **if=** parameter is followed by the full path where the linux image is stored + the name of the Linux image (such as **the name of /home/orangepi/Desktop/Linux image**). Because we have entered the path of the linux image above, we only need to fill in the name of the Linux image.
b. Please do not copy the linux image name in the following command, but replace it with the actual image name (because the version number of the image may be updated).

```
sudo dd bs=1M if=orangepi5plus_x.x.x_debian_bullseye_desktop_xfce_linux5.10.160.img of=/dev/nvme0n1 status=progress
```

```
sudo sync
```

Note, if you upload a .7z or .xz or .gz linux image compressed file, please remember to decompress it before using the dd command to burn.

The detailed description of all parameters of the dd command and more usage can be viewed by executing the man dd command in the linux system.

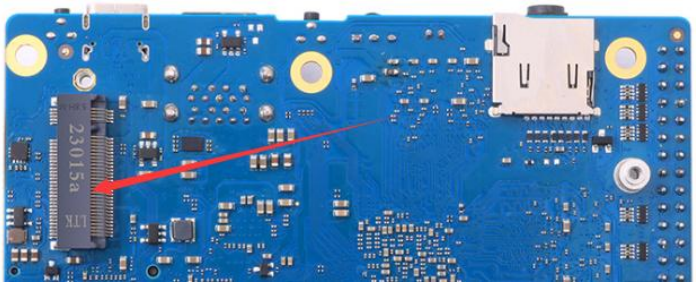
11) After successfully burning the linux image of the development board to the NVMe SSD, you can use the poweroff command to shut down. Then please pull out the TF card, and then short press the power button to turn on, then the linux system in SPIFlash+NVMe SSD will be started.

2.6.2. How to use balenaEtcher software to program

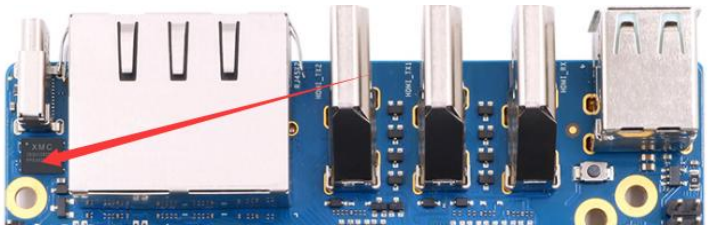
Please do not use this method for OPi OS Arch system and OpenWRT system.

1) First, you need to prepare an M-Key 2280 specification NVMe SSD solid state drive, and the specification of the PCIe interface in the M.2 slot of the development board is PCIe3.0x4.

2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board shown in the figure below, and fix it



3) The position of the SPI Flash on the development board is shown in the figure below, no other settings are required before starting the programming



4) Burning the linux image to SPIFlash+NVMe SSD needs to be done with a TF card, so first you need to burn the linux image to the TF card, and then use the TF card to start the development board to enter the linux system. For the method of burning the Linux image to the TF card, please refer to the instructions in the two sections of **the method of burning the Linux image to the TF card based on the Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC.**

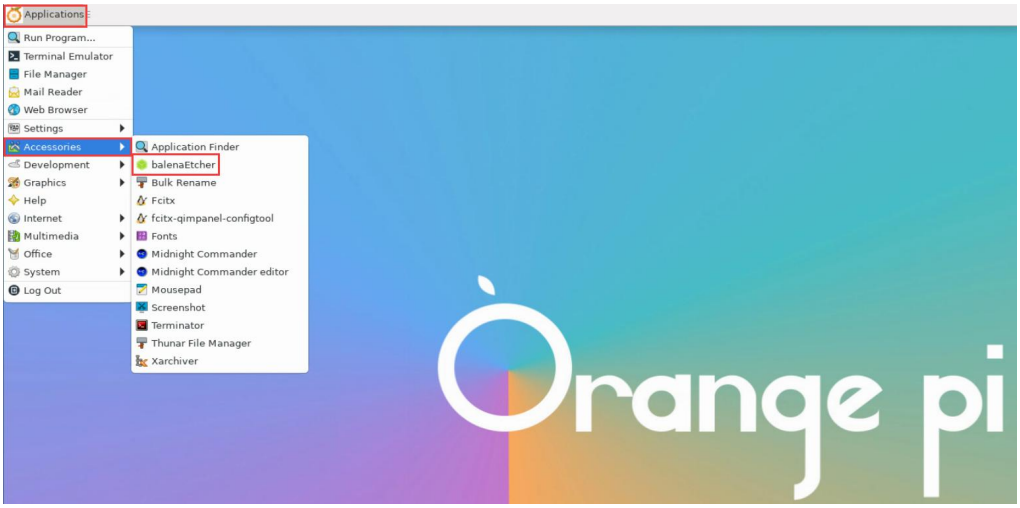
5) After booting into the linux system in the TF card, please confirm that the NVMe SSD has been recognized by the linux system of the development board. If the NVMe SSD is recognized normally, use the **sudo fdisk -l**command to see nvme-related information

```
orangepi@orangepi:~/Desktop$ sudo fdisk -l | grep "nvme0n1"
Disk /dev/nvme0n1: 1.86 TiB, 2048408248320 bytes, 4000797360 sectors
```

Use the lspci command to see an NVMe-related PCI device

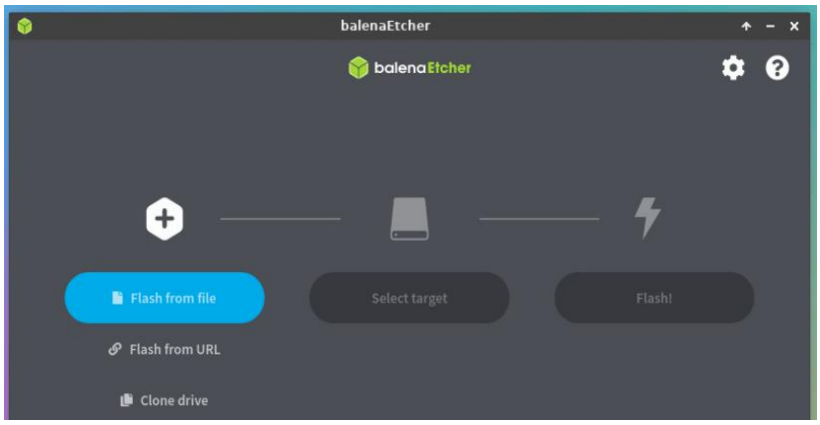
```
orangepi@orangepi:~$ lspci
0000:00:00.0 PCI bridge: Rockchip Electronics Co., Ltd Device 3588 (rev 01)
0000:01:00.0 Non-Volatile memory controller: SK hynix BC501 NVMe Solid State Drive
....
```

6) The balenaEtcher has been pre-installed in the linux image, and the opening method is as follows:



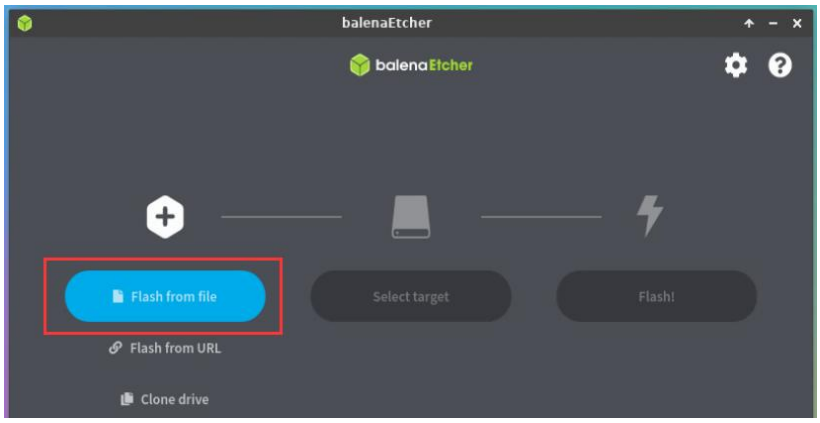
If it is not pre-installed, for how to download and install the arm64 version of balenaEtcher, please refer to the instructions in the section on how to download and install the arm64 version of balenaEtcher.

7) The interface after opening balenaEtcher is as follows:

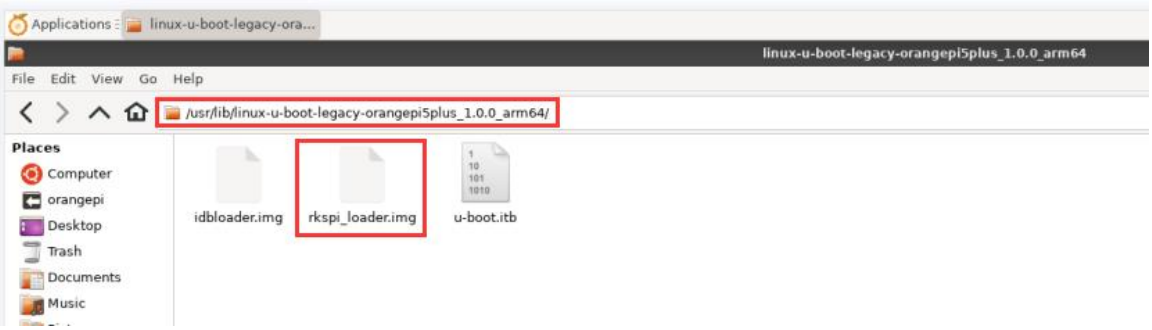


8) The method of using balenaEtcher to burn u-boot to the SPI Flash of the development board is as follows:

a. First click**Flash from file**



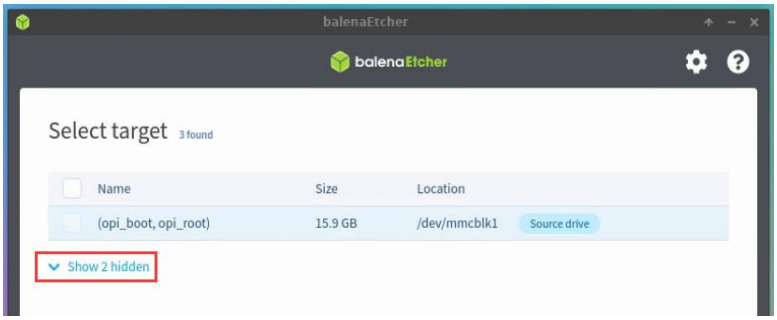
b. Then enter the **/usr/lib/linux-u-boot-legacy-orangepi5plus_1.x.x_arm64** directory, select **rkspi_loader.img**, and click **Open**to open



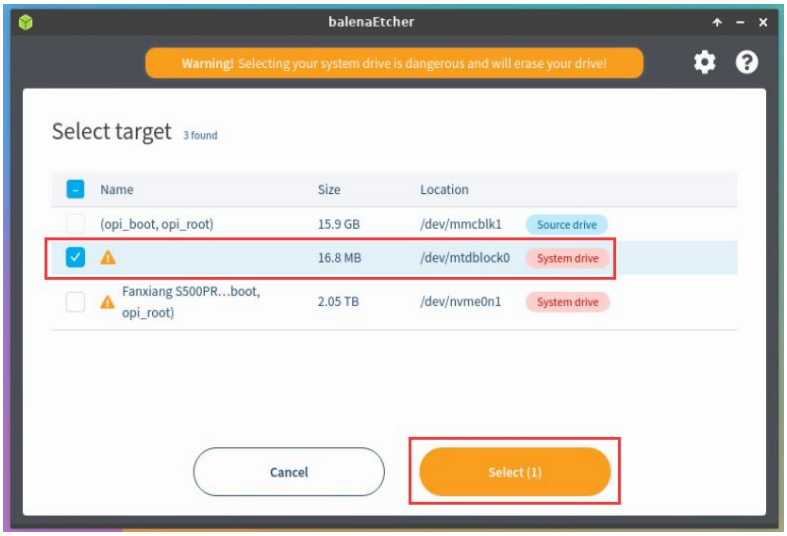
c. The interface after opening **rkspi_loader.img** is as follows:

d. Then click **Select target**

e. Then click **Show 2 hidden** to open more options for storage devices

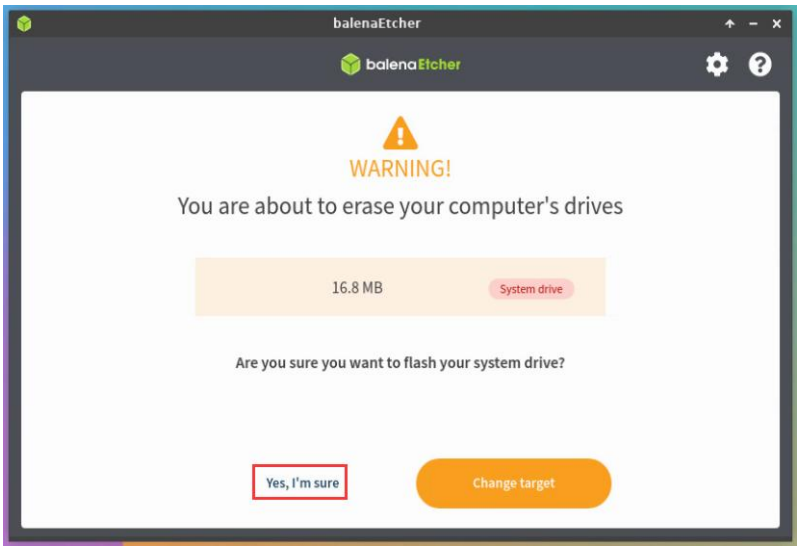


f. Then select the device name of SPI Flash **/dev/mtdblock0**, and click **Select**

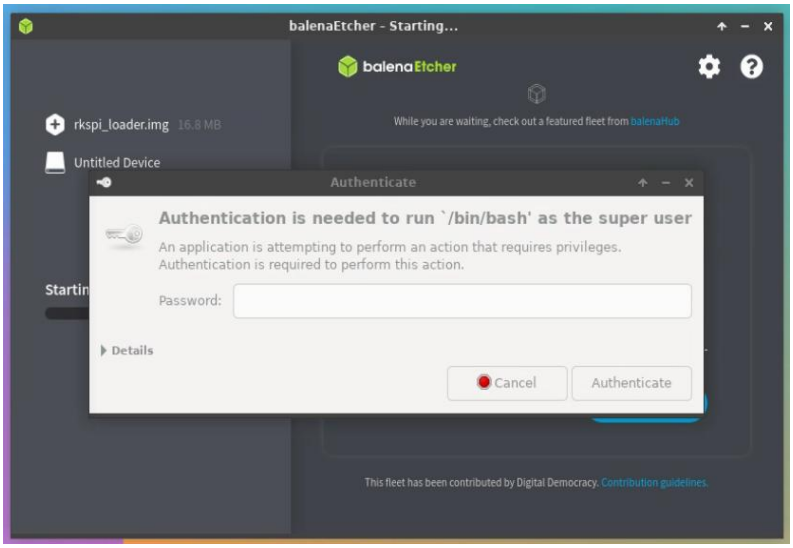


g. Then click **Flash**

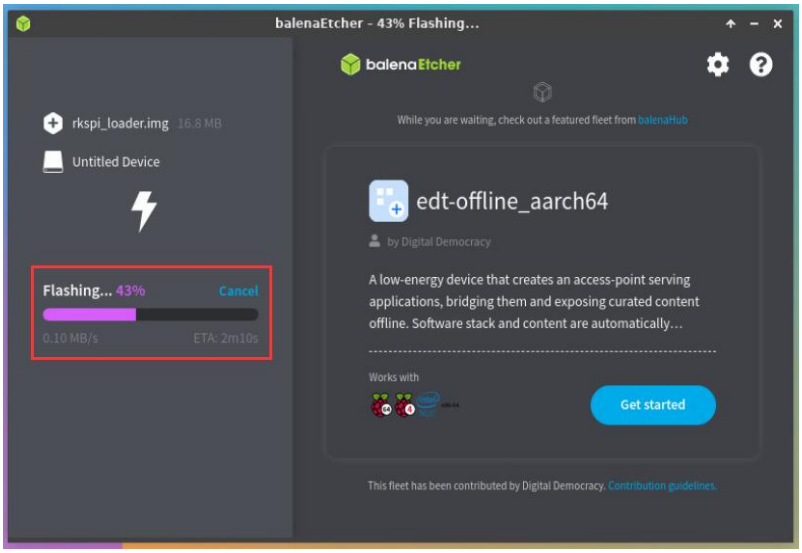
h. Then click **Yes, I'm sure**



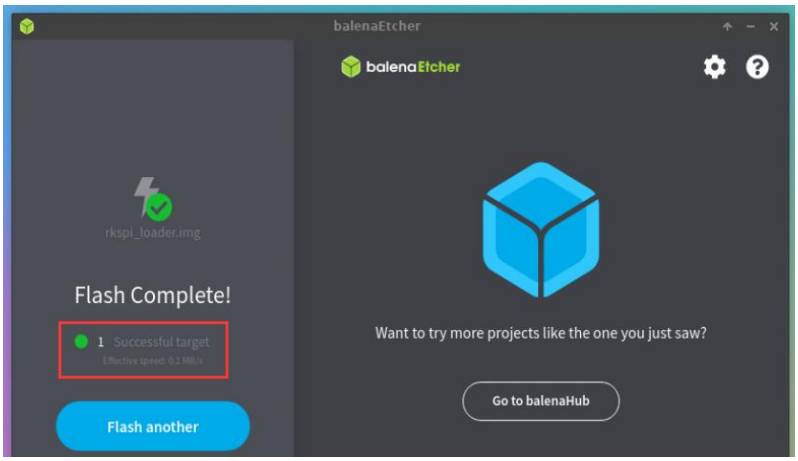
i. Then enter the password orangepi of the development board linux system, and it will start burning the u-boot image into the SPI Flash



j. The display of the burning process is as follows:

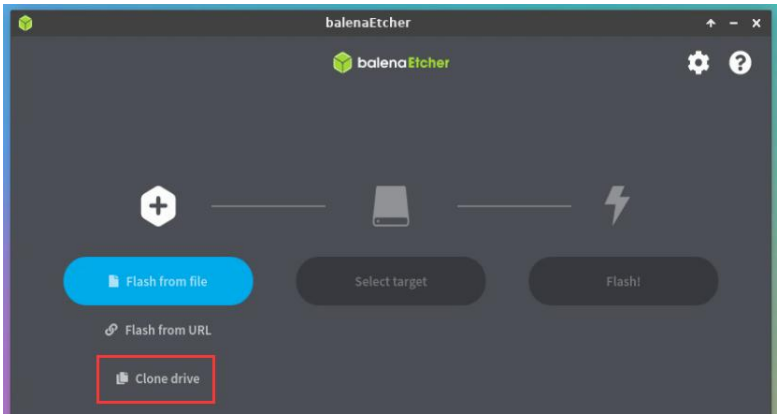


k. After the burning is completed, the display is as follows:

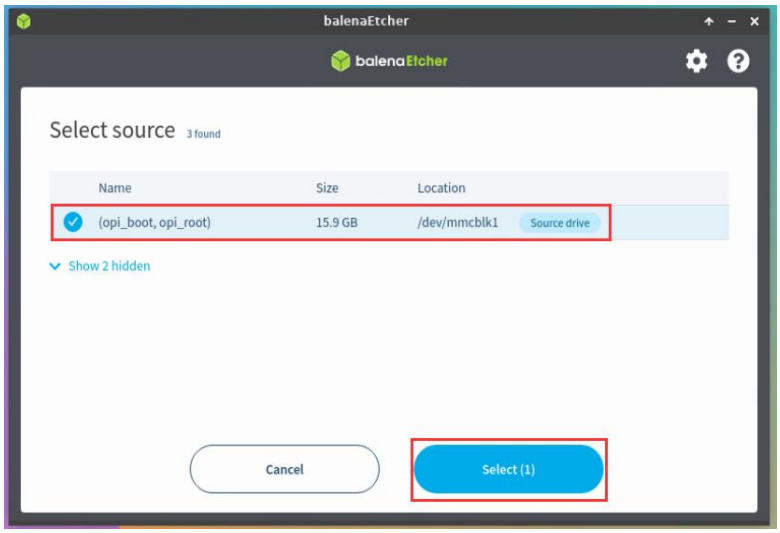


9) The method of burning the linux system in the TF card to the NVMe SSD (this method is equivalent to cloning the system in the TF card to the NVMe SSD)

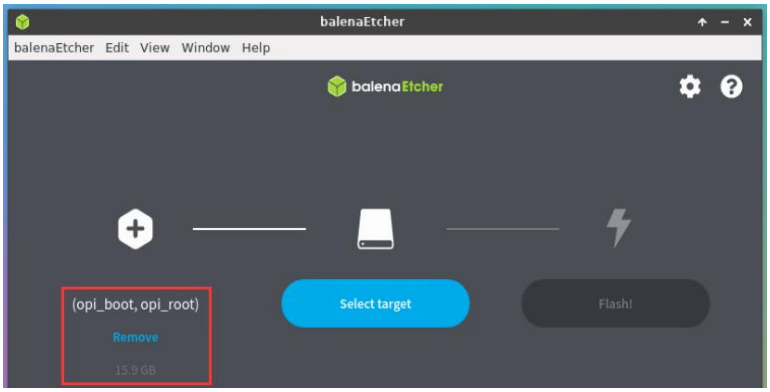
a. First click **Clone drive**



b. Then select the device name of the TF card **/dev/mmcblk1**

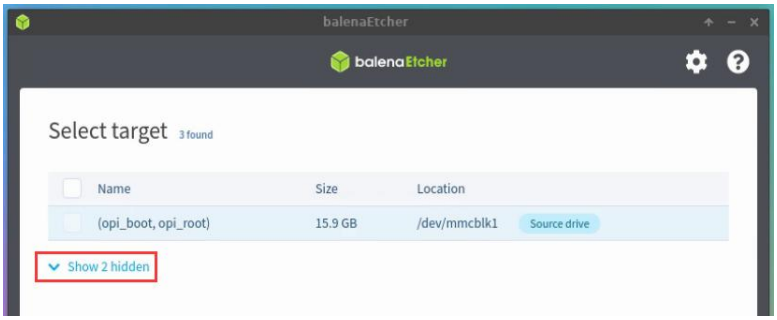


c. The interface after opening the TF card is as follows:

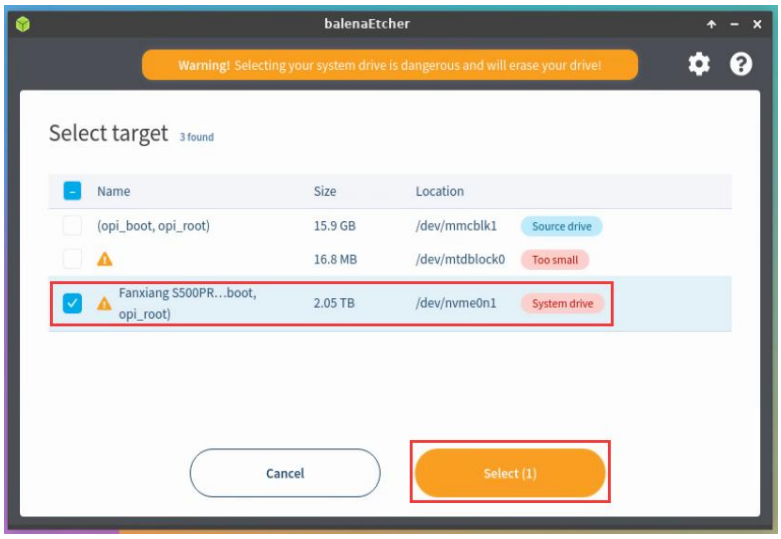


d. Then click **Select target**

e. Then click **Show 2 hidden** Option to open more storage devices

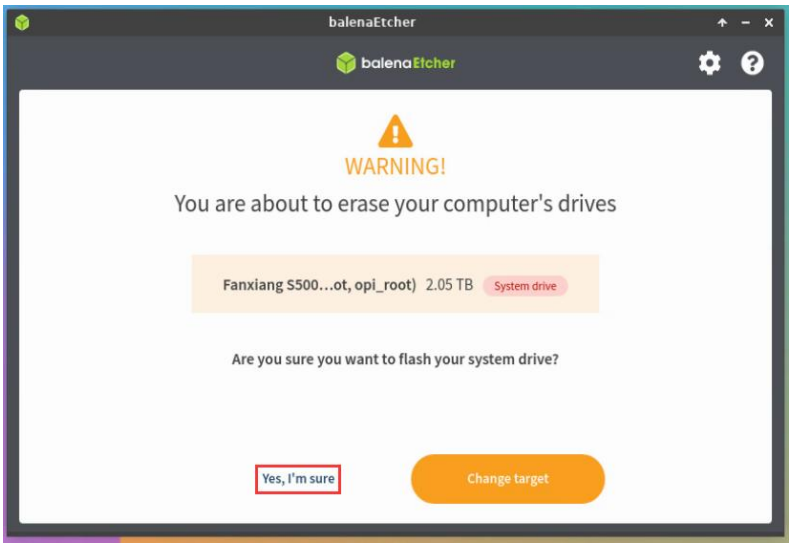


f. Then select the device name of the NVMe SSD **/dev/nvme0n1**, and click **Select**

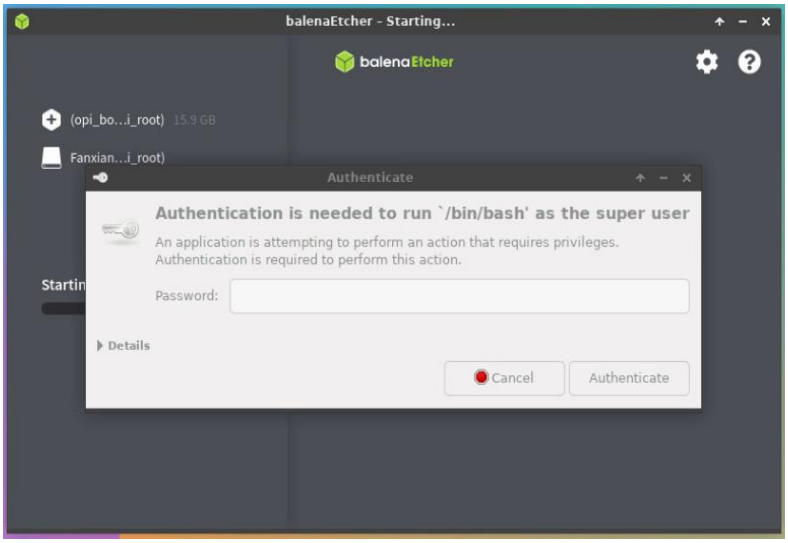


g. Then click **Flash**

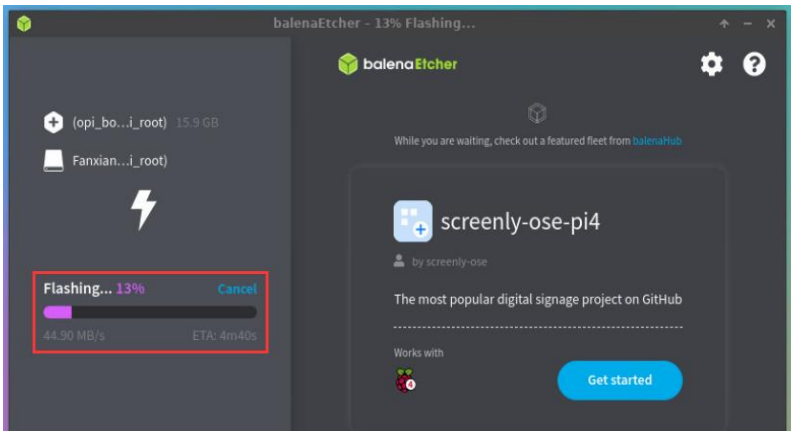
h. Then click **Yes, I'm sure**

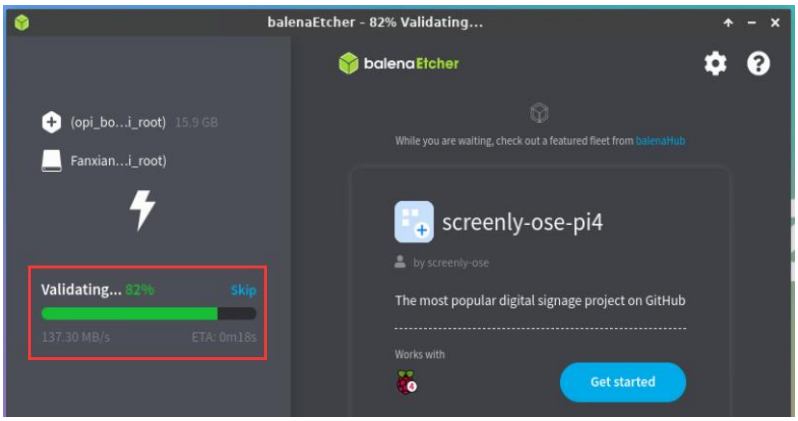


i. Then enter the password orangepi of the linux system on the development board, and it will start burning the linux image to the SSD

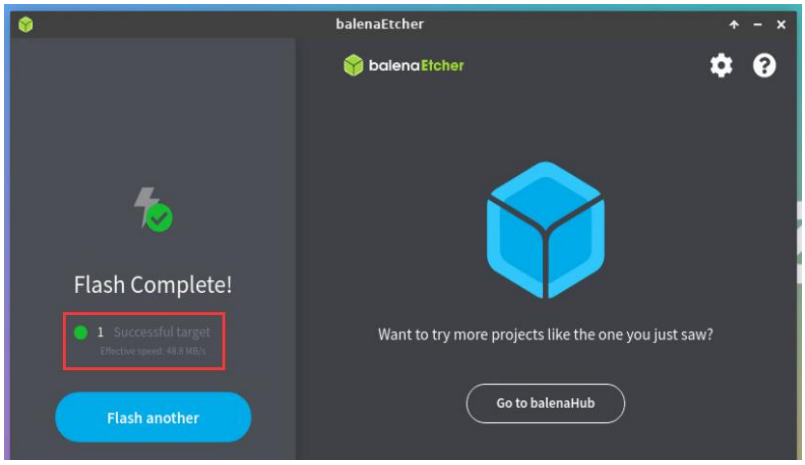


j. The display of the burning process is as follows:





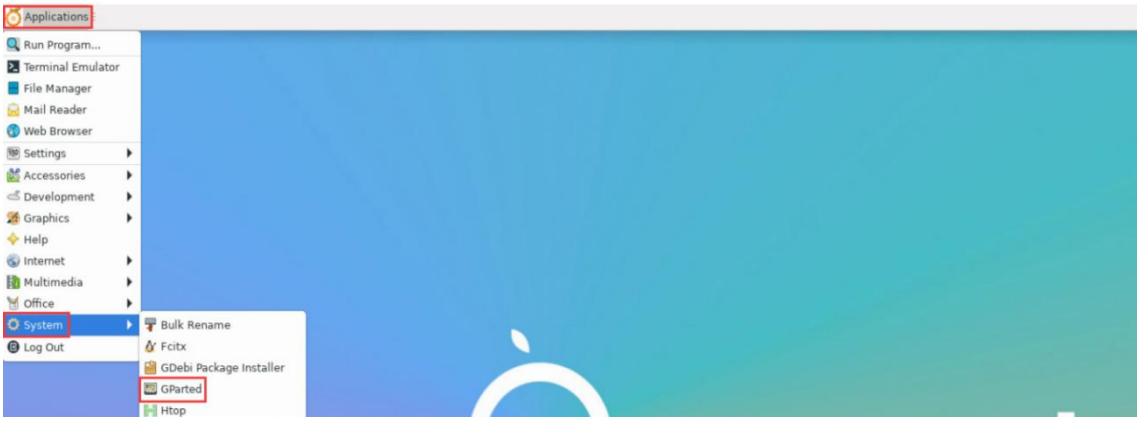
k. After the burning is completed, the display is as follows:



l. Then you need to expand the capacity of the rootfs partition in the NVMe SSD. The steps are as follows:

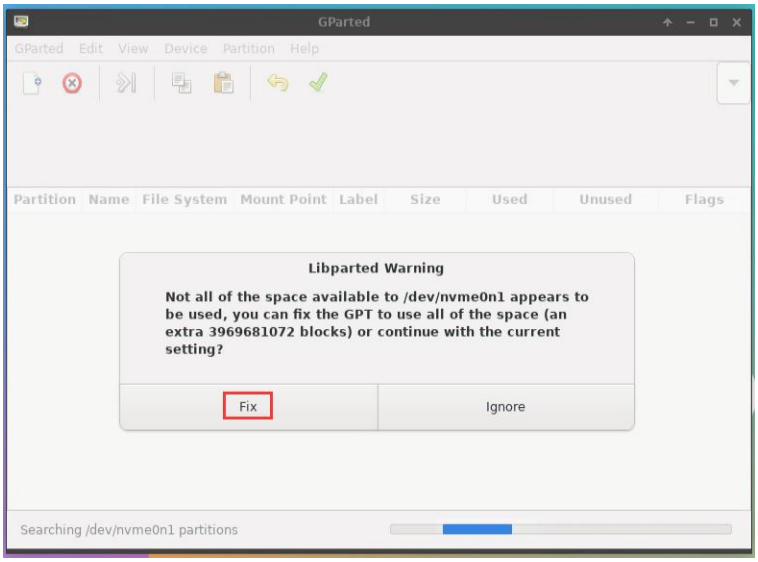
a) Open **GParted** first, if the system does not have Gparted pre-installed, please use the apt command to install it

```
orangepi@orangepi:~$ sudo apt-get install -y gparted
```

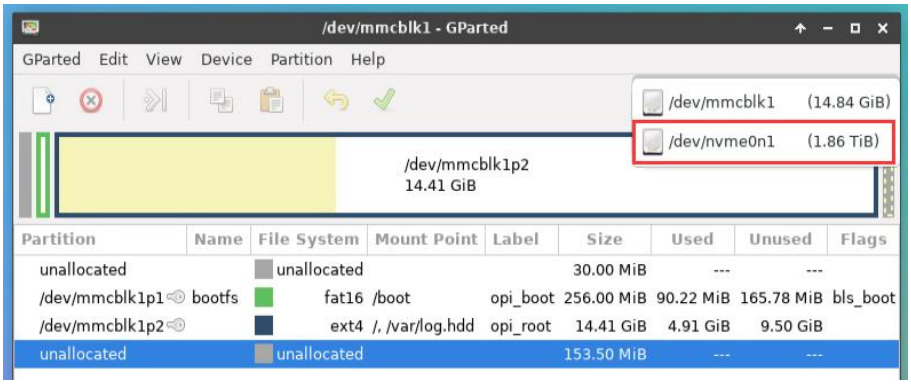


b) Then enter the password orangepi of the linux system, and click **Authenticate**

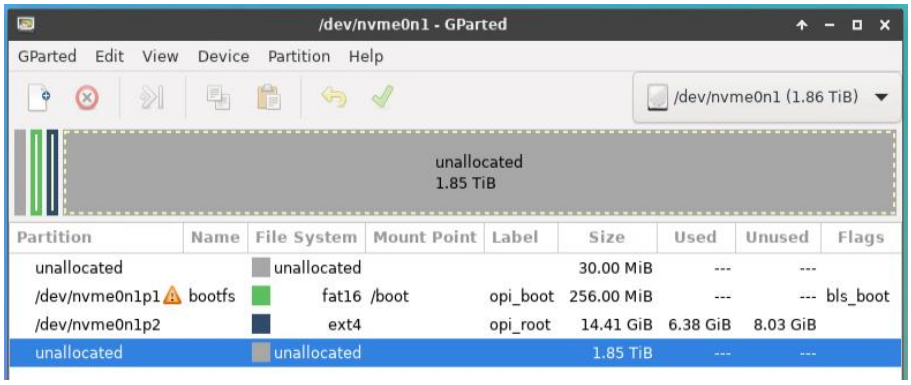
c) Then click **Fix**



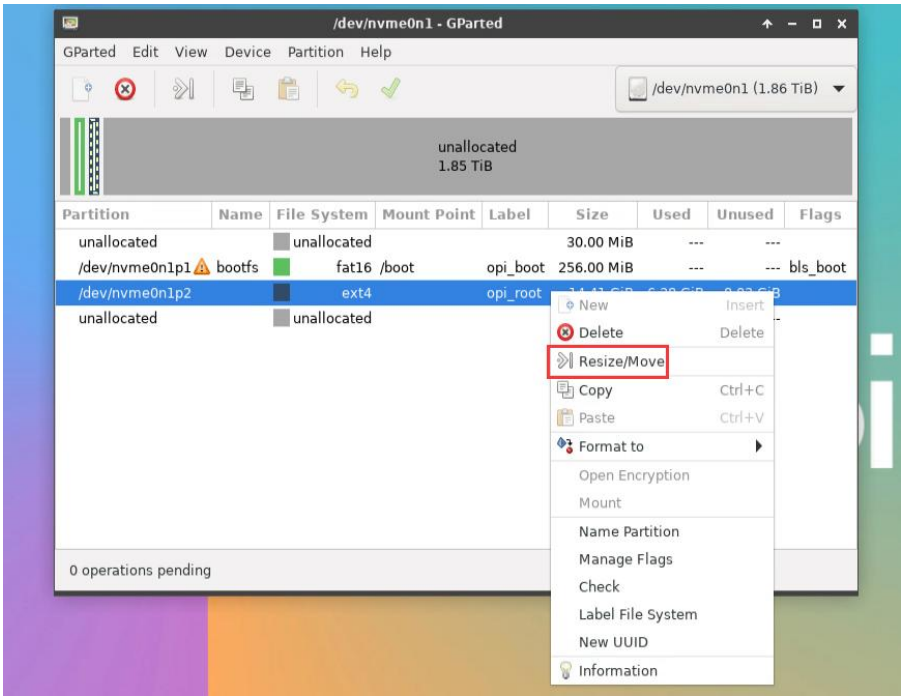
d) Then select NVMe SSD



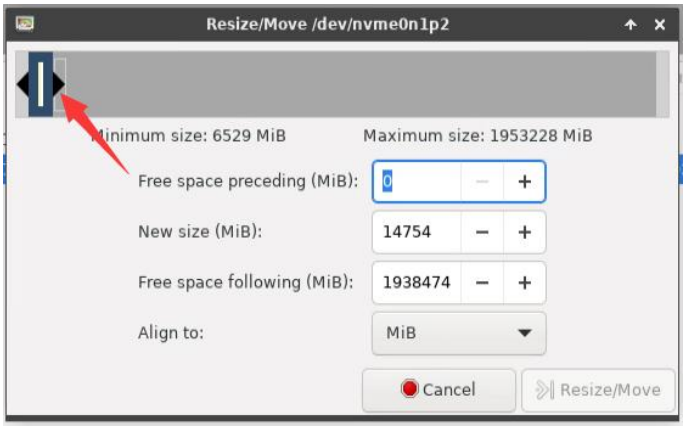
e) The display interface after selecting NVMe SSD is as follows:



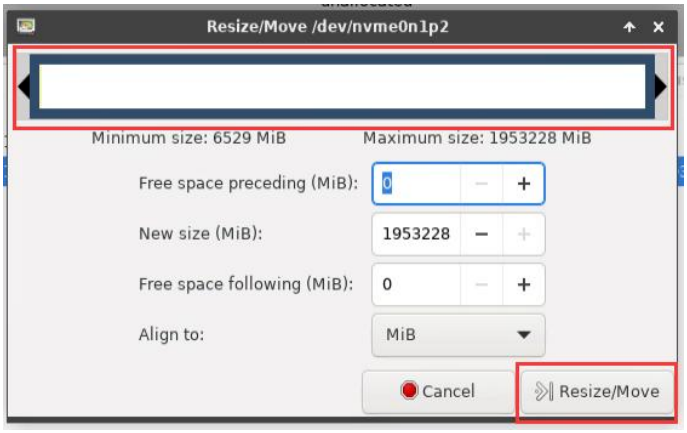
f) f) Then select the **/dev/nvme0n1p2** partition, click the right button again, and then select **Resize/Move**



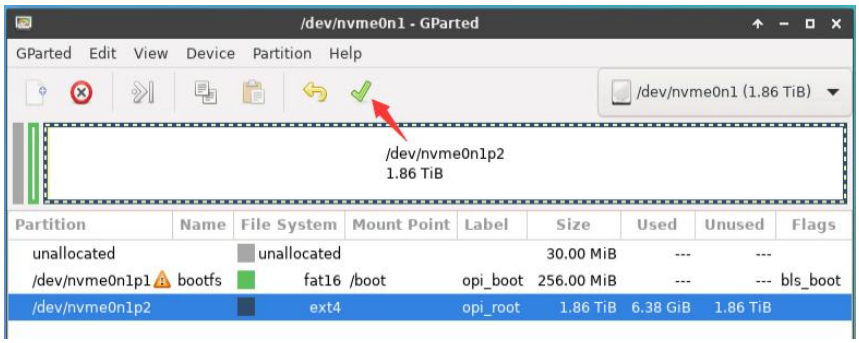
g) Then drag the capacity to the maximum at the position shown in the figure below



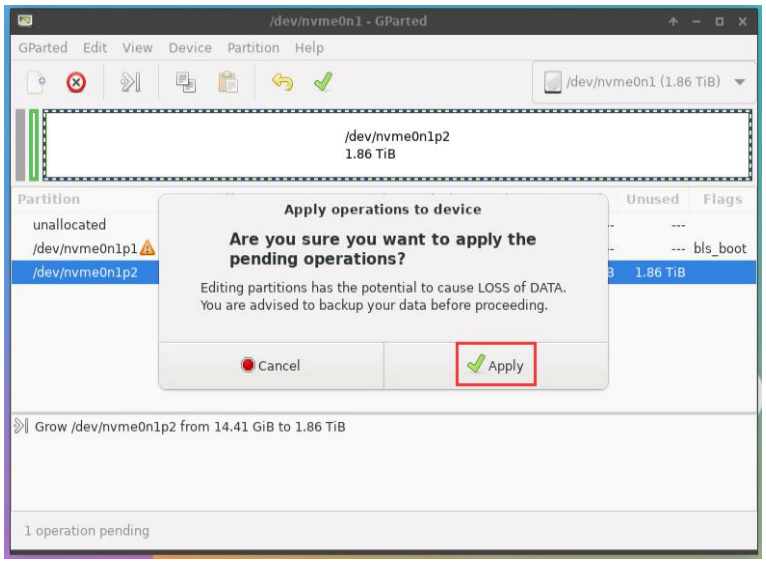
h) Then click **Resize/Move**



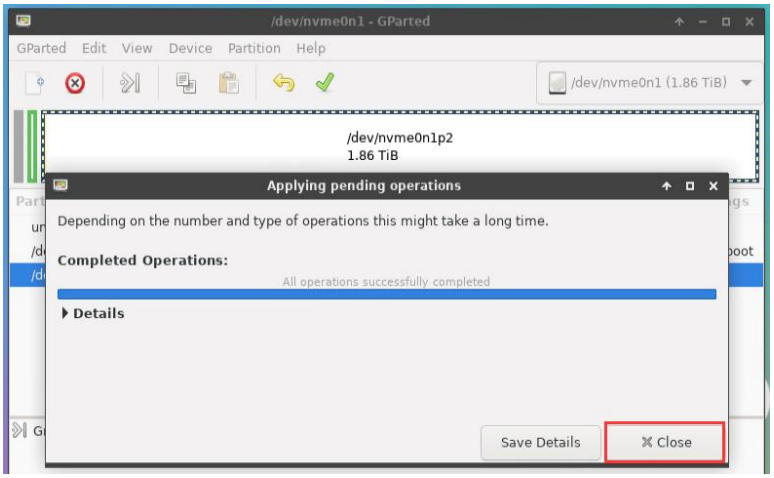
i) Then click the green √ in the position below



j) Then click **Apply**



k) Then click **Close** to close

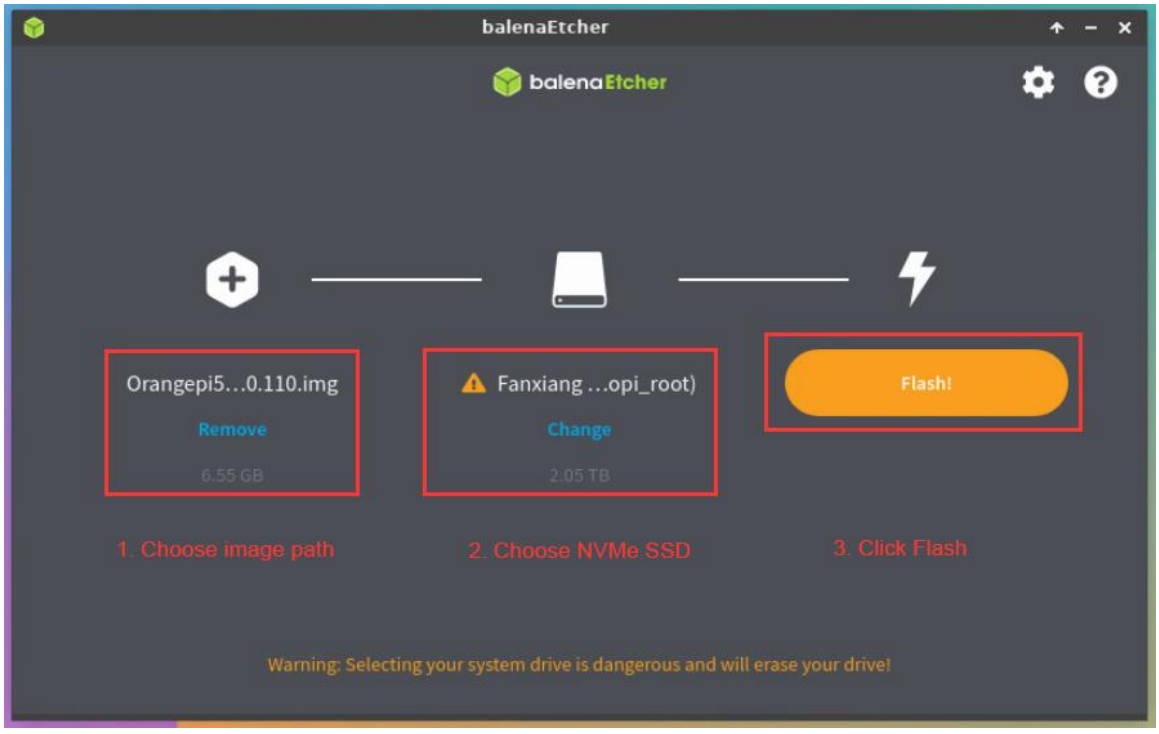


m. At this point, you can use the **sudo poweroff** command to shut down. Then please pull out the TF card, and then short press the power button to turn on, then the linux system in SPIFlash+NVMe SSD will be started.

10) Step **9)** is to clone the system in the TF card to the NMVe SSD. We can also directly burn the linux image file to the NVMe SSD. Here are the steps:

a. Upload the linux image file to the linux system of the development board

b. Then use balenaEtcher to burn



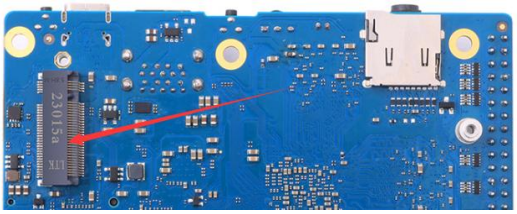
c. After using this method to burn the image, there is no need to manually expand the capacity, and it will automatically expand the capacity at the first

startup.

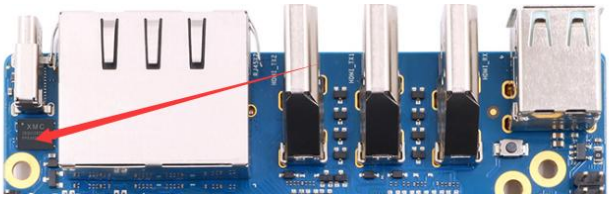
2. 6. 3. Using RKDevTool to burn

1) First, you need to prepare an M-Key 2280 specification NVMe SSD solid state drive, and the specification of the PCIe interface in the M.2 slot of the development board is PCIe3.0x4.

2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board shown in the figure below, and fix it



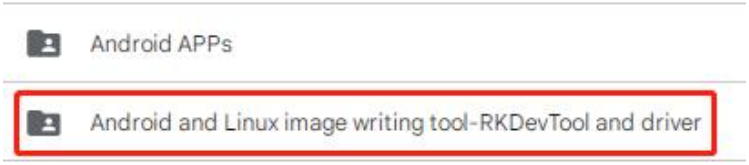
3) The position of the SPI Flash on the development board is shown in the figure below, no other settings are required before starting the programming



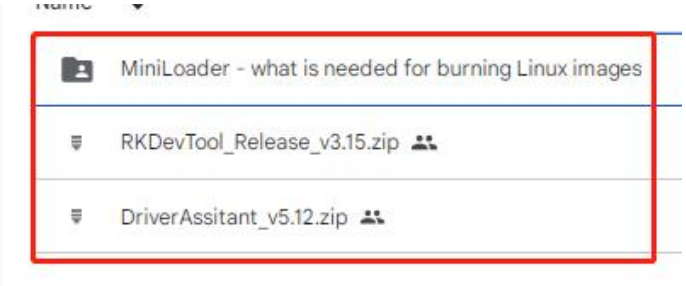
4) Then you need to prepare a data cable with good quality Type-C interface

5) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and MiniLoader and the burning tool **RKDevTool_Release_v3.15.zip** from the Orange Pi data download page

a. On the download page of Orange Pi, first select the official tool, and then enter the following folder



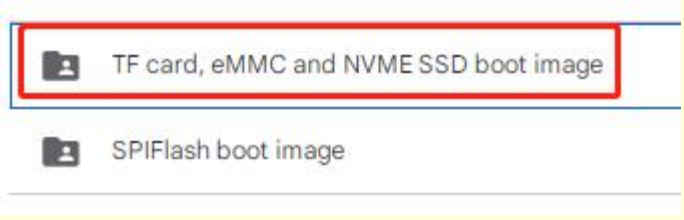
b. Then download all the files below



Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

6) Then download the Linux operating system image file compression package that you want to burn from the Orange Pi data download page, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system , the size is generally more than 2GB

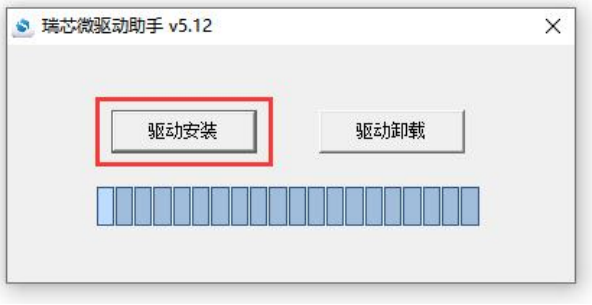
Note, if you download the OpenWRT image, you will see the following two types of images in the download link of the OpenWRT image, please download the image file in the "TF card, eMMC and NVME SSD boot image" folder.



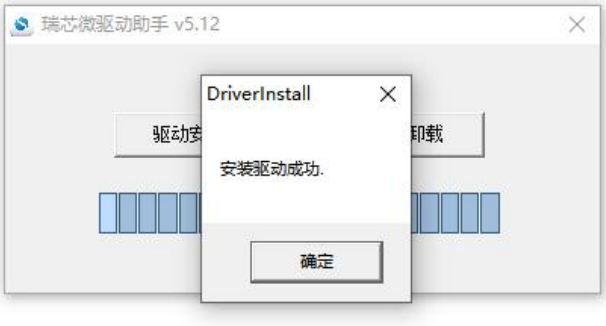
7) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, then find **DriverInstall.exe** executable file in the decompressed folder and open it

8) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

a. Click the "**Driver Installation**" button

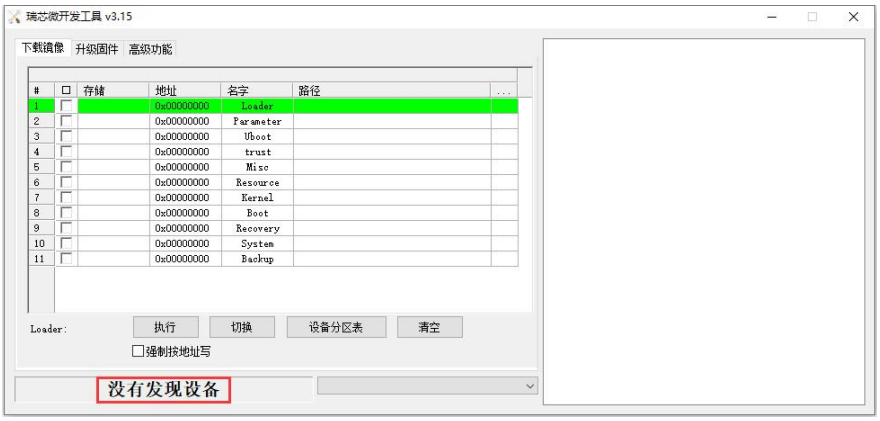


b. After waiting for a period of time, a pop-up window will prompt "**driver installed successfully**", and then click the "**OK**" button.



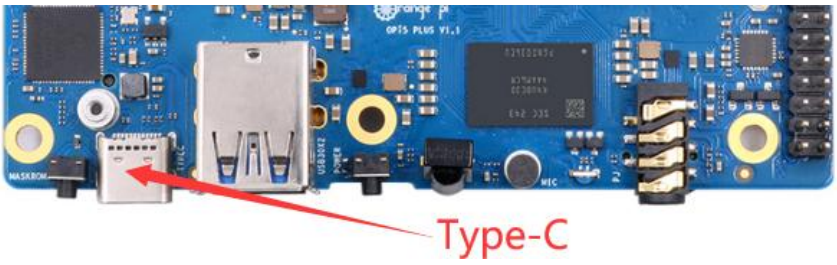
9) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

10) After opening the **RKDevTool** burning tool, because the computer is not connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



11) Then start burning the Linux image to the SSD

a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below

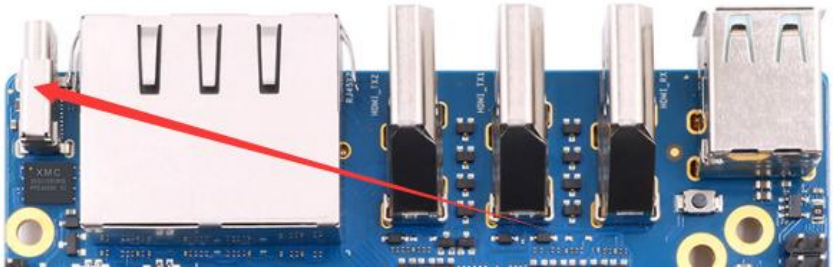


b. Make sure the development board is not connected to the power supply, and no TF card or eMMC module is inserted

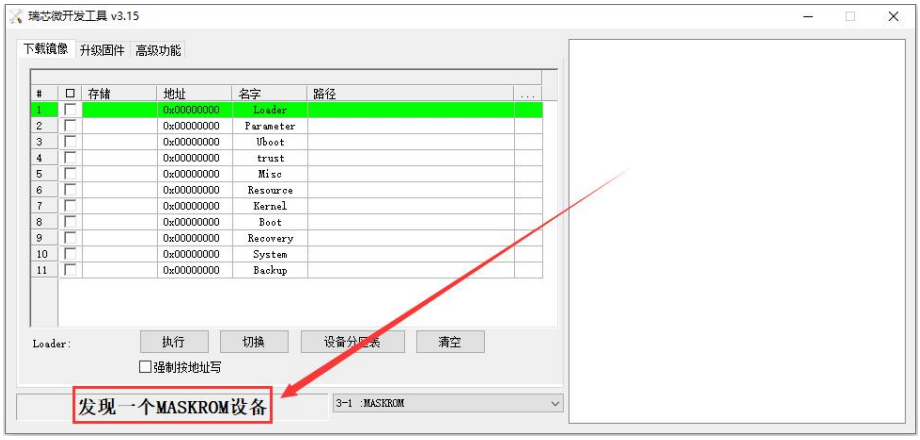
c. Then press and hold the MaskROM button on the development board. The position of the MaskROM button on the development board is shown in the figure below:

d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button. The location of the

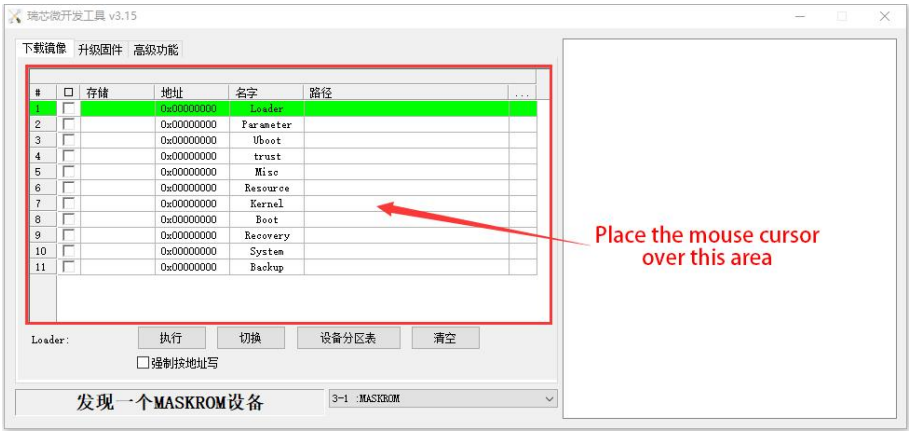
Type-C power interface is as follows:



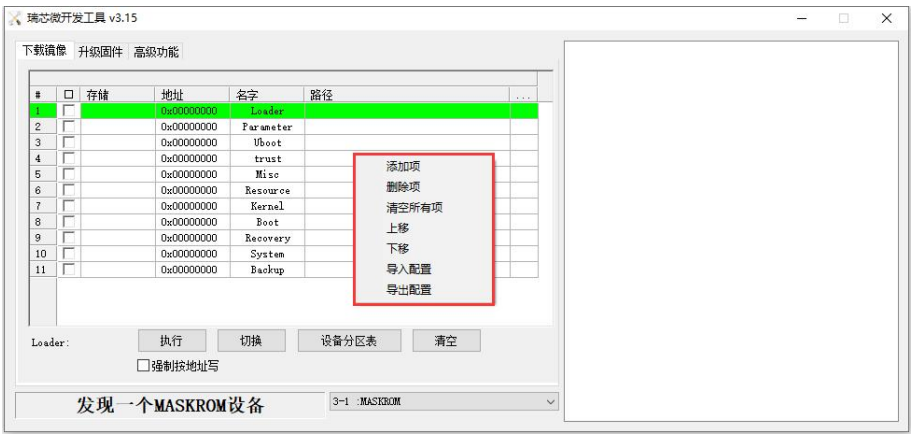
e. If the previous steps are successful, the development board will enter the MASKROM mode at this time, and the interface of the burning tool will prompt "**Found a MASKROM device**"



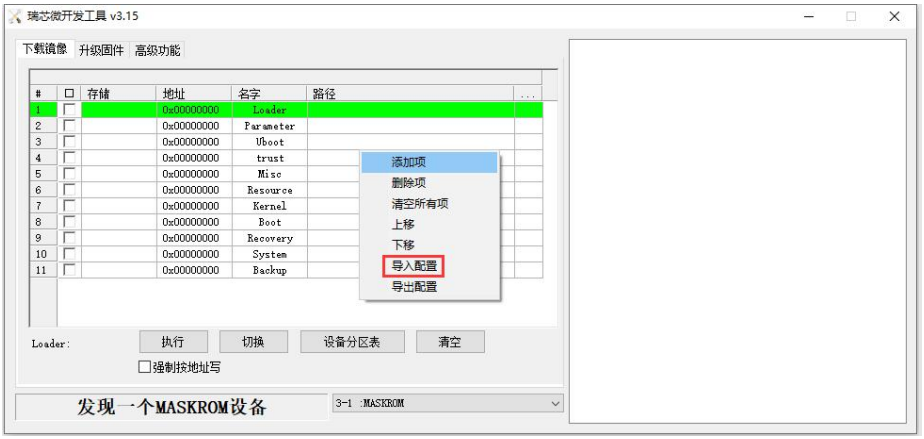
f. Then place the mouse cursor in the area below



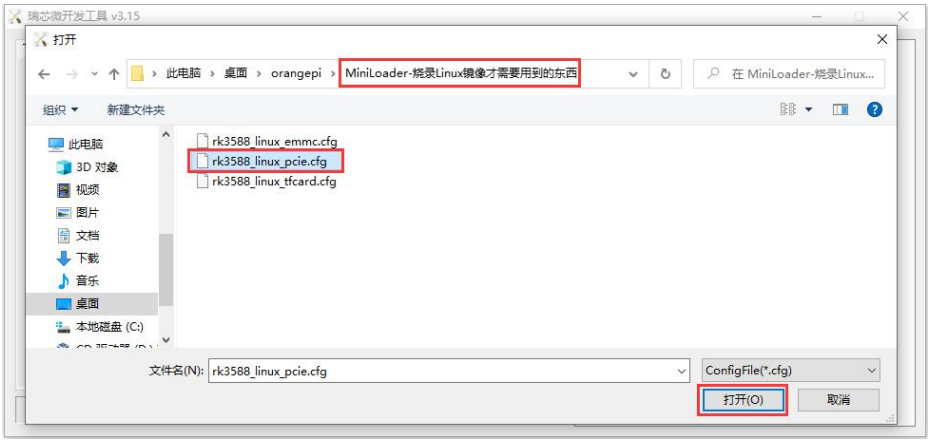
g. Then click the right mouse button and the selection interface shown in the figure below will pop up



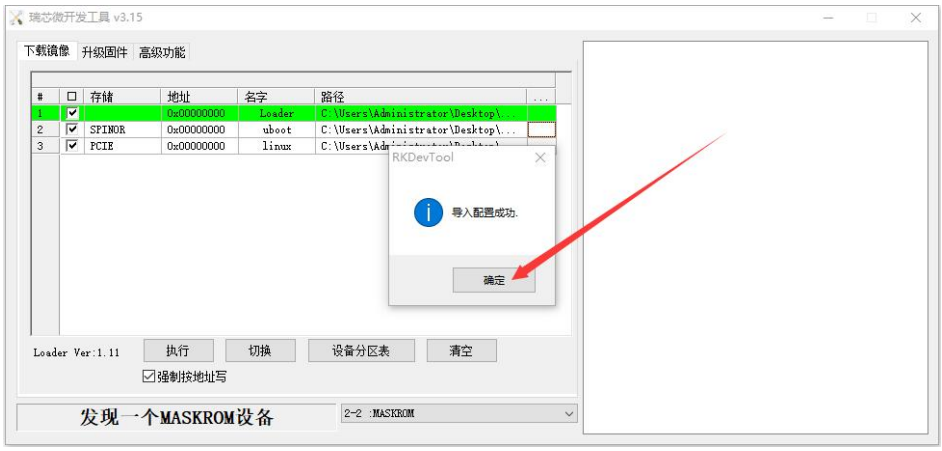
h. Then select the **Import configuration** option



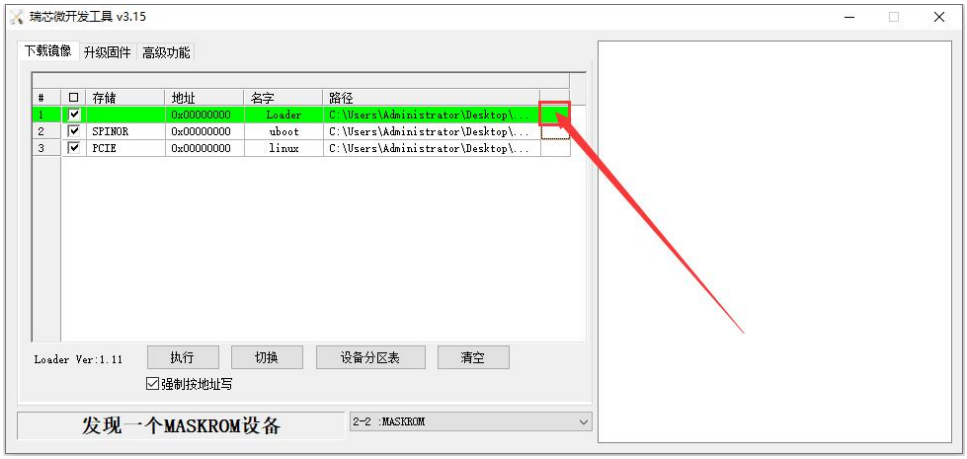
i. Then enter the MiniLoader folder downloaded earlier, then select the **rk3588_linux_pcie.cfg** configuration file, and click **Open**



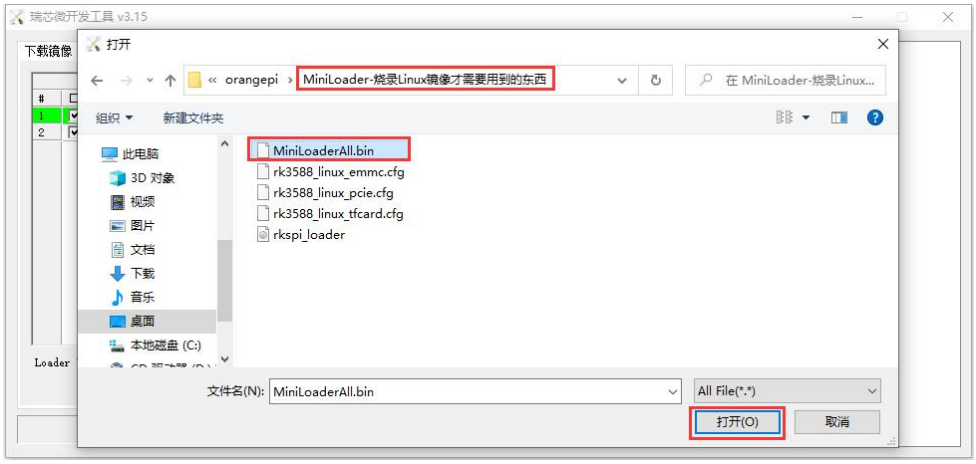
j. Then click **OK**



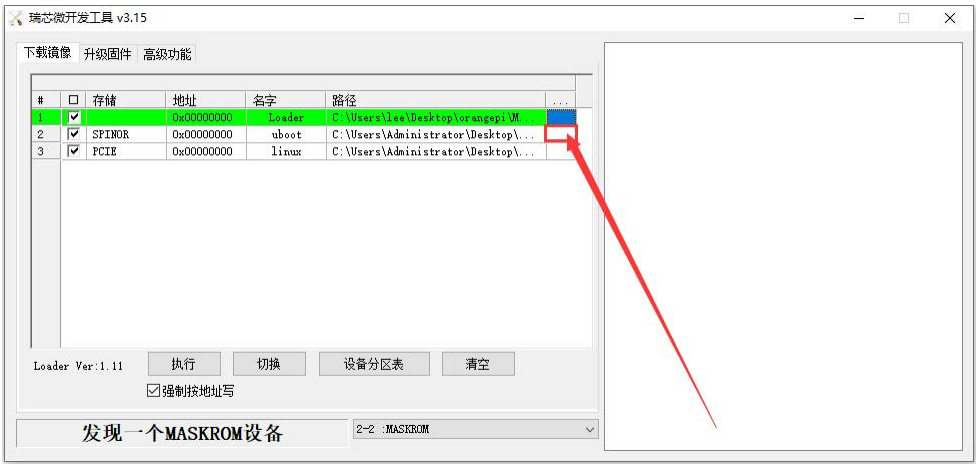
k. Then click the location shown in the figure below



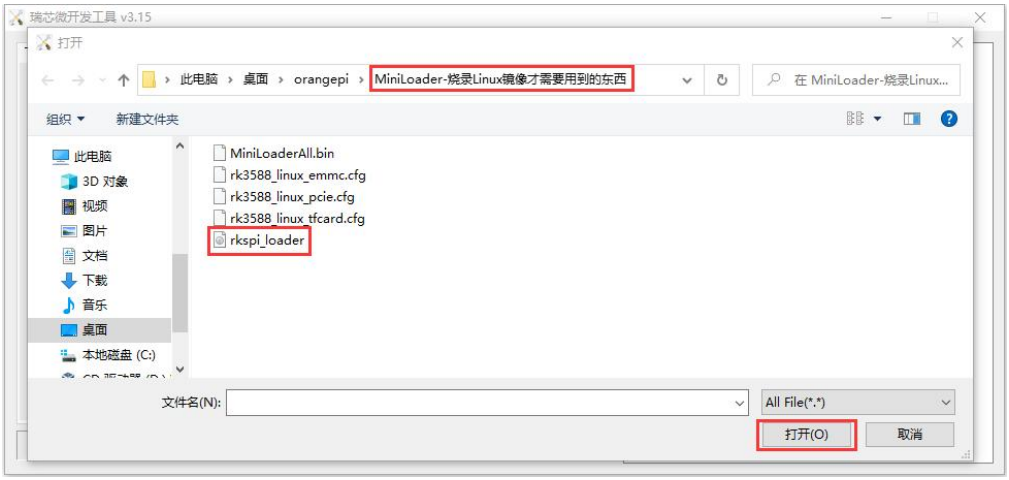
l. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and then click to **open**



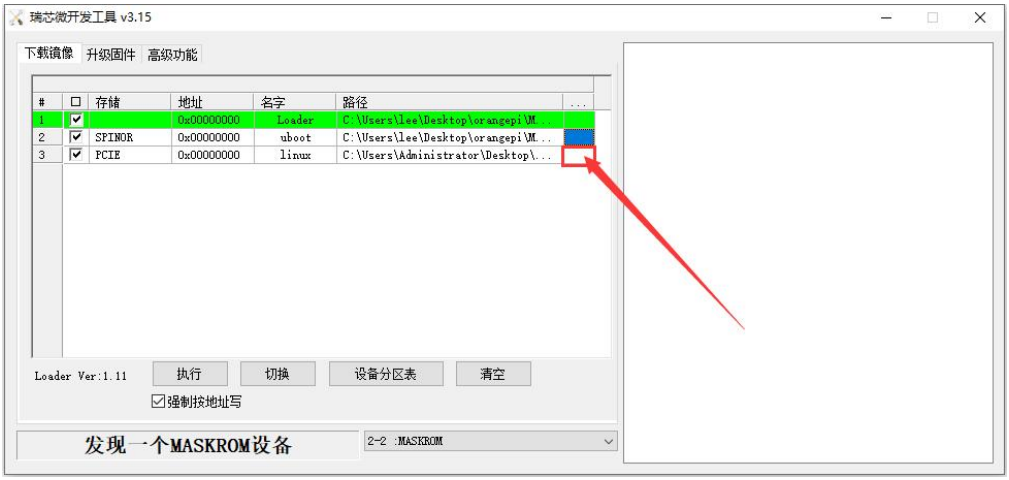
m. Then click the position shown in the figure below



n. Then enter the **MiniLoader** folder downloaded earlier, select **rkspi_loader.img,** and click **Open**



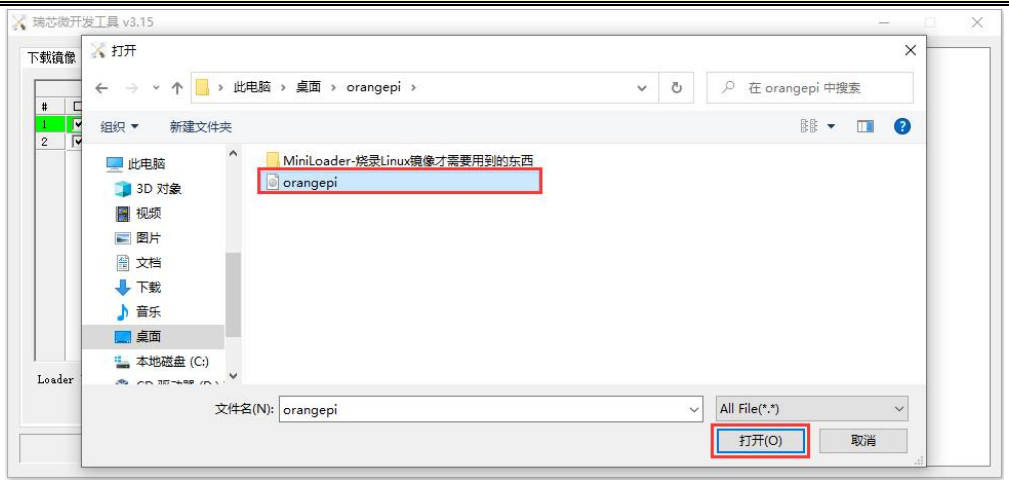
o. Then click the location shown in the figure below



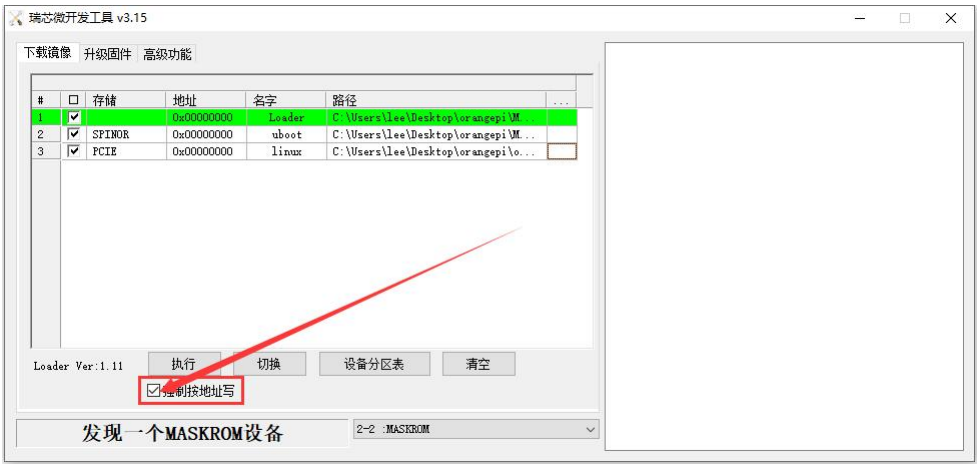
p. Then select the path of the linux image you want to burn, and click **Open**

Before burning the image, it is recommended to rename the linux image to be

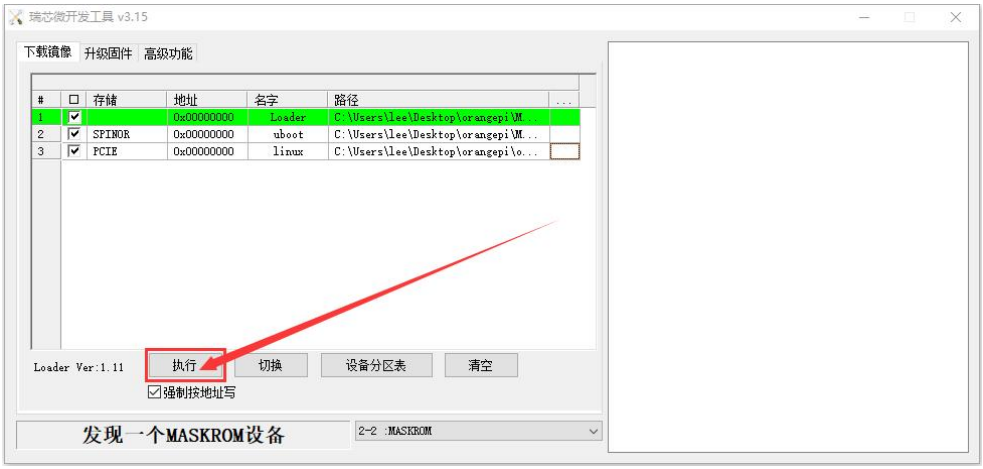
burned to orangepi.img or other shorter names, so that you can see the percentage value of the burning progress when burning the image.



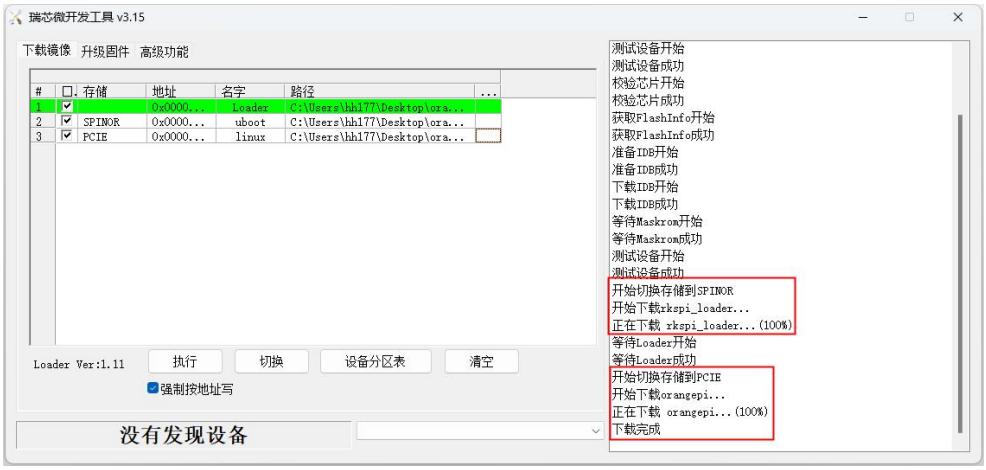
q. Then please check the option to **force write by address**



r. Click the Execute button again to start burning the u-boot+linux image to SPIFlash+SSD



s. The display log after burning the image is shown in the figure below



If there is a problem with burning, please clear the SPIFlash first and then try burning again. For the method of clearing SPIFlash, please refer to the instructions in the section of using RKDevTool to clear SPIFlash.

t. After the image is burnt, it will automatically start the linux system in SPIFlash+PCIe SSD. If it does not start normally, please power on and try again.

2. 7. How to burn OpenWRT image to SPI FLASH

The method introduced in this section is to burn the entire OpenWRT image to spi flash, no nvme ssd is required. In other words, u-boot, kernel and rootfs are all stored in spi flash.

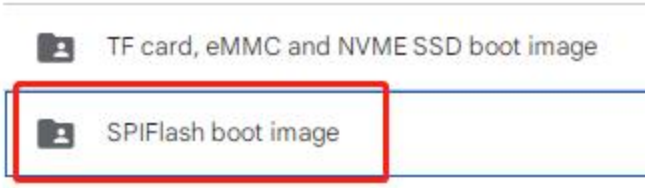
Since the spi flash on the development board is only 16MB, this system basically cannot install much software, and currently only some basic functions can be realized.

2. 7. 1. The method of using the dd command to burn

1) Burning the OpenWRT image to SPIFlash needs to be completed with the help of a TF card, so first you need to burn the OpenWRT image that supports TF card startup to the TF card, and then use the TF card to start the development board to enter the OpenWRT system. For the method of burning the OpenWRT image to the TF card, please refer to the instructions in the two sections of **the method of burning the Linux image to the TF card based on the Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC.**

2) Then download the **OpenWRT** image that can boot from **SPIFlash** from **Orange Pi's**

download page. After opening the download link, you can see the following two types of **OpenWRT images**, please select the image in the SPIFlash boot image folder to download



3) Then upload the image downloaded from the official website to the TF card.

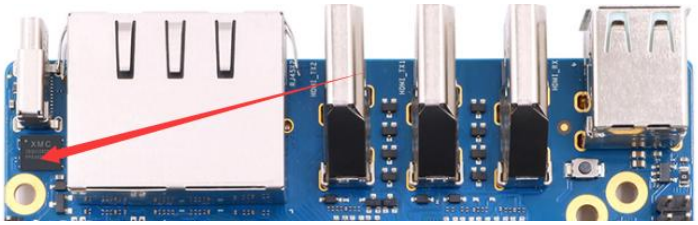
4) Then execute the following command to burn the OpenWRT image into SPIFlash. Note that after if=, you need to specify the actual path where the image is stored

```
root@OpenWrt:~# dd if=openwrt-rockchip-armv8-xunlong_orangepi-5-plus-spi-squashfs-sysupgrade.bin of=/dev/mtdblock0
```

5) Then you can use the poweroff command to shut down. Then please pull out the TF card, and then short press the power button to turn on, and then the OpenWRT system in SPIFlash will be started.

2.7.2. Using RKDevTool to burn

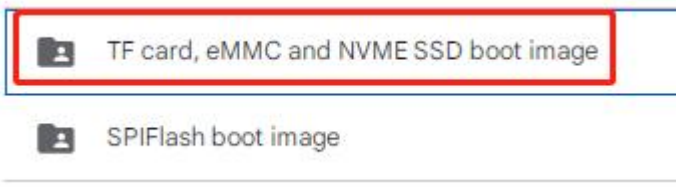
1) The position of the SPI Flash on the development board is shown in the figure below, no other settings are required before starting the programming



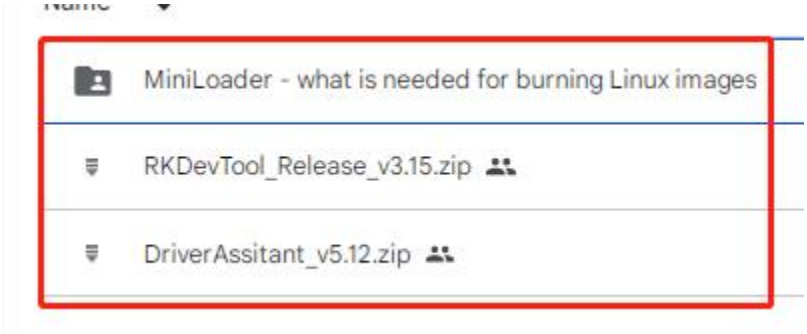
2) Then you need to prepare a data cable with good quality Type-C interface

3) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and MiniLoader and the burning tool **RKDevTool_Release_v3.15.zip** from the Orange Pi data download page

a. On the download page of Orange Pi, first select the official tool, and then enter the following folder

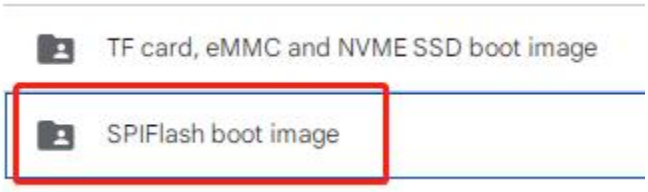


b. Then download all the files below



Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

4) Then download the **OpenWRT** image that can be booted from SPIFlash from the download page of Orange Pi. Limited by the capacity of SPIFlash, the image size is less than **16MB.** After opening the download link, you can see the following two types of OpenWRT images, please select the image in the **SPIFlash boot image** folder

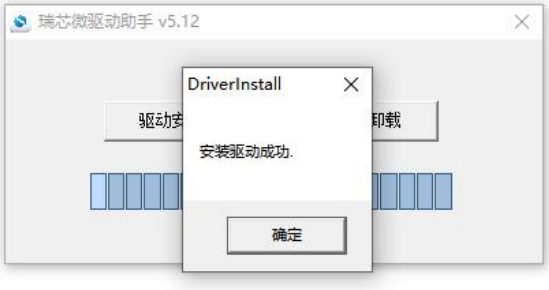


5) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

6) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

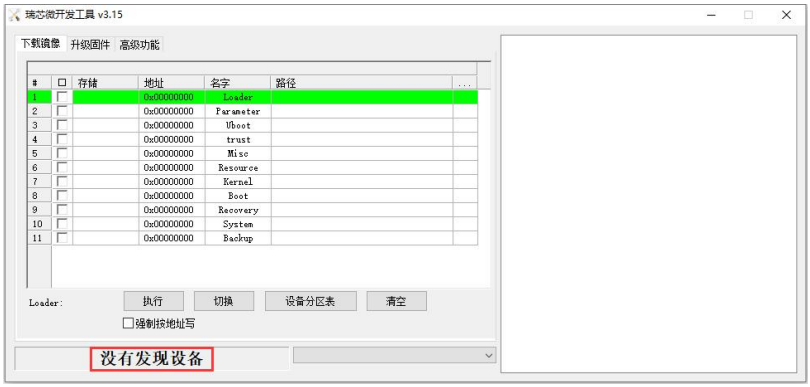
a. Click the "**Driver Installation**" button

b. After waiting for a period of time, a pop-up window will prompt "**driver installed successfully**", and then click the "**OK**" button.



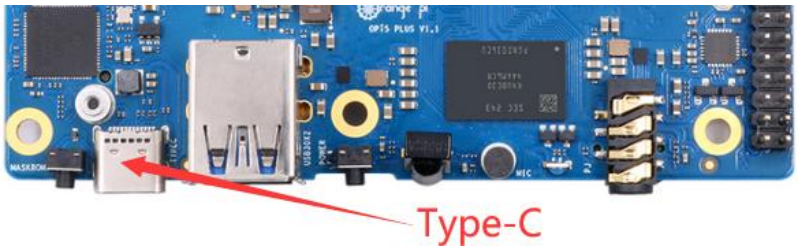
7) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

8) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



9) Then start burning the OpenWRT image into SPI FLASH

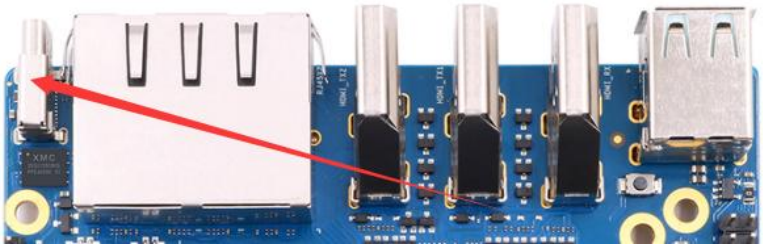
a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



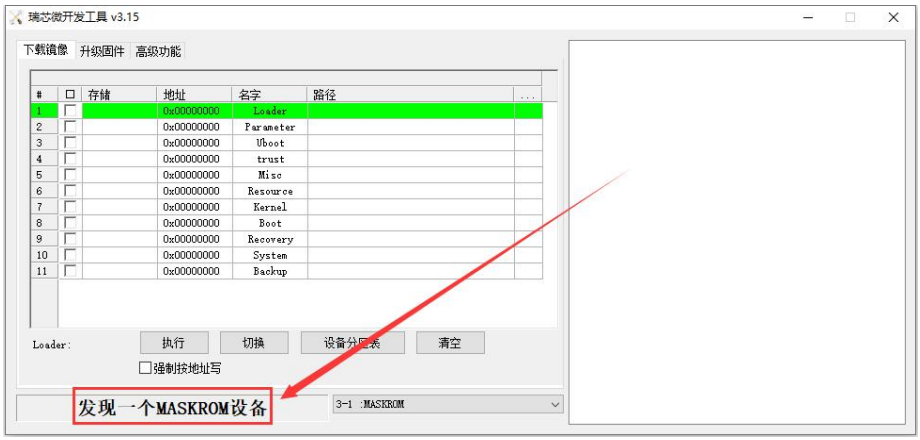
b. Make sure the development board is not connected to the power supply, and the TF card and eMMC module are not inserted

c. Then press and hold the MaskROM button on the development board. The position of the MaskROM button on the development board is shown in the figure below:

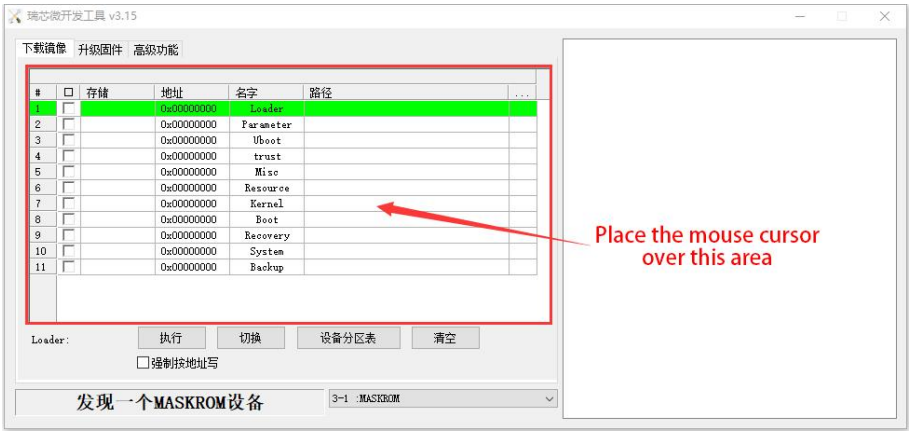
d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



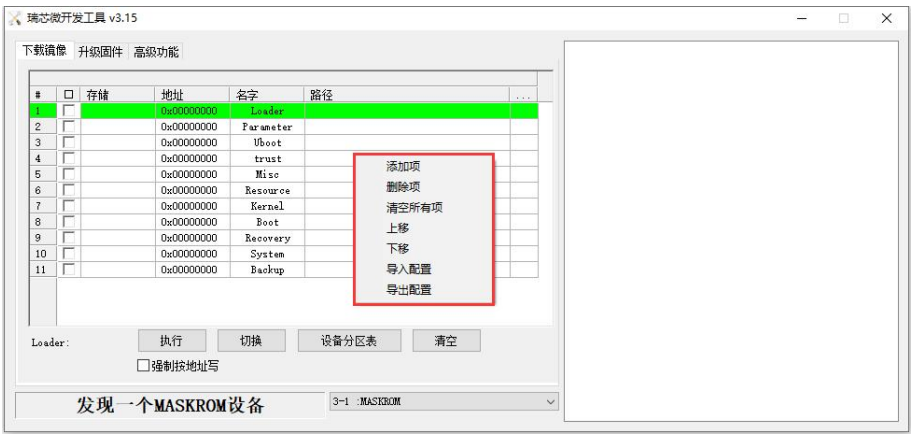
e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**Found a MASKROM device**"



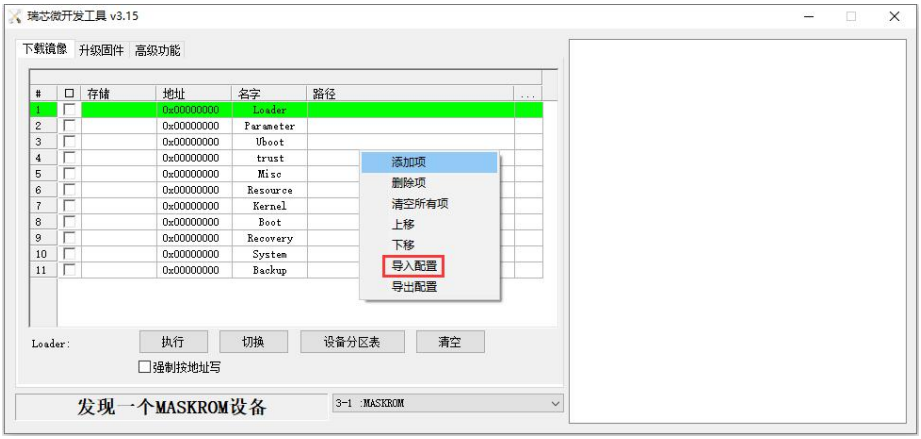
f. Then place the mouse cursor in the area below



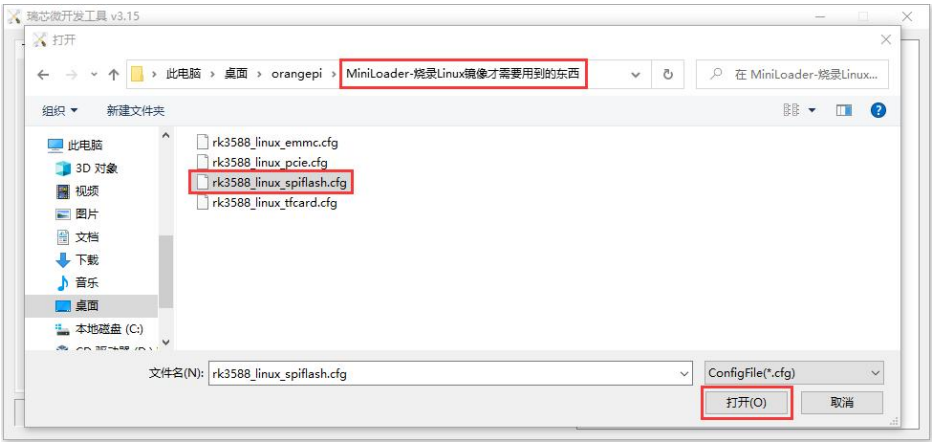
g. Then click the right mouse button and the selection interface shown in the figure below will pop up



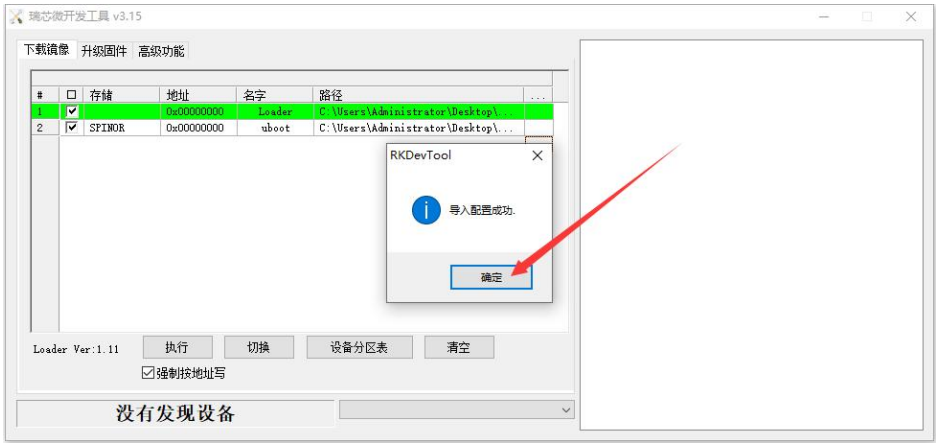
h. Then select the **Import configuration** option



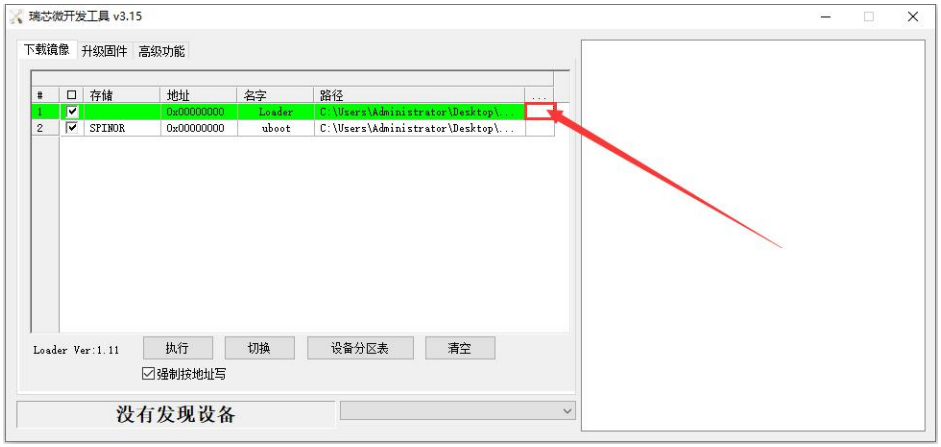
i. Then select the **rk3588_linux_spiflash.cfg** configuration file in the MiniLoader folder downloaded earlier, and click **Open**



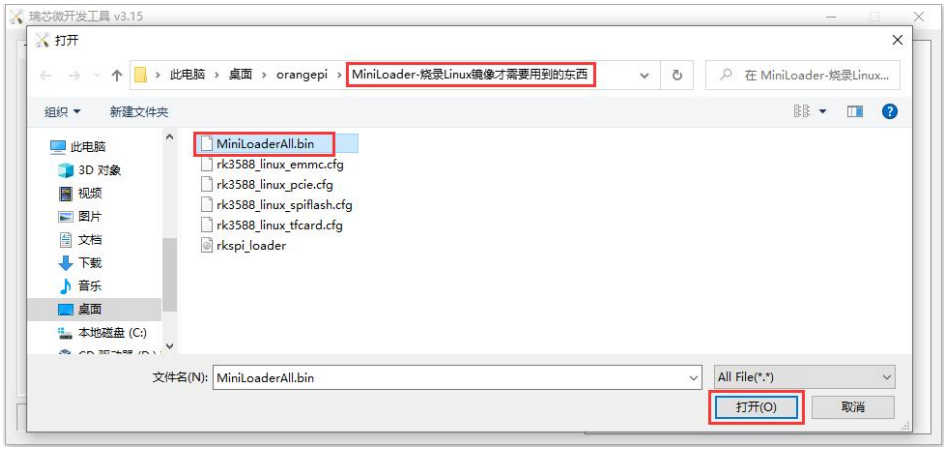
j. Then click **OK**



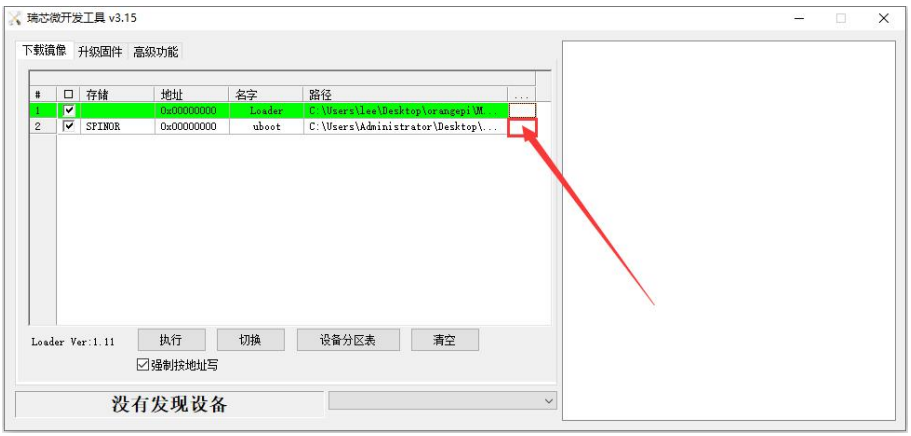
k. Then click the location shown in the figure below



l. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and click **Open**

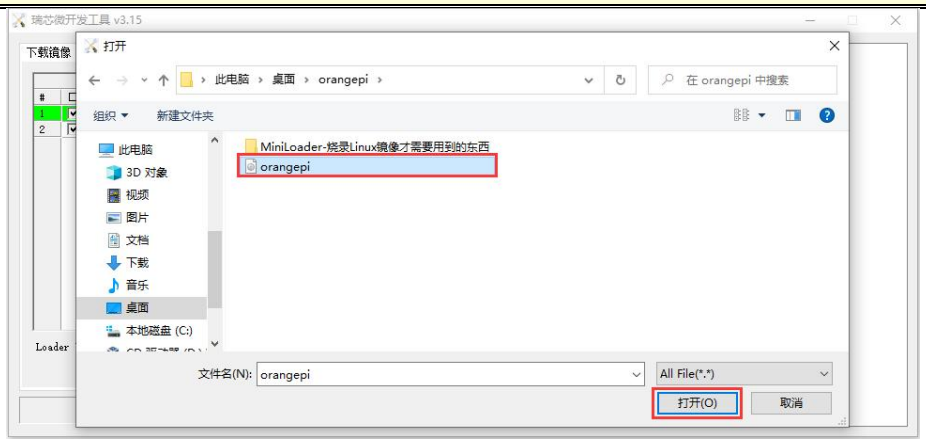


m. Then click the location shown in the figure below

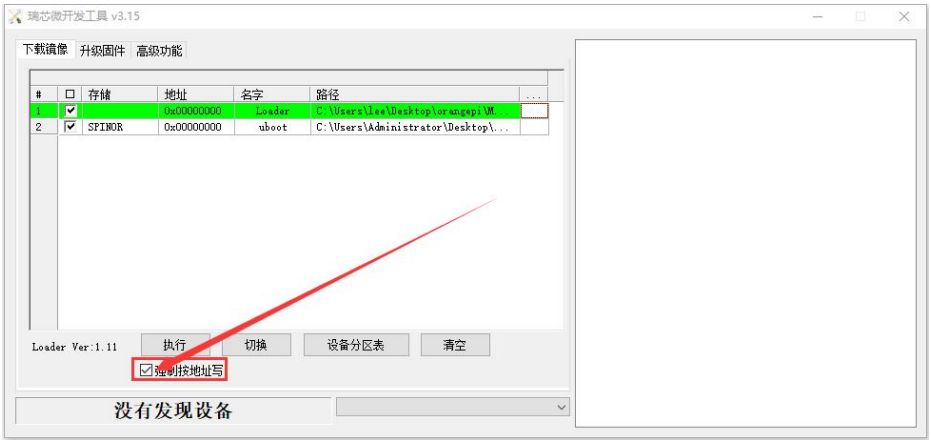


n. Then select the path of the OpenWRT image you want to burn, and click **Open**

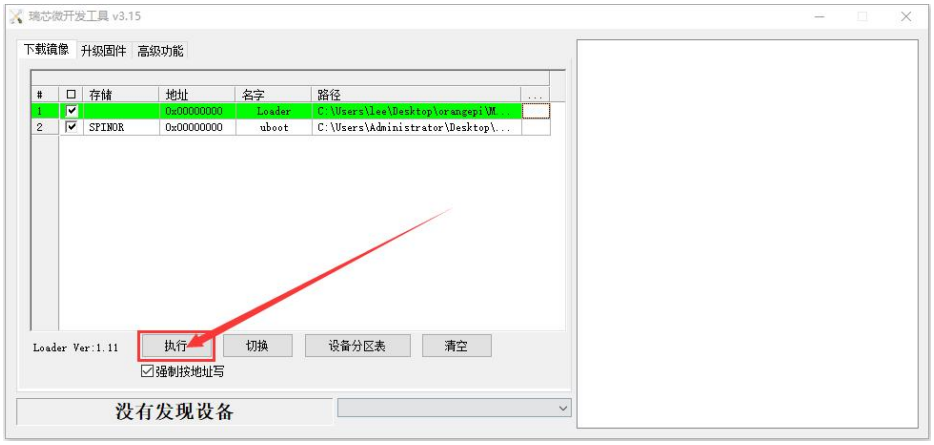
Before burning the image, it is recommended to rename the OpenWRT image to be burned to orangepi.img or other shorter names, so that you can see the percentage value of the burning progress when burning the image.



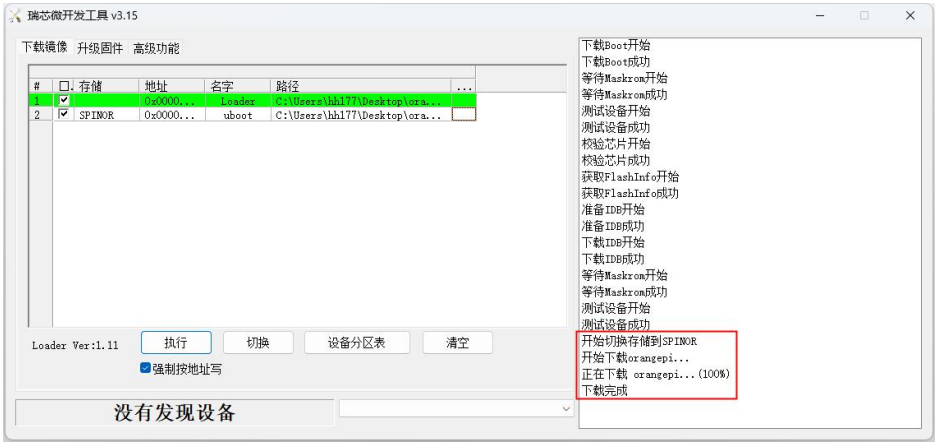
o. Then please make sure that the option to **force writing by address** is ticked



p. Click the **Execute** button again to start burning the OpenWRT image into SPIFlash



q. The display log after burning the OpenWRT image is shown in the figure below



If there is a problem with burning, please clear the SPIFlash first and then try burning again. For the method of clearing SPIFlash, please refer to the instructions in the section of using RKDevTool to clear SPIFlash.

r. The OpenWRT image will start automatically after burning, if it does not start normally, please try again with power on.

2. 8. How to burn Android image to TF card

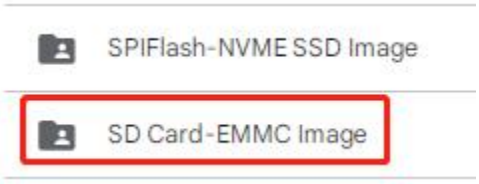
1) First prepare a TF card with a capacity of 16GB or greater. The transmission speed of the TF card must be class10 or above. It is recommended to use a TF card of SanDisk and other brands

2) Then use the card reader to insert the TF card into the computer

3) Then download the SDDiskTool programming tool from the Orange Pi data download page, **please make sure that the version of the SDDiskTool tool is the latest v1.72**

4) Then download the Android12 image from the Orange Pi download page

a. After opening the download link of the Android image, you can see the following two types of Android images, please select the image in the **TF card and eMMC boot image** folder to download

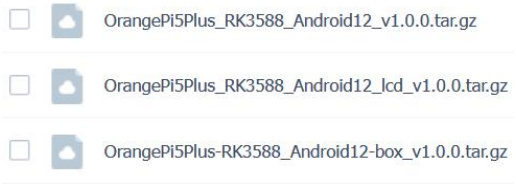


b. After entering the **TF card and eMMC boot image** folder, you can see the following three images, the difference between them is:

a) The first image is dedicated to HDMI display and supports 8K display. If you don't use LCD screen, please download the image without lcd

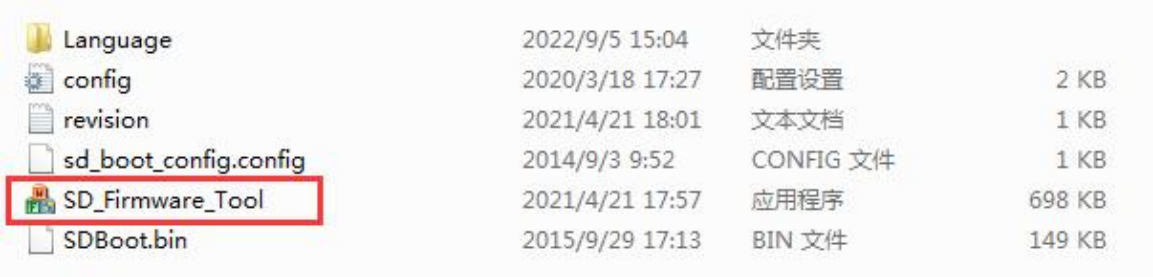
b) If you want to use lcd screen, please choose image with lcd

c) The image with box is a image dedicated to the TV box

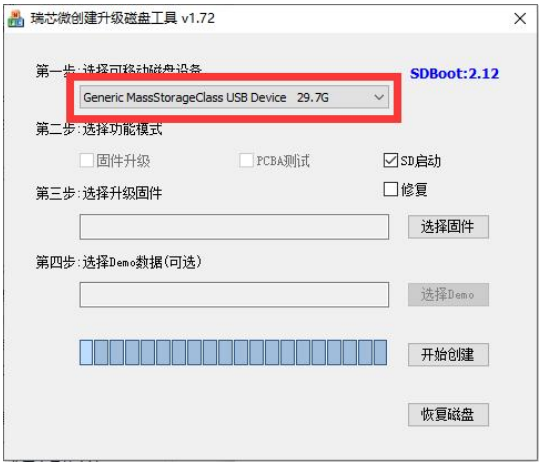


5) Then use decompression software to decompress the compressed package of the downloaded Android image. Among the decompressed files, the file ending with ".img" is the Android image file, and the size is more than 1GB

6) Then use decompression software to decompress **SDDiskTool_v1.72.zip**, this software does not need to be installed, just find **SD_Firmware_Tool.exe** in the decompressed folder and open it



7) After opening SDDiskTool, if the TF card is recognized normally, the inserted disk device will be displayed in the "**Select Removable Disk Device**" column. **Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn** If there is no display, you can try to unplug the TF card



8) After confirming the drive letter, you can format the TF card first, click the restore disk button in **SDDiskTool**, or use the SD Card Formatter mentioned above to format the TF card

9) Then start to write the Android image to the TF card

a. First check "**SD Boot**" in "**Select Function Mode**"

b. Then select the path of the Android image in the "**Select to upgrade firmware**" column

c. Finally click the "**Start Create**" button to start burning the Android image to the TF card

10) After burning, you can exit the SDDiskTool software, and then you can pull out the TF card from the computer and insert it into the development board to start

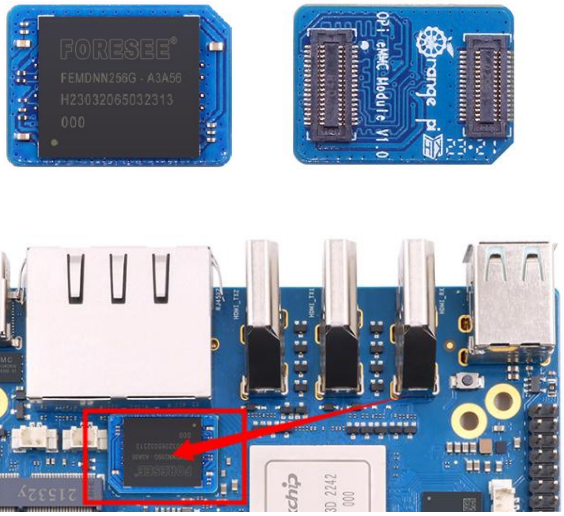
2.9. How to burn Android image into eMMC

Note, after burning the image into eMMC, if the test finds that it cannot be started, please clear the SPIFlash and try again. For the method of clearing SPIFlash, please refer to the method of using RKDevTool to clear SPIFlash.

2.9.1. How to burn Android image into eMMC via Type-C cable

Note that all the following operations are performed on a Windows computer.

1) The developmentd board reserves an eMMC expansion interface. Before programming the system to eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of plugging into the development board are as follows:



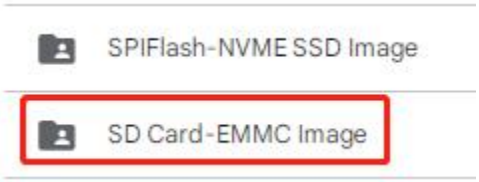
2) It is also necessary to prepare a data cable with a good quality Type-C interface

3) Then download Rockchip driver **DriverAssitant_v5.12.zip** and burning tool

RKDevTool_Release_v3.15.zip from **Orange Pi's download page.**

4) Then download the Android image from **Orange Pi's download page.**

a. After opening the download link of the Android image, you can see the following two types of Android images, please select the image in the **TF card and eMMC startup image** folder to download



b. After entering the TF card and eMMC boot image folder, you can see the following three images, the difference between them is:

a) The first image is dedicated to HDMI display and supports 8K display. If you don't use LCD screen, please download the image without lcd

b) If you want to use lcd screen, please choose image with lcd

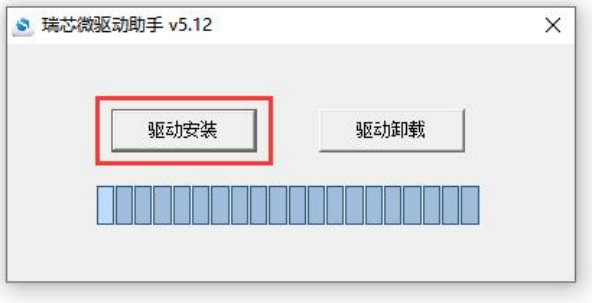
c) The image with box is a image dedicated to the TV box

5) Then use the decompression software to decompress the compressed package of the downloaded Android image. Among the decompressed files, the file ending with ".img" is the Android image file, and the size is more than 1GB

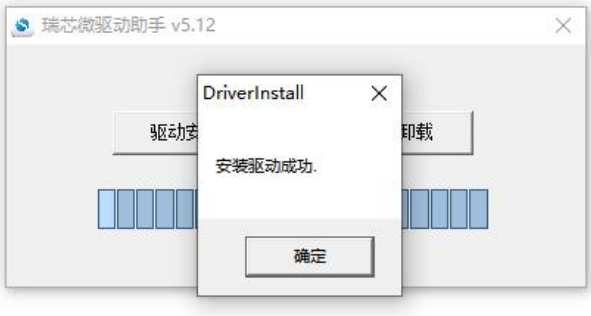
6) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

7) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

a. Click the "**Driver Installation**" button

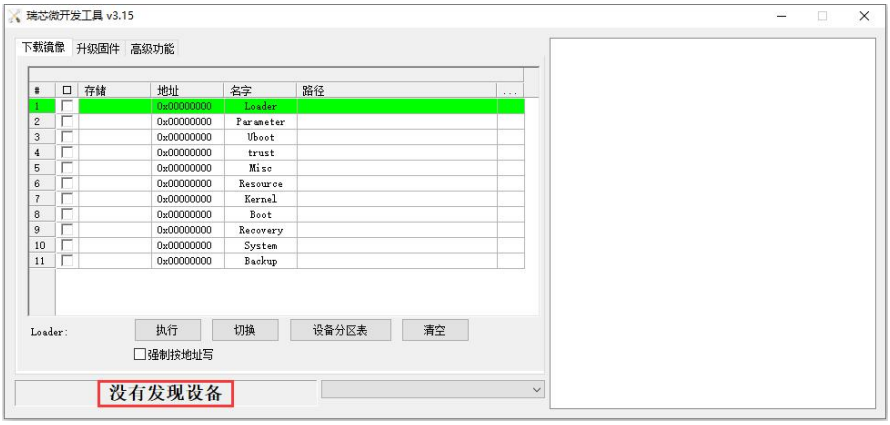


b. After waiting for a period of time, a pop-up window will prompt "driver installed successfully", then click "OK"



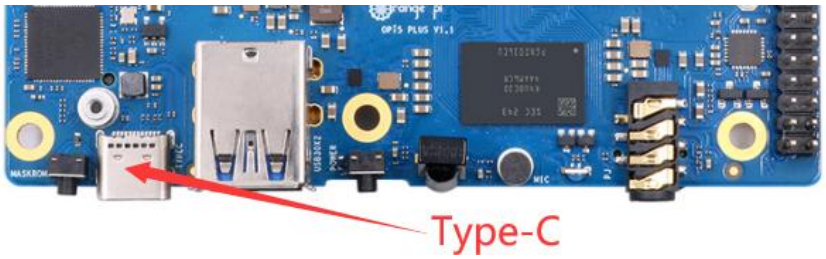
8) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

9) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



10) Then start burning the Android image into eMMC

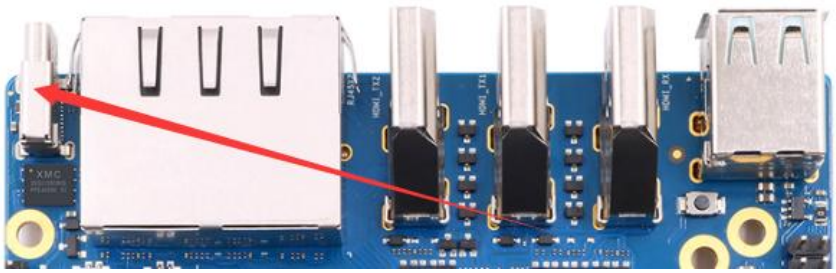
a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



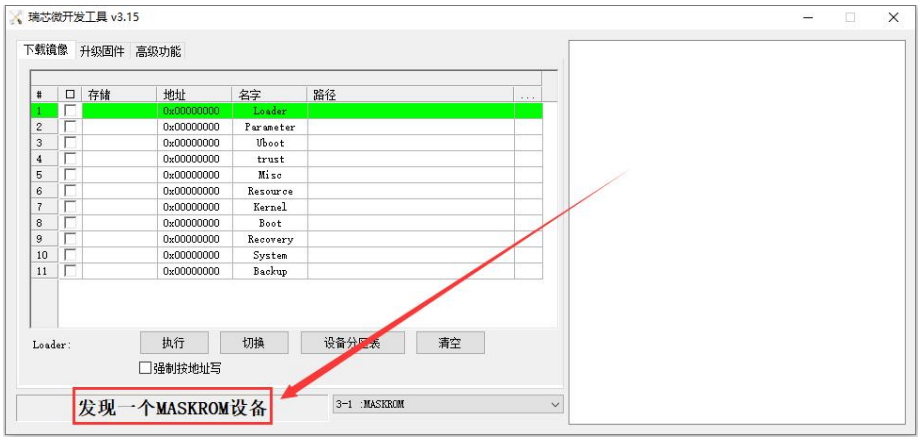
b. Then make sure that the development board is not inserted into the TF card and not connected to the power supply

c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below：

d. Then connect the power supply of the Type-C interface to the development board, and power on



e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"



f. Then click the "**Upgrade Firmware**" column of the burning tool

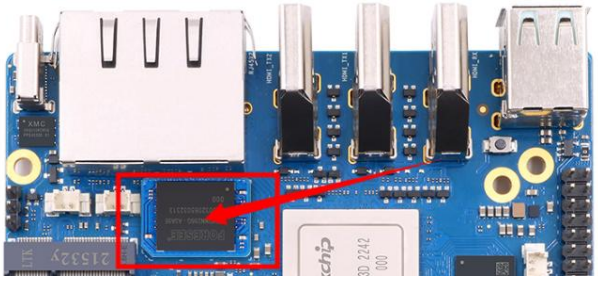
g. Then click the "**Firmware**" button to select the path of the Android image that needs to be burned

h. Finally, click the "**Upgrade**" button to start burning, and the log during the burning process is shown in the figure below. After burning is completed, the Android system will start automatically.

2.9.2. How to burn Android 12 image into eMMC via TF card

Note that all the following operations are performed on a Windows computer.

1) The development board reserves an eMMC expansion interface. Before programming the system to eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of plugging into the development board are as follows:



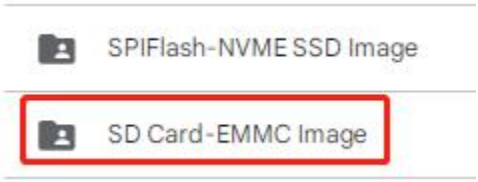
2) You also need to prepare a TF card with 8GB or larger capacity. The transmission speed of the TF card must be class10 or above. It is recommended to use a TF card of SanDisk and other brands

3) Then use the card reader to insert the TF card into the computer

4) Then download the SDDiskTool programming tool from the Orange Pi data download page, **please ensure that the version of the SDDiskTool tool is the latest v1.72**

5) Then download the Android image from **Orange Pi's download page**

a. After opening the download link of the Android image, you can see the following two types of Android images, please **select the image in the TF card and eMMC startup image** folder to download

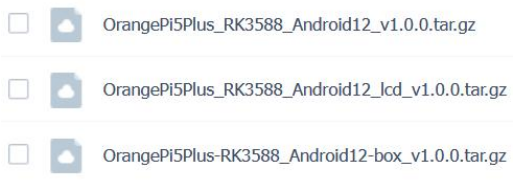


b. **After entering the TF card and eMMC boot image folder**, you can see the following three images, the difference between them is:

a) The first image is dedicated to HDMI display and supports 8K display. If you don't use LCD screen, please download the image without lcd

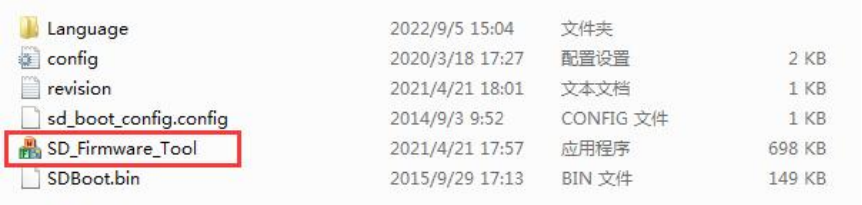
b) If you want to use lcd screen, please choose mirror with lcd

c) The mirror with box is a mirror dedicated to the TV box

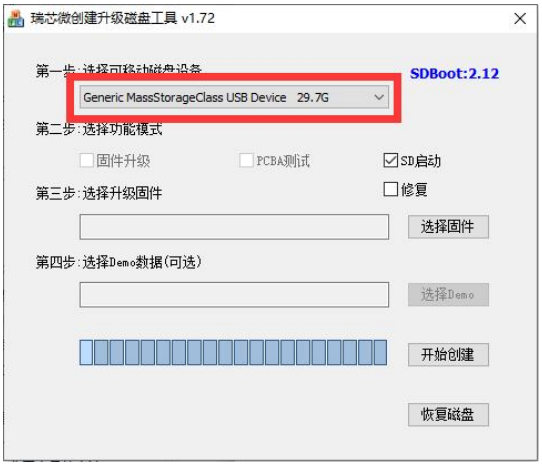


6) Then use decompression software to decompress the compressed package of the downloaded Android image. Among the decompressed files, the file ending with ".img" is the Android image file, and the size is more than 1GB

7) Then use decompression software to decompress **SDDiskTool_v1.72.zip**, this software does not need to be installed, just find **SD_Firmware_Tool.ex** in the decompressed folder and open it



8) After opening **SDDiskTool**, if the TF card is recognized normally, the inserted disk device will be displayed in the "**Select Removable Disk Device**" column. **Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn**, if there is no display, you can try to unplug the TF card



9) After confirming the drive letter, you can format the TF card first, click the **restore disk** button in **SDDiskTool,** or use the **SD Card Formatter** mentioned above to format the TF card

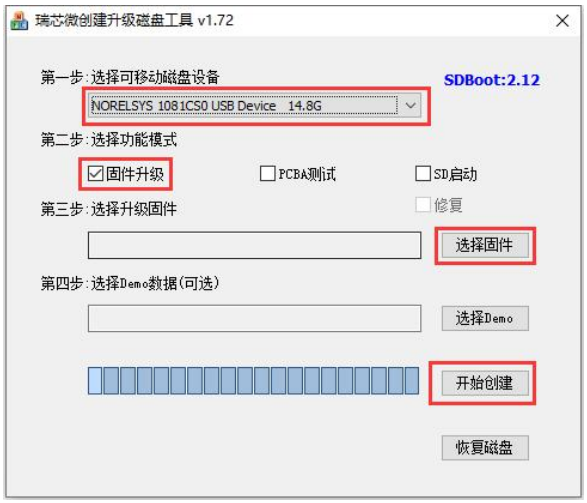
10) Then start to write the Android image into the TF card

a. First confirm that the displayed drive letter is the drive letter corresponding to the TF card under "**Select Removable Disk Device**"

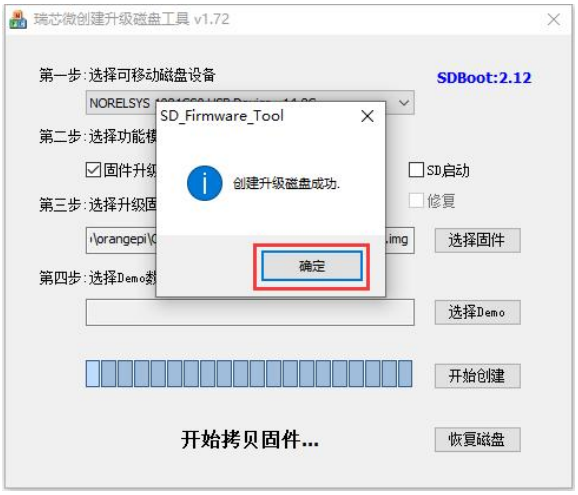
b. Then select "**Firmware Upgrade**" in "**Select Function Mode**"

c. Then select the path of the Android firmware in the "**Select Upgrade Firmware**" column

d. Finally click the "**Start Create**" button to start burning

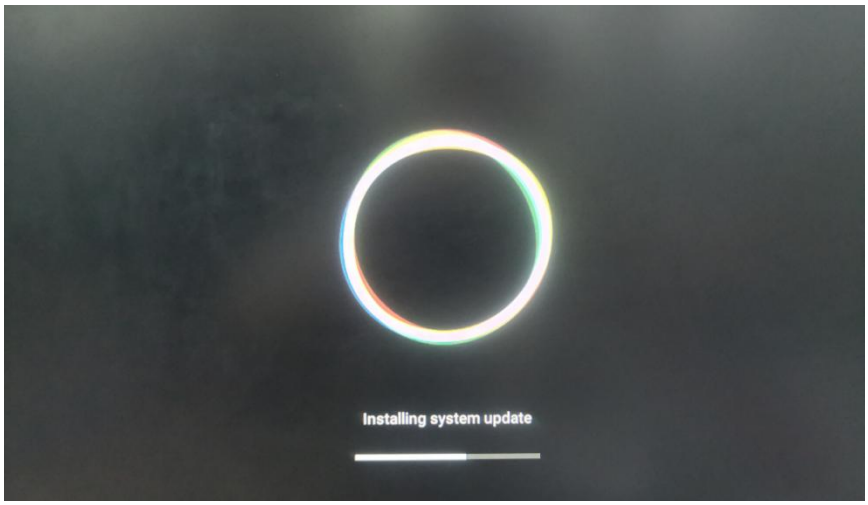


11) After the burning is completed, the display is as shown in the figure below, and then you can exit SDDiskTool

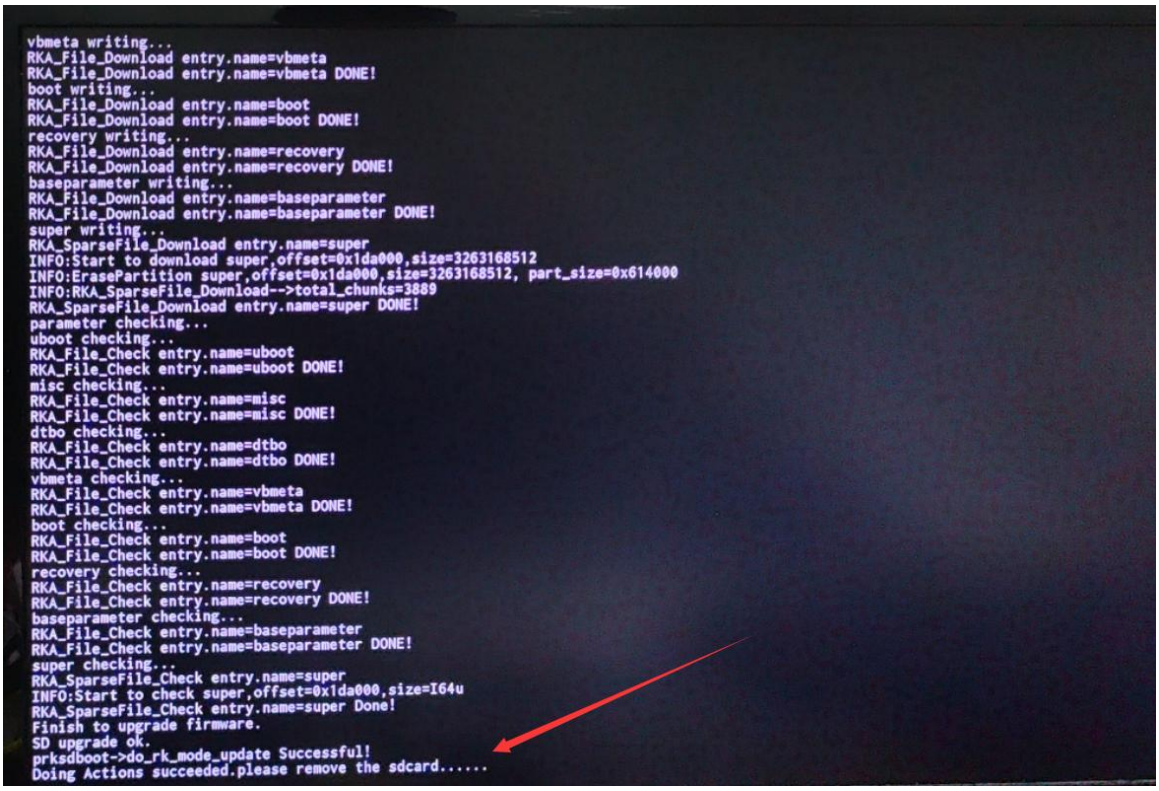


12) Then pull out the TF card from the computer and insert it into the development board. After the development board is powered on, it will automatically start burning the Android image in the TF card to the eMMC of the development board.

13) If the development board is connected to an HDMI display, you can also see the progress bar of burning the Android image to eMMC from the HDMI display



14) When the HDMI monitor displays the following information, it means that the burning of the Android image into the eMMC has been completed. At this time, the TF card can be pulled out, and then the Android system in the eMMC will start.

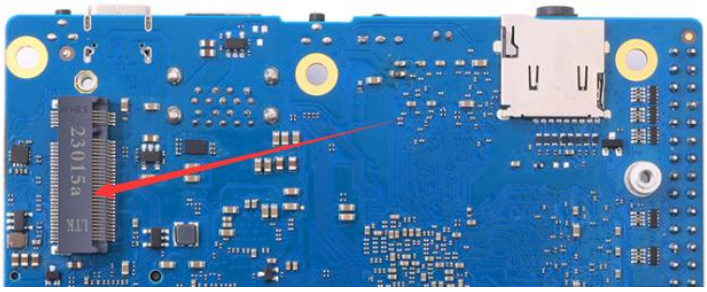


2. 10. How to burn Android image to SPIFlash+NVMe SSD

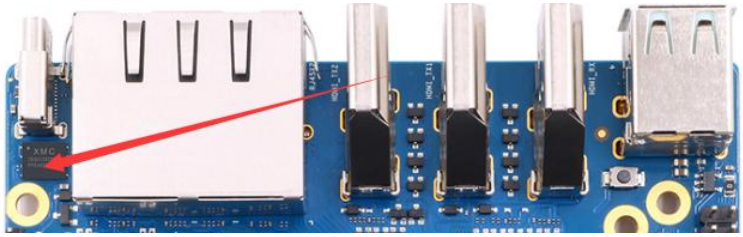
Note that all the following operations are performed on a Windows computer.

1) First, you need to prepare an M-Key 2280 specification NVMe SSD solid state drive, and the specification of the PCIe interface in the M.2 slot of the development board is PCIe3.0x4.

2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and fix it



3) The position of the SPI Flash on the development board is shown in the figure below, no other settings are required before starting the programming

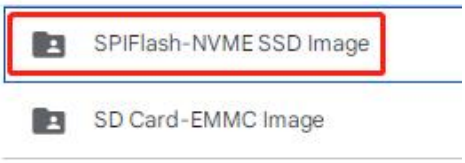


4) It is also necessary to prepare a data cable with a good quality Type-C interface

5) Then download Rockchip driver **DriverAssitant_v5.12.zip** and burning tool **RKDevTool_Release_v3.15.zip** from **Orange Pi's data download page.**

6) Then download the Android12 image from the **Orange Pi download page**

a. After opening the download link of the Android image, you can see the following two types of Android images, please select the image in the **SPIFlash-NVME SSD boot image** folder to download



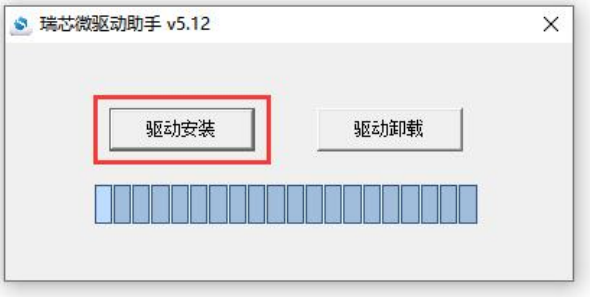
b. After entering the **SPIFlash-NVME SSD boot image** folder, you can see the following three images. Their differences are:

a) The first image is dedicated to HDMI display and supports 8K display. If you don't use LCD screen, please download the image without lcd
b) If you want to use lcd screen, please choose image with lcd
c) The image with box is a image dedicated to the TV box

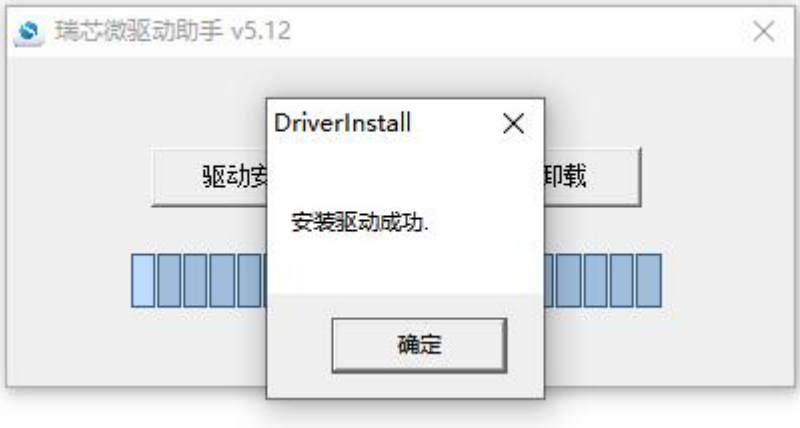
7) Then use the decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

8) After opening DriverInstall.exe, the steps to install the Rockchip driver are as followsa.

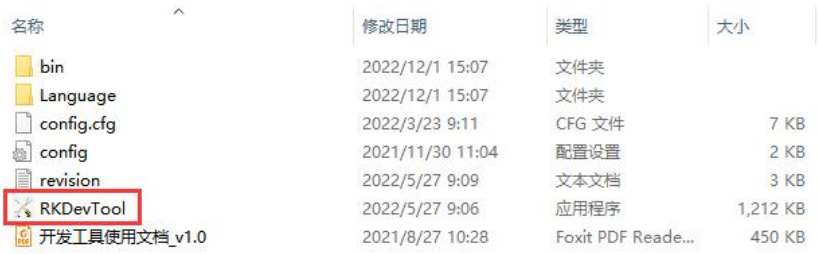
a. Click the "**Driver Install**" button



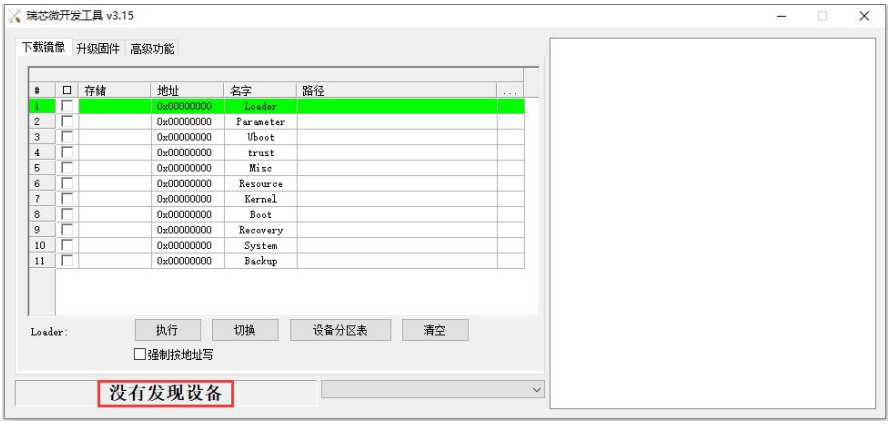
b. After waiting for a period of time, a pop-up window will prompt "**driver installed successfully**", then click the "**OK**" button



9) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

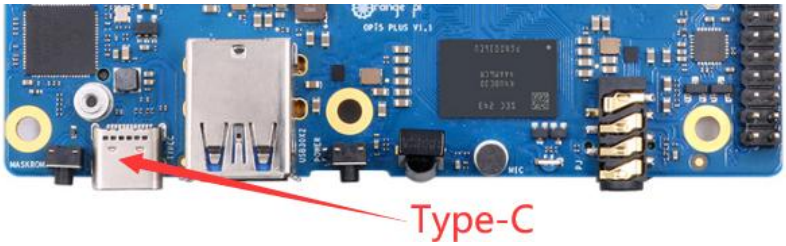


10)After opening the **RKDevTool** burning tool, because the computer is not connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



11) Then start burning the Android image to SPIFlash+NVMe SSD

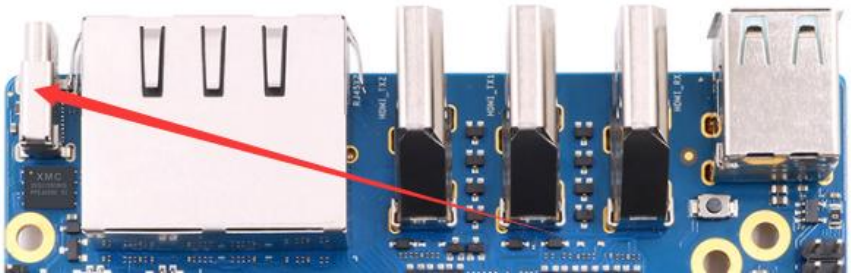
a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



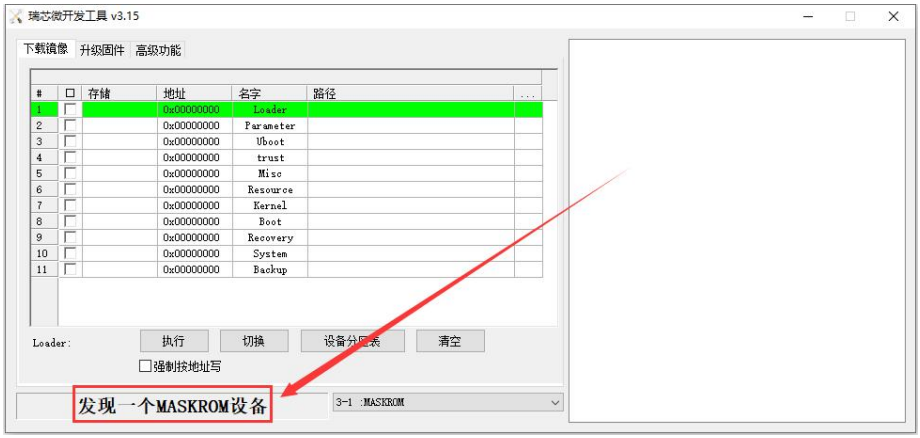
b. Make sure that the development board is not plugged into TF and eMMC modules, and is not connected to the power supply

c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below:

d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**Found a MASKROM device**"



f. Then click the "Upgrade Firmware" column of the burning tool

g. Then click the "Firmware" button to select the Android image to be burned

h. Finally, click the "Upgrade" button to start burning. The burning process is shown in the figure below. After the burning is completed, the Android system will automatically start.

2.11. How to burn Orange Pi OS (Droid) image to TF card

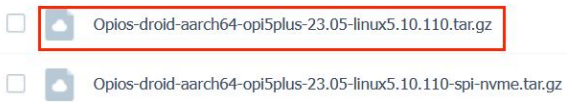
Note that all the following operations are performed on a Windows computer.

1) First prepare a TF card with 8GB or larger capacity. The transmission speed of the TF card must be class10 or above. It is recommended to use a TF card of SanDisk and other brands

2) Then use the card reader to insert the TF card into the computer

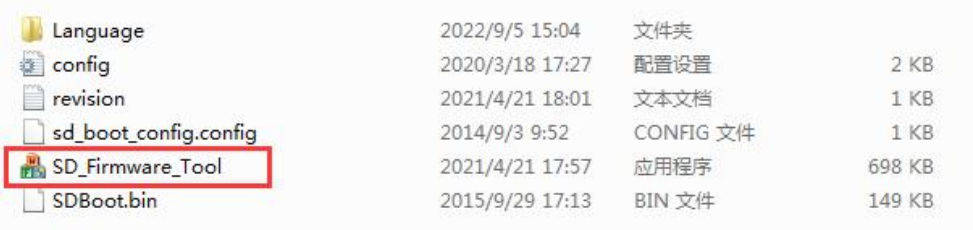
3) Then download the SDDiskTool programming tool from the **Orange Pi data download page**, **please make sure that the version of the SDDiskTool tool is the latest v1.72.**

4) Then download the Orange Pi OS (Droid) image from the **Orange Pi data download page**, open the download link of the Orange Pi OS (Droid) image, and you can see the following two types of images, please select the image below



5) Then use decompression software to decompress the compressed file of the downloaded Orange Pi OS (Droid) image. Among the decompressed files, the file ending with "**.img**" is the Orange Pi OS (Droid) image file, and the size is more than 1GB

6) Then use decompression software to decompress **SDDiskTool_v1.72.zip**, this software does not need to be installed, just find **SD_Firmware_Tool.ex** in the decompressed folder and open it



7) After opening **SDDiskTool**, if the TF card is recognized normally, the inserted disk device will be displayed in the "**Select Removable Disk Device**" column. **Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn** , if there is no display, you can try to unplug the TF card

8) After confirming the drive letter, you can format the TF card first, click the **restore disk** button in SDDiskTool, or use the **SD Card Formatter** mentioned above to format the TF card

9) Then start to write the Orange Pi OS (Droid) image into the TF card

a. First check "**SD Boot**" in "**Select Function Mode**"

b. Then select the path of the Orange Pi OS (Droid) image in the "**Select to upgrade firmware**" column

c. Finally, click the "**Start Create**" button to start burning the Orange Pi OS (Droid) image to the TF card

10) After burning, you can exit the SDDiskTool software, and then you can pull out the TF card from the computer and insert it into the development board to start

2.12. How to burn Orange Pi OS (Droid) image into eMMC

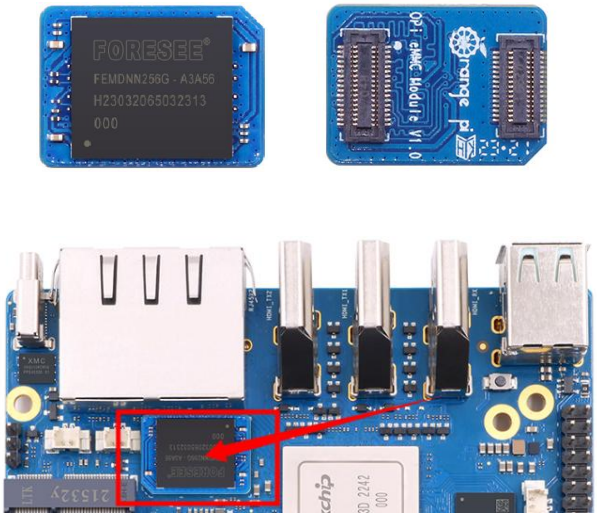
Note, after burning the image into eMMC, if the test finds that it cannot be started, please clear the SPIFlash and try again. For the method of clearing SPIFlash, please refer to the method of using RKDevTool to clear SPIFlash.

2.12.1. Burn Orange Pi OS (Droid) image to eMMC

Note that all the following operations are performed on a Windows computer.

1) The development board reserves an eMMC expansion interface. Before programming

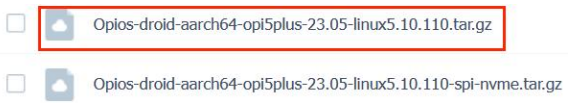
the system to eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of plugging into the development board are as follows:



2) It is also necessary to prepare a data cable with a good quality Type-C interface

3) Then download Rockchip driver **DriverAssitant_v5.12.zip** and burning tool **RKDevTool_Release_v3.15.zip** from Orange Pi's data download page

4) Then download the Orange Pi OS (Droid) image from the **Orange Pi download page**

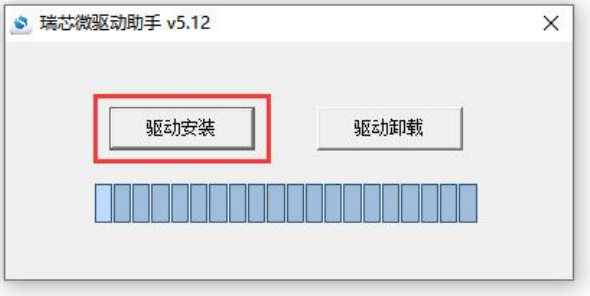


5) Then use decompression software to decompress the compressed file of the downloaded Orange Pi OS (Droid) image. Among the decompressed files, the file ending with "**.img**" is the Orange Pi OS (Droid) image file, and the size is more than 1GB

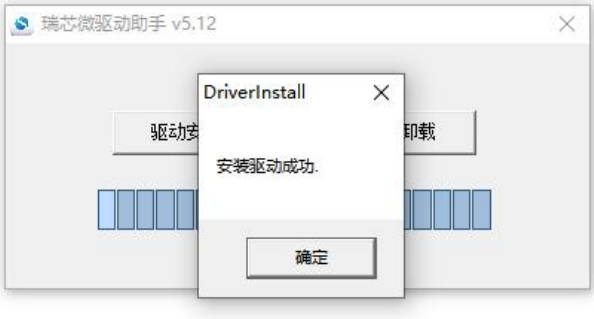
6) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, then find the **DriverInstall.exe** executable file in the decompressed folder and open it

7) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

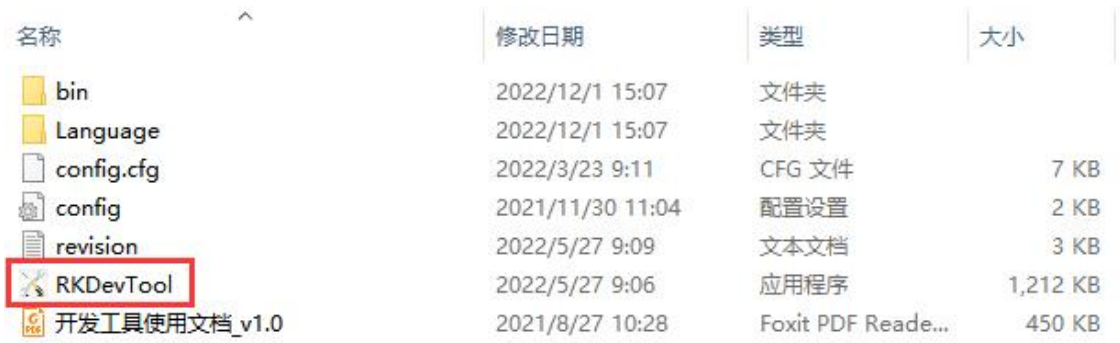
a. Click the "**Driver Installation**" button



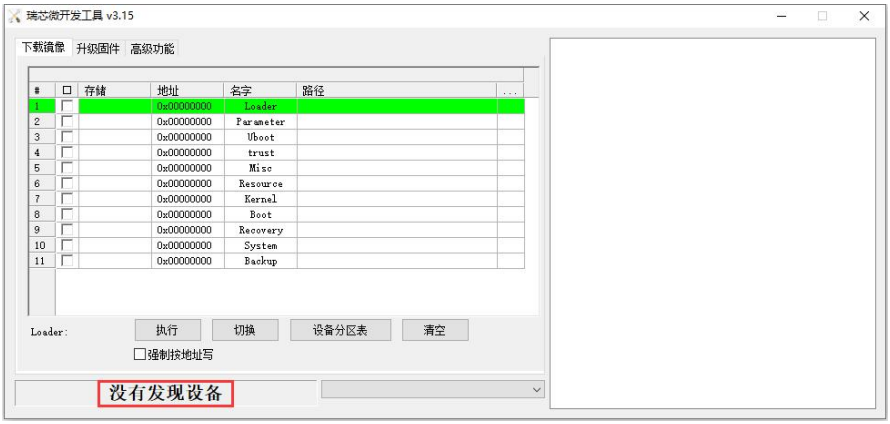
b. After waiting for a period of time, a pop-up window will prompt "**driver installed successfully**", and then click the "**OK**" button.



8) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

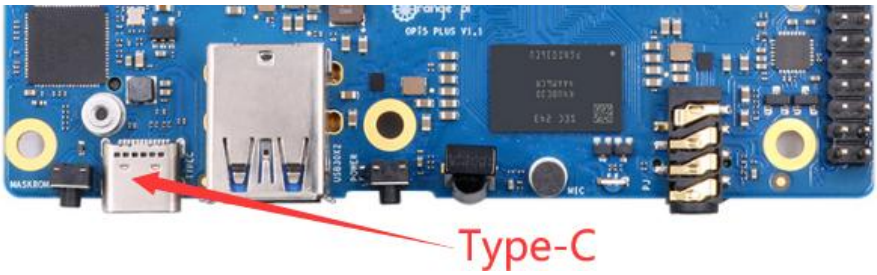


9) After opening the **RKDevTool** burning tool, because the computer is not connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



10) Then start burning Orange Pi OS (Droid) image into eMMC

a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below

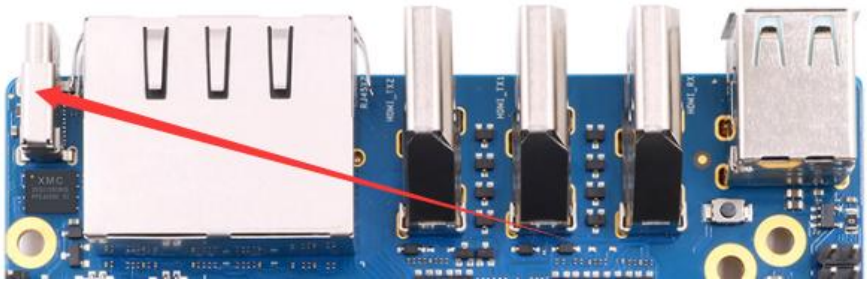


b. Make sure that the development board is not inserted into the TF card and not connected to the power supply

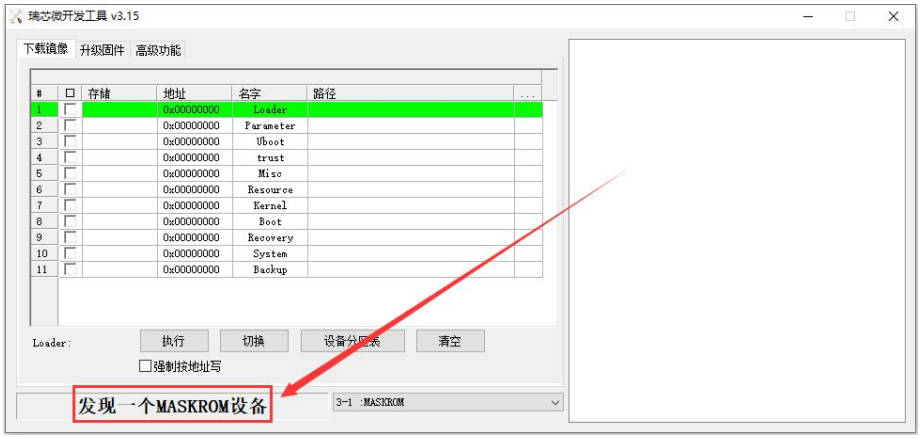
c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the

figure below:

d. Then connect the power supply of the Type-C interface to the development board, and power on



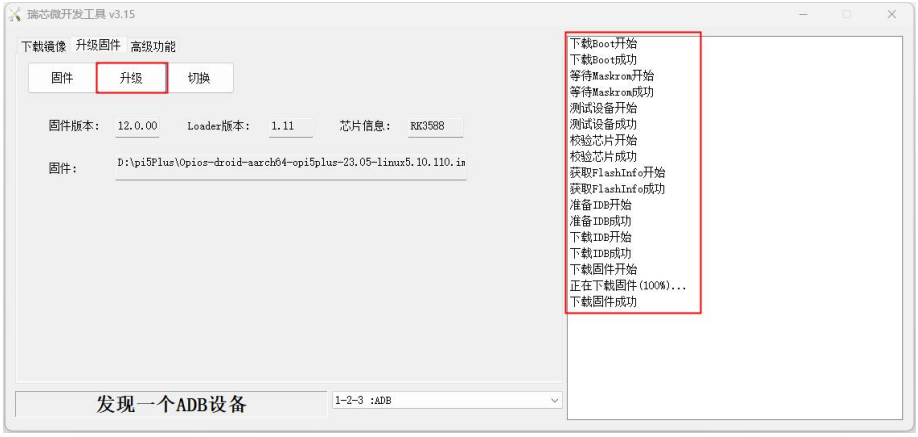
e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"



f. Then click the "**Upgrade Firmware**" column of the burning tool

g. Then click the "**Firmware**" button to select the path of the Orange Pi OS (Droid) image that needs to be burned

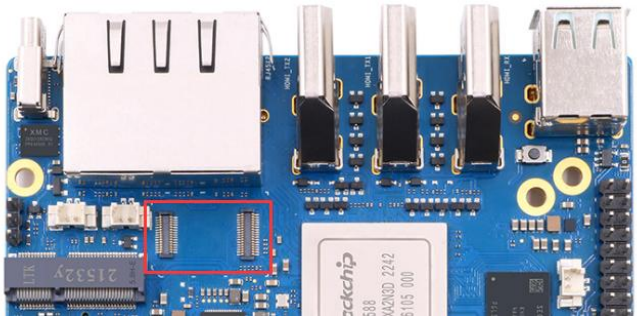
h. Finally, click the "**Upgrade**" button to start burning, and the log during the burning process is shown in the figure below. After burning, the Orange Pi OS (Droid) system will start automatically.



2. 12. 2. Burn Orange Pi OS (Droid) image to eMMC via TF card

Note that all the following operations are performed on a Windows computer.

1) The development board reserves an eMMC expansion interface. Before programming the system to eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The location of the eMMC interface is as follows:

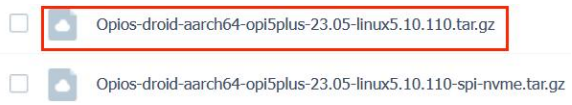


2) You also need to prepare a TF card with 8GB or larger capacity. The transmission speed of the TF card must be class10 or above. It is recommended to use a TF card of SanDisk and other brands

3) Then use the card reader to insert the TF card into the computer

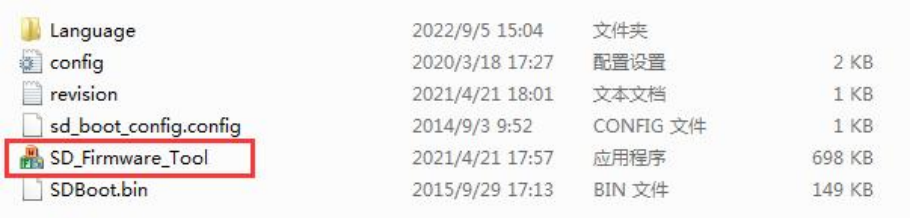
4) Then download the SDDiskTool programming tool from the Orange Pi data download page, **please ensure that the version of the SDDiskTool tool is the latest v1.72.**

5) Then download the Orange Pi OS (Droid) image from the **Orange Pi download page**

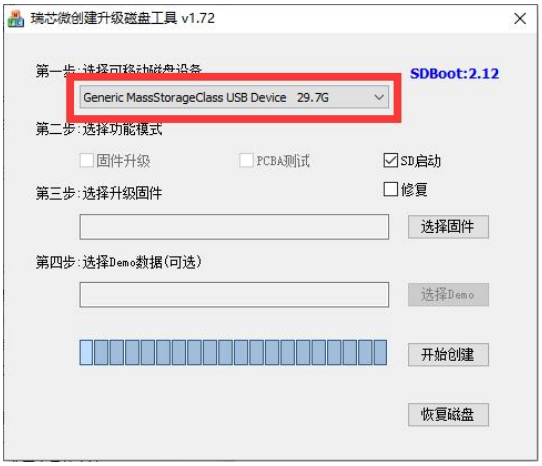


6) Then use the decompression software to decompress the compressed package of the downloaded Orange Pi OS (Droid) image. Among the decompressed files, the file ending with ".img" is the Orange Pi OS (Droid) image file, and the size is more than 1GB

7) Then use decompression software to decompress **SDDiskTool_v1.72.zip**, this software does not need to be installed, just find **SD_Firmware_Tool.exe** in the decompressed folder and open it



8) After opening **SDDiskTool**, if the TF card is recognized normally, the inserted disk device will be displayed in the "**Select Removable Disk Device**" column. **Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn**, if there is no display, you can try to unplug the TF card.



9) After confirming the drive letter, you can format the TF card first, click the restore disk button in **SDDiskTool**, or use the **SD Card Formatter** mentioned above to format the TF card

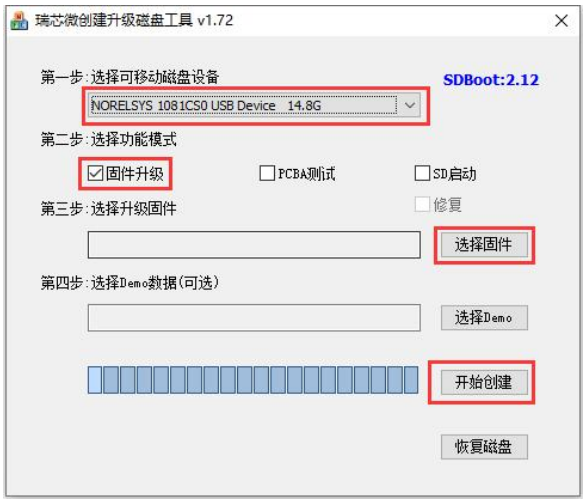
10) Then start to write the Orange Pi OS (Droid) image into the TF card

a. First confirm that the displayed drive letter is the drive letter corresponding to the TF card under "**Select Removable Disk Device**"

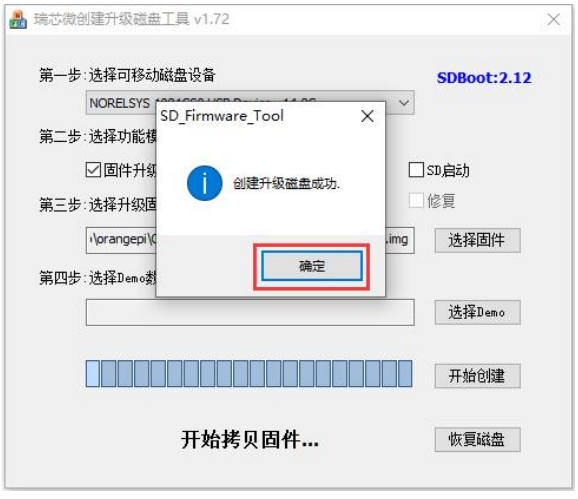
b. Then select "**Firmware Upgrade**" in "**Select Function Mode**"

c. Then select the path of the Orange Pi OS (Droid) firmware in the "**Select Upgrade Firmware**" column

d. Finally click the "**Start Create**" button to start burning

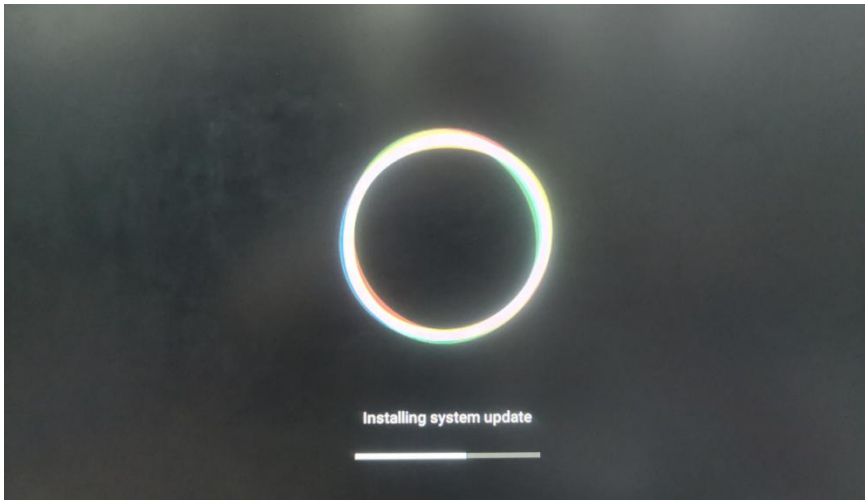


11) After the burning is completed, the display is as shown in the figure below, and then you can exit SDDiskTool

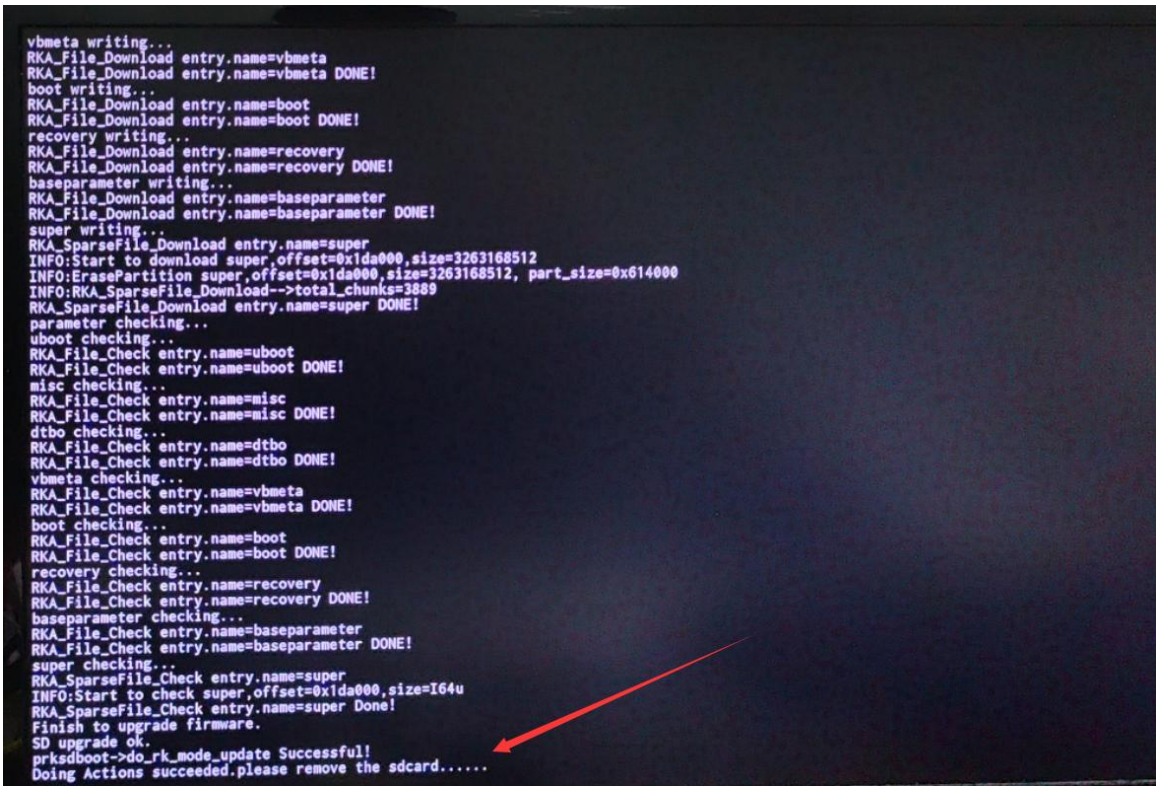


12) Then pull out the TF card from the computer and insert it into the development board. After the development board is powered on, it will automatically start burning the Orange Pi OS (Droid) image in the TF card to the eMMC of the development board.

13) If the development board is connected to an HDMI display, you can also see the progress bar of burning the Orange Pi OS (Droid) image to eMMC from the HDMI display



14) When the HDMI monitor displays the following information, it means that the burning of the Orange Pi OS (Droid) image to the eMMC has been completed. At this time, the TF card can be pulled out, and then the Orange Pi OS (Droid) system in the eMMC will start to start .

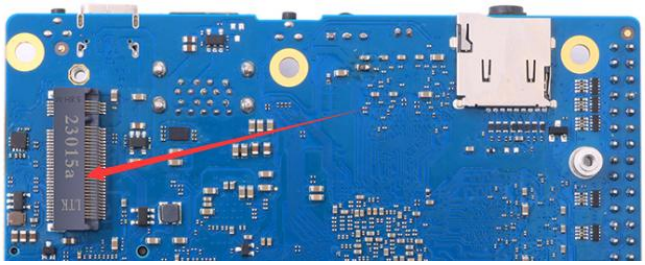


2. 13. Burn Orange Pi OS (Droid) image to SPIFlash+NVMe SSD

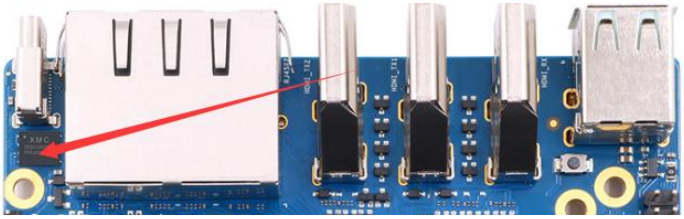
Note that all the following operations are performed on a Windows computer.

1) First, you need to prepare a 2280 specification NVMe SSD solid state drive. The specification of the PCIe interface in the M.2 slot of the development board is PCIe3.0x4.

2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and fix it



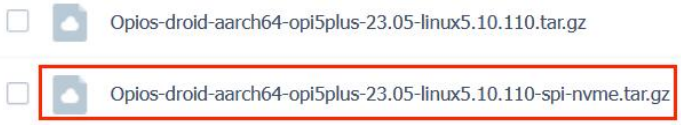
3) The position of the SPI Flash on the development board is shown in the figure below, no other settings are required before starting the programming



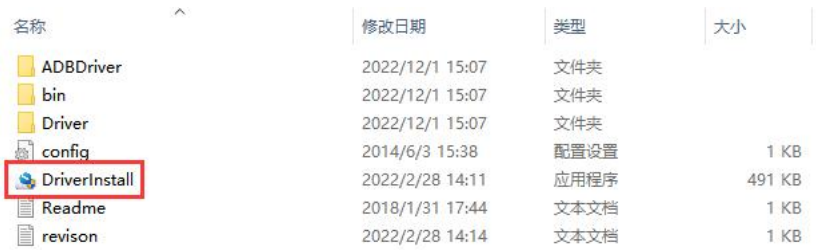
4) It is also necessary to prepare a data cable with a good quality Type-C interface

5) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and the burning tool **RKDevTool_Release_v3.15.zip** from the **Orange Pi data download page**,

6) Then download the Orange Pi OS (Droid) image, open the download link of the Orange Pi OS (Droid) image and you can see the following two types of images, please select the image with **spi-nvme** to download



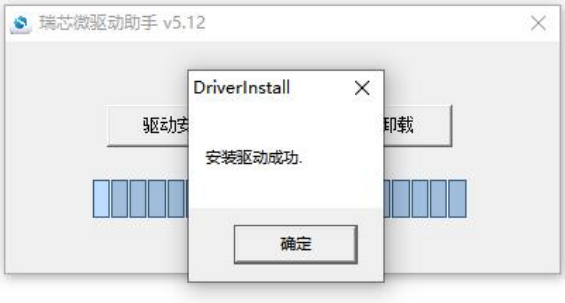
7) Then use the decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it



8) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

a. Click the "Driver Installation" button

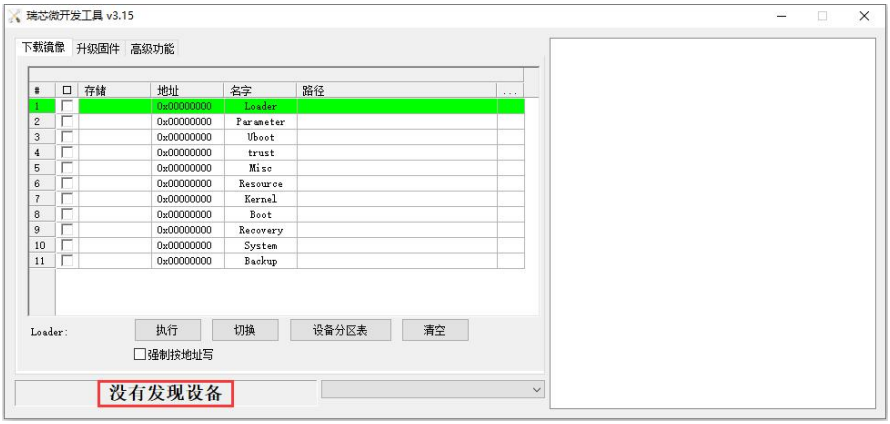
b. After waiting for a period of time, a pop-up window will prompt "**driver installed successfully**", and then click the "**OK**" button.



9) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

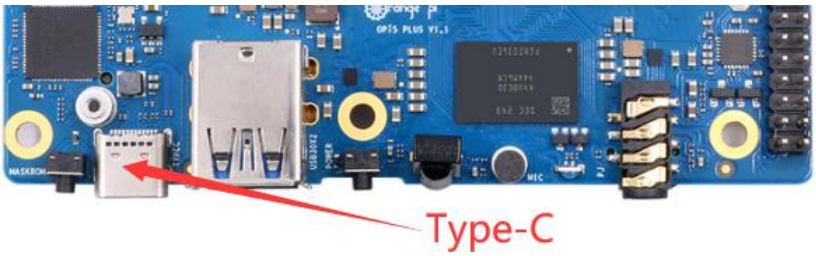
10) After opening the **RKDevTool** burning tool, because the computer is not connected

to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



11) Then start burning the Android image to SPIFlash+NVMe SSD

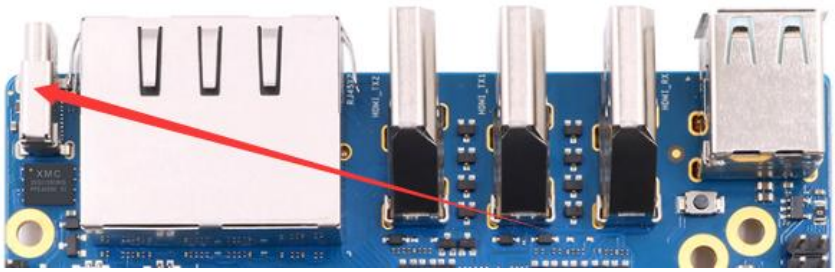
a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



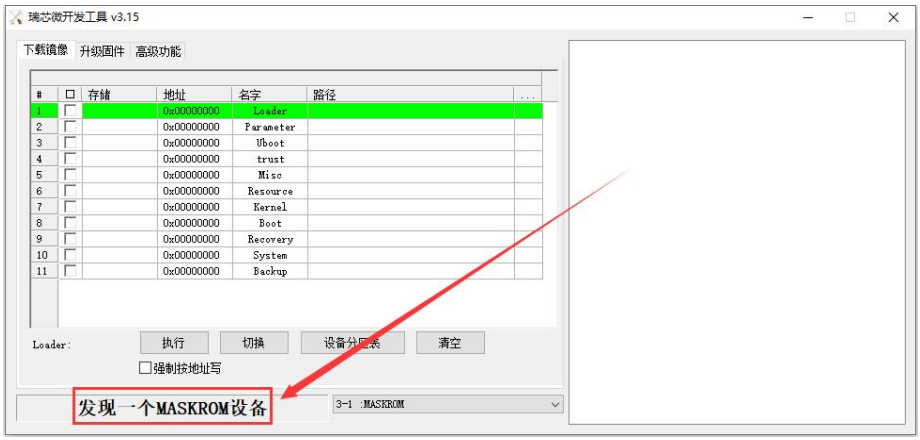
b. Make sure that the development board is not plugged into the TF and eMMC modules, and is not connected to the power supply

c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below:

d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



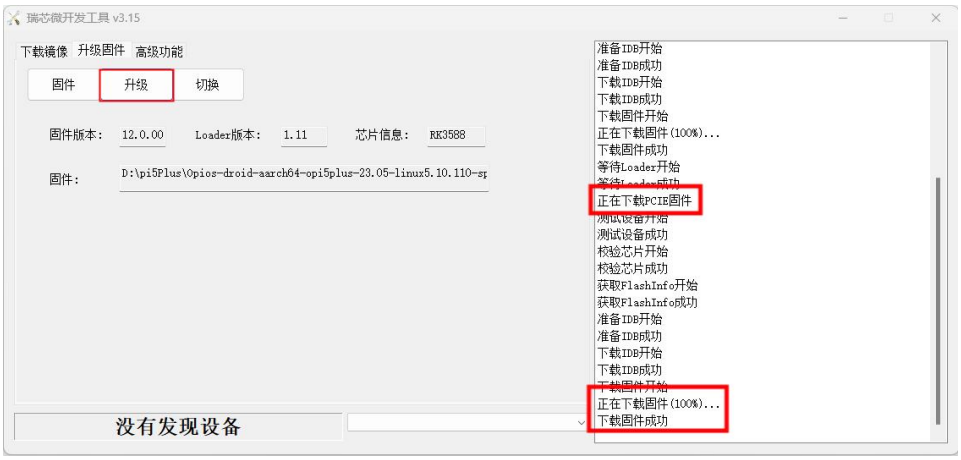
e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"



f. Then click the "**Upgrade Firmware**" column of the burning tool

g. Then click the "**Firmware**" button to select the Orange Pi OS (Droid) image to be burned

h. Finally, click the "**Upgrade**" button to start burning. The burning process is shown in the figure below. After the burning is completed, the Orange Pi OS (Droid) system will automatically start.



2. 14. How to burn Orange Pi OS (OH) image to TF card

Note that all operations below are performed on a Windows computer.

1) First prepare a TF card with 8GB or larger capacity. The transmission speed of the TF card must be class10 or above. It is recommended to use TF cards from SanDisk and other brands.

2) Then use the card reader to insert the TF card into the computer

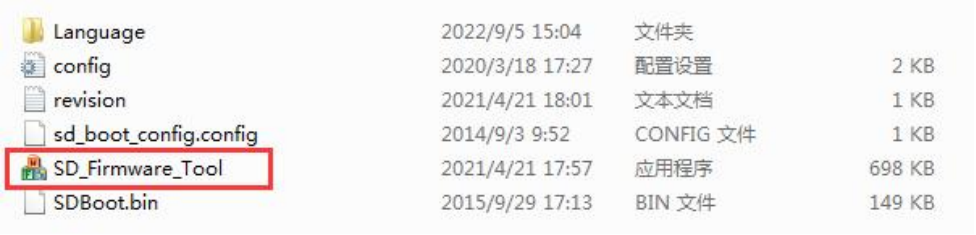
3) Then download the SDDiskTool burning tool from the Orange Pi download page.

Please ensure that the version of the SDDiskTool tool is the latest v1.72

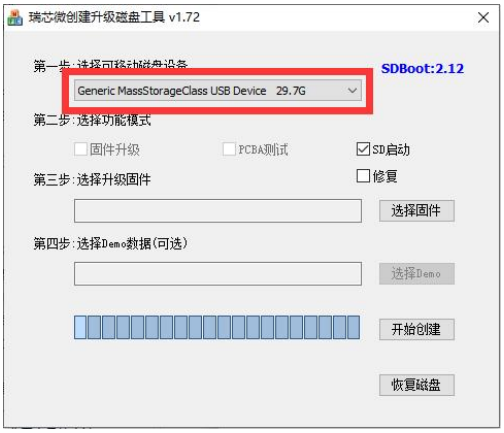
4) Then download the Orange Pi OS (OH) image from the Orange Pi information download page, and open the download link of the Orange Pi OS (OH) image. This image supports TF card and EMMC burning.

5) Then use decompression software to decompress the compressed package of the downloaded Orange Pi OS (OH) image. In the decompressed file, the file ending with ".img" is the Orange Pi OS (OH) image file, which is about 3GB in size.

6) Then use decompression software to decompress **SDDiskTool_v1.72.zip**. This software does not need to be installed. Just find **SD_Firmware_Tool.exe** in the decompressed folder and open it.



7) After opening **SDDiskTool**, if the TF card is recognized normally, the inserted disk device will be displayed in the "**Select Removable Disk Device**" column. Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn. If there is no display, try unplugging the TF card.



8) After confirming the drive letter, you can format the TF card first and click the **Recover Disk** button in **SDDiskTool**. You can also use the **SD Card Formatter** mentioned earlier to format the TF card.

9) Then start writing the Orange Pi OS (OH) image to the TF card

a. First check "**SD boot**" in "**Select function mode**"

b. Then select the path to the Orange Pi OS (OH) image in the "**Select Upgrade Firmware**" column

c. Finally, click the "**Start Creating**" button to start burning the Orange Pi OS (OH) image to the TF card.

10) After burning, you can exit the SDDiskTool software, and then you can pull out the TF card from the computer and insert it into the development board to start.

2. 15. How to burn Orange Pi OS (OH) image into eMMC

Note that after burning the image into eMMC, if you test and find that it cannot be started, please clear SPIFlash and try to start again. For the method of clearing SPIFlash, please refer to the section "How to clear SPIFlash using RKDevTool"。

2. 15. 1. Burn Orange Pi OS (OH) image to eMMC via Type-C cable

Note that all operations below are performed on a Windows computer.

1) The development board has reserved eMMC expansion interface. Before burning the system to eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of inserting the development board are as follows:

2) You also need to prepare a good quality Type-C interface data cable

3) Then download Rockchip microdriver **DriverAssitant_v5.12.zip** and burning tool **RKDevTool_Release_v3.15.zip** from the Orange Pi data download page

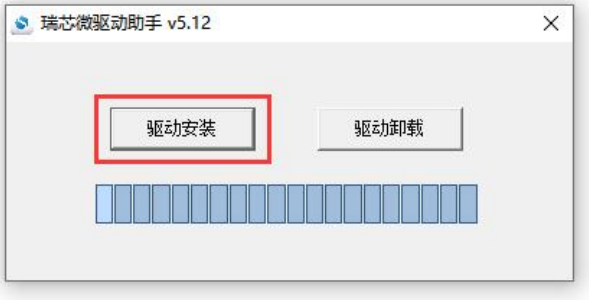
4) Then download the image of Orange Pi OS (OH) from the Orange Pi download page

5) Then use decompression software to decompress the compressed package of the downloaded Orange Pi OS (OH) image. In the decompressed file, the file ending with ".img" is the Orange Pi OS (OH) image file, which is about 3GB in size.

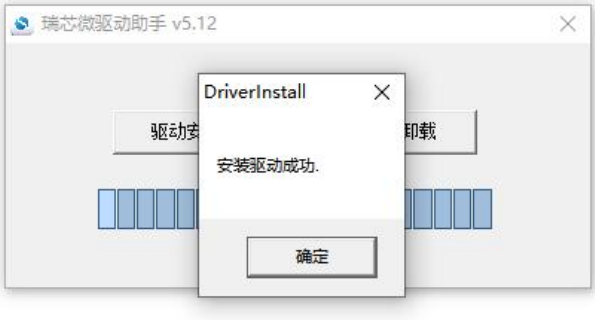
6) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, then find the **DriverInstall.exe** executable file in the decompressed folder and open it.

1) Open **DriverInstall.exe** and install the Rockchip microdriver as follows:

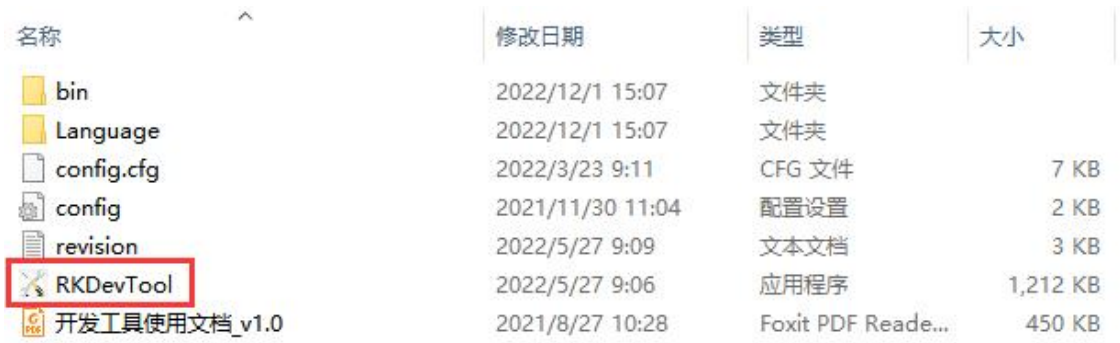
a. Click the "**Driver Installation**" button



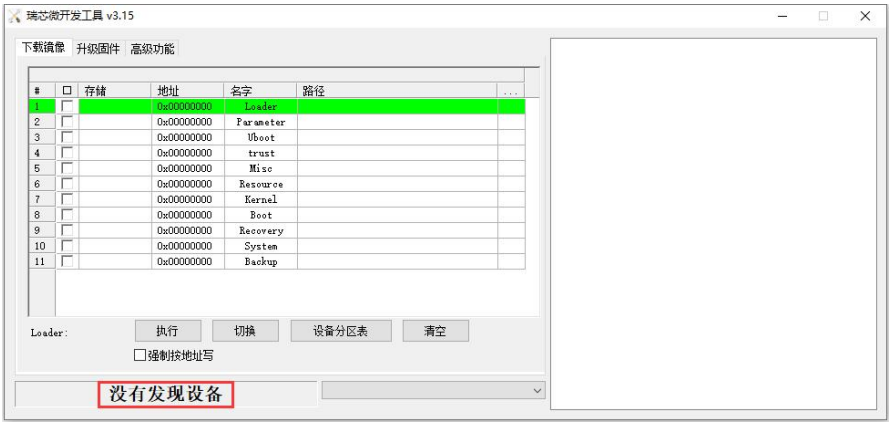
b. After waiting for a period of time, a window will pop up prompting "**Driver installation successful**", then click the "**OK**" button.



2) Then unzip **RKDevTool_Release_v3.15.zip**. This software does not need to be installed. Just find **RKDevTool** in the unzipped folder and open it.

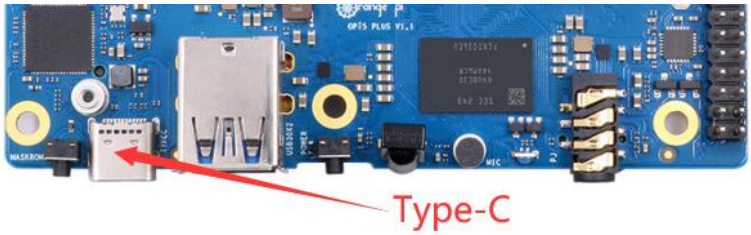


3) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, "**No device found**" will be prompted in the lower left corner.



4) Then start burning the Orange Pi OS (OH) image into the eMMC

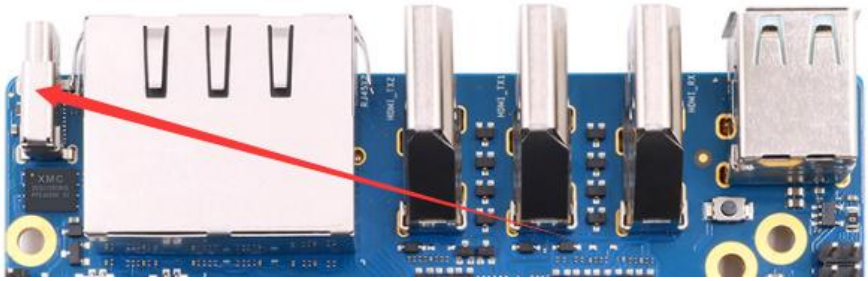
a. First, connect the development board and Windows computer through the Type-C data cable. The location of the Type-C interface of the development board is as shown in the figure below.



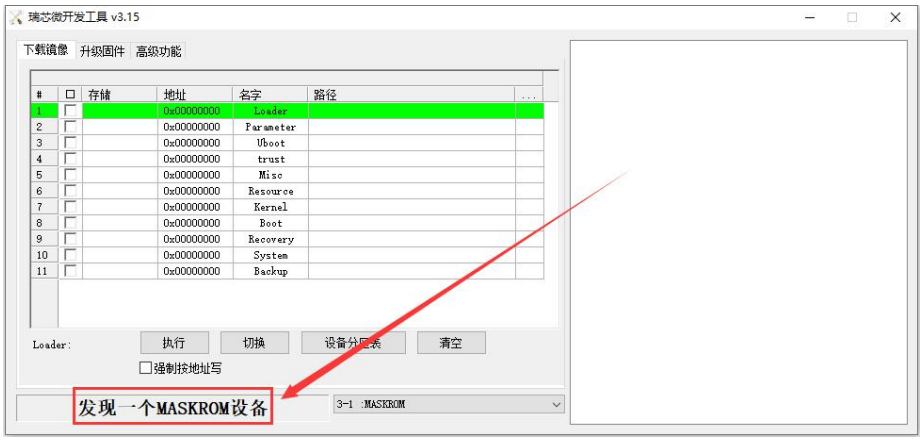
b. Make sure that the TF card is not inserted into the development board and the power supply is not connected.

c. Then press and hold the MaskROM button on the development board. The position of the MaskROM button on the development board is as shown in the figure below:

d. Then connect the development board to the power supply of the Type-C interface and power on



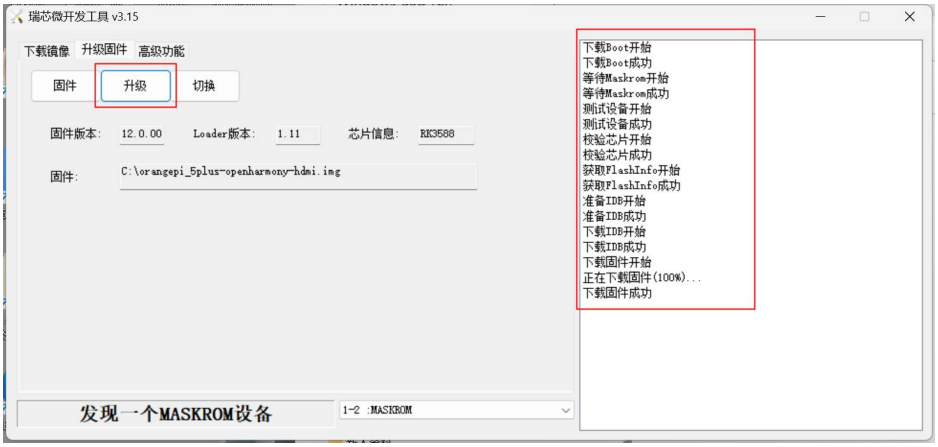
e. If the previous steps go well, the development board will enter MASKROM mode at this time, and the interface of the burning tool will prompt "**A MASKROM device was found**"



f. Then click the "**Upgrade Firmware**" column of the burning tool

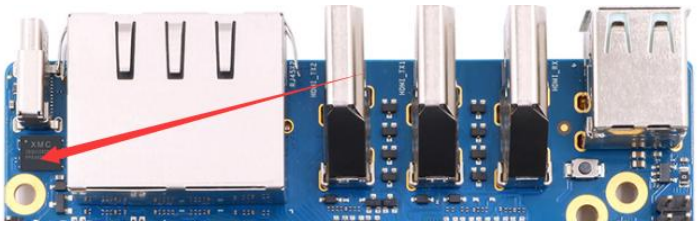
g. Then click the "**Firmware**" button to select the path to the Orange Pi OS (OH) image that needs to be burned.

h. Finally, click the "**Upgrade**" button to start burning. The log during the burning process is as shown below. After the burning is completed, the Orange Pi OS (OH) system will automatically start.



2. 16. How to use RKDevTool to clear SPIFlash

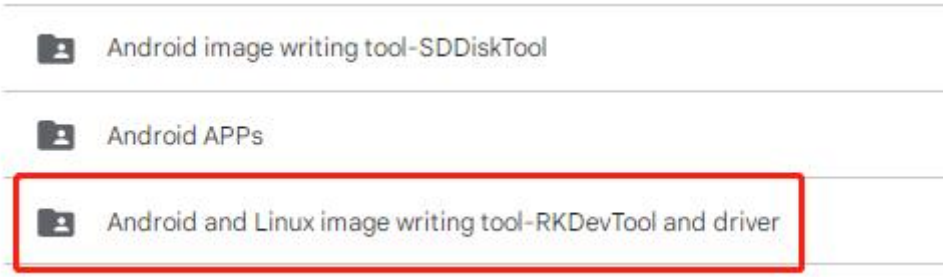
1) The position of SPI Flash on the development board is shown in the figure below



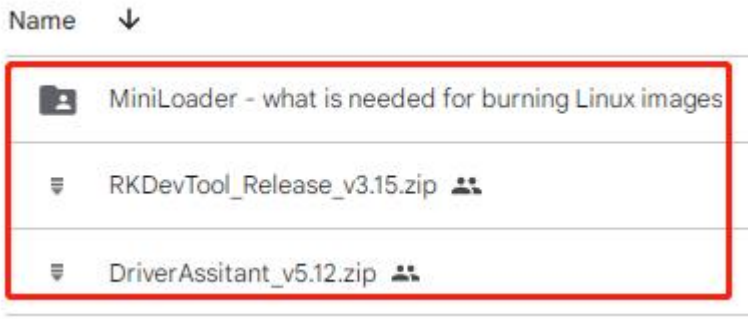
2) First, you need to prepare a data cable with a good quality Type-C interface

3) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v3.15.zip** from the **Orange Pi data download page**

a. On the Orange Pi data download page, first select the **official tool**, and then enter the following folder



b. Then download all the files below



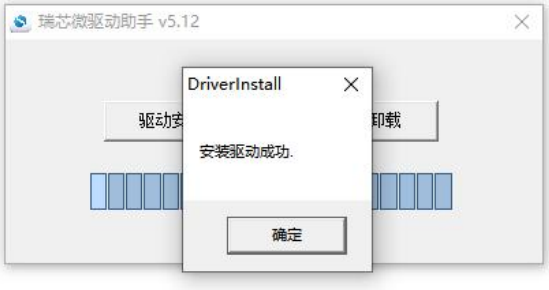
Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

4) Then use the decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

5) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

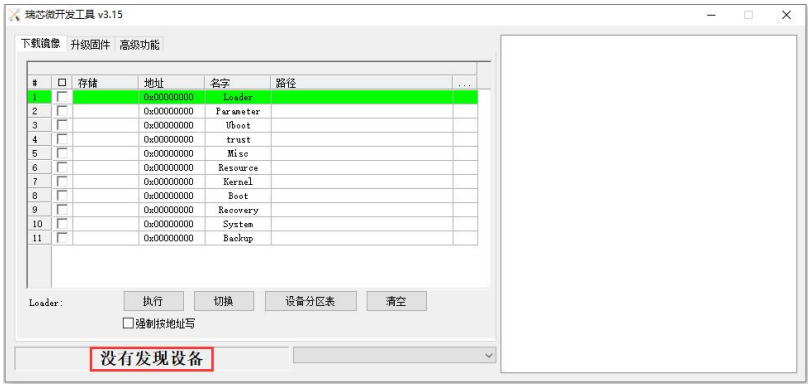
a. Click the "**Driver Installation**" button

b. After waiting for a period of time, a pop-up window will prompt "**The driver is installed successfully**", and then click the "**OK**" button.



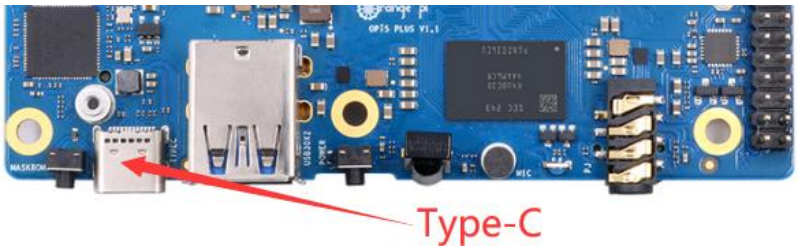
6) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

7) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



8) Then you can start to clear the contents of the SPI FLASH

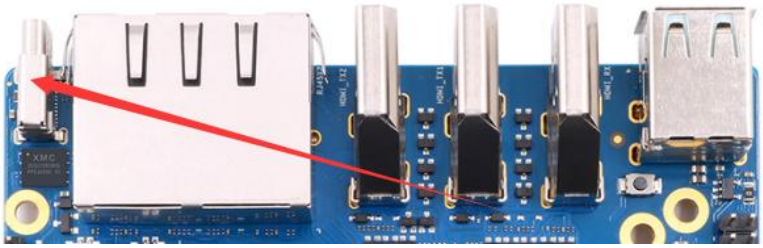
a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



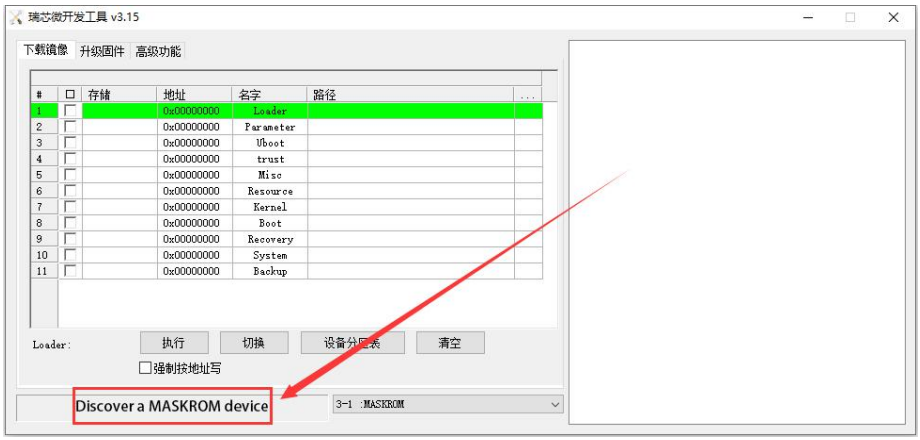
b. Make sure the development board is not connected to the power supply

c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below:

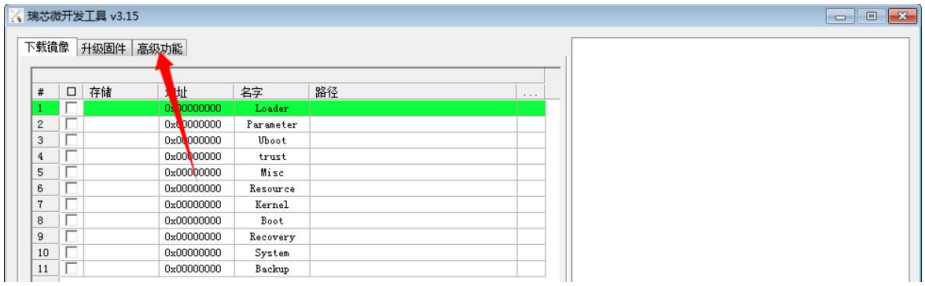
d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



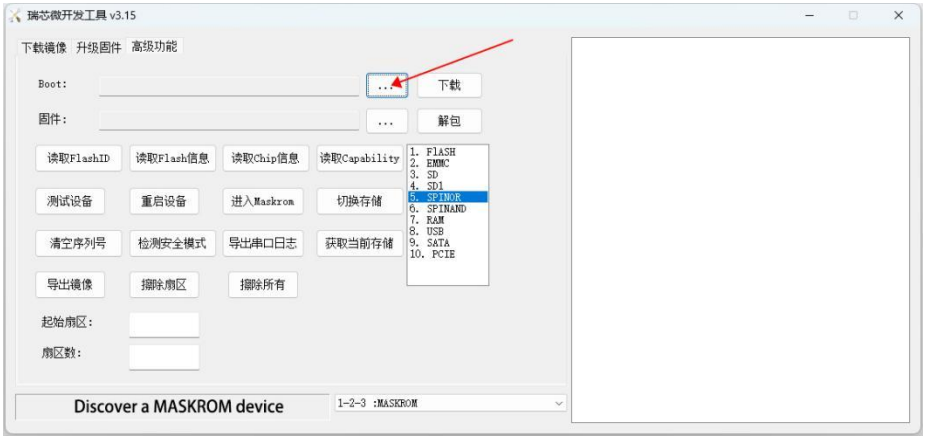
e. If the previous steps are successful, at this time the development board will enter the **Maskrom** mode, and it will be prompted "**Find a Maskrom device**" on the interface of the recording tool



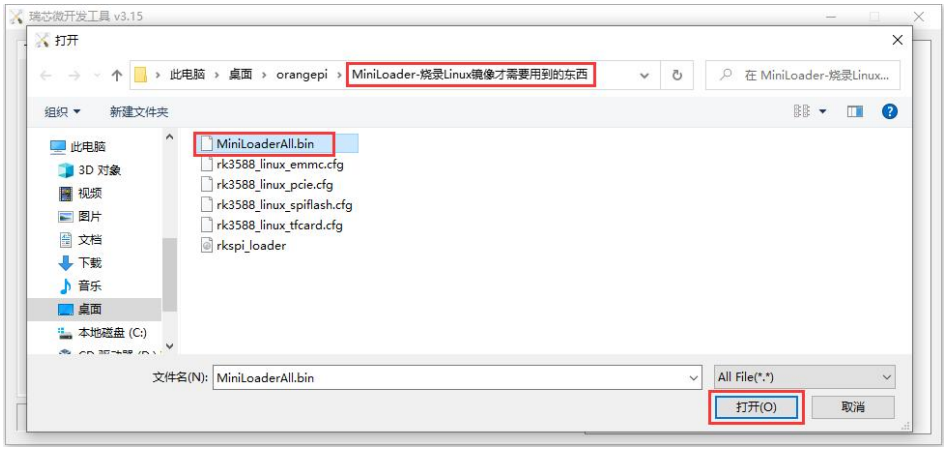
f. Then please select **advanced features**



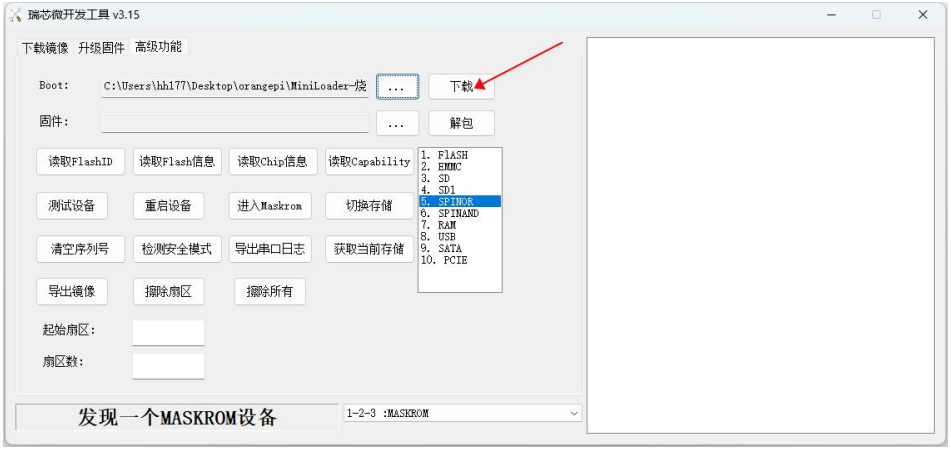
g. Then click the position shown in the figure below



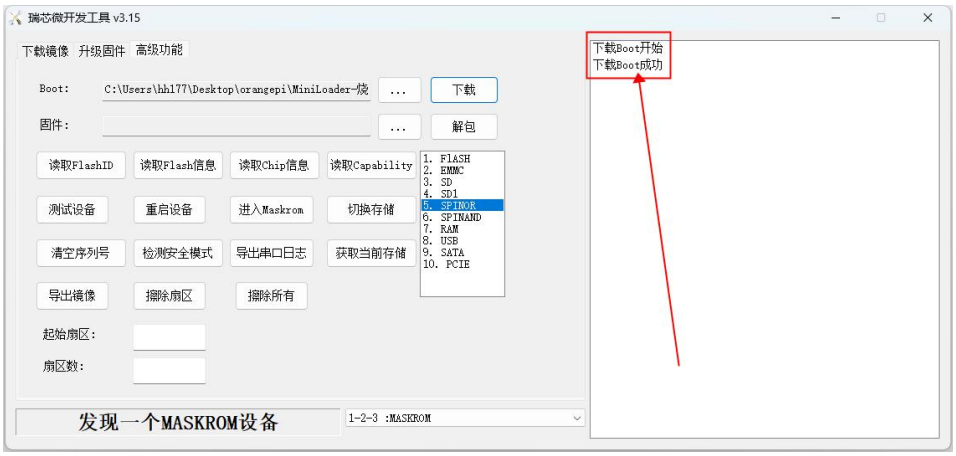
h. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and then click Open



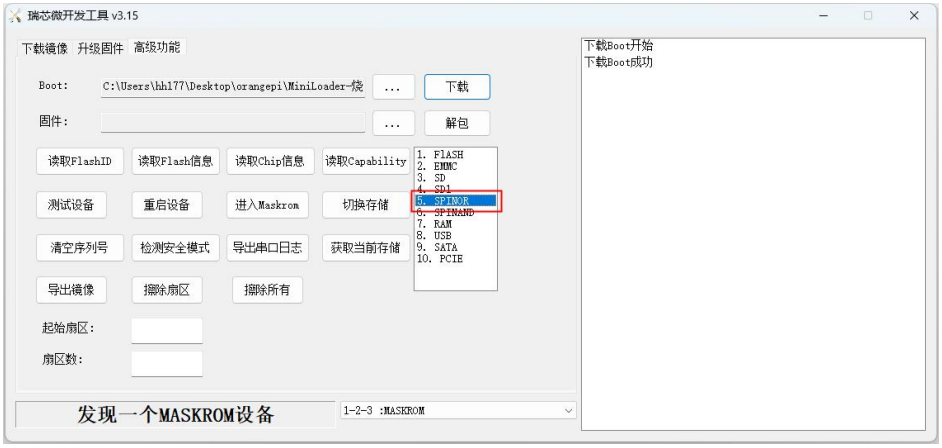
i. Then click **download**



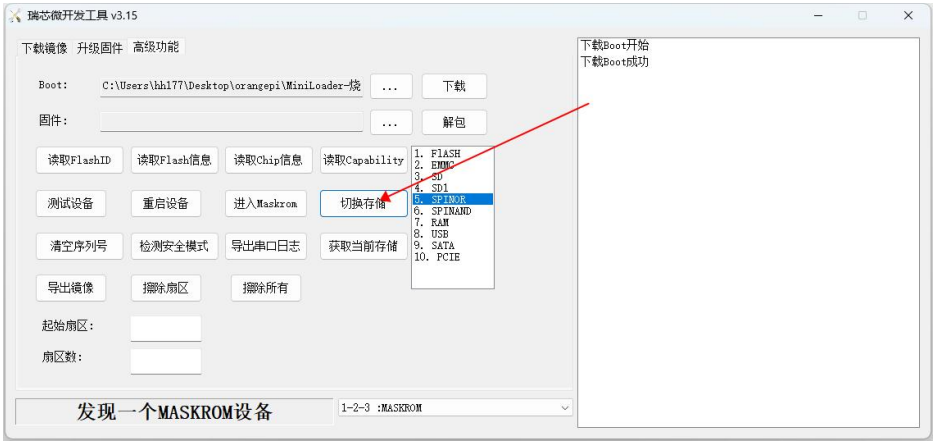
j. The display after downloading **MiniLoaderAll.bin** is shown in the figure below



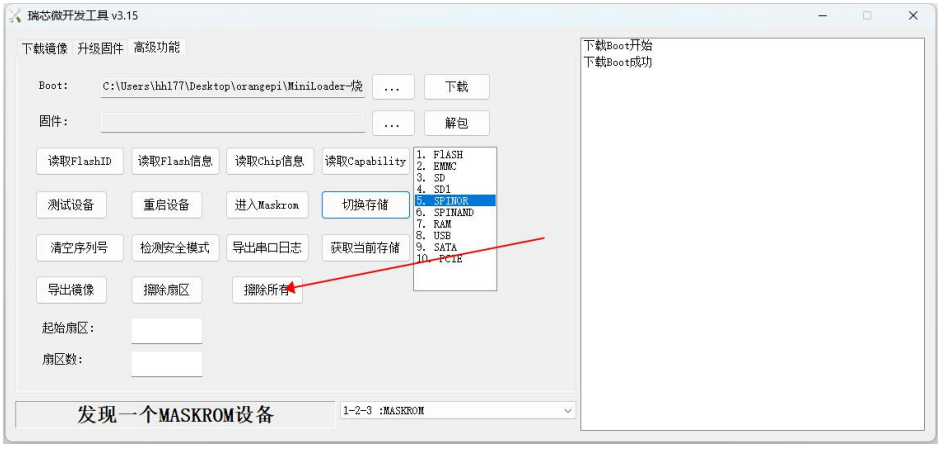
k. Then select the storage device as **SPINOR**



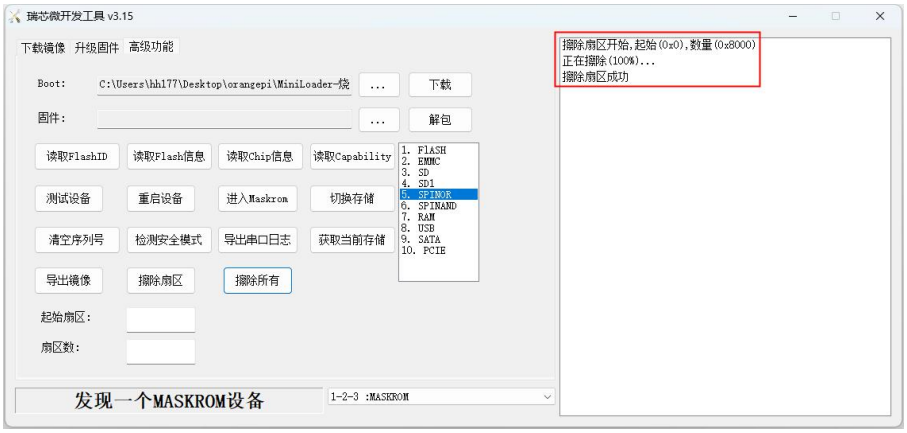
l. Then click **switch storage**



m. Then click **Erase All** to start erasing SPIFlash



n. The display log after erasing SPIFlash is shown in the figure below



2. 17. Start the Orange Pi development board

1) Insert the burned TF card or eMMC module into the TF card slot of the Orange Pi development board. If the image of SPIFlash+NVMe SSD has been burnt, then there is no need to insert a TF card or eMMC module, just make sure that the NVMe SSD is normally inserted into the development board.

2) The development board has an HDMI interface, and the development board can be connected to a TV or HDMI display through an HDMI-to-HDMI cable. If you buy an LCD screen, you can also use the LCD screen to display the system interface of the development board. If there is a Type-C to HDMI cable, the system interface of the development board can also be displayed through the Type-C interface.

3) Connect a USB mouse and keyboard to control the Orange Pi development board.

4) The development board has an Ethernet port, which can be plugged into a network cable for Internet access.

5) Connect a **high-quality** power adapter with a 5V/4A USB Type-C interface.

Remember not to plug in a power adapter with a voltage output greater than 5V, as this will burn out the development board.

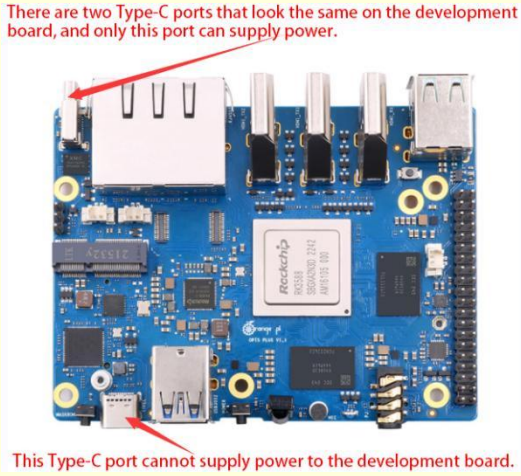
Many unstable phenomena during the power-on and start-up process of the system are basically caused by power supply problems, so a reliable power adapter is very important. If you find that there is a phenomenon of continuous restart during the startup process, please replace the power

supply or the Type-C data cable and try again.

The Type-C power port does not support PD negotiation.

In addition, please do not connect the USB interface of the computer to power the development board.

There are two Type-C ports that look the same on the development board. The one next to the network port is the power port, and the other Type-C port has no power supply function. Please don't connect it wrong.



6) Then turn on the switch of the power adapter. If everything is normal, you can see the startup screen of the system on the HDMI monitor or LCD screen.

7) If you want to view the output information of the system through the debugging serial port, please use the serial cable to connect the development board to the computer. For the connection method of the serial port, please refer to the section on **how to use the debugging serial port**.

2. 18. How to use the debugging serial port

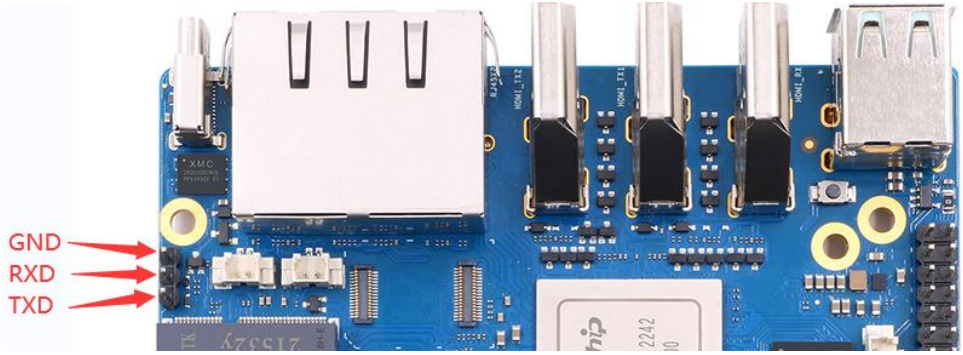
2. 18. 1. Connection instruction of debugging serial port

1) First, you need to prepare a **3.3V** USB to TTL module, and then insert the USB interface end of the USB to TTL module into the USB interface of the computer.

For better compatibility, it is recommended to use CH340 USB to TTL module, please do not use CP2102, PL2303 type USB to TTL module.

Before purchasing a USB to TTL module, please confirm that the module supports a baud rate of 1500000.

2) The corresponding relationship between GND, RXD and TXD pins of the debugging serial port of the development board is shown in the figure below:



3) The GND, TXD and RXD pins of the USB to TTL module need to be connected to the debugging serial port of the development board through a DuPont line

a. The GND of the USB to TTL module is connected to the GND of the development board
b. The **RX** of the USB to TTL module is **connected to the TX of the development board**
c. The **TX** of the USB to TTL module is **connected to the RX of the development board**

4) The schematic diagram of connecting the USB to TTL module to the computer and the Orange Pi development board is as follows

Schematic diagram of connecting the USB to TTL module to the computer and the Orange Pi development board

The TX and RX of the serial port need to be cross-connected. If you don't want to carefully distinguish the order of TX and RX, you can connect the TX and RX of the serial port casually. If there is no output in the test, then exchange the order of TX and RX, so that there is always a This order is correct.

2. 18. 2. How to use the debugging serial port on the Ubuntu platform

There are many serial port debugging software that can be used under Linux, such as putty, minicom, etc. The following demonstrates how to use putty.

1) First, insert the USB-to-TTL module into the USB port of the Ubuntu computer. If the connection and recognition of the USB-to-TTL module is normal, you can see the corresponding device node name under **/dev** on the Ubuntu PC. Remember this node name, and then set the serial port software will be used.

```
test@test:~$ ls /dev/ttyUSB*
/dev/ttyUSB0
```

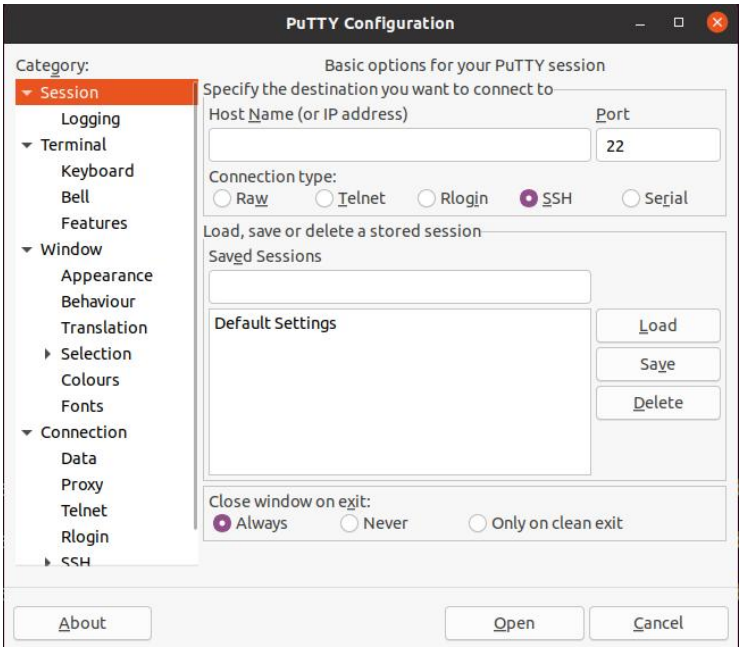
2) Then use the following command to install putty on Ubuntu PC

```
test@test:~$ sudo apt-get update
test@test:~$ sudo apt-get install -y putty
```

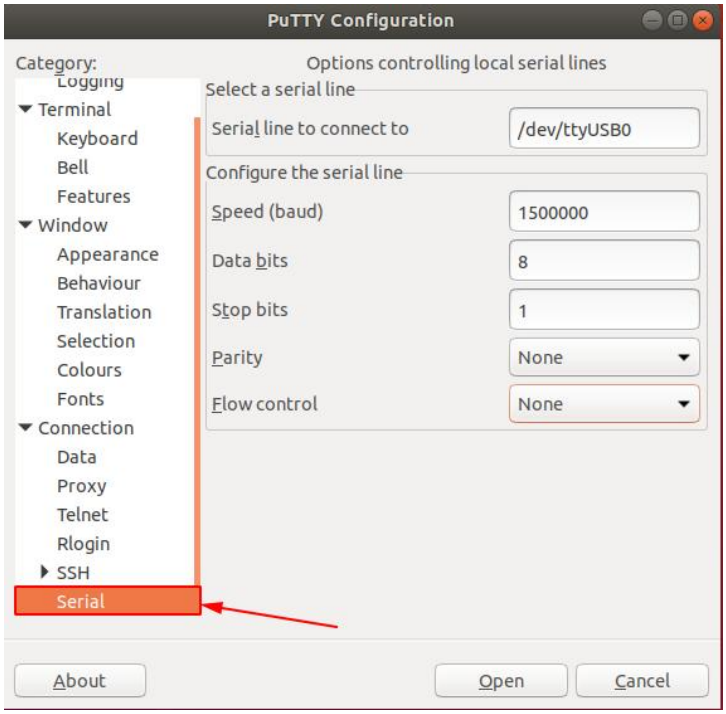
3) Then run putty, **remember to add sudo permission**

```
test@test:~$ sudo putty
```

4) After executing the putty command, the following interface will pop up



5) First select the setting interface of the serial port

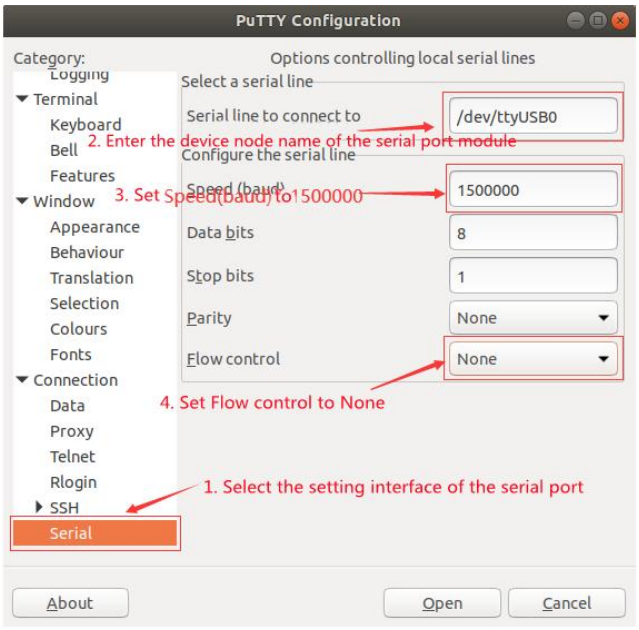


6) Then set the parameters of the serial port

a. Set the Serial line to connect to as /dev/ttyUSB0 (modify to the corresponding node name, generally /dev/ttyUSB0)

b. Set Speed(baud) to **1500000** (the baud rate of the serial port)

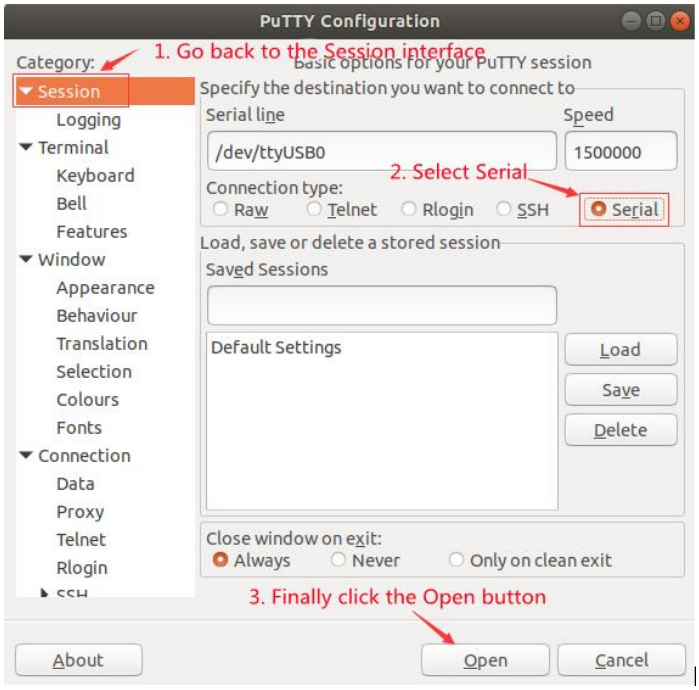
c. Set Flow control to None



7) After setting the serial port setting interface, return to the Session interface

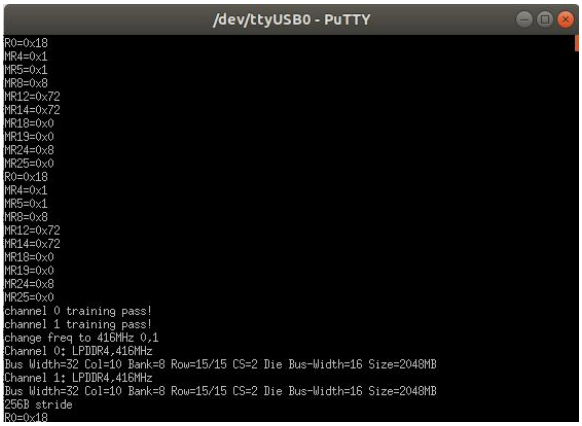
a. First select the Connection type as Serial

b. Then click the Open button to connect to the serial port



8) After starting the development board, you can see the Log information output by the

system from the opened serial port terminal



2. 18. 3. How to use the debugging serial port on Windows platform

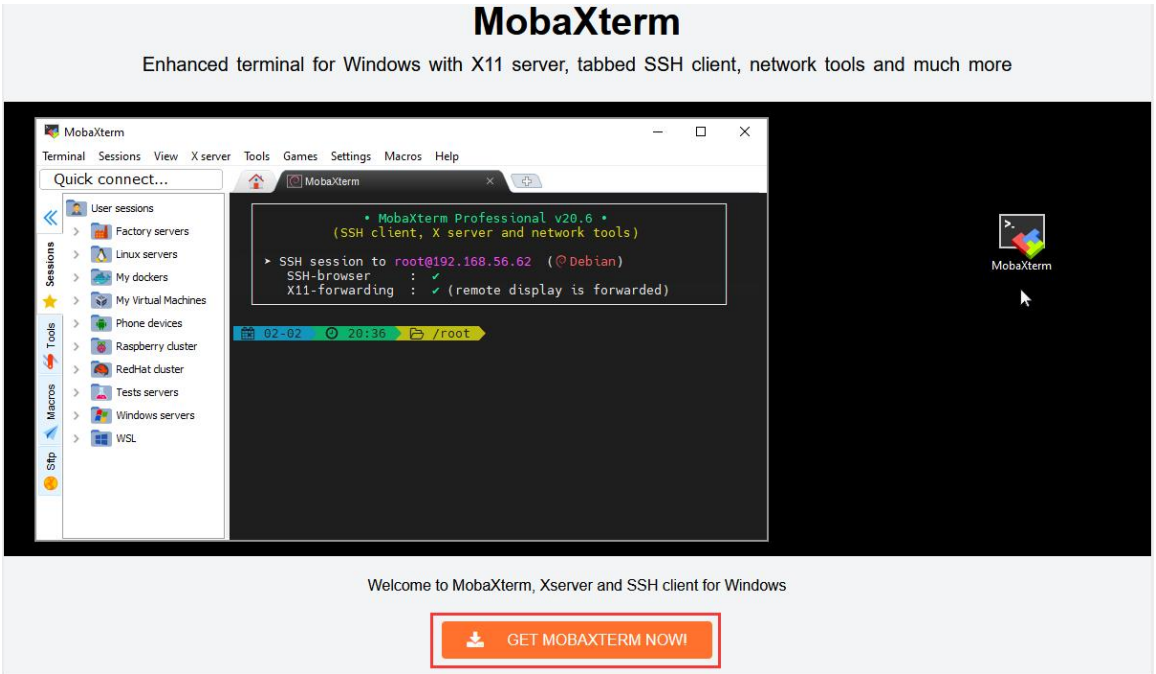
There are many serial port debugging software that can be used under Windows, such as SecureCRT, MobaXterm, etc. The following demonstrates how to use MobaXterm. This software has a free version and can be used without buying a serial number.

1) Download MobaXterm

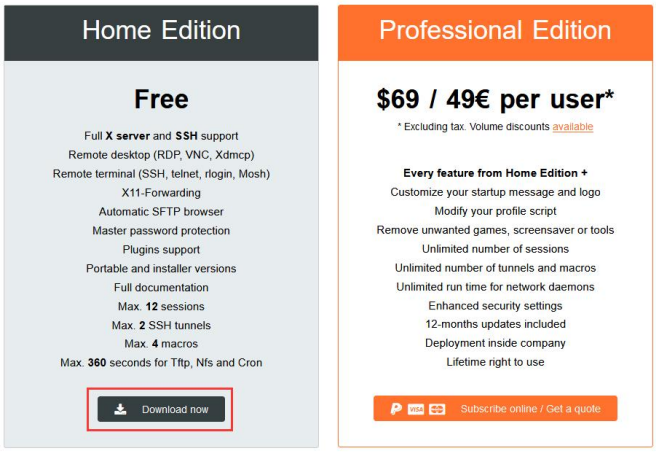
a. Download MobaXterm website as follows

https://mobaxterm.mobatek.net

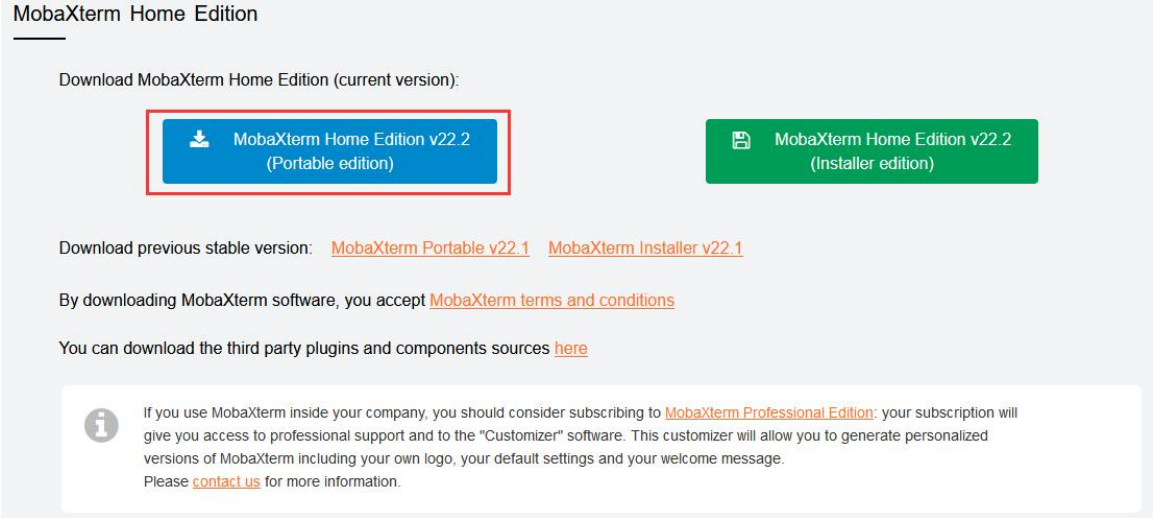
b. After entering the MobaXterm download page, click **GET XOBATERM NOW!**



c. Then choose to download the Home version



d. Then select Portable portable version, no need to install after downloading, just open it and use it



2) After downloading, use decompression software to decompress the downloaded compressed package, you can get the executable software of MobaXterm, and then double-click to open

3) After opening the software, the steps to set up the serial port connection are as follows

a. Open the session settings interface

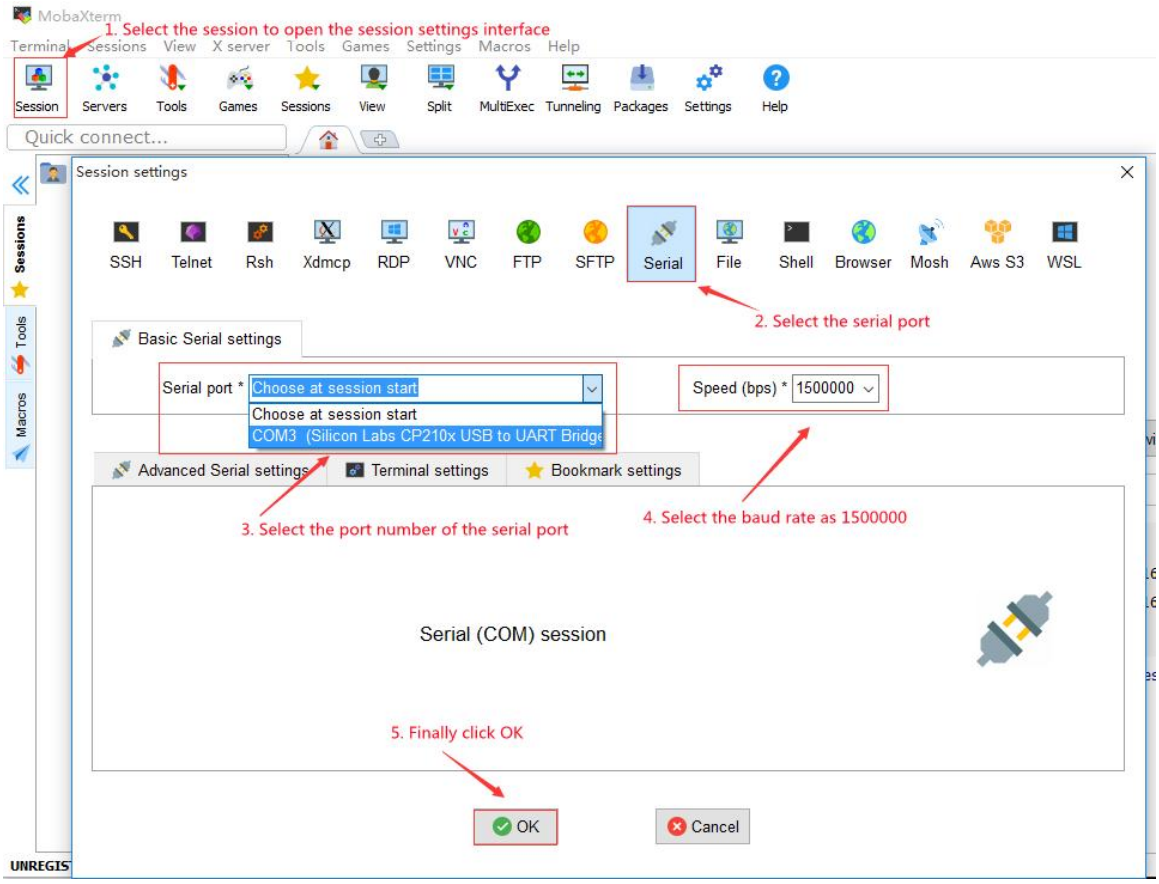
b. Select the serial port type

c. Select the port number of the serial port (select the corresponding port number

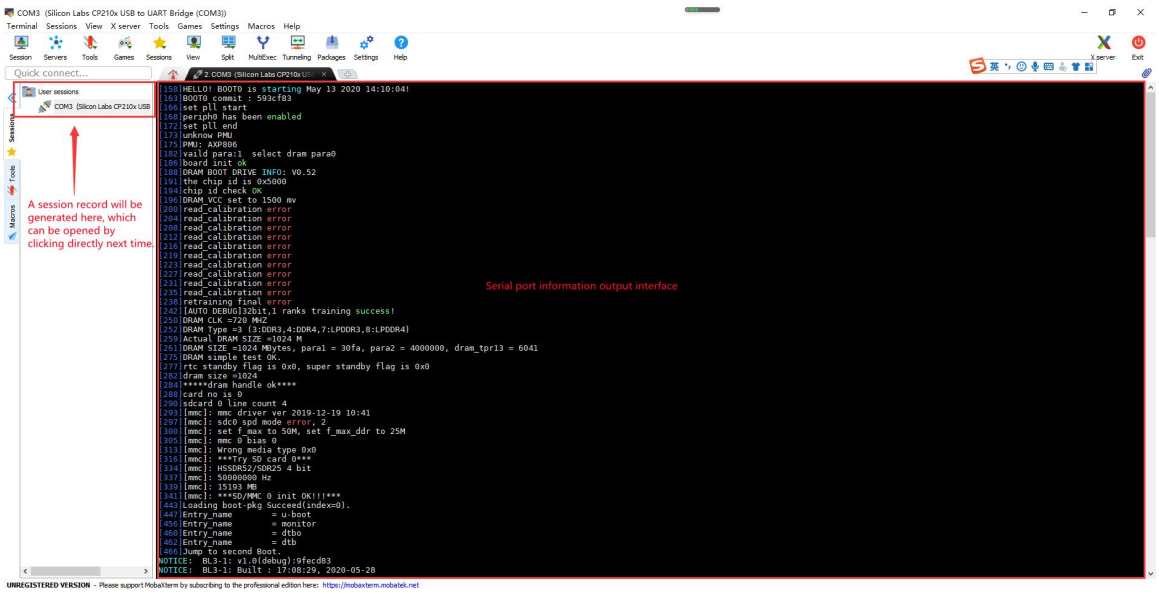
according to the actual situation), if you cannot see the port number, please use **360 Driver Master** to scan and install the driver for the USB to TTL serial port chip

d. Select the baud rate of the serial port as **1500000**

e. Finally click the "**OK**" button to complete the settings



4) After clicking the "**OK**" button, you will enter the following interface. At this time, start the development board and you can see the output information of the serial port



2. 19. Instructions for using the 5v pin in the 40pin interface of the development board to supply power

The power supply method we recommend for the development board is to use the 5V/4A or 5V/5A Type-C interface power cord to plug into the Type-C power interface of the development board for power supply. If you need to use the 5V pin in the 40pin interface to power the development board, please make sure that the power cable and power adapter used can meet the power supply requirements of the development board. If the use is unstable, please switch back to the Type-C power supply.

1) First, you need to prepare a power cord as shown in the figure below

The power cord shown in the picture above can be bought on Taobao, please search and buy by yourself.

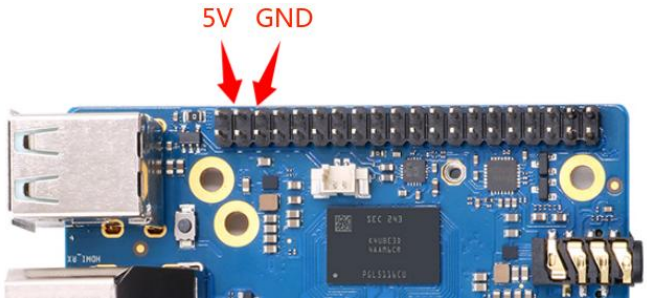
2) Use the 5V pin in the 40pin interface to supply power to the development board. The connection method of the power line is as follows

a. The USB A port of the power cord shown in the above picture needs to be plugged into the 5V/4A or 5V/5A power adapter connector (**please do not plug into the USB port of the computer for power supply, nor can the general mobile phone charging head, because the development board Without the PD function, the general mobile phone charging head can only output the lowest 5V/2A**)

b. The red DuPont line needs to be plugged into the 5V pin of the development board 40pin

c. The black DuPont line needs to be inserted into the GND pin of the 40pin interface

d. The positions of the 5V pin and the GND pin of the 40pin interface in the development board are shown in the figure below, **remember not to reverse the connection**



3. **Ubuntu/Debian Server** and **Xfce** desktop system instructions

The content of this chapter is written based on the Ubuntu/Debian server version image and the xfce desktop version image.

If you are using the Ubuntu22.04 Gnome image, please first check the instructions in the chapter Ubuntu22.04 Gnome Wayland Desktop System Instructions.

You can refer to the instructions in this chapter for the content that does not exist in the chapter of Ubuntu22.04 Gnome Wayland Desktop System User

Manual, but some details may be different, please pay special attention to this point.

If you are using the OPi OS Arch image, please refer to the chapter Orange Pi OS Arch System Instructions.

3.1. Supported Ubuntu/Debian image types and kernel versions

Linux image type	kernel version	server version	desktop version
Debian 11 - Bullseye	Linux5.10	support	support
Debian 12 - Bookworm	Linux5.10	plan support	plan support
Ubuntu 20.04 - Focal	Linux5.10	support	support
Ubuntu 22.04 - Jammy	Linux5.10	support	support
Debian 11 - Bullseye	Linux6.1	support	support
Debian 12 - Bookworm	Linux6.1	support	support
Ubuntu 20.04 - Focal	Linux6.1	support	support
Ubuntu 22.04 - Jammy	Linux6.1	support	support

3.2. Linux system adaptation

3.2.1. Linux5.10 system adaptation situation

Function	Linux5.10 driver	Debian11	Ubuntu20.04	Ubuntu22.04
HDMI TX1 Video	OK	OK	OK	OK
HDMI TX1 Audio	OK	OK	OK	OK
HDMI TX2 Video	OK	OK	OK	OK
HDMI TX2 Audio	OK	OK	OK	OK
HDMI RX Video	OK	OK	OK	OK
HDMI RX Audio	OK	OK	OK	OK
USB2.0X2	OK	OK	OK	OK
USB3.0X2	OK	OK	OK	OK
2.5G PCIe network port X2	OK	OK	OK	OK
2.5G PCIe network port light	OK	OK	OK	OK

Debug serial port	**OK**	**OK**	**OK**	**OK**
RTC Chip	**OK**	**OK**	**OK**	**OK**
FAN interface	**OK**	**OK**	**OK**	**OK**
eMMC Extension ports	**OK**	**OK**	**OK**	**OK**
AP6275P-WIFI	**OK**	**OK**	**OK**	**OK**
AP6275P-BT	**OK**	**OK**	**OK**	**OK**
AX200-WIFI	**OK**	**OK**	**OK**	**OK**
AX200-BT	**OK**	**OK**	**OK**	**OK**
AX210-WIFI	**OK**	**OK**	**OK**	**OK**
AX210-BT	**OK**	**OK**	**OK**	**OK**
RTL8852BE-WIFI	**OK**	**OK**	**OK**	**OK**
RTL8852BE-BT	**OK**	**OK**	**OK**	**OK**
MaskROM button	**OK**	**OK**	**OK**	**OK**
Type-C 转 USB3.0	**OK**	**OK**	**OK**	**OK**
Type-C ADB Function	**OK**	**OK**	**OK**	**OK**
Type-C DP Video	**OK**	**OK**	**OK**	**OK**
Type-C DP Audio	**OK**	**OK**	**OK**	**OK**
switch button	**OK**	**OK**	**OK**	**OK**
infrared function	**OK**	**OK**	**OK**	**OK**
Three-color LED light	**OK**	**OK**	**OK**	**OK**
Onboard MIC	**OK**	**OK**	**OK**	**OK**
headphone playback	**OK**	**OK**	**OK**	**OK**
headphone recording	**OK**	**OK**	**OK**	**OK**
SPK Horn	**OK**	**OK**	**OK**	**OK**
40PIN GPIO	**OK**	**OK**	**OK**	**OK**
40PIN I2C	**OK**	**OK**	**OK**	**OK**
40PIN SPI	**OK**	**OK**	**OK**	**OK**
40PIN UART	**OK**	**OK**	**OK**	**OK**
40PIN CAN	**OK**	**OK**	**OK**	**OK**
40PIN PWM	**OK**	**OK**	**OK**	**OK**
TF card start	**OK**	**OK**	**OK**	**OK**
SPI+NVME start	**OK**	**OK**	**OK**	**OK**
OV13850 camera	**OK**	**OK**	**OK**	**OK**
OV13855 camera	**OK**	**OK**	**OK**	**OK**

GPU	OK	OK	OK	OK
VPU	OK	OK	OK	OK
NPU	OK	OK	OK	OK
REBOOT command restarts	OK	OK	OK	OK
Poweroff command shutdown	OK	OK	OK	OK
MIPI LCD display	OK	OK	OK	OK
MIPI LCD Touch	OK	OK	OK	OK
Chromium hard solution video	OK	OK	OK	OK

3.2.2. Linux6.1 system adaptation situation

Function	Linux5.10 driver	Debian11	Ubuntu20.04	Ubuntu22.04
HDMI TX1 Video	OK	OK	OK	OK
HDMI TX1 Audio	OK	OK	OK	OK
HDMI TX2 Video	OK	OK	OK	OK
HDMI TX2 Audio	OK	OK	OK	OK
HDMI RX Video	OK	OK	OK	OK
HDMI RX Audio	OK	OK	OK	OK
USB2.0X2	OK	OK	OK	OK
USB3.0X2	OK	OK	OK	OK
2.5G PCIe network port X2	OK	OK	OK	OK
2.5G PCIe network port light	OK	OK	OK	OK
Debug serial port	OK	OK	OK	OK
RTC Chip	OK	OK	OK	OK
FAN interface	OK	OK	OK	OK
eMMC Extension ports	OK	OK	OK	OK
AP6275P-WIFI	OK	OK	OK	OK
AP6275P-BT	OK	OK	OK	OK
AX200-WIFI	OK	OK	OK	OK
AX200-BT	OK	OK	OK	OK
AX210-WIFI	OK	OK	OK	OK

AX210-BT	OK	OK	OK	OK
RTL8852BE-WIFI	OK	OK	OK	OK
RTL8852BE-BT	OK	OK	OK	OK
MaskROM button	OK	OK	OK	OK
Type-C 转 USB3.0	OK	OK	OK	OK
Type-C ADB Function	OK	OK	OK	OK
Type-C DP Video	OK	OK	OK	OK
Type-C DP Audio	OK	OK	OK	OK
switch button	OK	OK	OK	OK
infrared function	OK	OK	OK	OK
Three-color LED light	OK	OK	OK	OK
Onboard MIC	OK	OK	OK	OK
headphone playback	OK	OK	OK	OK
headphone recording	OK	OK	OK	OK
SPK Horn	OK	OK	OK	OK
40PIN GPIO	OK	OK	OK	OK
40PIN I2C	OK	OK	OK	OK
40PIN SPI	OK	OK	OK	OK
40PIN UART	OK	OK	OK	OK
40PIN CAN	NO	NO	NO	NO
40PIN PWM	OK	OK	OK	OK
TF card start	OK	OK	OK	OK
SPI+NVME start	OK	OK	OK	OK
OV13850 camera	OK	OK	OK	OK
OV13855 camera	OK	OK	OK	OK
GPU	OK	OK	OK	OK
VPU	OK	OK	OK	OK
NPU	OK	OK	OK	OK
REBOOT command restarts	OK	OK	OK	OK
Poweroff command shutdown	OK	OK	OK	OK
MIPI LCD display	OK	OK	OK	OK
MIPI LCD Touch	OK	OK	OK	OK
Chromium hard	OK	OK	OK	OK

solution video				

3. 3. The format of linux commands in this manual

1) In this manual, all commands that need to be entered in the Linux system will be framed in the following box

```
```

As shown below, the content in the yellow box indicates the content that needs special attention, except for the commands in it.

```
```

2) Description of the prompt type in front of the command

a. The prompt in front of the command refers to the content of the red part in the box below, which is not part of the linux command, so when entering the command in the linux system, please do not enter the content of the red font part.

```
orangepi@orangepi:~$ sudo apt update
root@orangepi:~# vim /boot/boot.cmd
test@test:~$ ssh root@192.168.1.xxx
root@test:~# ls
```

b. **root@orangepi:~$** prompt indicates that this command is entered in the **linux system of the development board**, and the last **$** of the prompt indicates that the current user of the system is an ordinary user. When executing a privileged command, you need to add **sudo**

c. **root@orangepi:~#** The prompt indicates that this command is entered in the **linux system of the development board**, and the # at the end of the prompt indicates that the current user of the system is the root user, who can execute any desired command

d. **test@test:~$** prompt indicates that this command is entered in the Ubuntu PC or Ubuntu virtual machine, not in the linux system of the development board. The **$** at the end of the prompt indicates that the current user of the system is an ordinary user. When executing privileged commands, you need to add **sudo**

e. **root@test:~#** prompt indicates that this command is entered in the Ubuntu PC or Ubuntu virtual machine, not in the linux system of the development board.

The # at the end of the prompt indicates that the current user of the system is the root user and can execute any command you want

3) What are the commands that need to be entered?

a. As shown below, the **black bold part** is the command that needs to be input, and the content below the command is the output content (some commands have output, some may not have output), this part of the content does not need to be input

```
root@orangepi:~# cat /boot/orangepiEnv.txt
verbosity=7
bootlogo=false
console=serial
```

b. As shown below, some commands cannot be written in one line and will be placed on the next line. As long as the black and bold parts are all commands that need to be input. When these commands are entered into one line, the last "\" of each line needs to be removed, this is not part of the command. In addition, there are spaces in different parts of the command, please don’t miss it

```
orangepi@orangepi:~$ echo  \
"deb [arch=$(dpkg --print-architecture)  \
signed-by=/usr/share/keyrings/docker-archive-keyring.gpg]  \
https://download.docker.com/linux/debian  \
$(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
```

3. 4. Linux system login instructions

3. 4. 1. Linux system default login account and password

Account	Password
root	orangepi
orangepi	orangepi

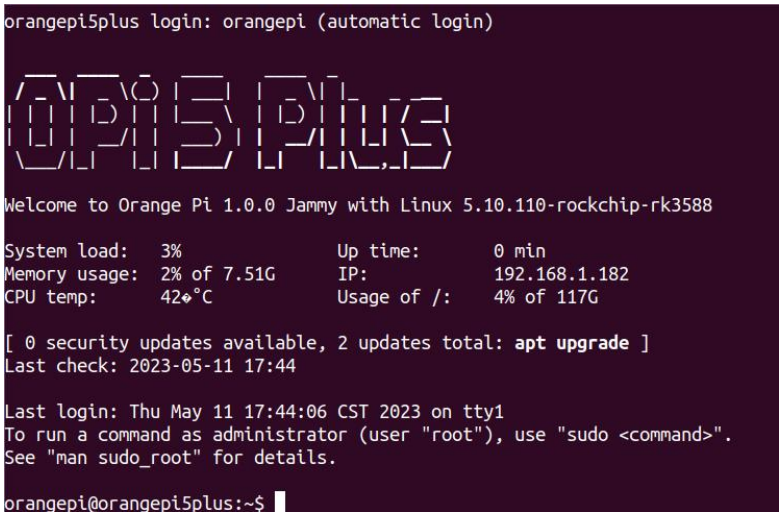
Note that when entering the password, the specific content of the entered password will not be displayed on the screen, please do not think that there is any fault, just press Enter after inputting.

When the wrong password is prompted, or there is a problem with the ssh

connection, please note that as long as you are using the Linux image provided by Orange Pi, please do not suspect that the above password is wrong, but look for other reasons.

3. 4. 2. How to set automatic terminal login in linux system

1) By default, the Linux system automatically logs in to the terminal, and the default login user name is **orangepi**



2) Use the following command to set the root user to automatically log in to the terminal

```
orangepi@orangepi:~$ sudo auto_login_cli.sh root
```

3) Use the following command to disable automatic login terminal

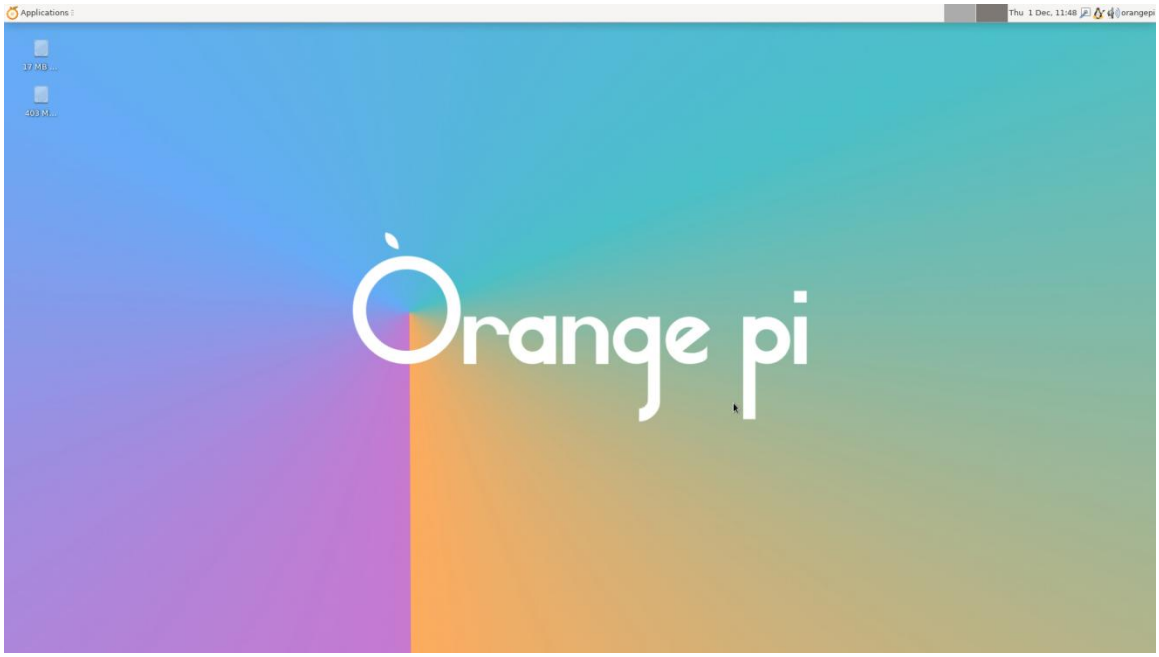
```
orangepi@orangepi:~$ sudo auto_login_cli.sh -d
```

4) Use the following command to set the orangepi user to automatically log in to the terminal again

```
orangepi@orangepi:~$ sudo auto_login_cli.sh orangepi
```

3. 4. 3. Instructions for automatic login of Linux desktop version system

1) After the desktop version system is started, it will automatically log in to the desktop without entering a password



2) Run the following command to prohibit the desktop system from automatically logging into the desktop

```
orangepi@orangepi:~$ sudo disable_desktop_autologin.sh
```

3) Then restart the system and a login dialog box will appear, at which point a **password** is required to enter the system

3.4.4. The setting method of root user automatic login in Linux desktop version system

1) Execute the following command to set the desktop system to automatically log in as the root user

```
orangepi@orangepi:~$ sudo desktop_login.sh root
```

2) Then restart the system, it will automatically use the root user to log in to the desktop

Note that if you log in to the desktop system as the root user, you cannot use pulseaudio in the upper right corner to manage audio devices.

Also note that this is not a bug, since pulseaudio is not allowed to run as root.

3) Execute the following command to set the desktop system to log in automatically with the orangepi user again

```
orangepi@orangepi:~$ sudo desktop_login.sh orangepi
```

3.4.5. The method of disabling the desktop in the Linux desktop version system

1) First enter the following command in the command line, **please remember to add sudo permission**

```
orangepi@orangepi:~$ sudo systemctl disable lightdm.service
```

2) Then restart the Linux system and you will find that the desktop will not be displayed

```
orangepi@orangepi:~$ sudo reboot
```

3) The steps to reopen the desktop are as follows:

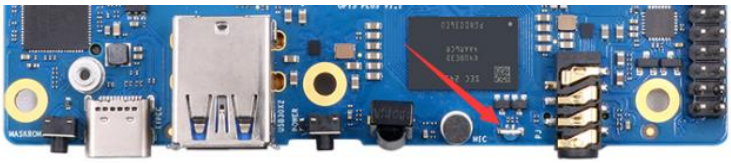
a. First enter the following command in the command line, **please remember to add sudo permission**

```
orangepi@orangepi:~$ sudo systemctl start lightdm.service
orangepi@orangepi:~$ sudo systemctl enable lightdm.service
```

b. After selection, the monitor will display the desktop

3. 5. Onboard LED Light Test Instructions

1) There is a red, green and blue three-color light on the development board, and its location is shown in the figure below:



2) As long as the development board is powered on, the red LED light will always be on, which is controlled by the hardware and cannot be turned off by the software. The red LED light can be used to determine whether the power supply of the development board is turned on normally.

3) The green and blue LED lights will keep blinking after the kernel boots, which is controlled by software.

4) The method of using the command to set the green light on and off and blinking is as follows:

Note that the following operations should be performed under the root user.

a. First enter the setting directory of the green light

```
root@orangepi:~# cd /sys/class/leds/green_led
```

b. The command to set the green light to stop flashing is as follows

```
root@orangepi:/sys/class/leds/green_led# echo none > trigger
```

c. The command to set the green light to be on is as follows

```
root@orangepi:/sys/class/leds/green_led# echo default-on > trigger
```

d. The command to set the green light to flash is as follows

```
root@orangepi:/sys/class/leds/green_led# echo heartbeat > trigger
```

5) The method of using the command to set the blue light on and off and flashing is as follows:

Note that the following operations should be performed under the root user.

a. First enter the setting directory of the blue light

```
root@orangepi:~# cd /sys/class/leds/blue_led
```

b. The command to set the blue light to stop flashing is as follows

```
root@orangepi:/sys/class/leds/blue_led# echo none > trigger
```

c. The command to set the blue light to be on is as follows

```
root@orangepi:/sys/class/leds/blue_led# echo default-on > trigger
```

d. The command to set the blue light to flash is as follows

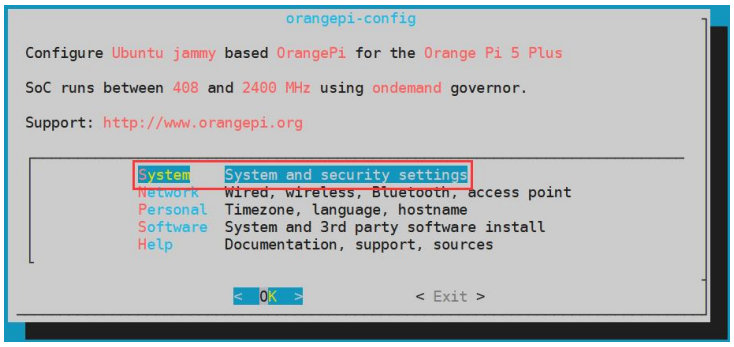
```
root@orangepi:/sys/class/leds/blue_led# echo heartbeat > trigger
```

6) If you don't want the LED light to flash after booting, you can use the following method to turn off the green light and blue light

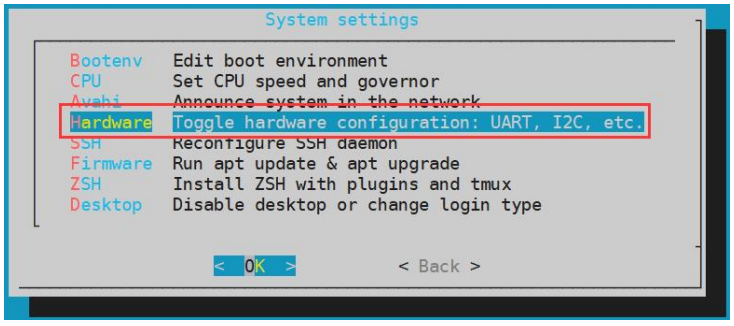
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

b. Then select **System**

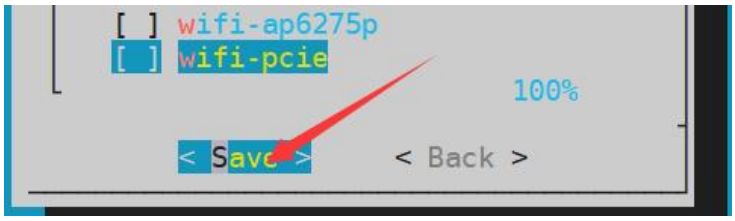


c. Then select **Hardware**

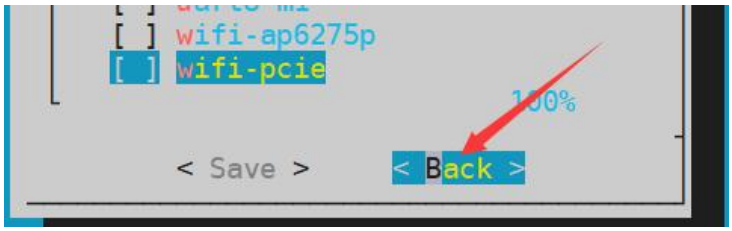


d. Then use the arrow keys of the keyboard to navigate to the position shown in the figure below, and then use the space to select the **opi5plus-disable-leds** configuration

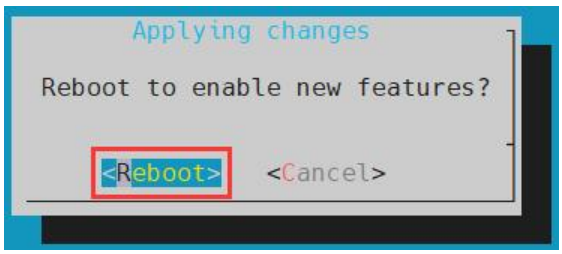
e. Then select **<Save>** to save



f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



h. After restarting, you can see that only the red light on the development board is always on, and the green and blue lights will not flash

3. 6. Network connection test

3. 6. 1. 2.5G Ethernet port test

1) The development board has two 2.5G Ethernet ports, and the test methods for the two ports are the same. First, insert one end of the network cable into the Ethernet interface of the development board, and connect the other end of the network cable to the router, and ensure that the network is unimpeded.

2) After the system starts, it will automatically assign an IP address to the Ethernet card through DHCP **without any other configuration**.

3) The command to view the IP address in the Linux system of the development board is as follows:

```
orangepi@orangepi:~$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enP3p49s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000
    link/ether 00:e0:4c:68:00:26 brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.245/24 brd 192.168.1.255 scope global dynamic noprefixroute enP3p49s0
       valid_lft 42537sec preferred_lft 42537sec
    inet6 fe80::9005:95ac:b9c0:2beb/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
3: enP4p65s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000
    link/ether 00:e0:4c:68:00:27 brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.247/24 brd 192.168.1.255 scope global dynamic noprefixroute enP4p65s0
       valid_lft 43179sec preferred_lft 43179sec
    inet6 fe80::62b5:dc5e:728e:39a3/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

When using ifconfig to view the IP address, if the following information is prompted, it is because sudo is not added. The correct command is: sudo ifconfig

orangepi@orangepi:~$ **ifconfig**
Command 'ifconfig' is available in the following places
 * /sbin/ifconfig
 * /usr/sbin/ifconfig
The command could not be located because '/sbin:/usr/sbin' is not included in the PATH environment variable.

This is most likely caused by the lack of administrative privileges associated with your user account.
ifconfig: command not found

There are three ways to check the IP address after the development board starts:
1. Connect the HDMI display, then log in to the system and use the ip addr show command to view the IP address
2. Enter the ip addr show command in the debugging serial terminal to view the IP address
3. If there is no debugging serial port and no HDMI display, you can also check the IP address of the development board's network port through the router's management interface. However, in this method, some people often cannot see the IP address of the development board normally. If you can't see it, the debug method looks like this:

A）First check whether the Linux system has started normally. If the three-color light on the development board is flashing, it is generally started normally. If only the red light is on, it means that the system has not started normally;

B）Check whether the network cable is plugged in tightly, or try another network cable;

C）Try another router (I have encountered many problems with the router, such as the router cannot assign the IP address normally, or the IP address has been assigned normally but cannot be seen in the router);

D）If there is no router to replace, you can only connect to an HDMI display or use the debugging serial port to check the IP address.

In addition, it should be noted that the development board DHCP automatically assigns an IP address without any settings.

4) The command to test the network connectivity is as follows, the **ping** command can be interrupted through the shortcut key of **Ctrl+C**

```
orangepi@orangepi:~$ ping www.baidu.com -I enP4p65s0        #Test command for one of the network ports
orangepi@orangepi:~$ ping www.baidu.com -I enP3p49s0        #Test command of another
```

```
network port
PING www.a.shifen.com (14.119.104.254) from 192.168.1.182 enP3p49s0: 56(84) bytes of data.
64 bytes from 14.119.104.254 (14.119.104.254): icmp_seq=1 ttl=56 time=6.26 ms
64 bytes from 14.119.104.254 (14.119.104.254): icmp_seq=6 ttl=56 time=5.69 ms
^C
--- www.a.shifen.com ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 5.671/5.859/6.264/0.202 ms
```

3.6.2. WIFI connection test

First of all, please note that there is no WIFI module on the Orange Pi 5 Plus development board, and an external PCIe network card or USB network card is required to use the WIFI function.

For instructions on using the external PCIe network card, please refer to the section on how to use the PCIe WIFI6+Bluetooth module.

For instructions on using the external USB network card, please refer to the USB wireless network card test section.

Please do not connect to WIFI by modifying the /etc/network/interfaces configuration file. There will be problems connecting to the WIFI network in this way.

3.6.2.1. The server image connects to WIFI through commands

When the development board is not connected to Ethernet, not connected to HDMI display, but only connected to the serial port, it is recommended to use the commands demonstrated in this section to connect to the WIFI network. Because nmtui can only display characters in some serial port software (such as minicom), and cannot display the graphical interface normally. Of course, if the development board is connected to an Ethernet or HDMI display, you can also use the commands demonstrated in this section to connect to the WIFI network.

The commands demonstrated below are the default WIFI network device node name wlan0, but the node names of different WIFI modules will be different, please replace it with the actual node name you see, do not copy it.

1) First log in to the linux system, there are the following three ways
   a. If the development board is connected with a network cable, you can **remotely log in to the Linux system through ssh**
   b. If the development board is connected to the debugging serial port, you can use the serial port terminal to log in to the Linux system
   c. If the development board is connected to the HDMI display, you can log in to the linux system through the HDMI display terminal

2) First use the **nmcli dev wifi** command to scan the surrounding WIFI hotspots

```
orangepi@orangepi:~$ nmcli dev wifi
```

```
root@orangepi:~# nmcli dev wifi
IN-USE  BSSID              SSID                MODE   CHAN  RATE        SIGNAL  BARS  SECURITY
        28:6C:07:6E:87:2E  [redacted]_orangepi  Infra  9     260 Mbit/s  97            WPA1 WPA2
        D8:D8:66:A5:BD:D1  [redacted]           Infra  10    270 Mbit/s  90            WPA1 WPA2
        A0:40:A0:A1:72:20  [redacted]           Infra  4     405 Mbit/s  82            WPA2
        28:6C:07:6E:87:2F  [redacted]_orangepi_5G Infra  149   540 Mbit/s  80            WPA1 WPA2
        CA:50:E9:89:E2:44  [redacted]           Infra  1     130 Mbit/s  79            WPA1 WPA2
        A0:40:A0:A1:72:31  [redacted]           Infra  100   405 Mbit/s  67            WPA2
        D4:EE:07:08:A9:E0  [redacted]           Infra  4     130 Mbit/s  55            WPA1 WPA2
        88:C3:97:49:25:13  [redacted]           Infra  6     130 Mbit/s  52            WPA1 WPA2
        00:BD:82:51:53:C2  [redacted]           Infra  12    130 Mbit/s  49            WPA1 WPA2
        C0:61:18:FA:49:37  [redacted]           Infra  149   270 Mbit/s  47            WPA1 WPA2
        04:79:70:8D:0C:B8  [redacted]           Infra  153   270 Mbit/s  47            WPA2
        04:79:70:FD:0C:B8  [redacted]           Infra  153   270 Mbit/s  47            WPA2
        9C:A6:15:DD:E6:0C  [redacted]           Infra  10    270 Mbit/s  45            WPA1 WPA2
        B4:0F:3B:45:D1:F5  [redacted]           Infra  48    270 Mbit/s  45            WPA1 WPA2
        E8:CC:18:4F:7B:44  [redacted]           Infra  157   135 Mbit/s  45            WPA1 WPA2
        B0:95:8E:D8:2F:ED  [redacted]           Infra  11    405 Mbit/s  39            WPA1 WPA2
        C0:61:18:FA:49:36  [redacted]           Infra  11    270 Mbit/s  24            WPA1 WPA2
root@orangepi:~#
```

3) Then use the **nmcli** command to connect to the scanned WIFI hotspot, where:
   a. **wifi_name** needs to be replaced with the
   b. **wifi_passwd** needs to be replaced with the password of the WIFI hotspot you want to connect to

```
orangepi@orangepi:~$ sudo nmcli dev wifi connect wifi_name password wifi_passwd
Device 'wlan0' successfully activated with 'cf937f88-ca1e-4411-bb50-61f402eef293'.
```

4) Through the **ip addr show wlan0** command, you can view the IP address of wifi

The device node names of WIFI are not necessarily all wlan0, please refer to what you actually see.

```
orangepi@orangepi:~$ ip addr show wlan0
11: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
```

```
    link/ether 23:8c:d6:ae:76:bb brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.11/24 brd 192.168.1.255 scope global dynamic noprefixroute wlan0
       valid_lft 259192sec preferred_lft 259192sec
    inet6 240e:3b7:3240:c3a0:c401:a445:5002:ccdd/64 scope global dynamic noprefixroute
       valid_lft 259192sec preferred_lft 172792sec
    inet6 fe80::42f1:6019:a80e:4c31/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

5) Use the **ping** command to test the connectivity of the wifi network, and the **ping** command can be interrupted through the shortcut key **Ctrl+C**

The device node names of WIFI are not necessarily all wlan0, please refer to what you actually see.

```
orangepi@orangepi:~$ ping www.orangepi.org -I wlan0
PING www.orangepi.org (182.92.236.130) from 192.168.1.49 wlan0: 56(84) bytes of data.
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=1 ttl=52 time=43.5 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=2 ttl=52 time=41.3 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=3 ttl=52 time=44.9 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=4 ttl=52 time=45.6 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=5 ttl=52 time=48.8 ms
^C
--- www.orangepi.org ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 41.321/44.864/48.834/2.484 ms
```

3.6.2.2. The server image connects to WIFI in a graphical way

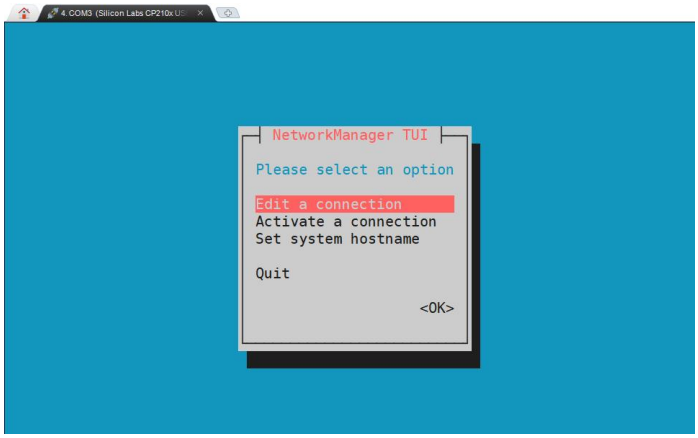
1) First log in to the linux system, there are the following three ways
   a. If the development board is connected with a network cable, you can **remotely log in to the Linux system through ssh**
   b. If the development board is connected to the debugging serial port, you can use the serial port terminal to log in to the linux system (please use MobaXterm for the serial port software, and minicom cannot display the graphical interface)
   c. If the development board is connected to the HDMI display, you can log in to the

linux system through the terminal displayed on the HDMI

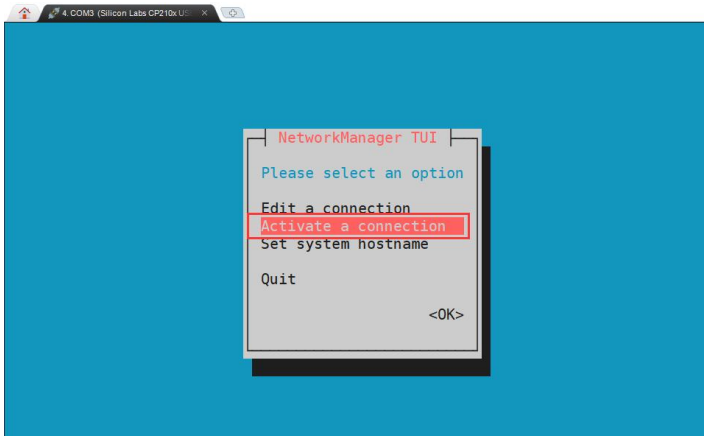
2) Then enter the nmtui command in the command line to open the wifi connection interface

```
orangepi@orangepi:~$ sudo nmtui
```

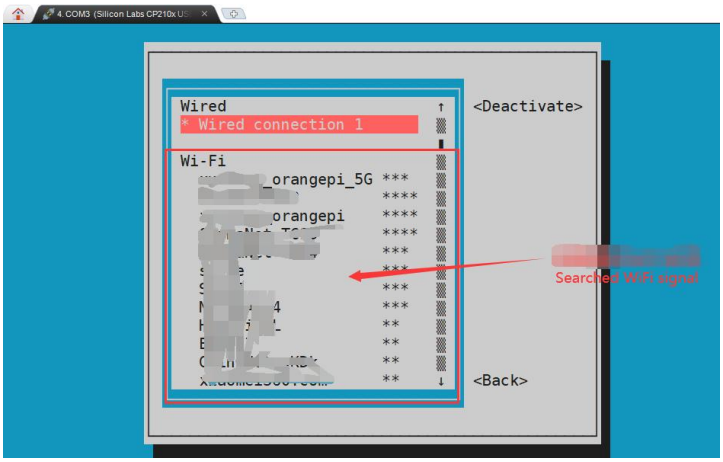
3) Enter the nmtui command to open the interface as shown below



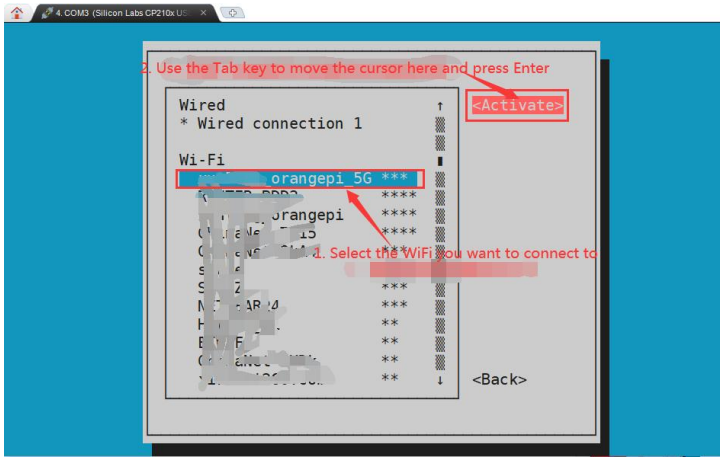
4) Select **Activate a connect** and press Enter



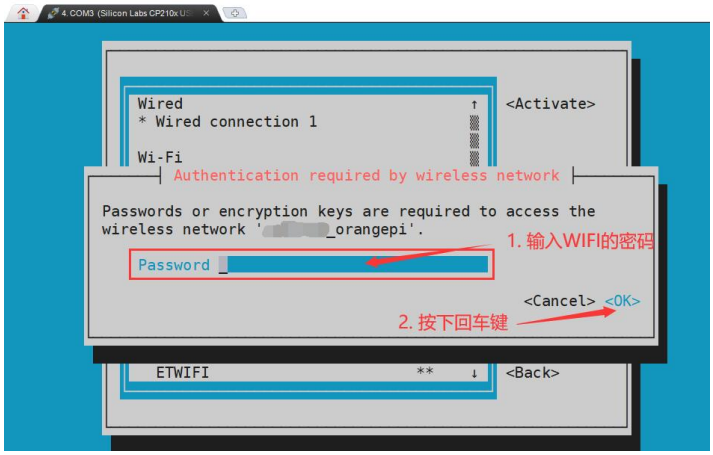
5) Then you can see all the searched WIFI hotspots



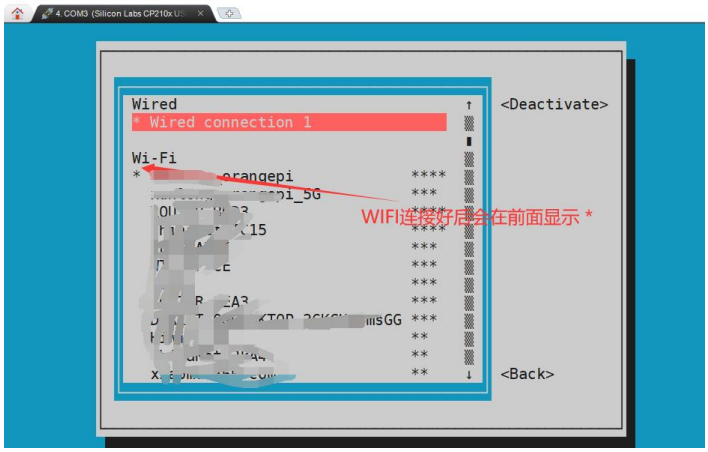
6) Select the WIFI hotspot you want to connect to, then use the Tab key to position the cursor on **Activate** and press Enter



7) Then a dialog box for entering a password will pop up, enter the corresponding password in **Password** and press Enter to start connecting to WIFI



8) After the WIFI connection is successful, a "*" will be displayed in front of the connected WIFI name



9) You can view the IP address of wifi through the **ip addr show wlan0** command

The device node names of WIFI are not necessarily all wlan0, please refer to what you actually see.

```
orangepi@orangepi:~$ ip addr show wlan0
11: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000
    link/ether 24:8c:d3:aa:76:bb brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.11/24 brd 192.168.1.255 scope global dynamic noprefixroute wlan0
       valid_lft 259069sec preferred_lft 259069sec
    inet6 240e:3b7:3240:c4a0:c401:a445:5002:ccdd/64 scope global dynamic noprefixroute
       valid_lft 259071sec preferred_lft 172671sec
    inet6 fe80::42f1:6019:a80e:4c31/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

10) Use the **ping** command to test the connectivity of the wifi network, and the **ping** command can be interrupted through the shortcut key **Ctrl+C**

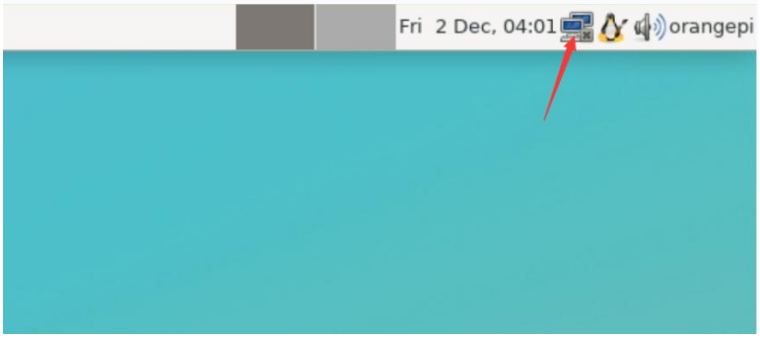
The device node names of WIFI are not necessarily all wlan0, please refer to what you actually see.

```
orangepi@orangepi:~$ ping www.orangepi.org -I wlan0
PING www.orangepi.org (182.92.236.130) from 192.168.1.49 wlan0: 56(84) bytes of data.
```

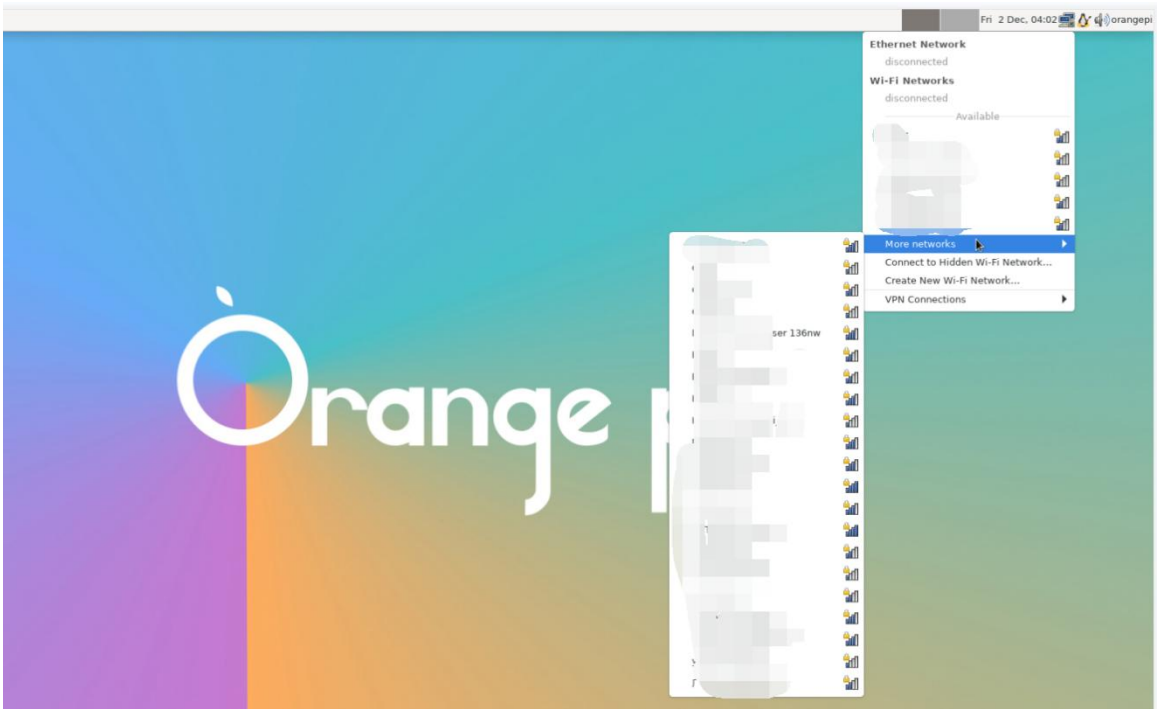
```
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=1 ttl=52 time=43.5 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=2 ttl=52 time=41.3 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=3 ttl=52 time=44.9 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=4 ttl=52 time=45.6 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=5 ttl=52 time=48.8 ms
^C
--- www.orangepi.org ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 41.321/44.864/48.834/2.484 ms
```

3.6.2.3. Test method of desktop image

1) Click the network configuration icon in the upper right corner of the desktop (please do not connect the network cable when testing WIFI)

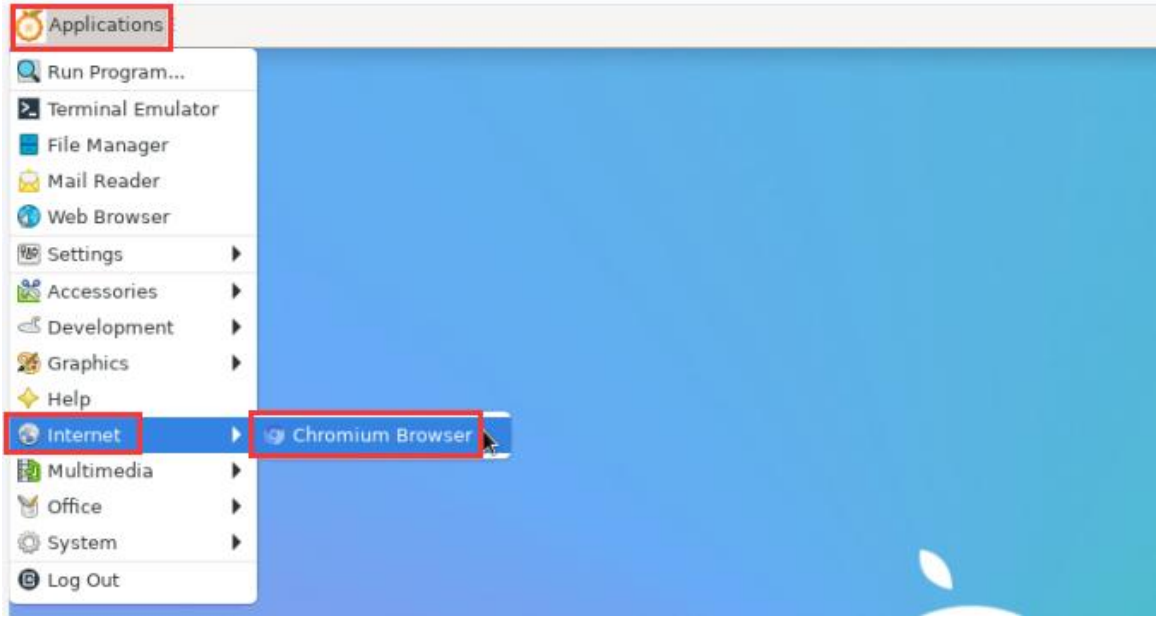


2) Click **More networks** in the pop-up drop-down box to see all scanned WIFI hotspots, and then select the WIFI hotspot you want to connect to

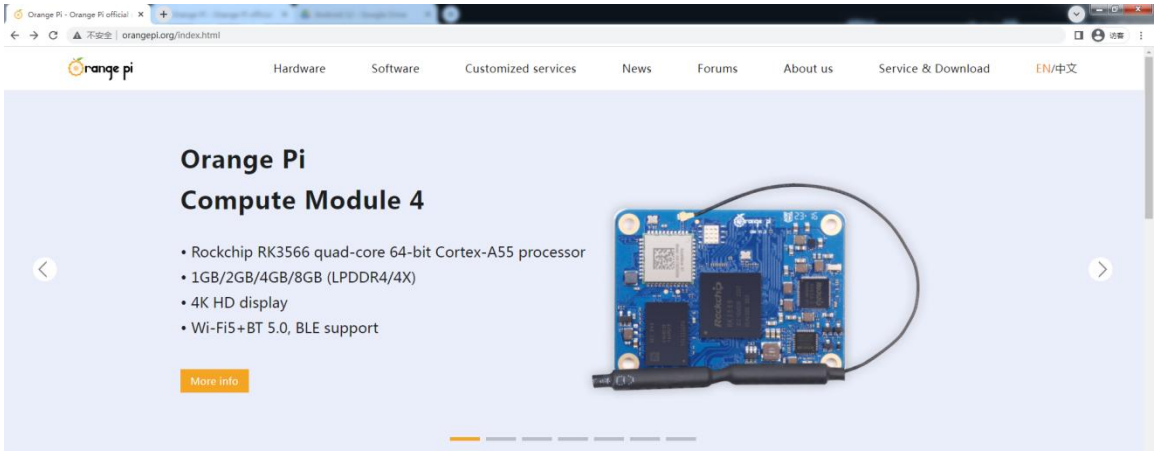


3) Then enter the password of the WIFI hotspot, and then click **Connect** to start connecting to WIFI

4) After connecting to WIFI, you can open the browser to check whether you can access the Internet. The entrance of the browser is shown in the figure below



5) If you can open other web pages after opening the browser, it means that the WIFI connection is normal



3. 6. 3. How to set a static IP address

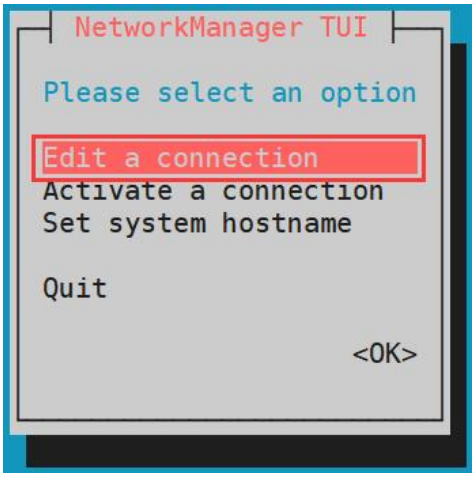
Please do not set a static IP address by modifying the /etc/network/interfaces configuration file.

3. 6. 3. 1. Use the nmtui command to set a static IP address

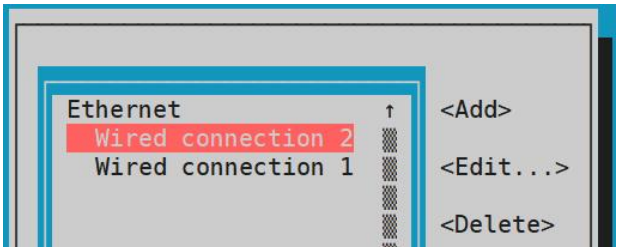
1) First run the **nmtui** command

```
orangepi@orangepi:~$ nmtui
```

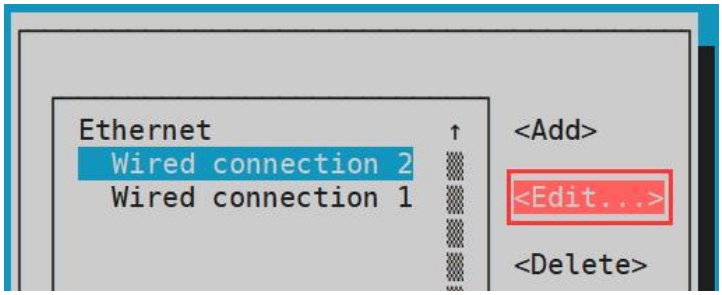
2) Then select **Edit a connection** and press Enter



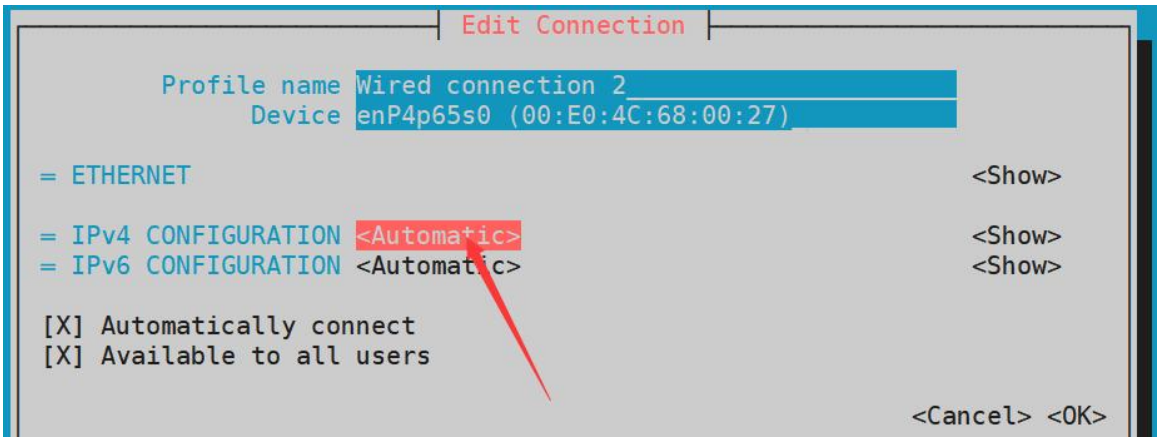
3) Then select the network interface that needs to set a static IP address, such as setting the static IP address of the Ethernet interface to select **Wired connection 1** or **Wired connection 2**



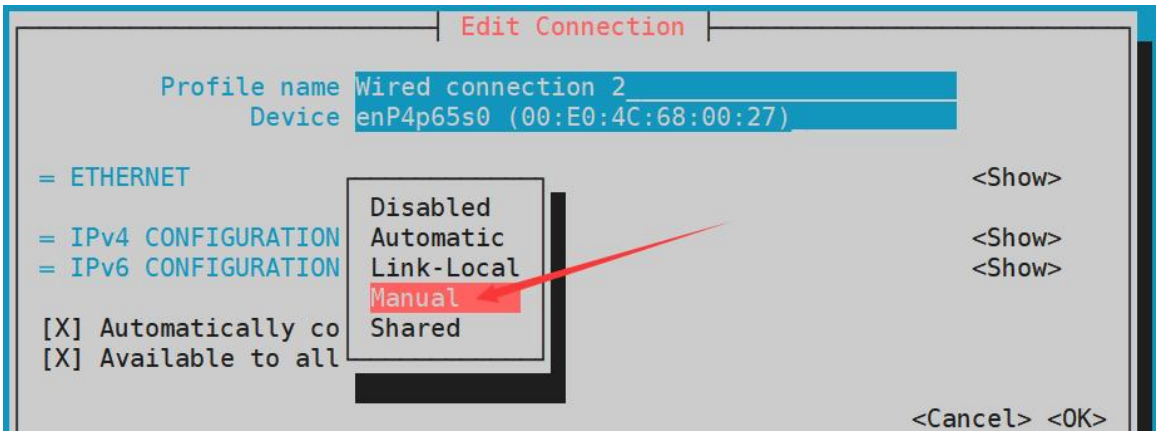
4) Then select **Edit** via the **Tab** key and press the Enter key



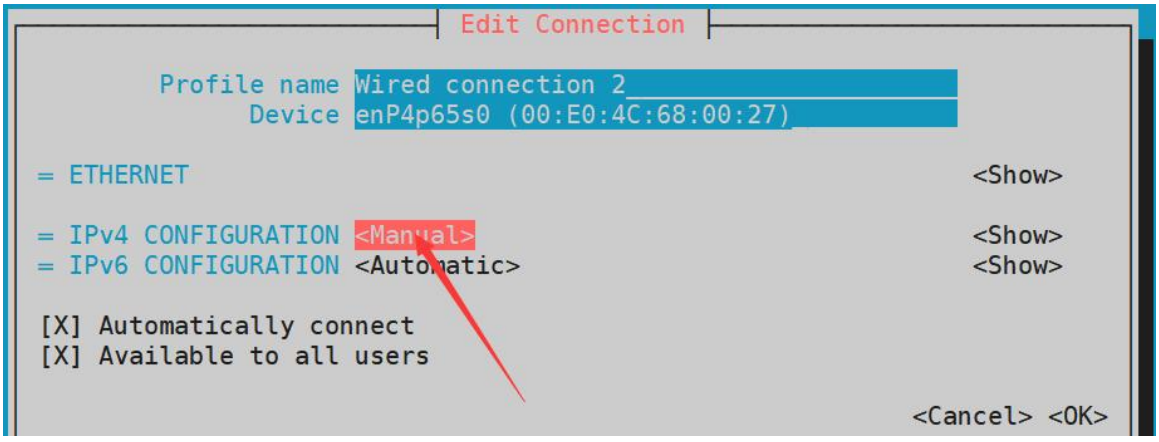
5) Then use the Tab key to move the cursor to the <**Automatic**> position shown in the figure below to configure IPv4



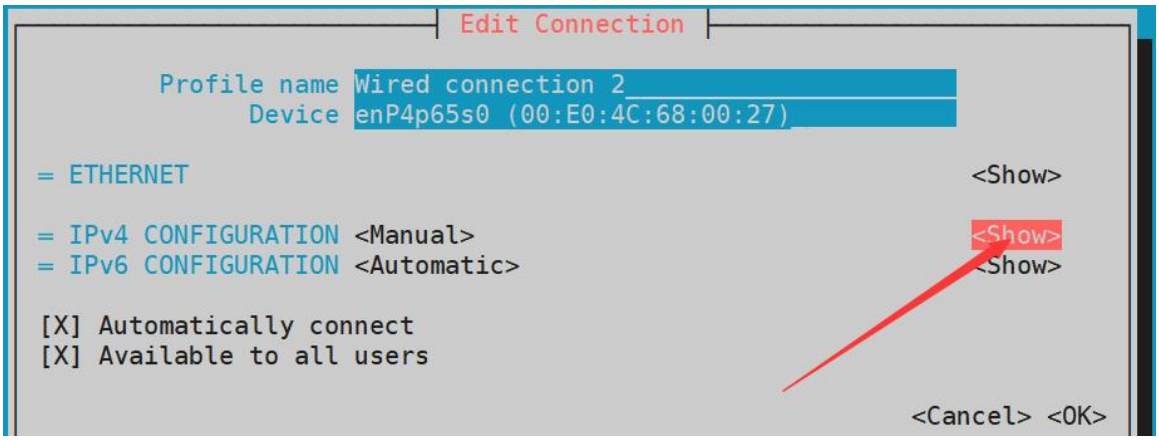
6) Then press Enter, select **Manual** through the up and down arrow keys, and press Enter to confirm



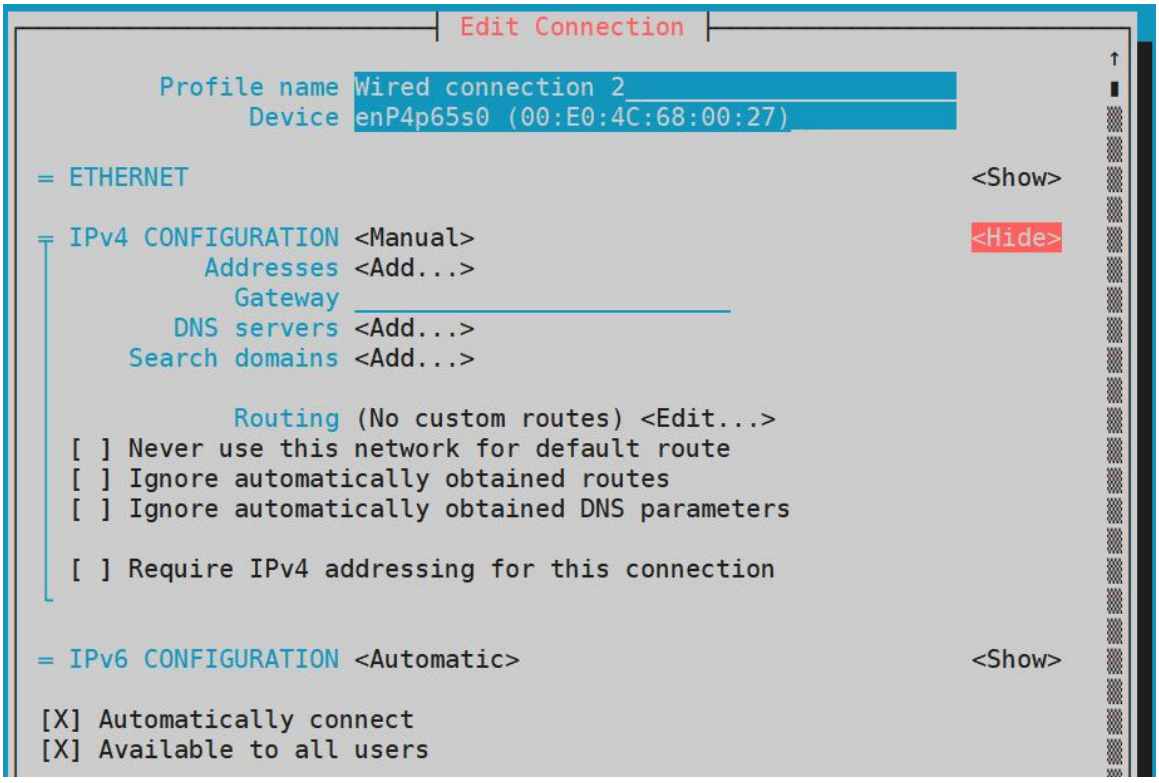
7) The display after selection is shown in the figure below



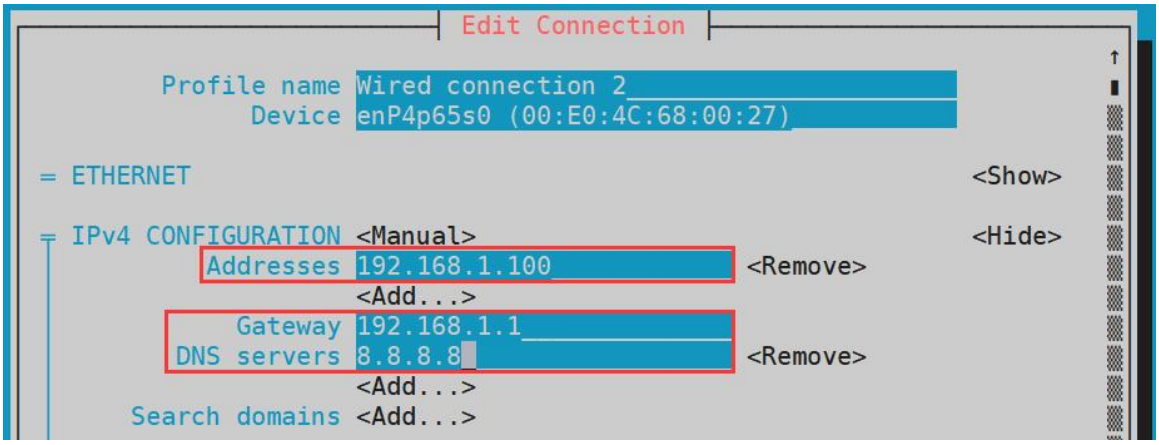
8) Then move the cursor to <**Show**> via the Tab key



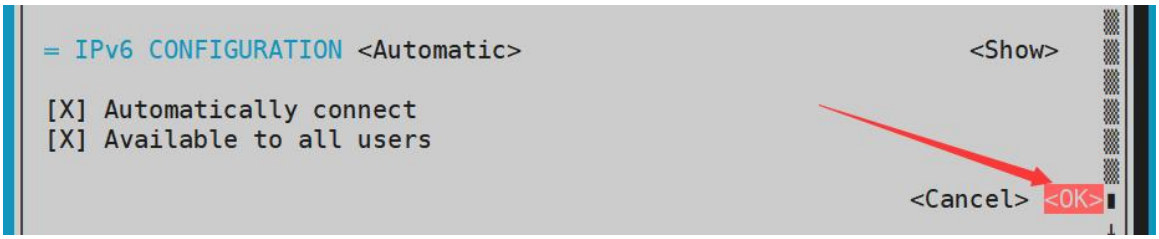
9) Then press Enter, and the following setting interface will pop up after entering



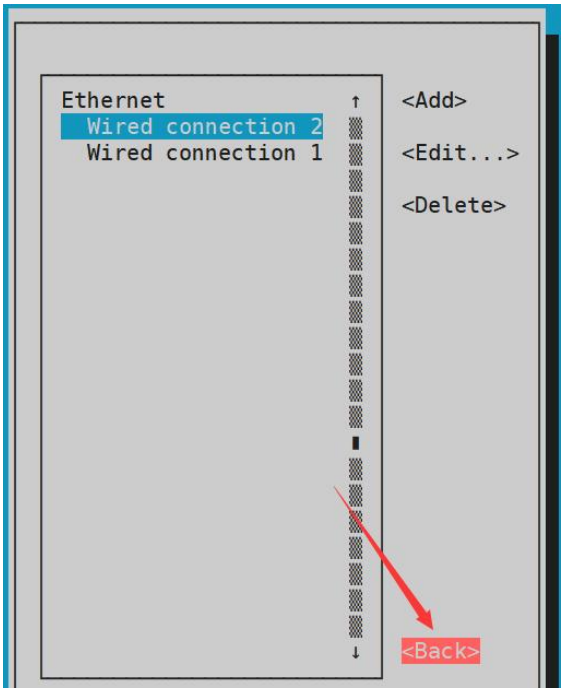
10) Then you can set the IP address (Addresses), gateway (Gateway) and DNS server address in the position shown in the figure below (there are many other setting options in it, please explore by yourself), **please set according to your specific needs, The values set in the image below are just an example**



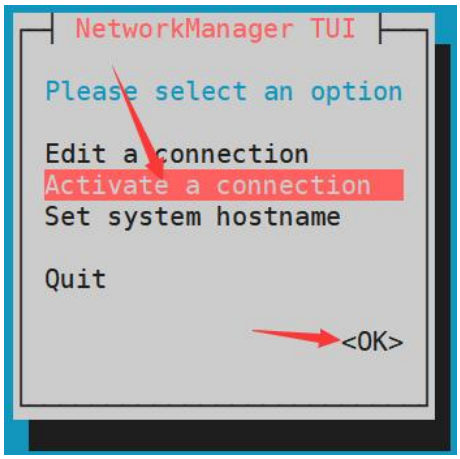
11) After setting, move the cursor to **<OK>** in the lower right corner, and press Enter to confirm



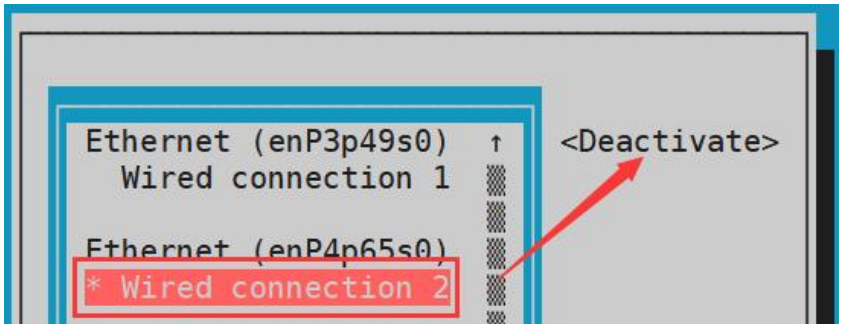
12) Then click **<Back>** to return to the previous selection interface



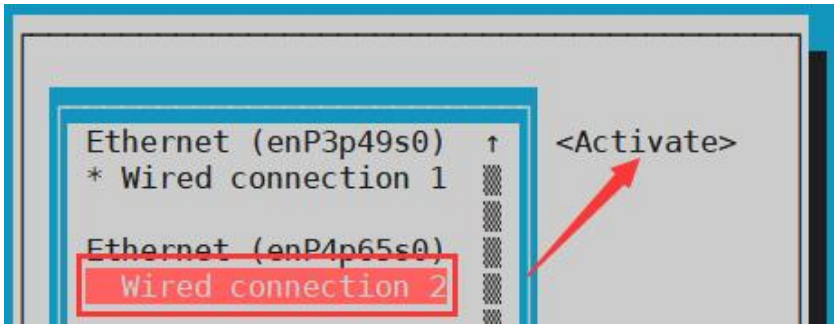
13) Then select **Activate a connection**, then move the cursor to **<OK>**, and finally click Enter



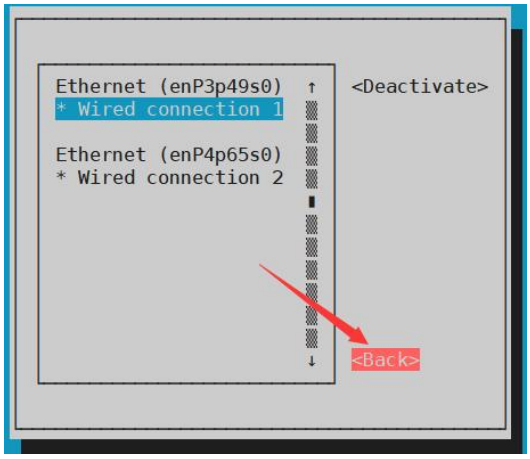
14) Then select the network interface that needs to be set, such as **Wired connection 2**, then move the cursor to **<Deactivate>**, and press the Enter key to disable **Wired connection 2**

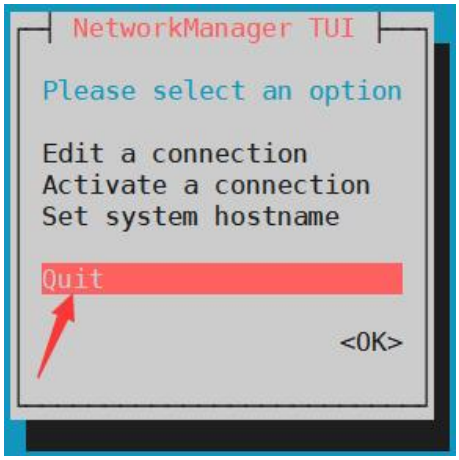


15) Then re-select and enable **Wired connection 2**, so that the static IP set earlier will take effect



16) Then you can exit nmtui through the **<Back>** and **Quit** buttons





17) Then through **ip addr show,** you can see that the IP address of the network port has changed to the static IP address set earlier

```
orangepi@orangepi:~$ ip addr show enP4p65s0
3: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state
UP group default qlen 1000
    link/ether 5e:ac:14:a5:92:b3 brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.100/24 brd 192.168.1.255 scope global noprefixroute enP4p65s0
       valid_lft forever preferred_lft forever
    inet6 241e:3b8:3240:c3a0:e269:8305:dc08:135e/64 scope global dynamic
noprefixroute
       valid_lft 259149sec preferred_lft 172749sec
    inet6 fe80::957d:bbbe:4928:3604/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

18) Then you can test the connectivity of the network to check whether the IP address is configured OK, and the **ping** command can be interrupted through the shortcut key **Ctrl+C**

```
orangepi@orangepi:~$ ping 192.168.1.47 -I enP4p65s0
PING 192.168.1.47 (192.168.1.47) from 192.168.1.188 enP4p65s0: 56(84) bytes of data.
64 bytes from 192.168.1.47: icmp_seq=1 ttl=64 time=0.233 ms
64 bytes from 192.168.1.47: icmp_seq=2 ttl=64 time=0.263 ms
^C
--- 192.168.1.47 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4042ms
```

```
rtt min/avg/max/mdev = 0.233/0.262/0.275/0.015 ms
```

3.6.3.2. Use the nmcli command to set a static IP address

1) If you want to set the static IP address of the network port, please insert the network cable into the development board first. **If you need to set the static IP address of WIFI, please connect the WIFI first**, and then start to set the static IP address

2) Then use the **nmcli con show** command to view the name of the network device, as shown below, **Wired connection 1** and **Wired connection 2** are the names of the Ethernet interfaces

```
orangepi@orangepi:~$ nmcli con show
NAME                UUID                                  TYPE      DEVICE
Wired connection 1  c043c817-1156-3b72-a559-9a8cd642bf70  ethernet  enP3p49s0
Wired connection 2  6f74598a-ccc6-358b-be05-87eaf34df930  ethernet  enP4p65s0
```

3) Then enter the following command, where

a. **"Wired connection 1"** means to set the static IP address of the Ethernet port. If you need to set the static IP address of other network ports, please modify it to the name corresponding to the corresponding network interface (you can get it through the **nmcli con show** command)

b. **ipv4.addresses** is followed by the static IP address to be set, which can be modified to the value you want to set

c. **ipv4.gateway** represents the address of the gateway

```
orangepi@orangepi:~$ sudo nmcli con mod "Wired connection 1"  \
ipv4.addresses "192.168.1.110"  \
ipv4.gateway "192.168.1.1"  \
ipv4.dns "8.8.8.8"  \
ipv4.method "manual"
```

4) Then restart the linux system

```
orangepi@orangepi:~$ sudo reboot
```

5) Then re-enter the linux system and use the **ip addr show** command to see that the IP address has been set to the desired value

```
orangepi@orangepi:~$ ip addr show
2: enP3p49s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state
UP group default qlen 1000
    link/ether 00:e0:4c:68:00:26 brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.110/32 scope global noprefixroute enP3p49s0
       valid_lft forever preferred_lft forever
    inet6 fe80::9005:95ac:b9c0:2beb/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

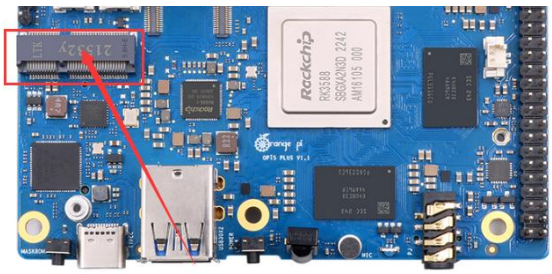
3. 7. How to use E-Key PCIe WIFI6+Bluetooth module

1) First you need to buy a PCIe WIFI6+Bluetooth module

S/N	Model	Physical picture	Supported OS
1	AX200 （PCIE+USB port）		Debian Ubuntu OpenWRT OPi OS Arch
2	AX210 （PCIE+USB port）		Debian Ubuntu OpenWRT OPi OS Arch
3	RTL8852BE （PCIE+USB port）		Debian Ubuntu Android12 OPi OS Arch OPi OS Droid

Pay attention to RTL8852BE, please do not buy the module shown in the figure below, there will be problems after testing.

2) Then insert the module into the M.2 E-Key interface of the development board and fix it. The position is shown in the figure below:



3) Then use the lspci command, if you can see the information of the WIFI module, it means that the module is in good contact

a. AX200 displays as follows

```
orangepi@orangepi:~$ lspci | grep "Network"
0002:21:00.0 Network controller: Intel Corporation Wi-Fi 6 AX200 (rev 1a)
```

b. AX210 displays as follows

```
orangepi@orangepi:~$ lspci | grep "Network"
0002:21:00.0 Network controller: Intel Corporation Wi-Fi 6 AX210/AX211/AX411 160MHz (rev 1a)
```

c. RTL8852 display as shown below

```
orangepi@orangepi:~$ lspci | grep "Network"
0002:21:00.0 Network controller: Realtek Semiconductor Co., Ltd. Device b852
```

4) Then use the following command to see that there will be an additional WIFI device node

```
[orangepi@orangepi ~]$ ip a
```

5) For the WIFI connection and test method, please refer to the **WIFI connection test section**, and will not repeat them here.

6) For the test method of Bluetooth, please refer to the section on **Bluetooth usage**, so I won't go into details here.

3.8. SSH remote login development board

Linux systems enable ssh remote login by default and allow the root user to log in to the system. Before logging in with ssh, you first need to ensure that the Ethernet or wifi network is connected, and then use the ip addr command or check the router to obtain the IP address of the development board.

3.8.1. SSH remote login development board under Ubuntu

1) Obtain the IP address of the development board

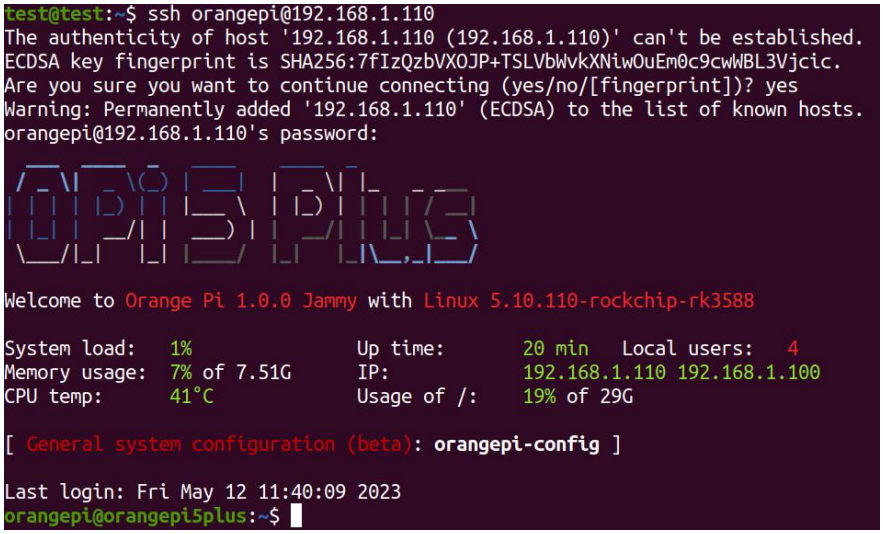
2) Then you can remotely log in to the linux system through the ssh command

```
test@test:~$ ssh root@192.168.1.xxx          (Need to be replaced with the IP address of the development board)
root@192.168.1.xx's password:          （Enter the password here, the default password is orangepi）
```

Note that when entering the password, the specific content of the entered password will not be displayed on the screen, please do not think that there is any fault, just press Enter after inputting.

If you are prompted to refuse the connection, as long as you are using the image provided by Orange Pi, please do not suspect that the password orangepi is wrong, but look for other reasons.

3) After successfully logging in to the system, the display is as shown in the figure below



If ssh fails to log in to the linux system normally, first check whether the IP address of the development board can be pinged. If the ping is ok, you can log in to the linux system through the serial port or HDMI display and then enter the following command on the development board and try again. Is it possible to connect:

root@orangepi:~# **reset_ssh.sh**

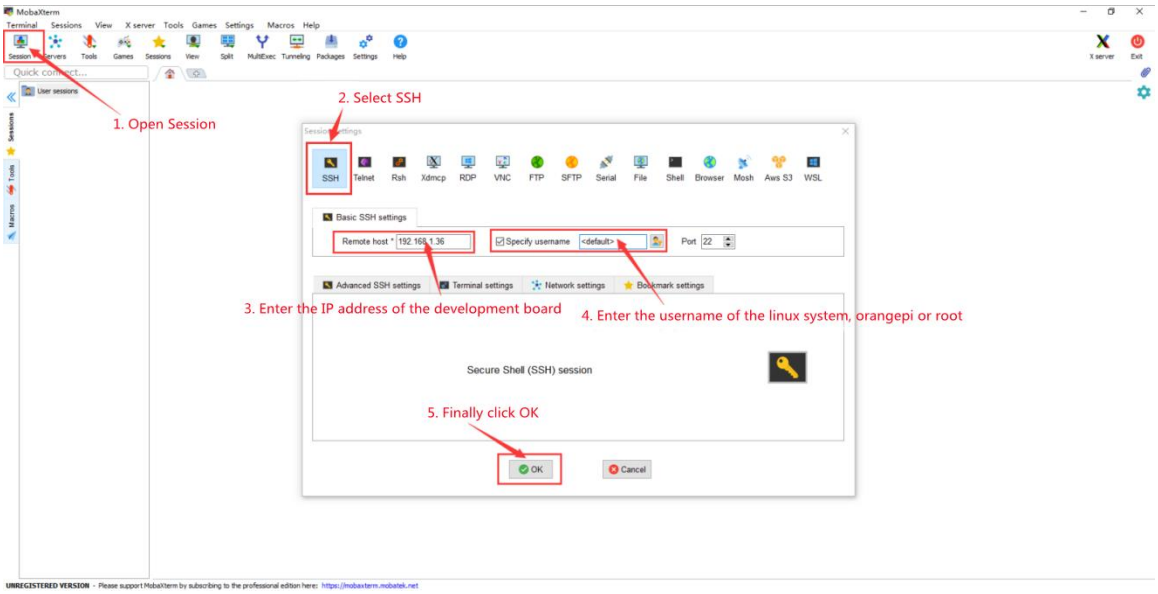
If it still doesn't work, try to reset the system.

3. 8. 2. SSH remote login development board under Windows

1) First obtain the IP address of the development board

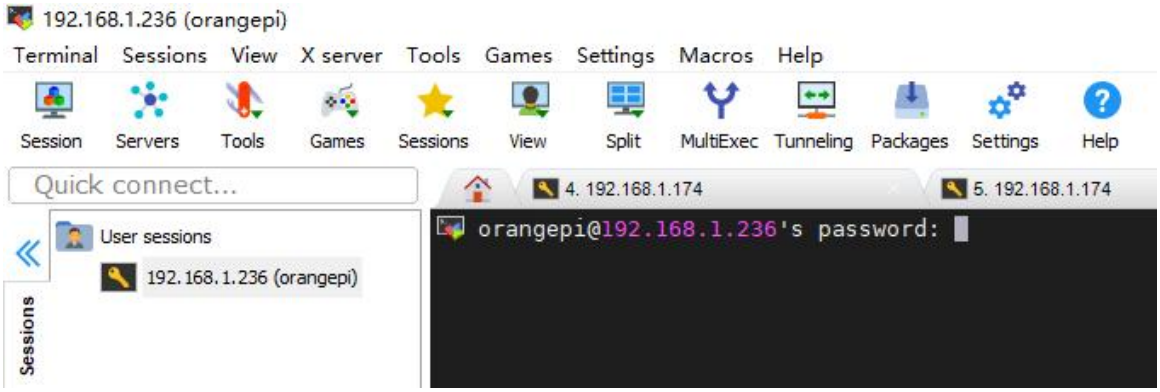
2) Under Windows, you can use MobaXterm to remotely log in to the development board, first create a new ssh session

a. Open **Session**
b. Then select **SSH** in **Session Setting**
c. Then enter the IP address of the development board in the **Remote host**
d. Then enter the user name **root** or **orangepi** of the linux system in **Specify username**
e. Finally click **OK**

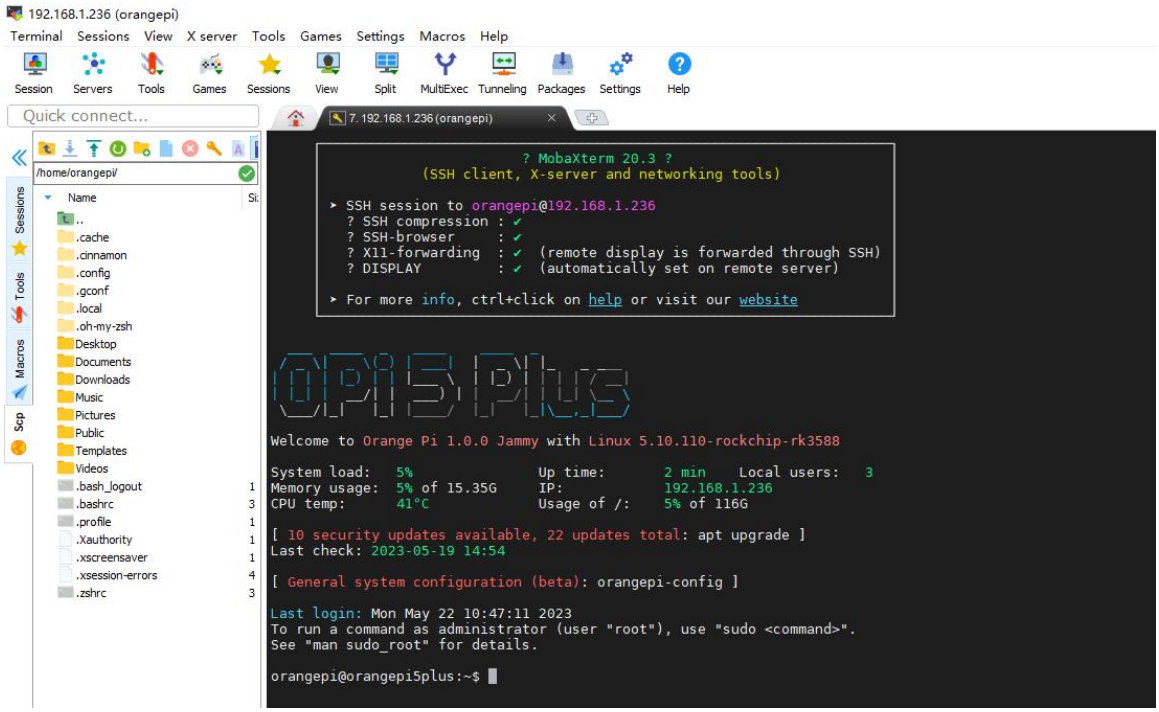


3) Then you will be prompted to enter a password. The default passwords for root and orangepi users are orangepi

Note that when entering the password, the specific content of the entered password will not be displayed on the screen, please do not think that there is any fault, just press Enter after inputting.



4) After successfully logging in to the system, the display is as shown in the figure below



3. 9. How to use ADB

3. 9. 1. How to use network adb

1) After the system starts, please confirm that **adbd** has been started

```
orangepi@orangepi:~$ ps -ax | grep "adbd"
    808 ?        Sl     0:00 /usr/bin/adbd
   3707 ttyFIQ0  S+     0:00 grep --color=auto adbd
```

2) Then check the IP address of the development board and write it down

3) Then install the adb tool on the Ubuntu PC

```
test@test:~$ sudo apt-get update
test@test:~$ sudo apt-get install -y adb
```

4) Then use the following command to connect to the network adb

```
test@test:~$ adb connect 192.168.1.xx:5555      #Please replace the IP address with the IP address of the development board
* daemon not running; starting now at tcp:5037
* daemon started successfully
```

```
connected to 192.168.1.xx:5555
test@test:~$ adb devices
List of devices attached
192.168.1.xx:5555          device
```

5) Then use the following command to log in to the linux system of the development board

```
test@test:~$ adb shell
root@orangepi5plus:/#      <--- After seeing this prompt, it means that you have successfully logged in to the development board
```

6) The command to upload files to the development board using adb is as follows

```
test@test:~$ adb push filename /root
filename: 1 file pushed. 3.7 MB/s (1075091 bytes in 0.277s)
```

7) The command to restart the development board using adb is as follows

```
test@test:~$ adb reboot
```

If there is no adb tool in your Windows system, you can use the adb program in the RKDevTool software (this software is useful in the section on how to use RKDevTool to burn the Linux image to the TF card).

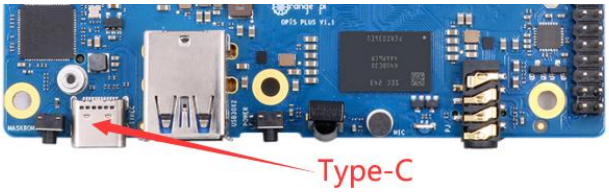
An example using adb in Windows looks like this:

```
命令提示符
Microsoft Windows [版本 10.0.19044.2251]
(c) Microsoft Corporation。保留所有权利。

C:\Users\Administrator>cd C:\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin

C:\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin>dir
 驱动器 C 中的卷没有标签。
 卷的序列号是 62AE-5AED

 C:\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin 的目录

2022/08/09  13:19    <DIR>          .
2022/08/09  13:19    <DIR>          ..
2019/06/24  09:13         1,850,368 adb.exe
2019/06/24  09:13            97,792 AdbWinApi.dll
2019/06/24  09:13            62,976 AdbWinUsbApi.dll
2021/08/23  09:04           894,976 AFPTool.exe
2021/08/16  14:05           890,368 RKImageMaker.exe
               5 个文件      3,796,480 字节
               2 个目录 64,033,034,240 可用字节

C:\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin>.\adb.exe connect 192.168.1.144
connected to 192.168.1.144:5555

C:\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin>.\adb.exe devices
List of devices attached
192.168.1.144:5555      device


C:\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin>.\adb.exe push adb.exe /root
adb.exe: 1 file pushed. 4.1 MB/s (1850368 bytes in 0.427s)

C:\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin>
```

3.9.2. adb3.9.2. Use type-c data cable to connect to adb

1) First prepare a good quality Type-C data cable

2) Then connect the development board and Ubuntu PC through the Type-C data cable. The position of the Type-C interface of the development board is shown in the figure below:



3) Then run the following command to set the Type-C interface to **device** mode

```
orangepi@orangepi:~$ sudo set_device.sh
```

If the **set_device.sh** script does not exist in the Linux system, please use the following command directly:

```
orangepi@orangepi:~$ sudo bash -c "echo device > /sys/kernel/debug/usb/fc000000.usb/mode"
orangepi@orangepi:~$ sudo systemctl restart usbdevice
```

4) **Then please confirm that adbd has been started**

```
orangepi@orangepi:~$ ps -ax | grep "adbd"
    808 ?        Sl     0:00 /usr/bin/adbd
   3707 ttyFIQ0  S+     0:00 grep --color=auto adbd
```

5) Then install the adb tool on the Ubuntu PC

```
test@test:~$ sudo apt-get update
test@test:~$ sudo apt-get install -y adb
```

6) Then use the following command to check whether the adb device is recognized

```
test@test:~$ adb devices
List of devices attached
e0f9f71bc343c305     device
```

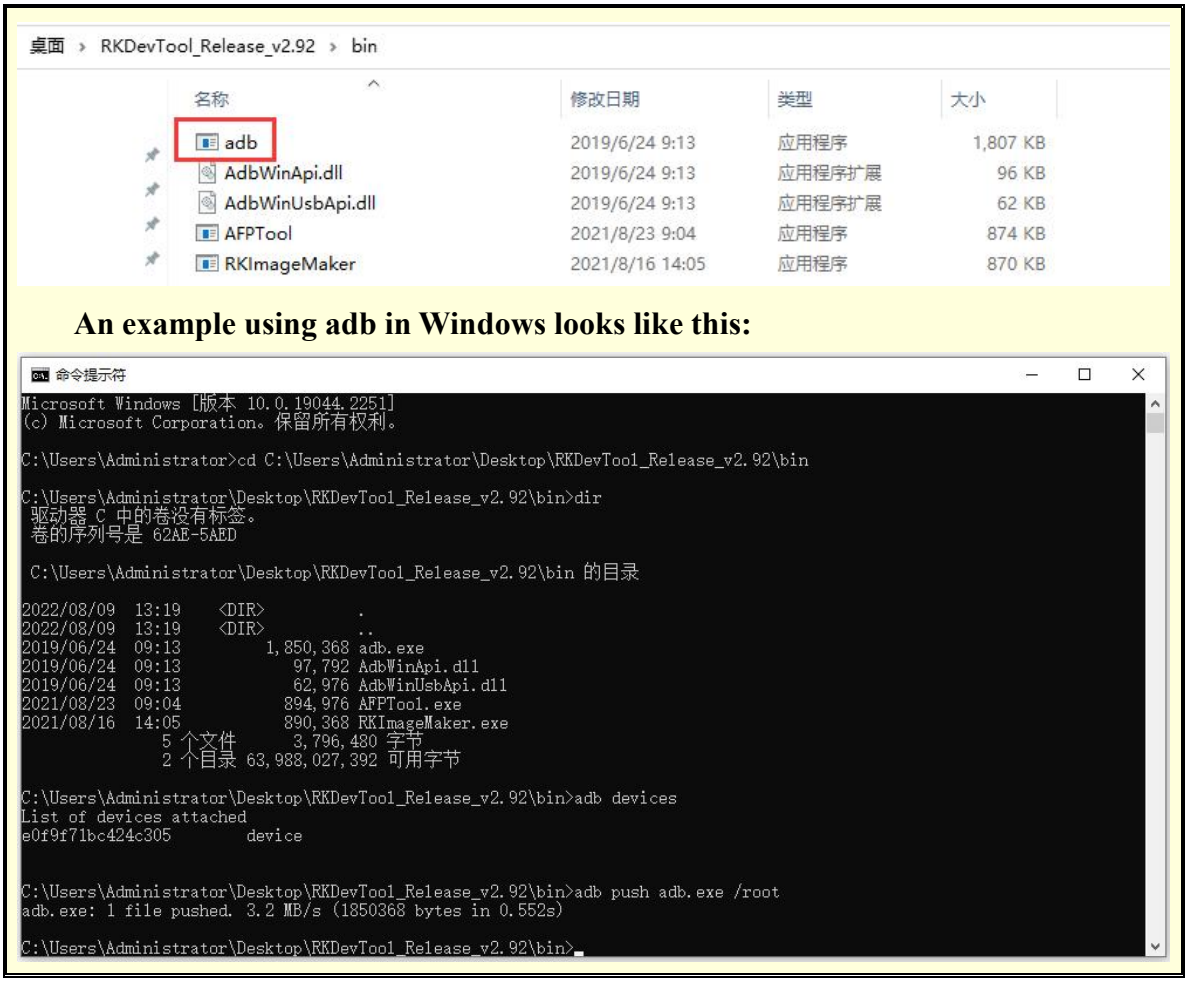
8) Then use the following command to log in to the linux system of the development board

```
test@test:~$ adb shell
root@orangepi5plus:/#      <--- After seeing this prompt, it means that you have successfully logged in to the development board
```

9) The command to upload files to the development board using adb is as follows

```
test@test:~$ adb push filename /root
filename: 1 file pushed. 3.7 MB/s (1075091 bytes in 0.277s)
```

If there is no adb tool in your Windows system, you can use the adb program in the RKDevTool software (this software is useful in the section on how to use RKDevTool to burn the Linux image to the TF card).



3.10. The method of uploading files to the Linux system of the development board

3.10.1. How to upload files to the development board Linux system in Ubuntu PC

3.10.1.1. How to upload files using the scp command

1) Use the scp command to upload files from the Ubuntu PC to the Linux system on the development board. The specific commands are as follows

a. **file_path**: need to be replaced with the path of the file to be uploaded

b. **orangepi**: It is the user name of the Linux system of the development board, and it can also be replaced with other ones, such as root

c. **192.168.xx.xx**: It is the IP address of the development board, please modify it

according to the actual situation

d. **/home/orangepi**: The path in the Linux system of the development board, which can also be modified to other paths

```
test@test:~$ scp    file_path    orangepi@192.168.xx.xx:/home/orangepi/
```

2) If you want to upload a folder, you need to add the -r parameter

```
test@test:~$ scp    -r    dir_path    orangepi@192.168.xx.xx:/home/orangepi/
```

3) There are more usages of scp, please use the following command to view the man manual

```
test@test:~$ man scp
```

3.10.1.2. How to upload files using filezilla

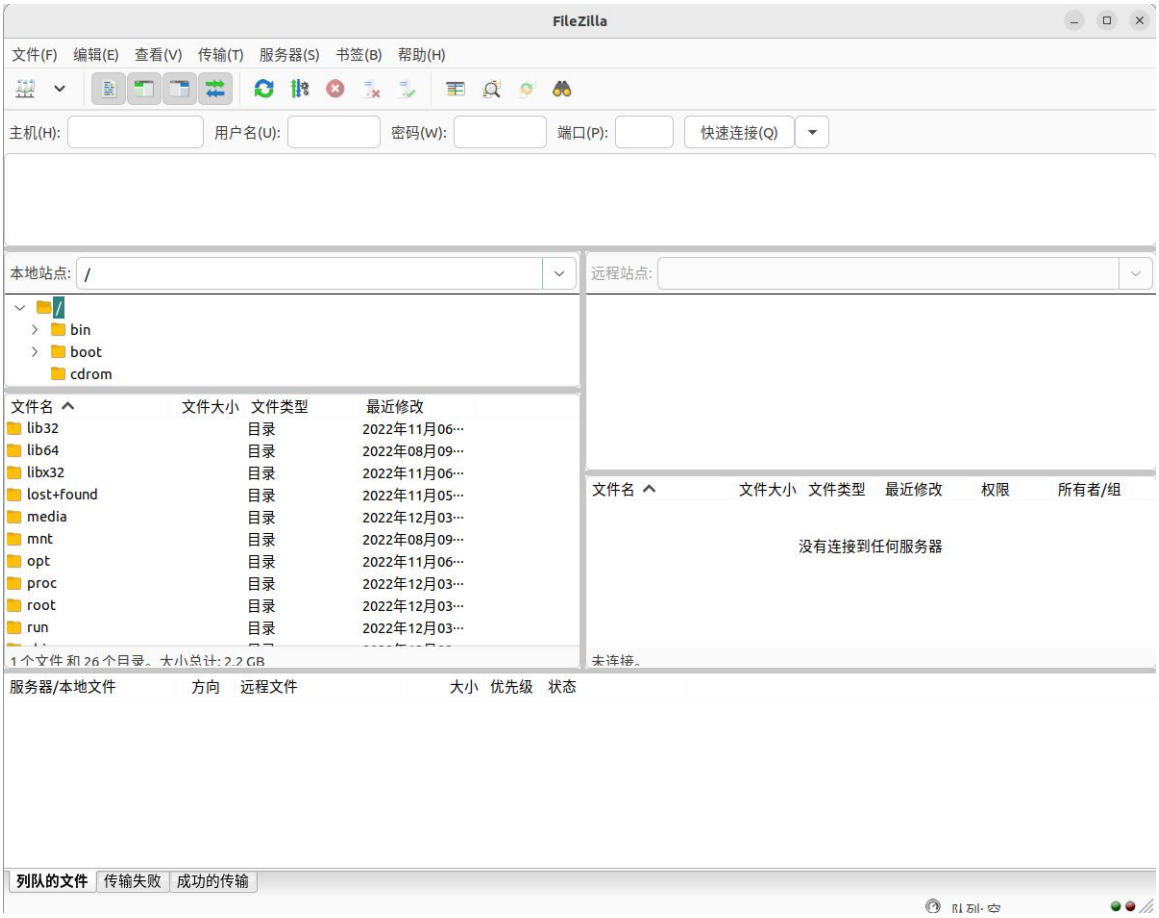
1) First install filezilla in Ubuntu PC

```
test@test:~$ sudo apt install -y filezilla
```

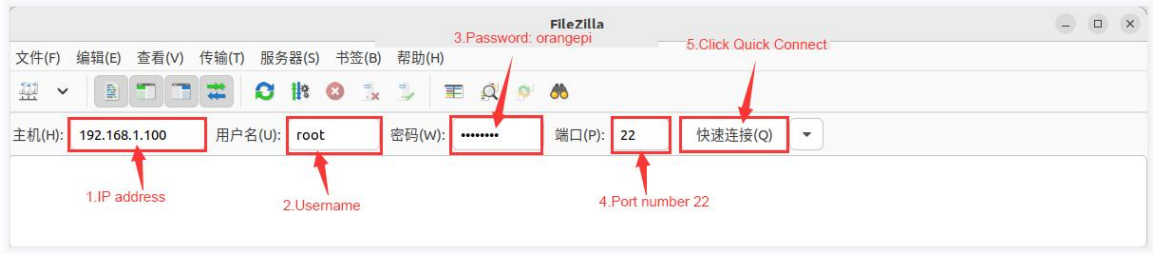
2) Then use the following command to open filezilla

```
test@test:~$ filezilla
```

3) The interface after filezilla is opened is as follows, at this time, the display under the remote site on the right is empty

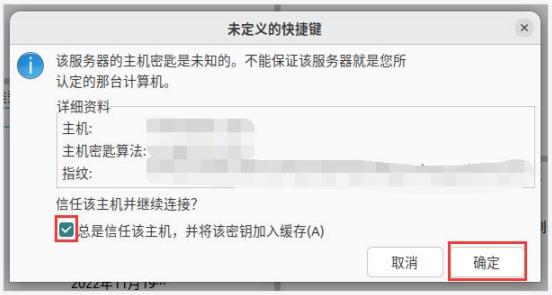


4) The method of connecting the development board is shown in the figure below

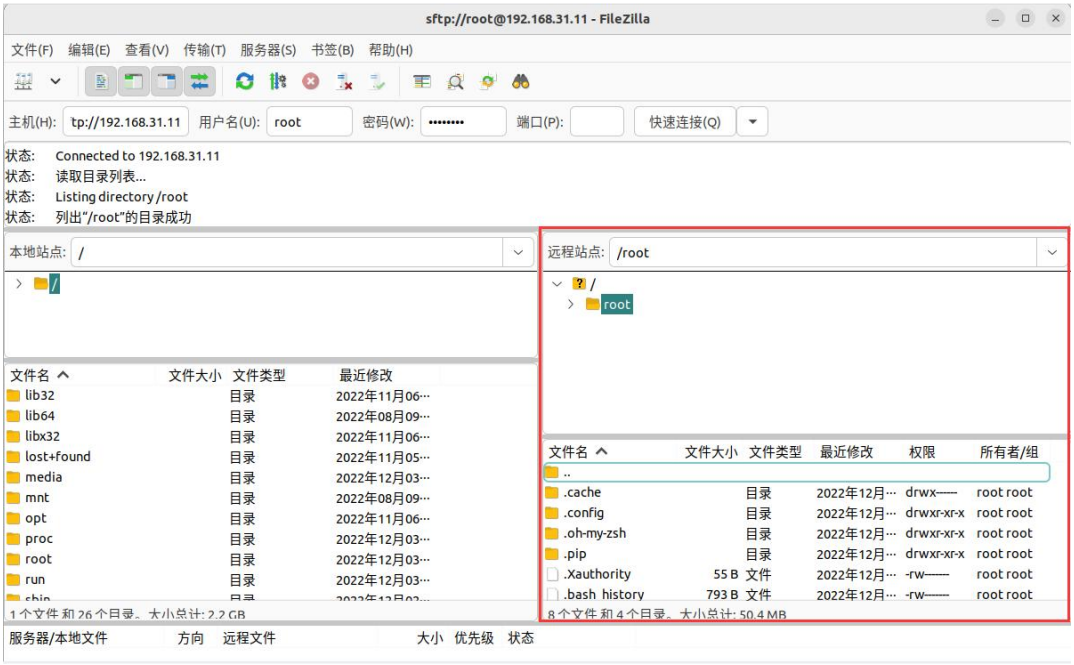


5) Then choose to **save the password**, and then click **OK**

6) Then choose to **always trust this host**, and then click **OK**

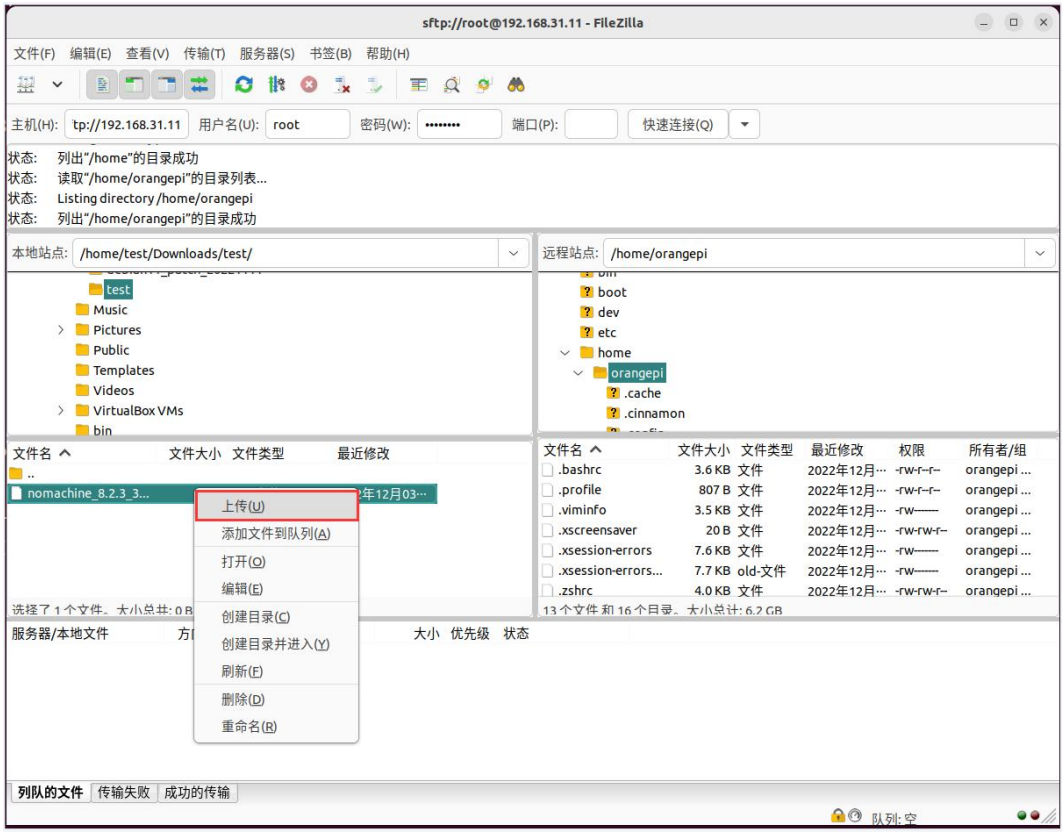


7) After the connection is successful, you can see the directory structure of the development board linux file system on the right side of the filezilla software



8) Then select the path to be uploaded to the development board on the right side of the

filezilla software, and then select the file to be uploaded on the Ubuntu PC on the left side of the filezilla software, then click the right mouse button, and then click the upload option to start uploading the file to the development board bingo.



9) After the upload is complete, you can go to the corresponding path in the Linux system of the development board to view the uploaded file

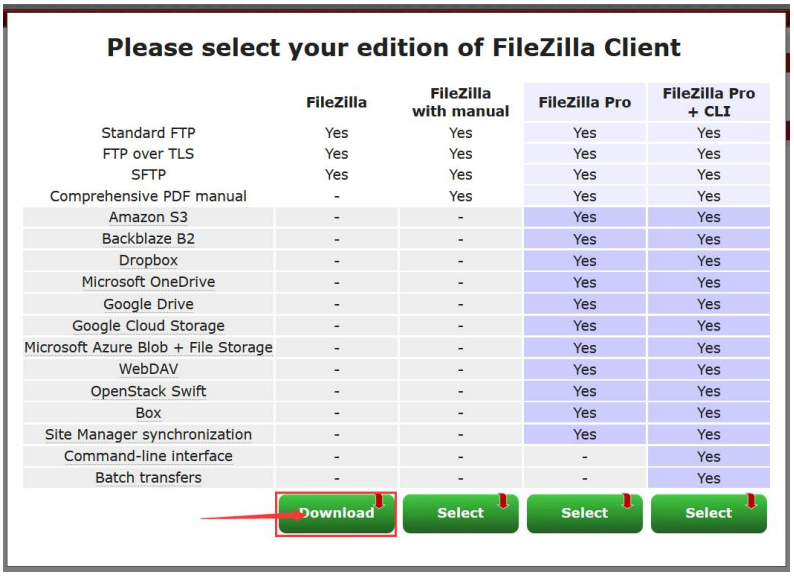
10) The method of uploading a folder is the same as that of uploading a file, so I won't go into details here

3.10.2. The method of uploading files to the development board Linux system in Windows PC

3.10.2.1. How to upload files using filezilla

1) First download the installation file of the Windows version of the filezilla software, the download link is as follows

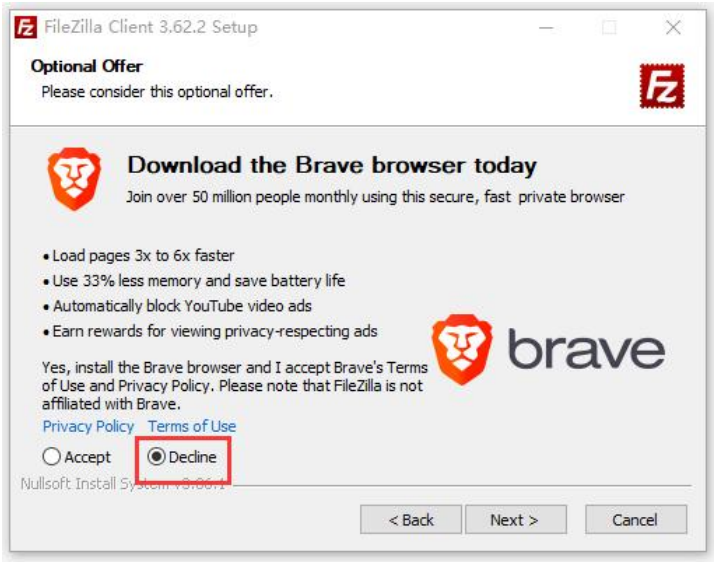
https://filezilla-project.org/download.php?type=client



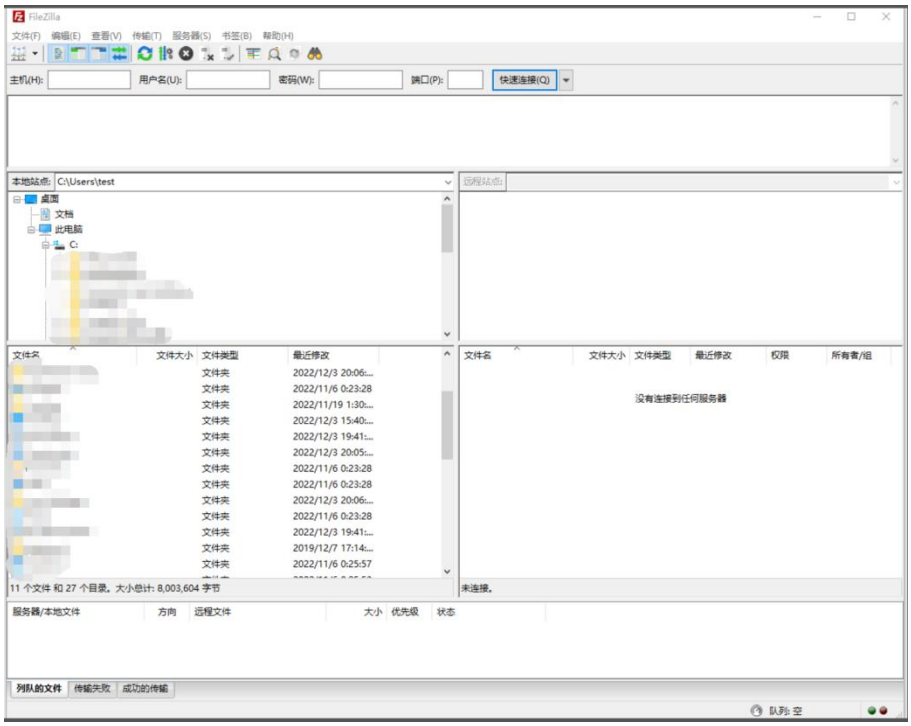
2) The downloaded installation package is as follows, and then double-click to install directly

FileZilla_Server_1.5.1_win64-setup.exe

During the installation process, please select `Decline` on the following installation interface, and then select `Next>`

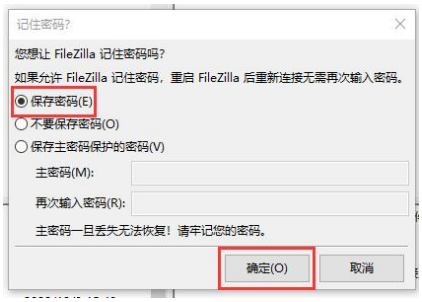


3) The interface after filezilla is opened is as follows, at this time, the display under the remote site on the right is empty

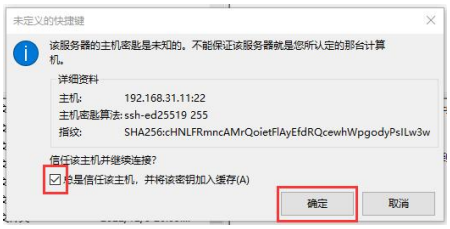


4) The method of connecting the development board is shown in the figure below:

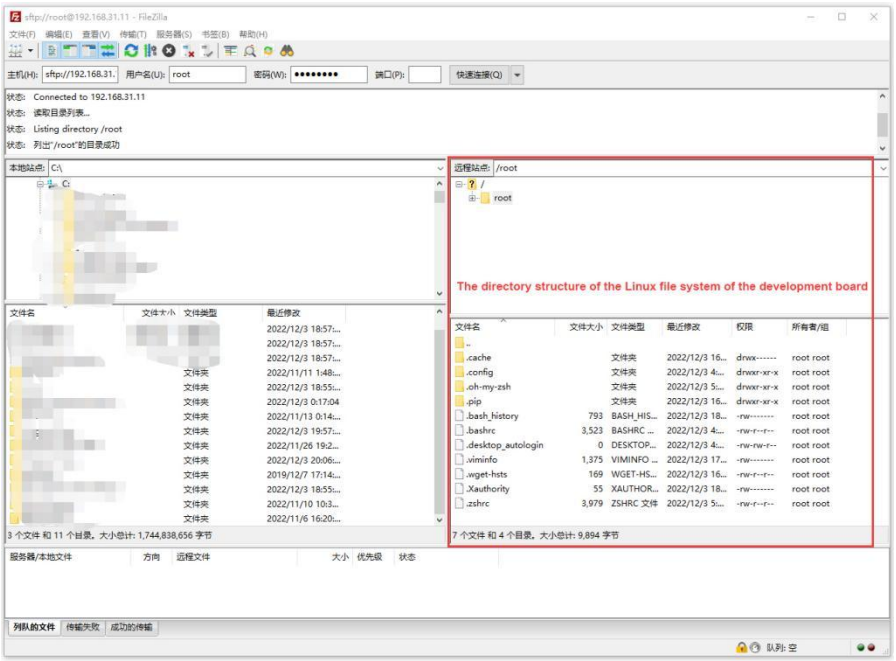
5) Then choose to **save the password**, and then click **OK**



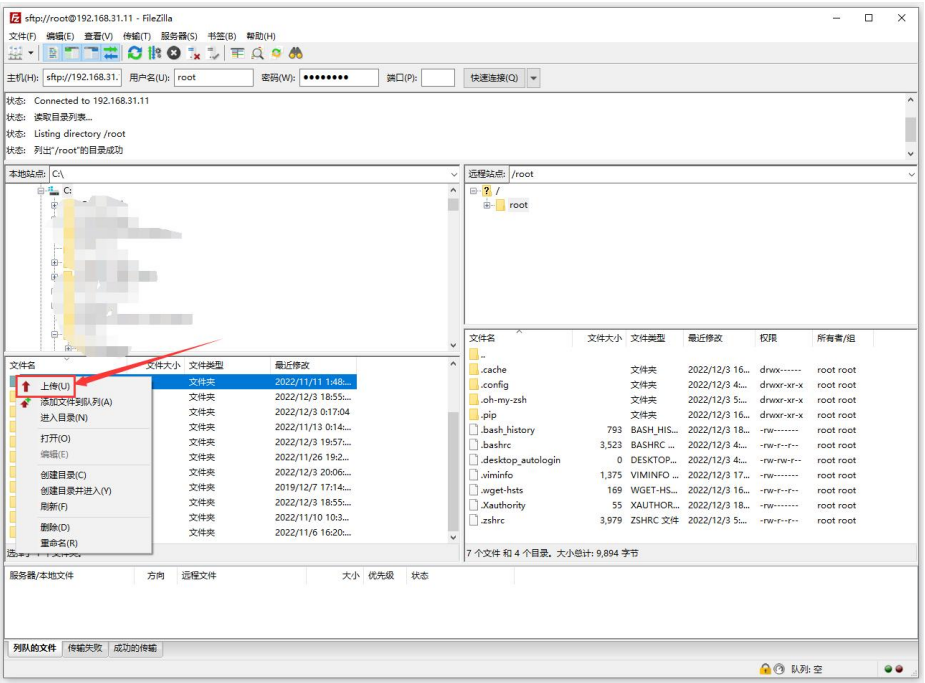
6) Then choose to **always trust this host**, and then click **OK**



7) After the connection is successful, you can see the directory structure of the development board linux file system on the right side of the filezilla software



8) Then select the path to be uploaded to the development board on the right side of the filezilla software, and then select the file to be uploaded on the Windows PC on the left side of the filezilla software, then click the right mouse button, and then click the upload option to start uploading the file to the development board bingo



9) After the upload is complete, you can go to the corresponding path in the Linux

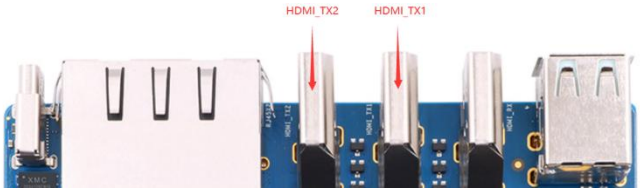
system of the development board to view the uploaded file

10) The method of uploading folders is the same as that of uploading files, so I won't go into details here.

3. 11. HDMI test

3. 11. 1. HDMI test

1) There are two HDMI output interfaces on the development board, and their locations are shown in the figure below:

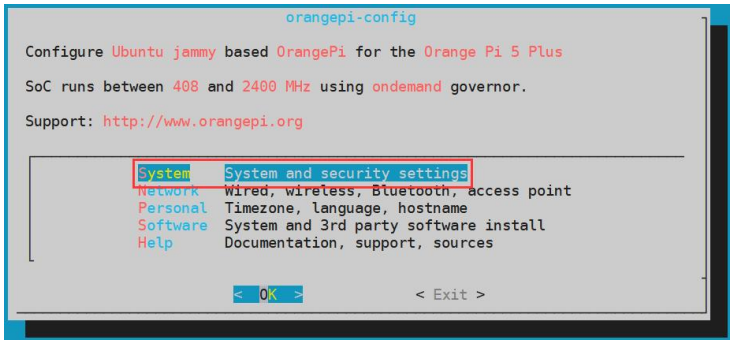


2) By default, the Linux system configures HDMI_TX1 to support 8K display, and HDMI_TX2 supports only 4K display by default (only one HDMI_TX interface can support 8K display at a time). If you want to set HDMI_TX2 to support 8K display, please follow the steps below:

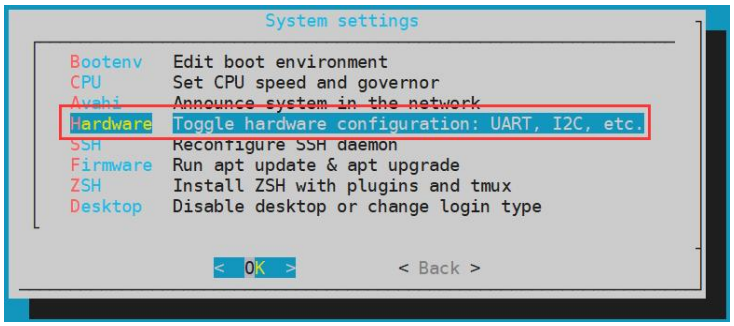
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

b. Then select **System**

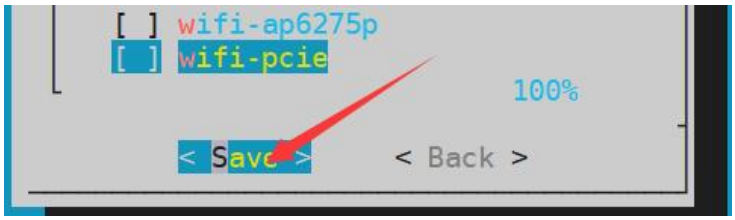


c. Then select **Hardware**

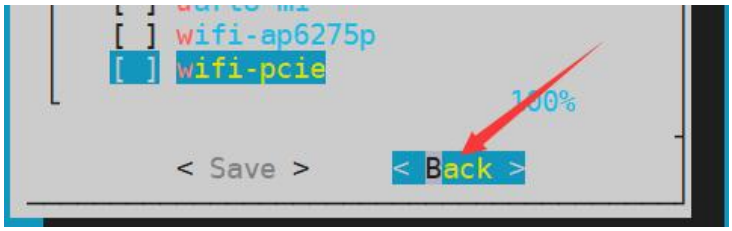


d. Then use the arrow keys of the keyboard to navigate to the position shown in the figure below, and then use the **space** to select **hdmi2-8k** configuration

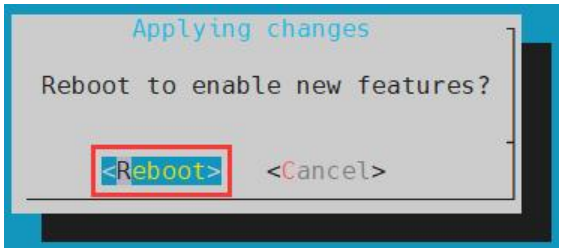
e. Then select **<Save>** to save



f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



3) Then use HDMI to HDMI cable to connect Orange Pi development board and HDMI display

Note, if you want to connect a 4K or 8K display, please make sure that the HDMI cable supports 4K or 8K video display.

4) After starting the linux system, if the HDMI display has image output, it means that the HDMI interface is in normal use

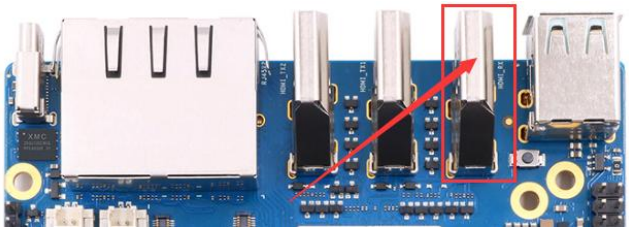
Note that although many laptops have an HDMI interface, the HDMI interface of the notebook generally only has the output function, and does not have the function of HDMI in, that is to say, the HDMI output of the development board cannot be displayed on the screen of the notebook.

When you want to connect the HDMI of the development board to the HDMI port of the laptop, please make sure that your laptop supports the HDMI in function.

When the HDMI is not displayed, please check whether the HDMI cable is plugged in tightly. After confirming that there is no problem with the connection, you can change a different screen and try to see if it is displayed.

3.11.2. HDMI IN test method

1) The location of the HDMI In interface on the development board is as follows:



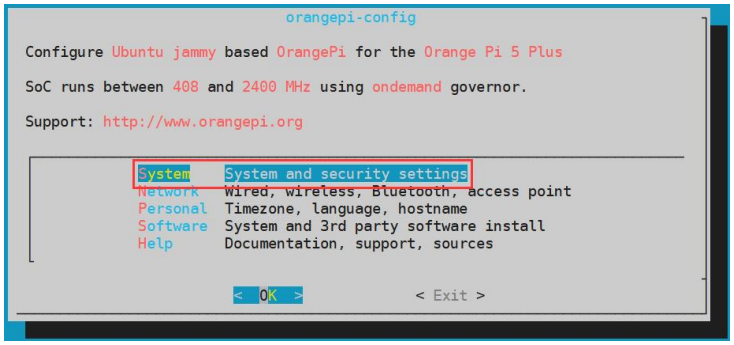
2) First use the HDMI to HDMI cable shown in the figure below to connect the HDMI output of other devices to the HDMI In interface of the development board

3) The HDMI In function of the Linux system is disabled by default, and the opening method is as follows:

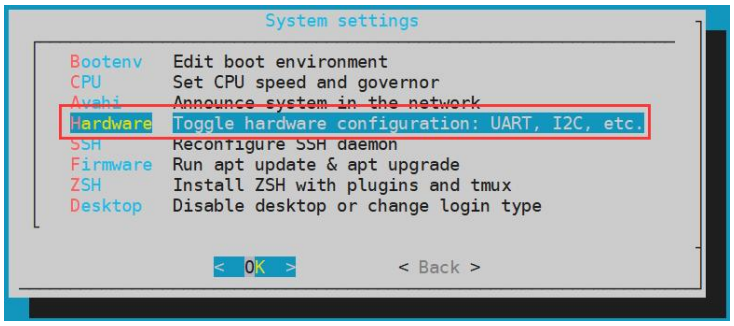
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

b. Then select **System**

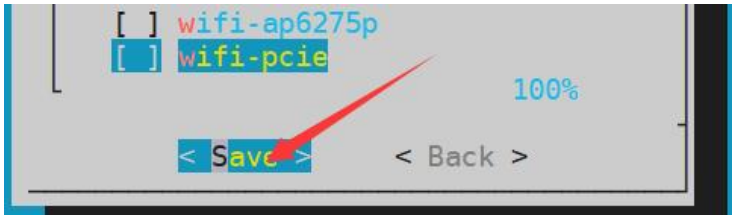


c. Then select **Hardware**

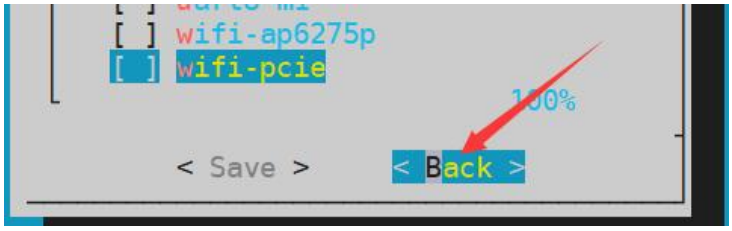


d. Then use the arrow keys of the keyboard to navigate to the position shown in the figure below, and then use the **space** to select the **hdmirx** configuration

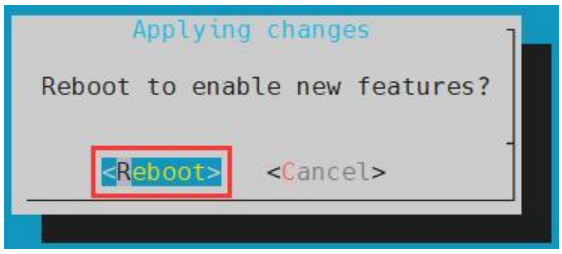
e. Then select **<Save>** to save



f. Then select **<Back>**



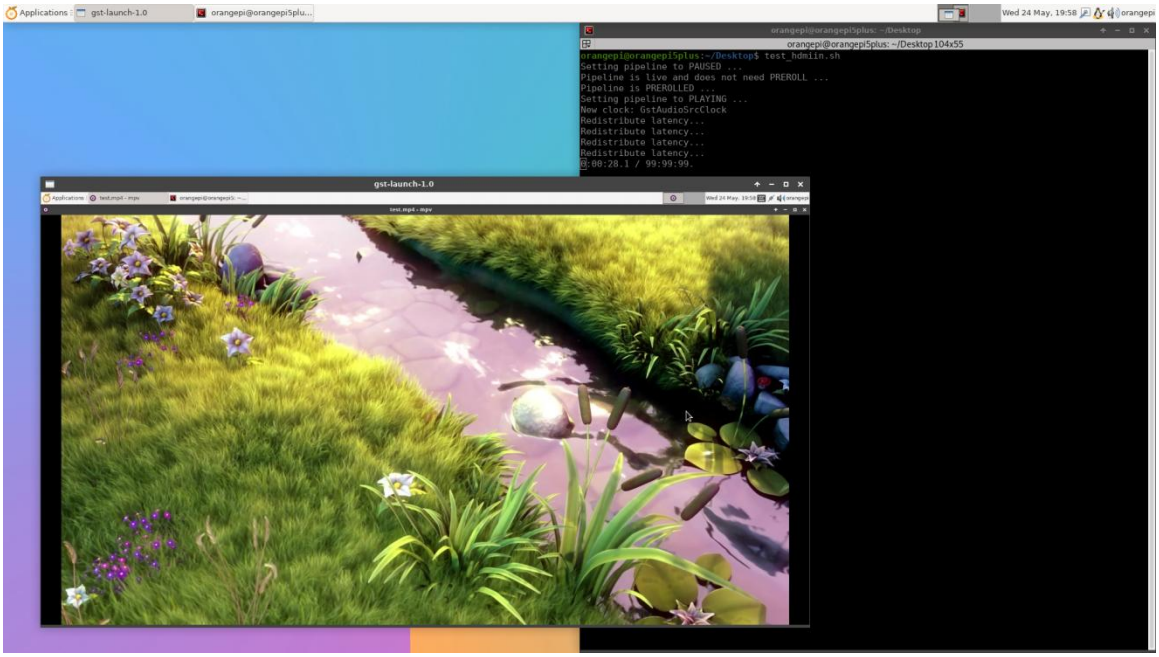
g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) Restart the system and open a terminal on the desktop, then run the **test_hdmiin.sh** script

```
[orangepi@orangepi ~]$ test_hdmiin.sh
```

5) Then you can see the input screen of HDMI In (the HDMI In in the figure below shows the HDMI output screen of the opi5 development board, and a video is being played at this time). The **test_hdmiin.sh** script will play the audio input from HDMI In to HDMI_TX1, HDMI_TX2 and ES8388 (representing speakers or headphones) of the development board by default.



3. 11. 3. HDMI to VGA display test

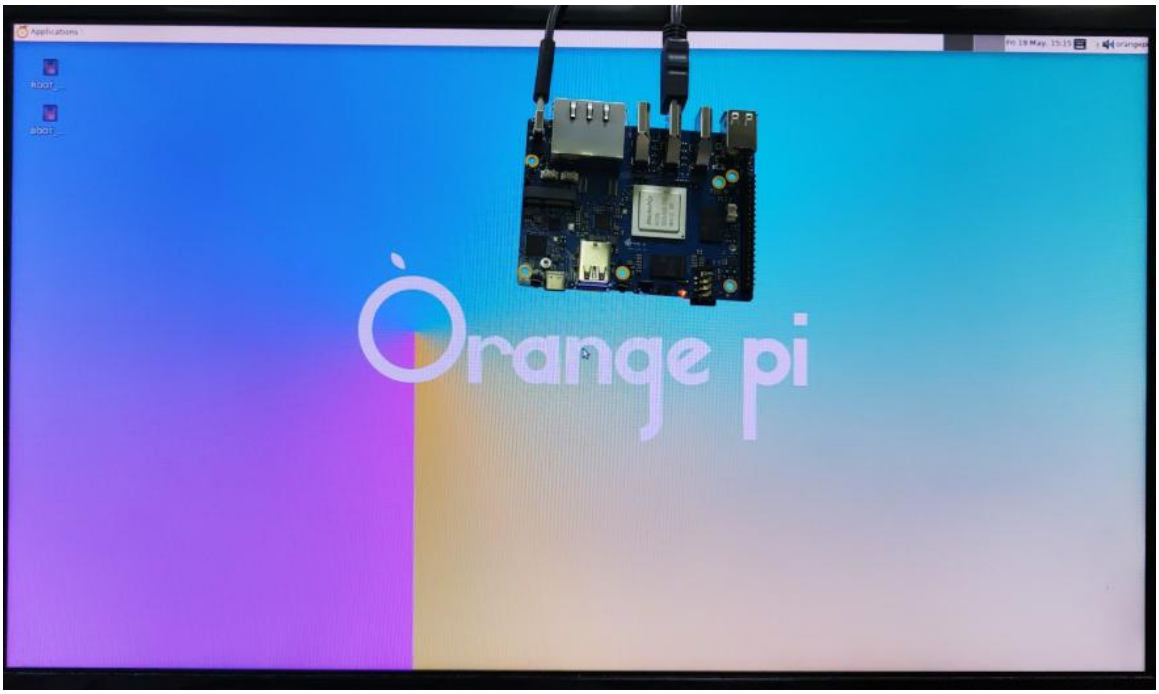
1) First, you need to prepare the following accessories

a. HDMI to VGA Converter

b. A VGA cable

c. A monitor or TV that supports VGA interface

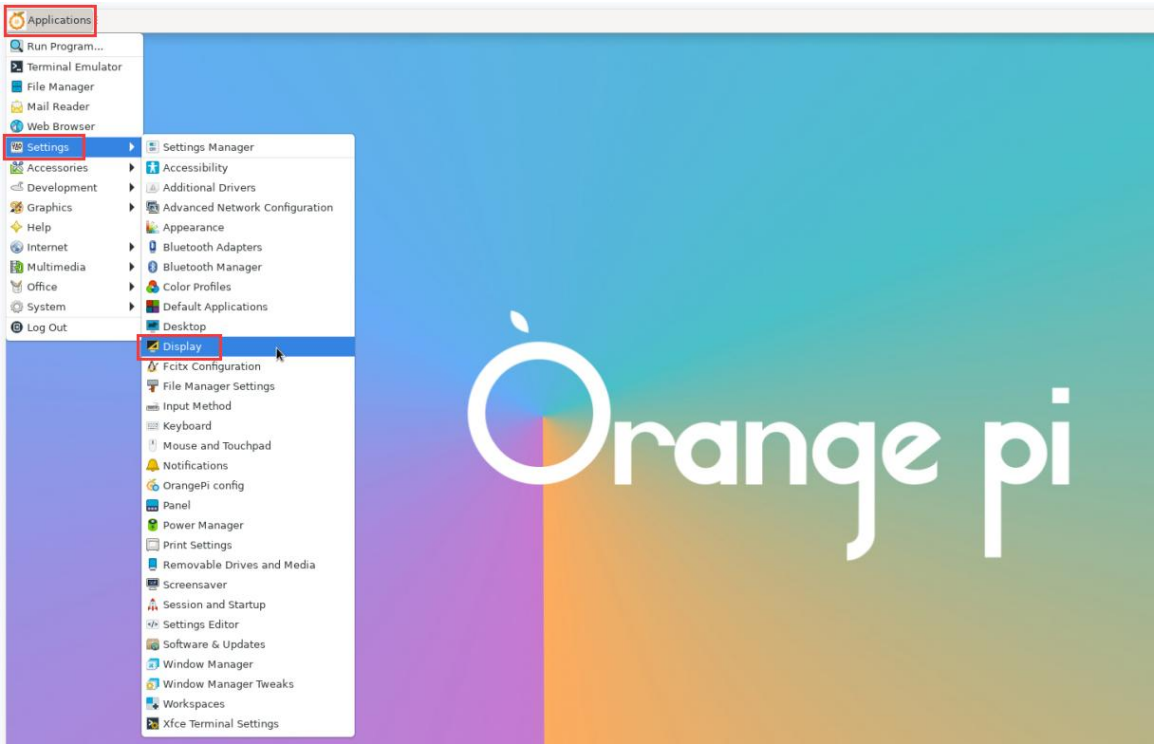
2) The HDMI to VGA display test is as follows:



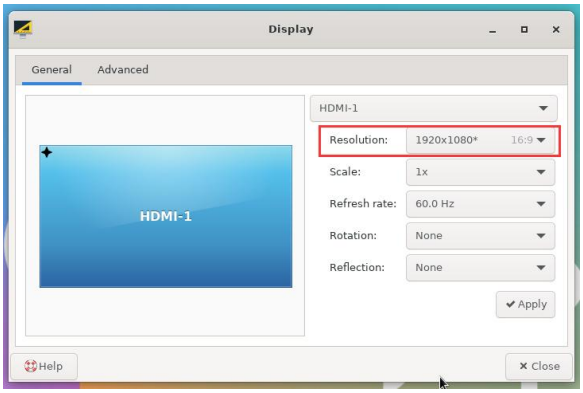
When using HDMI to VGA display, the development board and the Linux system of the development board do not need to make any settings, only the HDMI interface of the development board can display normally. So if there is a problem with the test, please check whether there is a problem with the HDMI to VGA converter, VGA cable and monitor.

3.11.4. HDMI resolution setting method

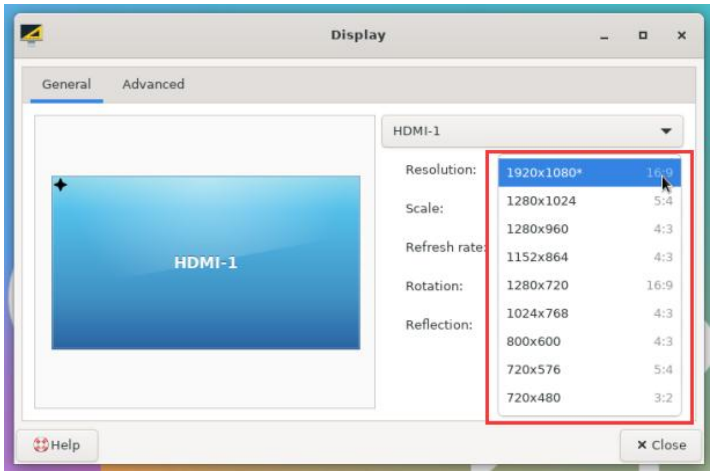
1) First open **Display** in **Settings**



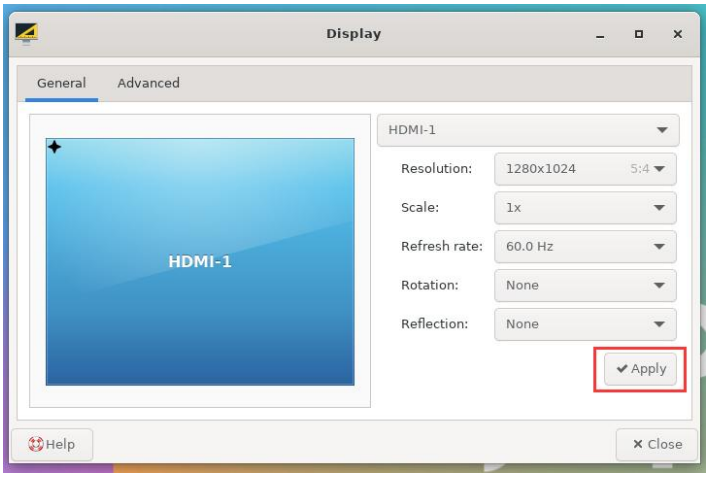
2) Then you can see the current resolution of the system



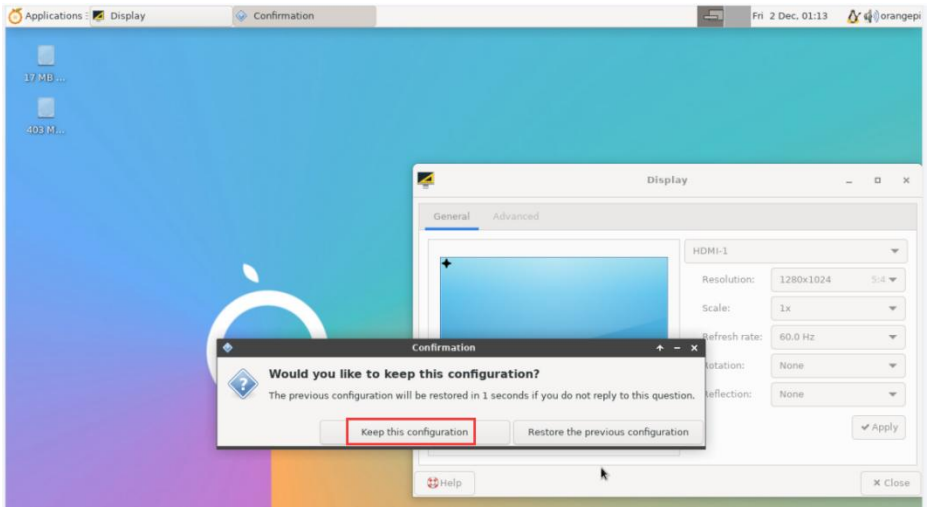
3) Click the drop-down box of Resolution to see all resolutions currently supported by the monitor



4) Then select the resolution you want to set, and click Apply



5) After the new resolution is set, select **Keep the configuration**



3. 12. How to use Bluetooth

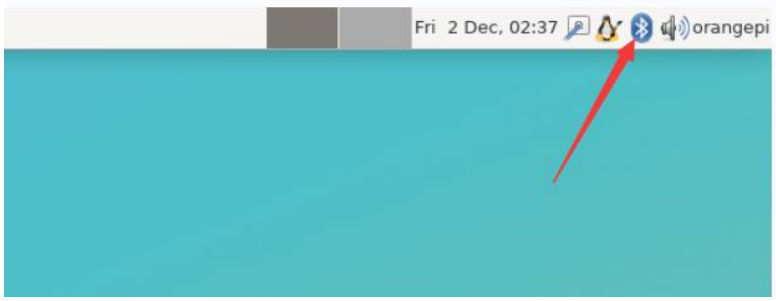
Please note that there is no Bluetooth module on the Orange Pi 5 Plus development board, and an external PCIe network card with Bluetooth or a USB network card with Bluetooth is required to use the Bluetooth function.

For instructions on using the external PCIe network card, please refer to the section on how to use the PCIe WIFI6+Bluetooth module.

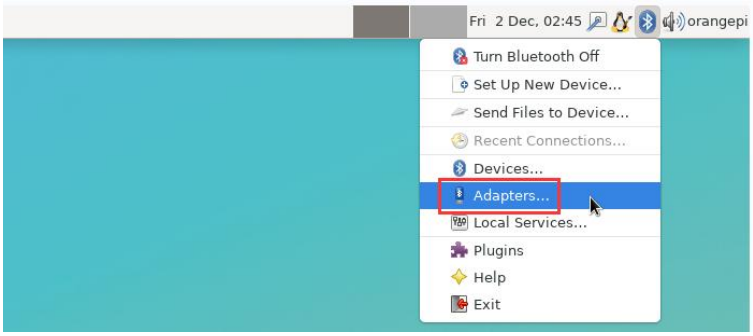
For instructions on using the external USB network card, please refer to the USB wireless network card test section.

3. 12. 1. Test method of desktop image

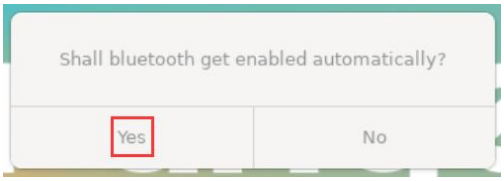
1) Click on the Bluetooth icon in the upper right corner of the desktop



2) Then select the adapter

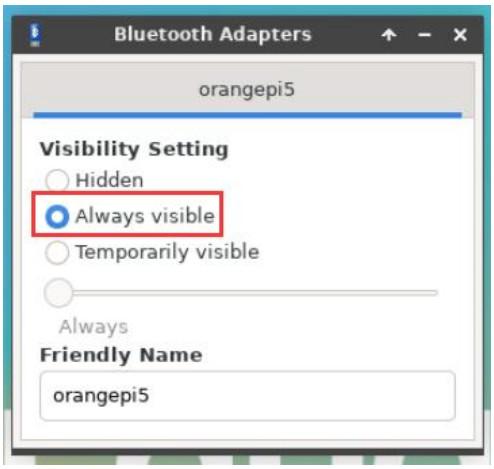


3) If there is a prompt on the following interface, please select **Yes**

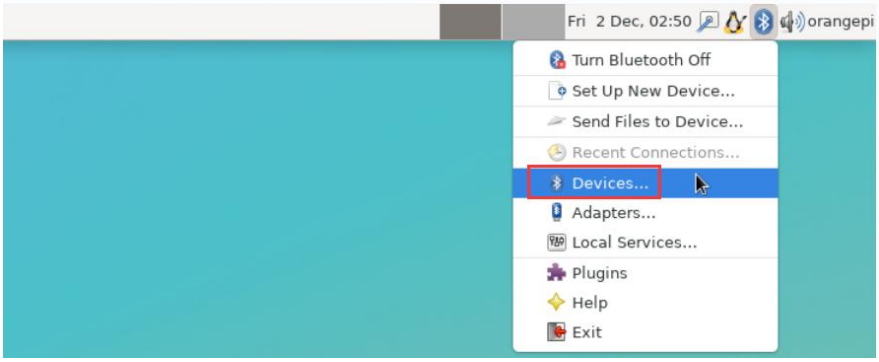


4) Then set the **Visibility Setting** to **Always visible** in the Bluetooth adapter setting

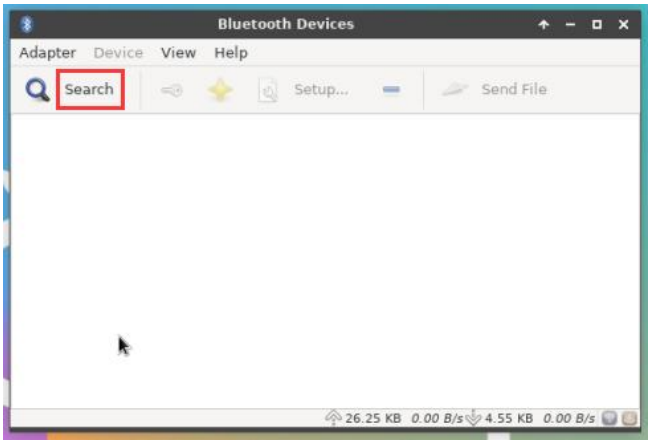
interface, and then close it



5) Then open the configuration interface of the Bluetooth device

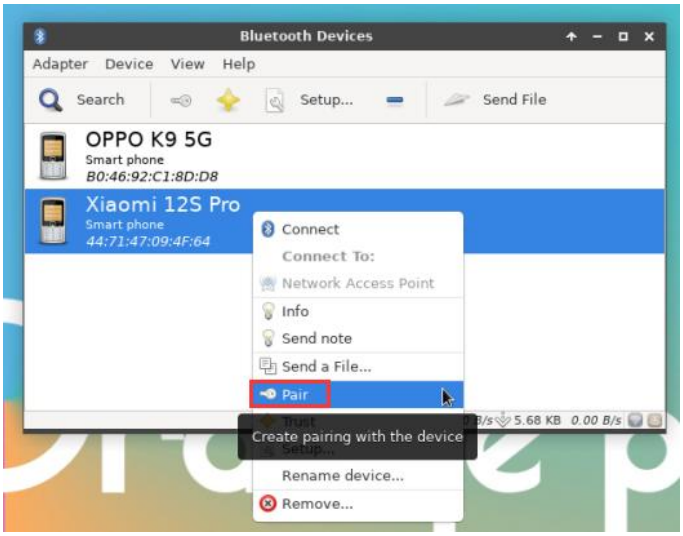


6) Click **Search** to start scanning the surrounding Bluetooth devices



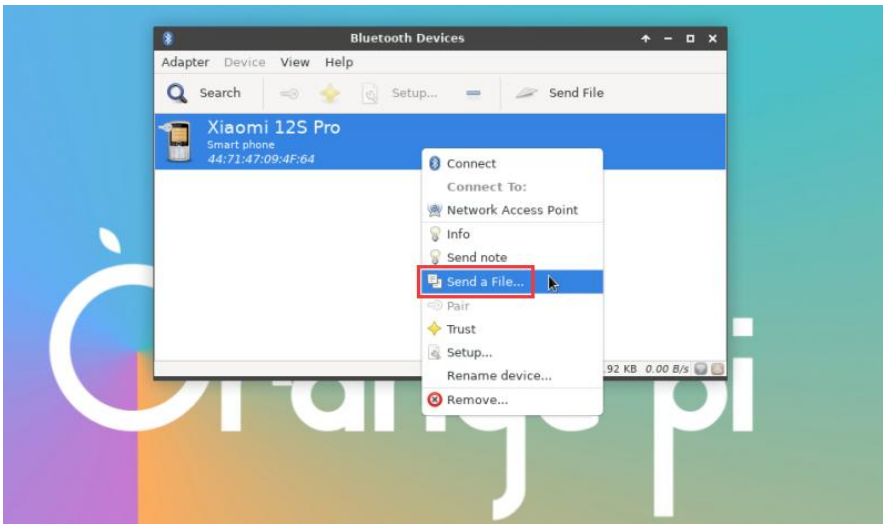
7) Then select the Bluetooth device you want to connect to, and then click the right mouse button to pop up the operation interface for this Bluetooth device, select **Pair** to

start pairing, and the demonstration here is to pair with an Android phone

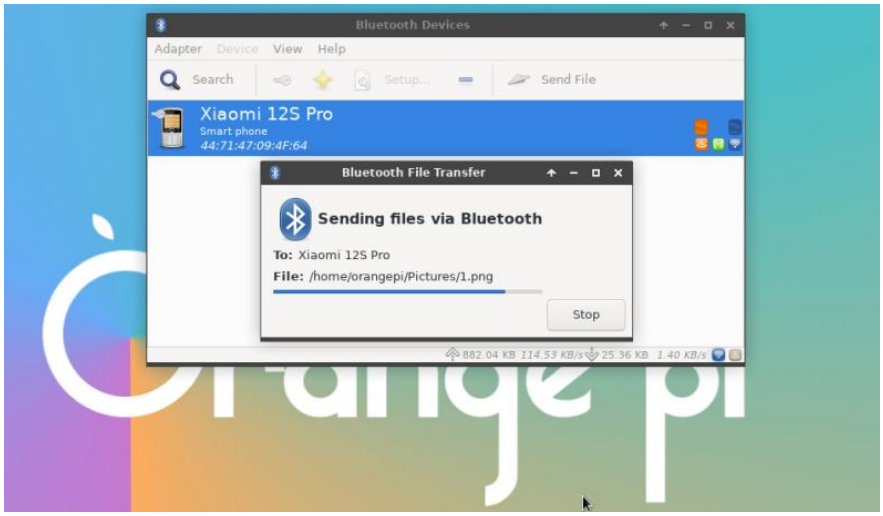


8) When pairing, a pairing confirmation box will pop up in the upper right corner of the desktop, just select **Confirm** to confirm, and the phone also needs to confirm at this time

9) After pairing with the mobile phone, you can select the paired Bluetooth device, then right-click and select **Send a File** to start sending a picture to the mobile phone



10) The interface for sending pictures is as follows



3. 13. USB interface test

The USB interface can be connected to a USB hub to expand the number of USB interfaces.

3. 13. 1. Connect USB mouse or keyboard to test

1) Insert the keyboard with USB interface into the USB interface of Orange Pi development board

2) Connect the Orange Pi development board to the HDMI display

3) If the mouse or keyboard can operate normally, it means that the USB interface is working normally (the mouse can only be used in the desktop version of the system)

3. 13. 2. Connect USB storage device test

1) First insert the U disk or USB mobile hard disk into the USB interface of the Orange Pi development board

2) Execute the following command, if you can see the output of sdX, it means that the U disk is recognized successfully

```
orangepi@orangepi:~$ cat /proc/partitions | grep "sd*"
major minor  #blocks  name
   8        0   30044160 sda
```

```
8          1      30043119 sda1
```

3) Use the mount command to mount the U disk to **/mnt**, and then you can view the files in the U disk

```
orangepi@orangepi:~$ sudo mount /dev/sda1 /mnt/
orangepi@orangepi:~$ ls /mnt/
test.txt
```

4) After mounting, you can view the capacity usage and mount point of the U disk through the **df -h** command

```
orangepi@orangepi:~$ df -h | grep "sd"
/dev/sda1              29G  208K   29G   1% /mnt
```

3.13.3. USB wireless network card test

The usable USB wireless network cards that **have been tested** so far are as follows. For other types of USB wireless network cards, please test them yourself. If they cannot be used, you need to transplant the corresponding USB wireless network card driver.

S/N	model	Physical picture
1	RTL8723BU Support 2.4G WIFI+BT4.0	
2	RTL8811 Support 2.4G +5G WIFI	
3	RTL8821CU Support 2.4G +5G WIFI Support BitTorrent 4.2	

3.13.3.1. RTL8723BU test

1) First insert the RTL8723BU wireless network card module into the USB interface of the development board

2) Then the linux system will automatically load the RTL8723BU bluetooth and WIFI-related kernel modules, through the lsmod command, you can see that the following kernel modules have been automatically loaded

```
orangepi@orangepi:~$ lsmod
Module                  Size  Used by
rfcomm                 57344  16
rtl8xxxu              106496  0
rtk_btusb              61440  0
```

3) Through the dmesg command, you can see the loading information of the RTL8723BU module

```
orangepi@orangepi:~$ dmesg
......
[    83.438901] usb 2-1: new high-speed USB device number 2 using ehci-platform
[    83.588375] usb 2-1: New USB device found, idVendor=0bda, idProduct=b720, bcdDevice= 2.00
[    83.588403] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[    83.588422] usb 2-1: Product: 802.11n WLAN Adapter
[    83.588443] usb 2-1: Manufacturer: Realtek
[    83.588460] usb 2-1: SerialNumber: 00e04c000001
[    83.601974] Bluetooth: hci0: RTL: examining hci_ver=06 hci_rev=000b lmp_ver=06 lmp_subver=8723
[    83.603894] Bluetooth: hci0: RTL: rom_version status=0 version=1
[    83.603920] Bluetooth: hci0: RTL: loading rtl_bt/rtl8723b_fw.bin
[    83.610108] Bluetooth: hci0: RTL: loading rtl_bt/rtl8723b_config.bin
[    83.611274] Bluetooth: hci0: RTL: cfg_sz 68, total sz 22564
[    83.658494] rtk_btusb: Realtek Bluetooth USB driver ver 3.1.6d45ddf.20220519-142432
[    83.658651] usbcore: registered new interface driver rtk_btusb
[    83.667124] usb 2-1: This Realtek USB WiFi dongle (0x0bda:0xb720) is untested!
[    83.667137] usb 2-1: Please report results to Jes.Sorensen@gmail.com
[    83.890140] usb 2-1: Vendor: Realtek
[    83.890153] usb 2-1: Product: 802.11n WLAN Adapter
[    83.890159] usb 2-1: rtl8723bu_parse_efuse: dumping efuse (0x200 bytes):
......
[    83.890412] usb 2-1: RTL8723BU rev E (SMIC) 1T1R, TX queues 3, WiFi=1, BT=1,
```

```
GPS=0, HI PA=0
[    83.890417] usb 2-1: RTL8723BU MAC: 00:13:ef:f4:58:ae
[    83.890421] usb 2-1: rtl8xxxu: Loading firmware rtlwifi/rtl8723bu_nic.bin
[    83.895289] usb 2-1: Firmware revision 35.0 (signature 0x5301)
[    84.050893] Bluetooth: hci0: RTL: fw version 0x0e2f9f73
[    84.266905] Bluetooth: RFCOMM TTY layer initialized
[    84.266949] Bluetooth: RFCOMM socket layer initialized
[    84.266999] Bluetooth: RFCOMM ver 1.11
[    84.884270] usbcore: registered new interface driver rtl8xxxu
[    84.912046] rtl8xxxu 2-1:1.2 wlx0013eff458ae: renamed from wlan0
```

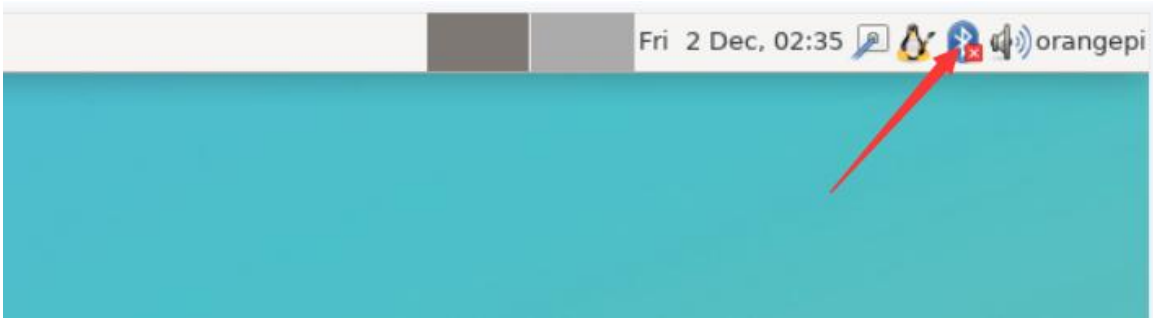
4) Then through the **sudo ifconfig** command, you can see the device node of RTL8723BU WIFI. For the connection and test method of WIFI, please refer to the section of **WIFI connection test**, which will not be repeated here

```
orangepi@orangepi:~$ sudo ifconfig wlx0013eff458ae
wlx0013eff458ae: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether 00:13:ef:f4:58:ae  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

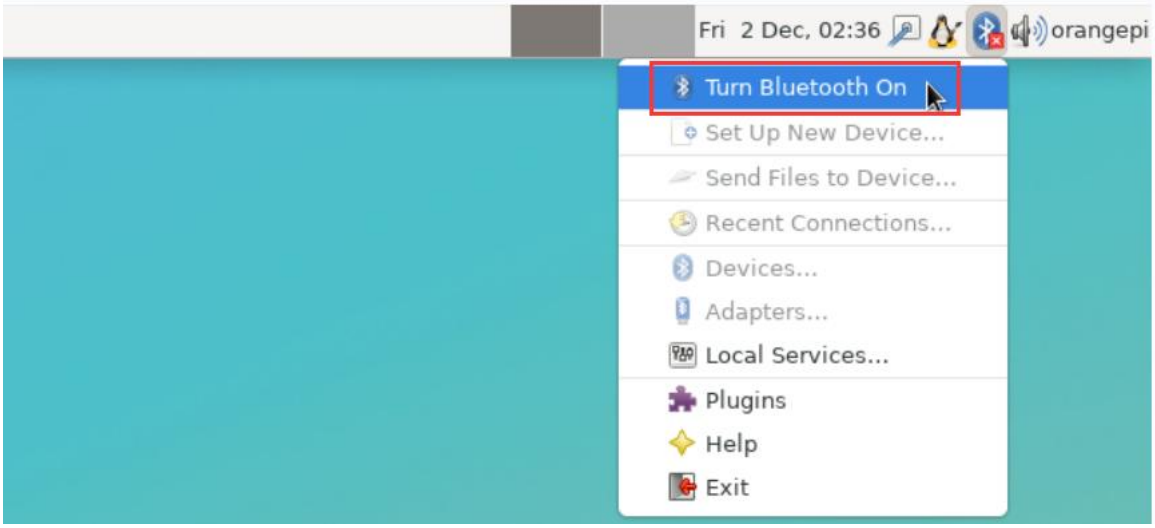
5) Then you can see the USB Bluetooth device through the **hciconfig** command

```
orangepi@orangepi:~$ sudo apt update && sudo apt install bluez
orangepi@orangepi:~$ hciconfig
hci0:   Type: Primary  Bus: USB
        BD Address: 00:13:EF:F4:58:AE  ACL MTU: 820:8  SCO MTU: 255:16
        DOWN
        RX bytes:1252 acl:0 sco:0 events:125 errors:0
        TX bytes:23307 acl:0 sco:0 commands:125 errors:0
```

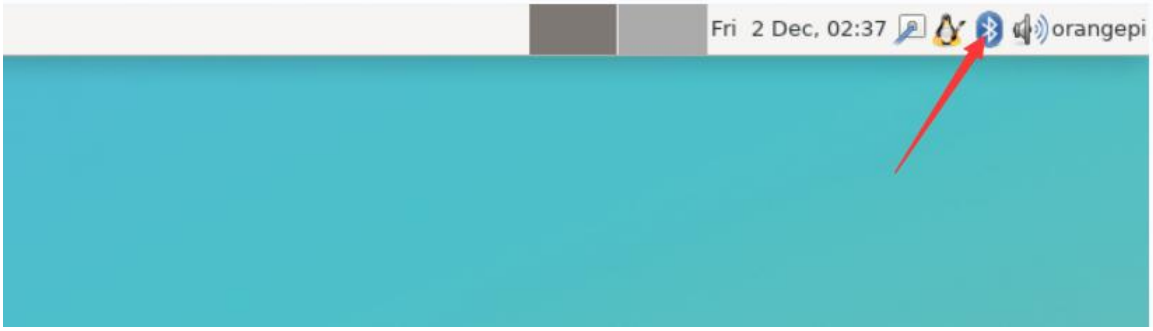
6) You can also see the bluetooth icon on the desktop. At this time, the bluetooth is not turned on, so a red **x** will be displayed



7) Click **Turn Bluetooth On** to turn on Bluetooth



8) The display after turning on Bluetooth is as follows



9) For the test method of Bluetooth, please refer to the section on **Bluetooth usage**, so I won’t go into details here

3. 13. 3. 2. RTL8811 test

1) First insert the RTL8811 wireless network card module into the USB interface of the development board

2) Then the linux system will automatically load the kernel module related to RTL8811 WIFI, through the lsmod command, you can see that the following kernel module has been automatically loaded

```
orangepi@orangepi:~$ lsmod
Module                  Size  Used by
8821cu                1839104  0
```

3) Through the dmesg command, you can see the loading information of the RTL8811 module

```
orangepi@orangepi:~$ dmesg
[   118.618194] usb 2-1: new high-speed USB device number 2 using ehci-platform
[   118.767152] usb 2-1: New USB device found, idVendor=0bda, idProduct=c811, bcdDevice= 2.00
[   118.767181] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[   118.767199] usb 2-1: Product: 802.11ac NIC
[   118.767219] usb 2-1: Manufacturer: Realtek
[   118.767235] usb 2-1: SerialNumber: 123456
[   119.500530] usbcore: registered new interface driver rtl8821cu
[   119.525498] rtl8821cu 2-1:1.0 wlx1cbfced9d260: renamed from wlan0
```

4) Then, you can see the WIFI device node through the **sudo ifconfig** command. For the **WIFI connection and test method**, please refer to the section of WIFI connection test, which will not be repeated here

```
orangepi@orangepi:~$ sudo ifconfig wlx1cbfced9d260
wlx1cbfced9d260: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        ether 1c:bf:ce:d9:d2:60  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

3. 13. 4. USB camera test

1) First, you need to prepare a USB camera that supports the UVC protocol as shown in the figure below or similar, and then insert the USB camera into the USB port of the Orange Pi development board

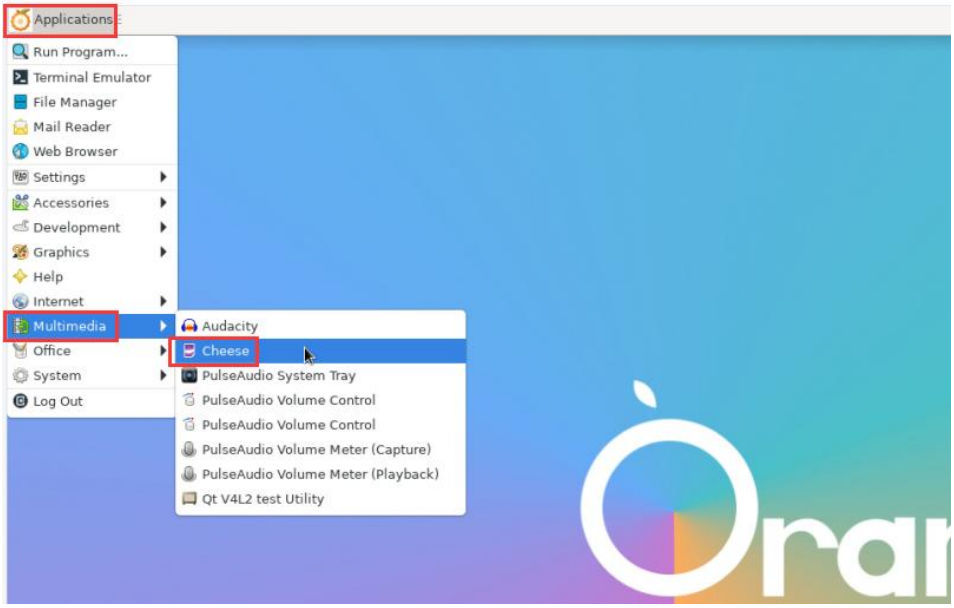
2) Through the v4l2-ctl command, you can see that the device node information of the USB camera is /dev/video0

```
orangepi@orangepi:~$ v4l2-ctl --list-devices
Q8 HD Webcam: Q8 HD Webcam (usb-fc880000.usb-1):
        /dev/video0
        /dev/video1
        /dev/media0
```

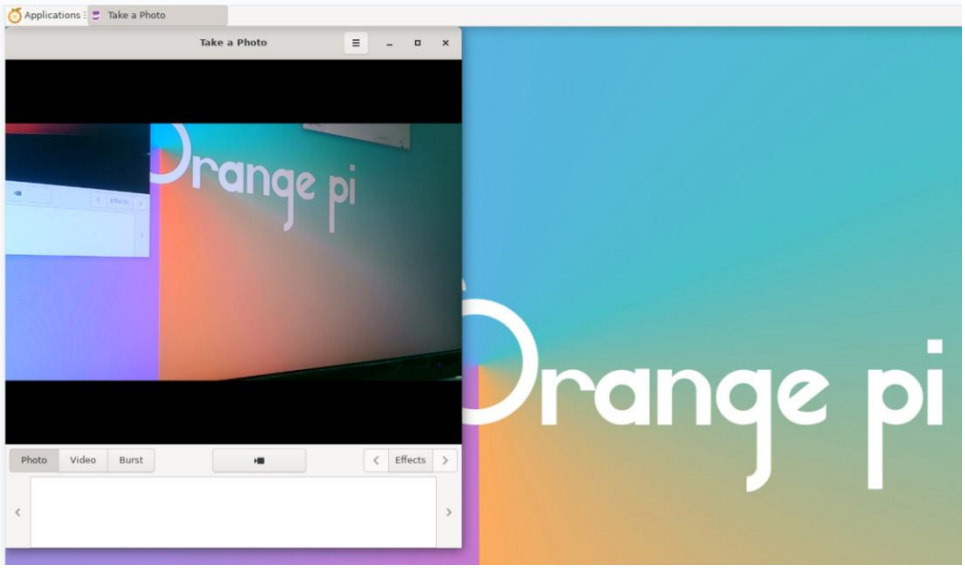
Note that the l in v4l2 is a lowercase letter l, not the number 1.

In addition, the serial number of the video is not necessarily video0, please refer to what you actually see.

3) In the desktop system, Cheese can be used to directly open the USB camera. The method of opening Cheese is shown in the figure below:



The interface after Cheese turns on the USB camera is shown in the figure below:



4) Method of using fswebcam to test USB camera

a. Install fswebcam

```
orangepi@orangepi:~$ sudo apt update
orangepi@orangepi:~$ sudo apt-get install -y fswebcam
```

b. After installing fswebcam, you can use the following command to take pictures

a) -d option is used to specify the device node of the USB camera

b) --no-banner is used to remove the watermark of the photo

c) -r option is used to specify the resolution of the photo

d) -S option is used to set the number of previous frames to skip

e) ./image.jpg is used to set the name and path of the generated photo

```
orangepi@orangepi:~$ sudo fswebcam -d /dev/video0  \
--no-banner -r 1280x720 -S 5 ./image.jpg
```

c. In the server version of the linux system, you can use the scp command to transfer the taken pictures to the Ubuntu PC for image viewing after taking pictures

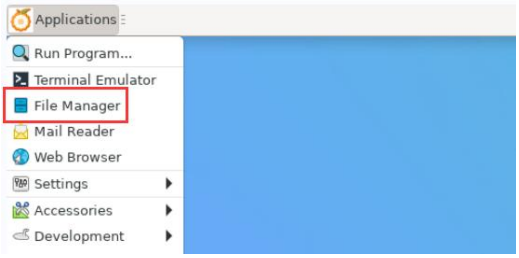
```
orangepi@orangepi:~$ scp image.jpg test@192.168.1.55:/home/test （Modify the IP address and path according to the actual situation）
```

d. In the desktop version of the linux system, you can directly view the captured pictures through the HDMI display d. In the desktop version of the linux system, you can directly view the captured pictures through the HDMI display

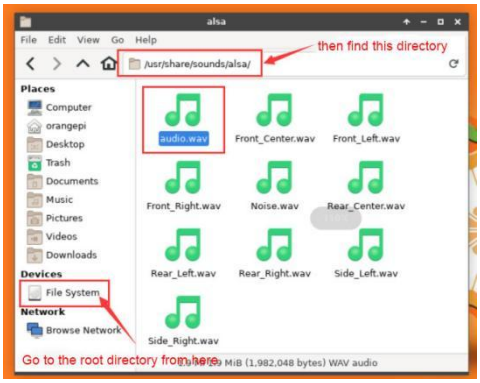
3. 14. Audio Test

3. 14. 1. Testing audio methods on desktop systems

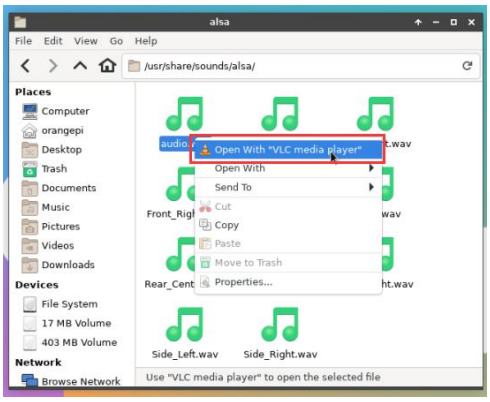
1) First open the file manager



2) Then find the following file (if there is no audio file in the system, you can upload an audio file to the system yourself)

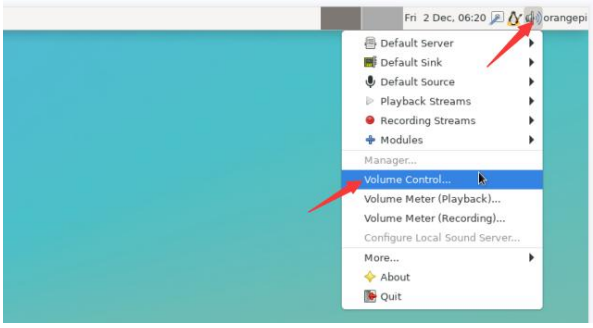


3) Then select the audio.wav file, right click and select open with vlc to start playing

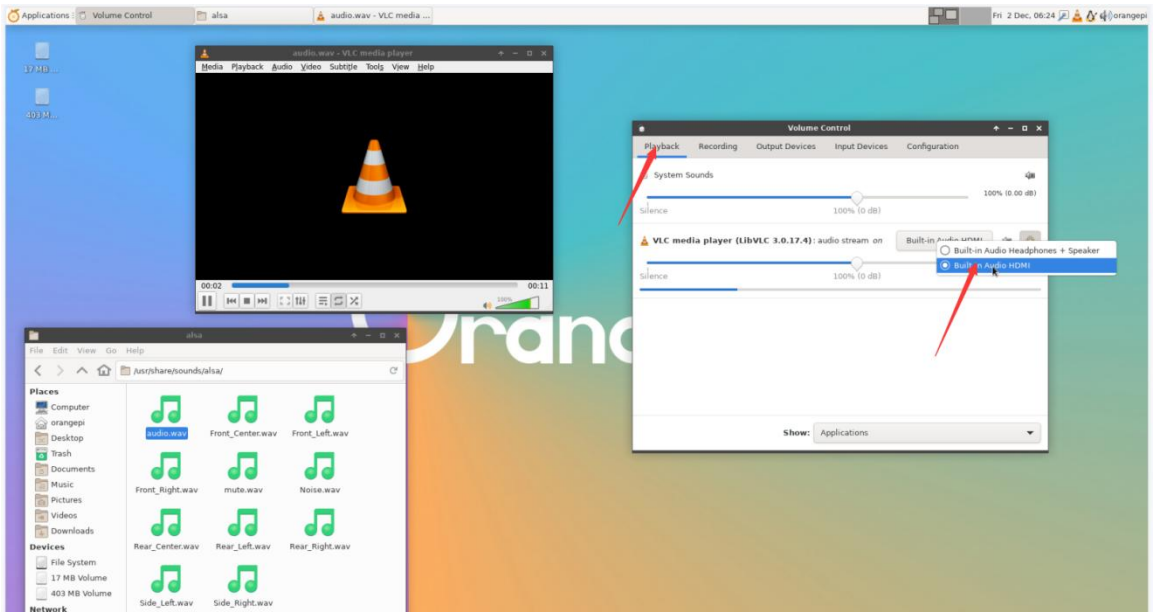


4) How to switch between different audio devices such as HDMI playback and headphone playback

a. First open the volume control interface



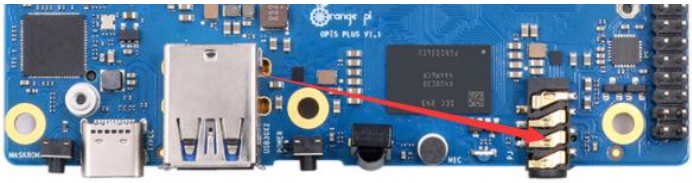
b. When playing audio, the audio device options that the playback software can use will be displayed in **Playback**, as shown in the figure below, where you can set which audio device to play to



3. 14. 2. The method of using commands to play audio

3. 14. 2. 1. Headphone interface playback audio test

1) First insert the earphone into the earphone jack of the development board



2) Then you can use the **aplay -l** command to view the sound card devices supported by the linux system. From the output below, you can see that **card 3** is the sound card device of es8388, that is, the sound card device of the headset

```
orangepi@orangepi:~$ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: rockchipdp0 [rockchip,dp0], device 0: rockchip,dp0 spdif-hifi-0 [rockchip,dp0 spdif-hifi-0]
  Subdevices: 0/1
  Subdevice #0: subdevice #0
card 1: rockchiphdmi0 [rockchip-hdmi0], device 0: rockchip-hdmi0 i2s-hifi-0 [rockchip-hdmi0 i2s-hifi-0]
  Subdevices: 0/1
  Subdevice #0: subdevice #0
card 2: rockchiphdmi1 [rockchip-hdmi1], device 0: rockchip-hdmi1 i2s-hifi-0 [rockchip-hdmi1 i2s-hifi-0]
  Subdevices: 1/1
```

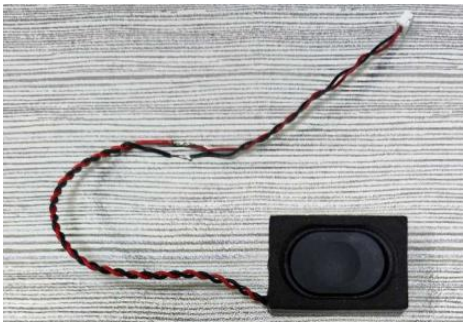
```
  Subdevice #0: subdevice #0
card 3: rockchipes8388 [rockchip,es8388], device 0: dailink-multicodecs ES8323.7-0011-0 [dailink-multicodecs ES8323.7-0011-0]
  Subdevices: 0/1
  Subdevice #0: subdevice #0
```

3) Then use the **aplay** command to play the audio file that comes with the system. If the earphone can hear the sound, it means that the hardware can be used normally.

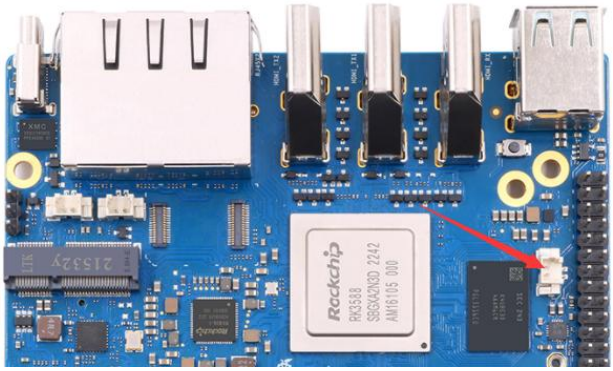
```
orangepi@orangepi:~$ aplay -D hw:3,0 /usr/share/sounds/alsa/audio.wav
Playing WAVE 'audio.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

3. 14. 2. 2. Speaker interface playback audio test

1) First, you need to prepare a speaker as shown in the figure below. The specification of the speaker seat on the development board is 2pin 1.25mm pitch



2) The position of the speaker interface on the development board is as follows. After preparing the speaker, please insert it into the speaker interface of the development board



3) The speaker and earphone use the same sound card. Before using the speaker, please

make sure that the earphone jack is not plugged into the earphone (if the earphone is plugged in, the audio will be played to the earphone). Then use the **aplay** command to play the audio file that comes with the system. If the speaker can hear the sound, it means that the hardware can be used normally.

```
orangepi@orangepi:~$ aplay -D hw:3,0 /usr/share/sounds/alsa/audio.wav
Playing WAVE 'audio.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

3.14.2.3. HDMI audio playback test

1) First use the HDMI to HDMI cable to connect the Orange Pi development board to the TV (other HDMI monitors need to ensure that they can play audio)

2) Then check the serial number of the HDMI sound card. From the output below, you can know that the sound card of HDMI_TX1 is **card 1**, and the sound card of HDMI_TX2 is **card 2**

```
orangepi@orangepi:~$ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: rockchipdp0 [rockchip,dp0], device 0: rockchip,dp0 spdif-hifi-0 [rockchip,dp0 spdif-hifi-0]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 1: rockchiphdmi0 [rockchip-hdmi0], device 0: rockchip-hdmi0 i2s-hifi-0 [rockchip-hdmi0 i2s-hifi-0]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
card 2: rockchiphdmi1 [rockchip-hdmi1], device 0: rockchip-hdmi1 i2s-hifi-0 [rockchip-hdmi1 i2s-hifi-0]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
```

3) Then use the **aplay** command to play the audio file that comes with the system. If the HDMI monitor or TV can hear the sound, it means that the hardware can be used normally.

a. The command to play audio to HDMI_TX1 is as follows:

```
orangepi@orangepi:~$ aplay -D hw:1,0 /usr/share/sounds/alsa/audio.wav
```

b. The command to play audio to HDMI_TX2 is as follows:

```
orangepi@orangepi:~$ aplay -D hw:2,0 /usr/share/sounds/alsa/audio.wav
```

3. 14. 3. Method of using commands to test recording

1) There is an onboard MIC on the development board, the location is as follows:

2) Running the **test_record.sh main** command will record a piece of audio through the onboard MIC, and then play it to HDMI_TX1 and the headset.

```
orangepi@orangepi:~$ test_record.sh main
Start recording: /tmp/test.wav
Recording WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
Start playing
Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

3) In addition to the onboard MIC, we can also record audio through headphones with MIC function. After inserting the headset with MIC function into the development board, run the **test_record.sh headset** command to record a piece of audio through the headset, and then play it to HDMI_TX1 and the headset.

```
orangepi@orangepi:~$ test_record.sh headset
Start recording: /tmp/test.wav
Recording WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
Start playing
Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

3. 15. Temperature sensor

1） The command to view the system temperature sensor is:

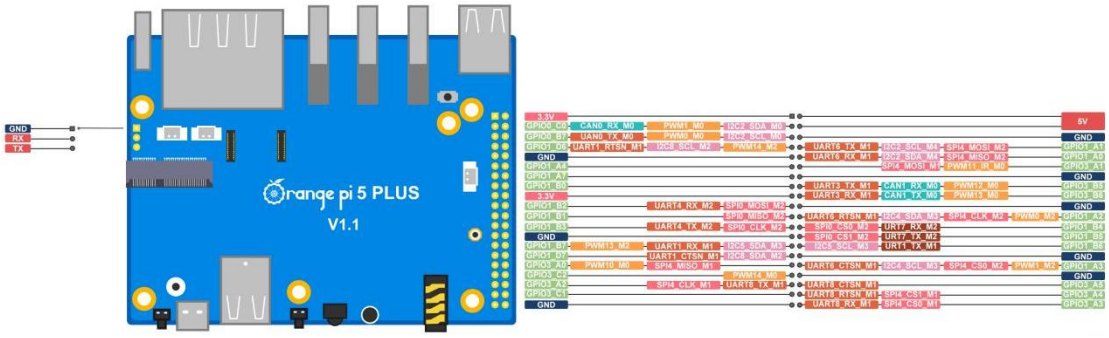
```
orangepi@orangepi:~$ sensors
gpu_thermal-virtual-0
Adapter: Virtual device
temp1:          +47.2°C
```

```
littlecore_thermal-virtual-0
Adapter: Virtual device
temp1:          +47.2°C

bigcore0_thermal-virtual-0
Adapter: Virtual device
temp1:          +47.2°C

tcpm_source_psy_6_0022-i2c-6-22
Adapter: rk3x-i2c
in0:             0.00 V  (min =  +0.00 V, max =  +0.00 V)
curr1:           0.00 A  (max =  +0.00 A)

npu_thermal-virtual-0
Adapter: Virtual device
temp1:          +47.2°C

center_thermal-virtual-0
Adapter: Virtual device
temp1:          +47.2°C

bigcore1_thermal-virtual-0
Adapter: Virtual device
temp1:          +47.2°C

soc_thermal-virtual-0
Adapter: Virtual device
temp1:          +47.2°C  (crit = +115.0°C)
```

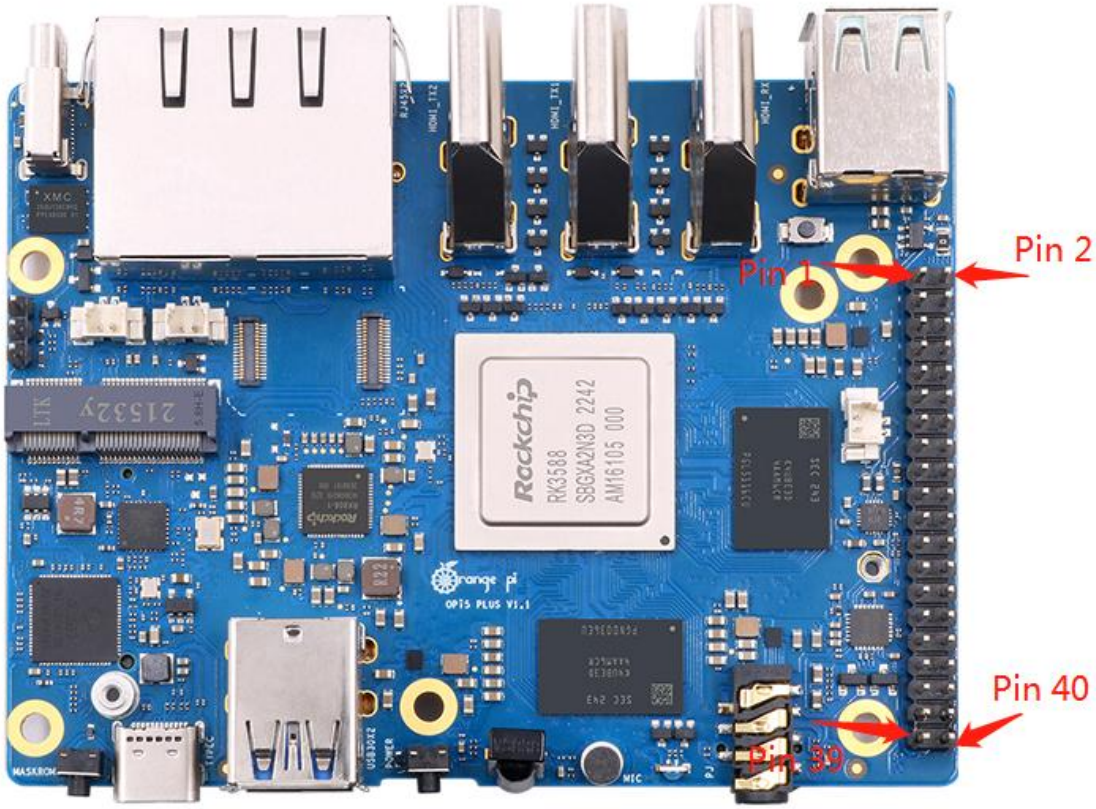
2） The command to view the current temperature of the nvme ssd solid state drive is:

```
orangepi@orangepi:~$ sudo smartctl -a /dev/nvme0 | grep "Temperature:"
Temperature:                        40 Celsius
```

3. 16. 40 Pin Expansion Interface Pin Instructions



1) Please refer to the figure below for the order of the 40 pin expansion interface pins on the Orange Pi 5 Plus development board:

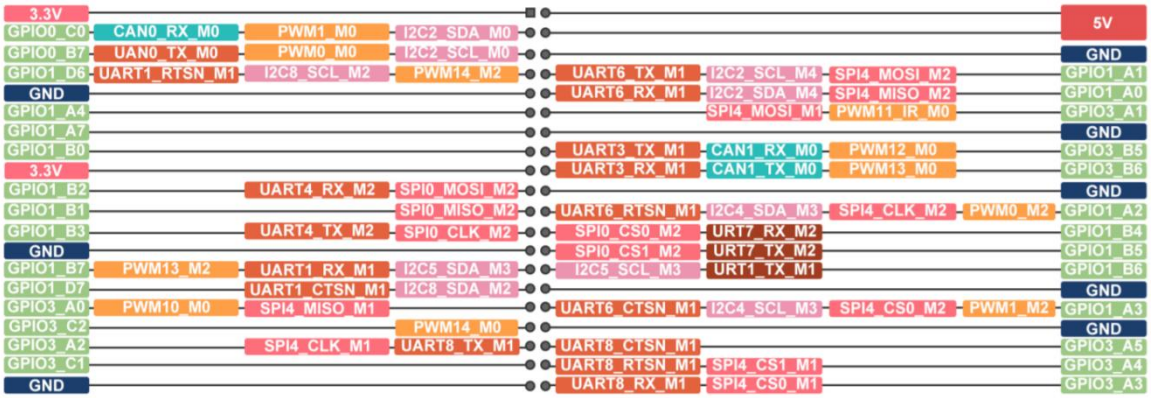


2) The functions of the 40 pin interface pins on the Orange Pi 5 Plus development board are shown in the table below

a. The following is the complete pin diagram of 40 pin

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

The following is a color map containing some of the content in the above table:



b. The table below is the picture of the left half of the complete table above, so you can see it clearly

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号
			3.3V		1
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7
			GND		9
			GPIO1_A4	36	11
			GPIO1_A7	39	13
			GPIO1_B0	40	15
			3.3V		17
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19
		SPI0_MISO_M2	GPIO1_B1	41	21
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23
			GND		25
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31
		PWM14_M0（febf0020）	GPIO3_C2	114	33
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35
			GPIO3_C1	113	37
			GND		39

c. The table below is the picture of the right half of the complete table above, so you can see it clearly

引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
2		5V				
4		5V				
6		GND				
8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
14		GND				
16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
20		GND				
22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
30		GND				
32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
34		GND				
36	101	GPIO3_A5	UART8_CTSN_M1			
38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

The pwm in the above table has marked the base address of the corresponding register, which is useful when checking which pwmchip in /sys/class/pwm/ corresponds to which pwm pin in the 40 pin header.

3) There are a total of **28** GPIO ports in the 40 pin interface, and the voltage of all GPIO ports is **3.3v**.

3. 17. How to install wiringOP

Note that wiringOP has been pre-installed in the linux image released by Orange Pi. Unless the code of wiringOP is updated, there is no need to re-download, compile and install, just use it directly.

The storage path of the compiled wiringOP deb package in orangepi-build is:
orangepi-build/external/cache/debs/arm64/wiringpi_x.xx.deb

After entering the system, you can run the gpio readall command. If you can see the following output, it means that wiringOP has been pre-installed and can be used normally.

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |    PWM14 |     IN | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 | IN     | GPIO3_A1 | 6   | 97   |
 |   39 |   7 | GPIO1_A7 |     IN | 1 | 13 || 14 |   |        | GND      |     |      |
 |   40 |   8 | GPIO1_B0 |     IN | 1 | 15 || 16 | 1 | IN     | GPIO3_B5 | 9   | 109  |
 |      |     |     3.3V |        |   | 17 || 18 | 0 | IN     | GPIO3_B6 | 10  | 110  |
 |   42 |  11 | SPI0_TXD |     IN | 0 | 19 || 20 |   |        | GND      |     |      |
 |   41 |  12 | SPI0_RXD |     IN | 0 | 21 || 22 | 0 | IN     | GPIO1_A2 | 13  | 34   |
 |   43 |  14 | SPI0_CLK |     IN | 0 | 23 || 24 | 1 | IN     | SPI0_CS0 | 15  | 44   |
 |      |     |      GND |        |   | 25 || 26 | 1 | IN     | SPI0_CS1 | 16  | 45   |
 |   47 |  17 | GPIO1_B7 |     IN | 1 | 27 || 28 | 1 | IN     | GPIO1_B6 | 18  | 46   |
 |   63 |  19 | GPIO1_D7 |     IN | 1 | 29 || 30 |   |        | GND      |     |      |
 |   96 |  20 | GPIO3_A0 |     IN | 1 | 31 || 32 | 0 | IN     | GPIO1_A3 | 21  | 35   |
 |  114 |  22 | GPIO3_C2 |     IN | 0 | 33 || 34 |   |        | GND      |     |      |
 |   98 |  23 | GPIO3_A2 |     IN | 1 | 35 || 36 | 0 | IN     | GPIO3_A5 | 24  | 101  |
 |  113 |  25 | GPIO3_C1 |     IN | 0 | 37 || 38 | 0 | IN     | GPIO3_A4 | 26  | 100  |
 |      |     |      GND |        |   | 39 || 40 | 1 | IN     | GPIO3_A3 | 27  | 99   |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
orangepi@orangepi5plus:~$
```

wiringOP is currently mainly adapted to the functions of setting GPIO port input and output, setting GPIO port output high and low levels, and setting up and down pull-down resistors. Functions such as hardware PWM are not available.

1) Download the code of wiringOP

```
orangepi@orangepi:~$ sudo apt update
orangepi@orangepi:~$ sudo apt install -y git
orangepi@orangepi:~$ git clone https://github.com/orangepi-xunlong/wiringOP.git -b next
```

Note that Orange Pi 5 Plus needs to download the code of the wiringOP next branch, please don't miss the -b next parameter.

If you have problems downloading the code from GitHub, you can directly use the wiringOP source code that comes with the Linux image, and the storage location is: /usr/src/wiringOP

2) Compile and install wiringOP

```
orangepi@orangepi:~$ cd wiringOP
```

```
orangepi@orangepi:~/wiringOP$ sudo ./build clean
orangepi@orangepi:~/wiringOP$ sudo ./build
```

3) Test the output of the gpio readall command as follows

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |    PWM14 |     IN | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 | IN     | GPIO3_A1 | 6   | 97   |
 |   39 |   7 | GPIO1_A7 |     IN | 1 | 13 || 14 |   |        | GND      |     |      |
 |   40 |   8 | GPIO1_B0 |     IN | 1 | 15 || 16 | 1 | IN     | GPIO3_B5 | 9   | 109  |
 |      |     |     3.3V |        |   | 17 || 18 | 0 | IN     | GPIO3_B6 | 10  | 110  |
 |   42 |  11 | SPI0_TXD |     IN | 0 | 19 || 20 |   |        | GND      |     |      |
 |   41 |  12 | SPI0_RXD |     IN | 0 | 21 || 22 | 0 | IN     | GPIO1_A2 | 13  | 34   |
 |   43 |  14 | SPI0_CLK |     IN | 0 | 23 || 24 | 1 | IN     | SPI0_CS0 | 15  | 44   |
 |      |     |      GND |        |   | 25 || 26 | 1 | IN     | SPI0_CS1 | 16  | 45   |
 |   47 |  17 | GPIO1_B7 |     IN | 1 | 27 || 28 | 1 | IN     | GPIO1_B6 | 18  | 46   |
 |   63 |  19 | GPIO1_D7 |     IN | 1 | 29 || 30 |   |        | GND      |     |      |
 |   96 |  20 | GPIO3_A0 |     IN | 1 | 31 || 32 | 0 | IN     | GPIO1_A3 | 21  | 35   |
 |  114 |  22 | GPIO3_C2 |     IN | 0 | 33 || 34 |   |        | GND      |     |      |
 |   98 |  23 | GPIO3_A2 |     IN | 1 | 35 || 36 | 0 | IN     | GPIO3_A5 | 24  | 101  |
 |  113 |  25 | GPIO3_C1 |     IN | 0 | 37 || 38 | 0 | IN     | GPIO3_A4 | 26  | 100  |
 |      |     |      GND |        |   | 39 || 40 | 1 | IN     | GPIO3_A3 | 27  | 99   |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
orangepi@orangepi5plus:~$
```

3. 18. 40 pin interface GPIO, I2C, UART, SPI, CAN and PWM test

3. 18. 1. 40 pin GPIO port test

The linux system released by Orange Pi has a pre-installed blink_all_gpio program, which will set all 28 GPIO ports in the 40 pins to switch between high and low levels continuously.

After running the blink_all_gpio program, when using a multimeter to measure the level of the GPIO port, you will find that the GPIO pin will switch between 0 and 3.3v continuously. Using this program we can test whether the GPIO port is working properly.

The way to run the blink_all_gpio program is as follows:

orangepi@orangepi5plus:~$ **sudo blink_all_gpio #Remember to add sudo permission**

[sudo] password for orangepi:	**#A password is required here**

1) There are a total of **28** GPIO ports in the 40 pins of the development board that can be used. The following uses pin 7 — the corresponding GPIO is GPIO1_D6 — — the corresponding wPi number is 2—as an example to demonstrate how to set the high and low levels of the GPIO port

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |    PWM14 |     IN | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 | IN     | GPIO3_A1 | 6   | 97   |
```

2) First set the GPIO port to output mode, where the third parameter needs to input the serial number of wPi corresponding to the pin

```
root@orangepi:~/wiringOP# gpio mode 2 out
```

3) Then set the GPIO port to output a low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 0v, it means that the low level is set successfully.

```
root@orangepi:~/wiringOP# gpio write 2 0
```

Use gpio readall to see that the value (V) of pin 7 has changed to 0

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |    PWM14 |    OUT | 0 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
```

4) Then set the GPIO port to output a high level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 3.3v, it means that the high level is set successfully.

```
root@orangepi:~/wiringOP# gpio write 2 1
```

Use gpio readall to see that the value (V) of pin 7 has changed to 1

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |   PWM14  |    OUT | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
```

5) The setting method of other pins is similar, just modify the serial number of wPi to the corresponding serial number of the pin

3. 18. 2. How to set the pull-down resistance of pin GPIO port

1) The following takes pin No. 7 — the corresponding GPIO is GPIO1_D6 — the corresponding wPi number is 2—as an example to demonstrate how to set the pull-up and pull-down resistance of the GPIO port

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |   PWM14  |    OUT | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
```

2) First, you need to set the GPIO port to the input mode, and the third parameter needs to be the serial number of the wPi corresponding to the input pin

```
root@orangepi:~/wiringOP# gpio mode 2 in
```

3) After setting to input mode, execute the following command to set the GPIO port to pull-up mode

```
root@orangepi:~/wiringOP# gpio mode 2 up
```

4) Then enter the following command to read the level of the GPIO port, if the level is 1, it means that the pull-up mode is set successfully

```
root@orangepi:~/wiringOP# gpio read 2
1
```

5) Then execute the following command to set the GPIO port to pull-down mode

```
root@orangepi:~/wiringOP# gpio mode 2 down
```

6) Then enter the following command to read the level of the GPIO port, if the level is 0, the pull-down mode is set successfully

```
root@orangepi:~/wiringOP# gpio read 2
0
```

3.18.3. 40 pin SPI test

1) As can be seen from the figure below, the SPIs available for Orange Pi 5 Plus are SPI0 and SPI4

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins of SPI0 and SPI4 in 40pin are shown in the table below. SPI4_M1 and SPI4_M2 can only use one of them at the same time, and they cannot be used at the same time. They are all the same SPI4, but they are connected to different pins. Please don't think that they are two different sets of SPI buses.

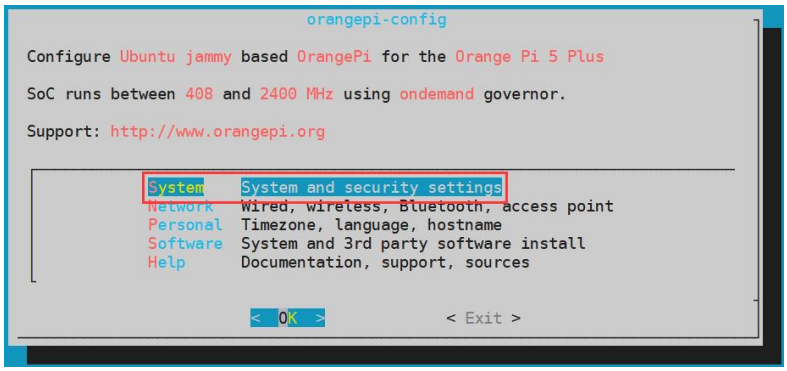
	SPI0_M2 corresponds to 40pin	**SPI4_M1 corresponds to 40pin**	**SPI4_M2 corresponds to 40pin**
MOSI	**Pin 19**	**Pin 12**	**Pin 8**
MISO	**Pin 21**	**Pin 31**	**Pin 10**
CLK	**Pin 23**	**Pin 35**	**Pin 22**
CS0	**Pin 24**	**Pin 40**	**Pin 31**
CS1	**Pin 26**	**Pin 38**	**none**
dtbo configuration	**spi0-m2-cs0-spidev spi0-m2-cs1-spidev spi0-m2-cs0-cs1-spidev**	**spi4-m1-cs0-spidev spi4-m1-cs1-spidev spi4-m1-cs0-cs1-spidev**	**spi4-m2-cs0-spidev**

3) In the linux system, the SPI in the 40 pin is closed by default, and it needs to be opened manually before it can be used. The detailed steps are as follows:

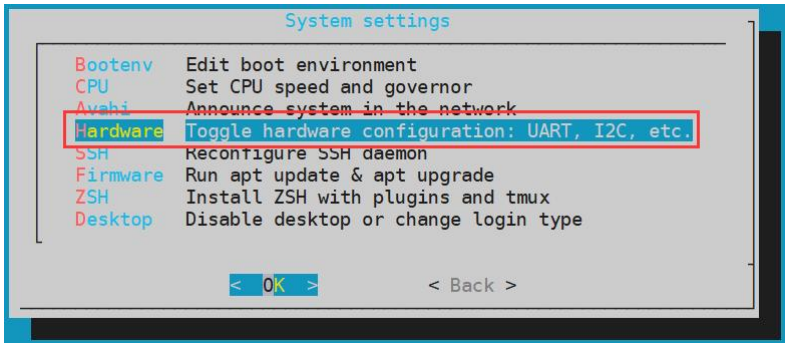
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

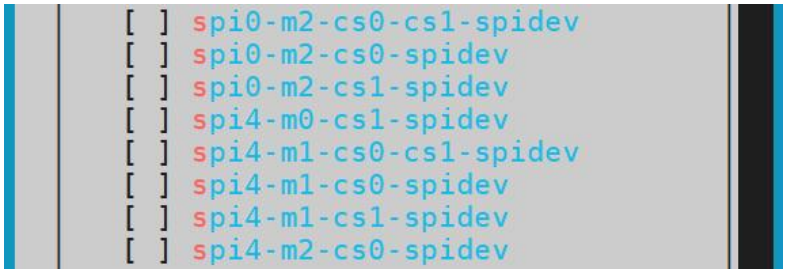
b. Then select **System**



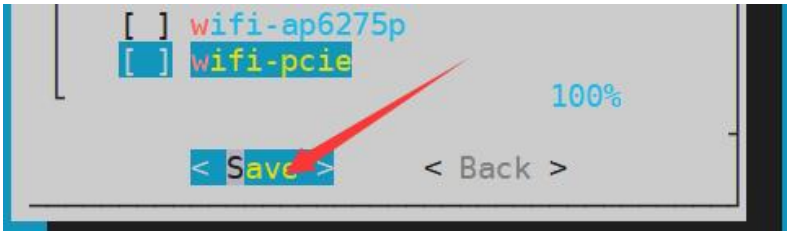
c. Then select **Hardware**



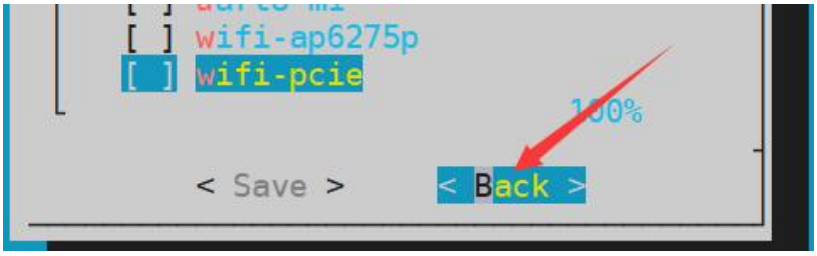
d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the **space** to select the SPI configuration you want to open



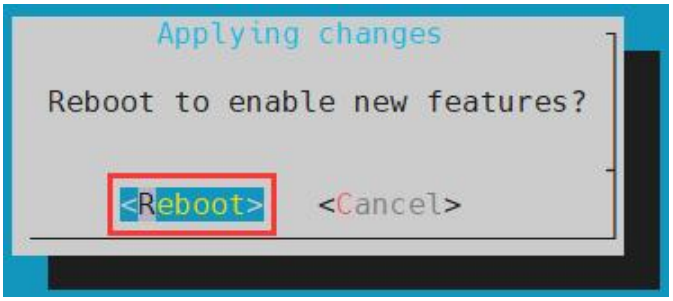
e. Then select **<Save>** to save



f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) After restarting, enter the system and first check whether there is a **spidevx.x** device node in the linux system. If it exists, it means that the SPI has been set up and can be used directly.

```
orangepi@orangepi:~$ ls /dev/spidev*
/dev/spidev0.0  /dev/spidev0.1  /dev/spidev4.0  /dev/spidev4.1
```

The above is the result displayed after turning on spi0-m2-cs0-cs1-spidev and spi4-m1-cs0-cs1-spidev.

5) Then do not short-circuit the MOSI and MISO pins of SPI0 or SPI4, the output result of running spidev_test is as follows, you can see that the data of TX and RX are inconsistent

```
orangepi@orangepi:~$ sudo spidev_test -v -D /dev/spidev4.0
or
```

```
orangepi@orangepi:~$ sudo spidev_test -v -D /dev/spidev0.0
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 KHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF F0 0D    | ......@....▒.................▒.
RX | FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF    | ................................
```

6) Then short-circuit the MOSI and MISO pins of SPI0 or SPI4, and then run the output of spidev_test as follows. You can see that the sent and received data are the same, indicating that the SPI loopback test is normal.

```
orangepi@orangepi:~$ sudo spidev_test -v -D /dev/spidev4.0
or
orangepi@orangepi:~$ sudo spidev_test -v -D /dev/spidev0.0
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 KHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF F0 0D    | ......@....▒.................▒.
RX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF F0 0D    | ......@....▒.................▒.
```

3. 18. 4. 40 pin I2C test

1) As can be seen from the table below, the available i2c for Orange Pi 5 Plus is i2c2, i2c4, i2c5 and i2c8, a total of four sets of i2c buses.

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins of the 4 groups of I2C buses in 40pin are shown in the table below. I2C2_M0 and I2C2_M4 can only use one of them at the same time, and they cannot be used at the same time. They are all the same I2C2, but they are connected to

different pins. Please don’t think that they are two different sets of I2C2 buses.

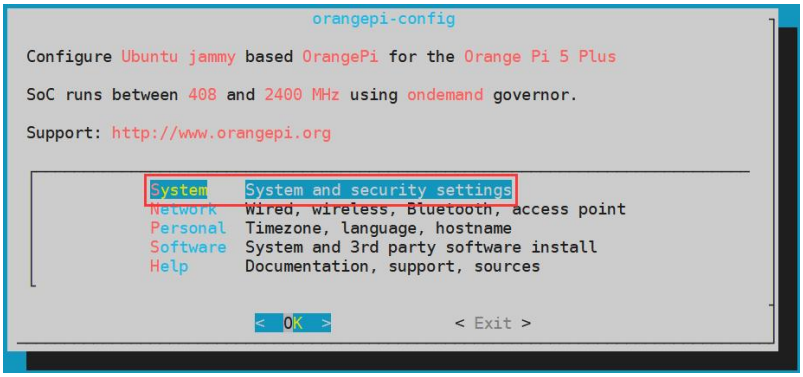
I2C bus	SDA corresponds to 40pin	SCL corresponds to 40pin	dtbo corresponding configuration
I2C2_M0	Pin 3	Pin 5	i2c2-m0
I2C2_M4	Pin 10	Pin 8	i2c2-m4
I2C4_M3	Pin 22	Pin 32	i2c4-m3
I2C5_M3	Pin 27	Pin 28	i2c5-m3
I2C8_M2	Pin 29	Pin 7	i2c8-m2

3) In the linux system, the I2C bus in the 40 pin is closed by default, and it needs to be opened manually to use it. The detailed steps are as follows:

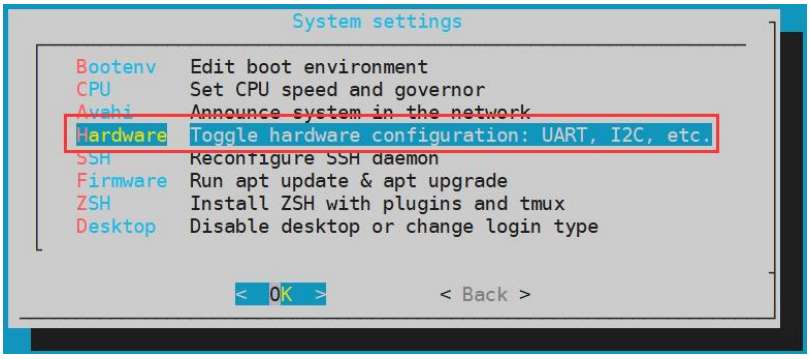
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

b. Then select **System**

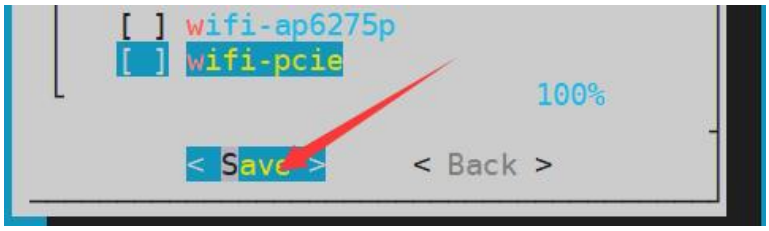


c. Then select **Hardware**

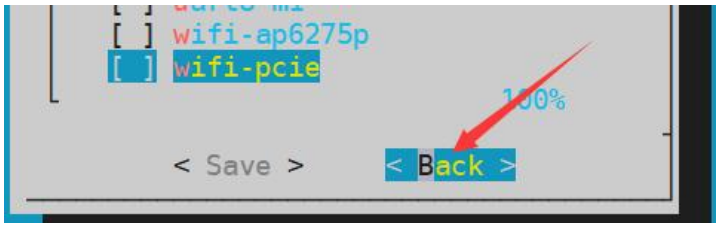


d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the **space** to select the I2C configuration you want to open

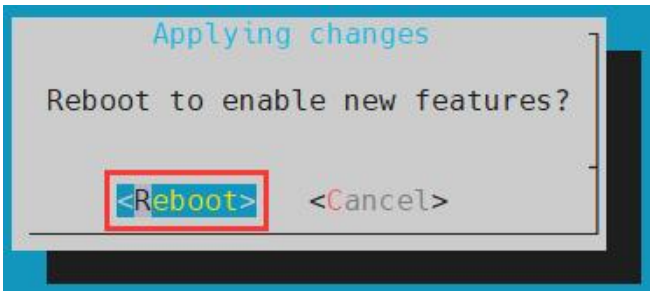
e. Then select **<Save>** to save



f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) After starting the linux system, first confirm that there are device nodes that need to use I2C under **/dev**

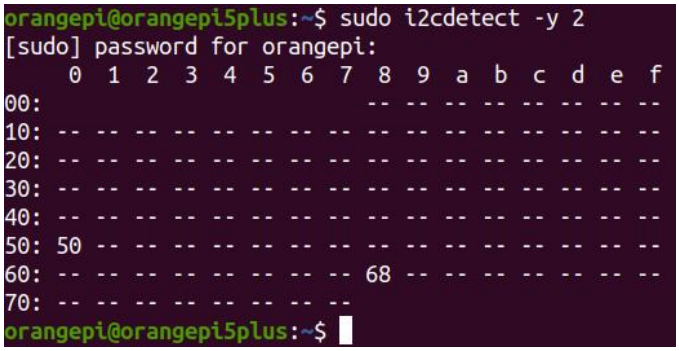
```
orangepi@orangepi:~$ ls /dev/i2c-*
```

5) Then connect an I2C device to the I2C pin corresponding to the 40 pin interface

6) Then use the **i2cdetect -y** command, if the address of the connected i2c device can be detected, it means that i2c can be used normally

```
orangepi@orangepi:~$ sudo i2cdetect -y 2      #i2c2 command
```

```
orangepi@orangepi:~$ sudo i2cdetect -y 4      #i2c4 command
orangepi@orangepi:~$ sudo i2cdetect -y 5      #i2c8 command
orangepi@orangepi:~$ sudo i2cdetect -y 8      #i2c8 command
```



3.18.5. 40 pin UART test

1) As can be seen from the table below, the uarts available for Orange Pi 5 Plus are uart1, uart3, uart4, uart6, uart7 and uart8, a total of 6 sets of uart buses

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins of the 6 groups of UART buses in 40pin are shown in the following table:

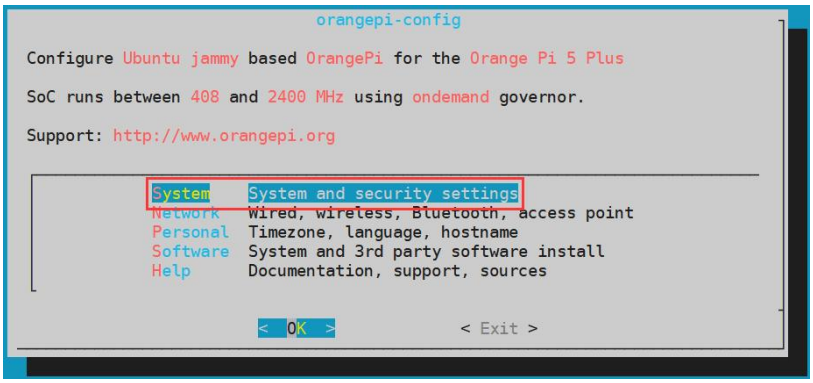
UART bus	RX corresponds to 40pin	TX corresponds to 40pin	dtbo corresponding configuration
UART1_M1	Pin 27	Pin 28	uart1-m1
UART3_M1	Pin 18	Pin 16	uart3-m1
UART4_M2	Pin 19	Pin 23	uart4-m2
UART6_M1	Pin 10	Pin 8	uart6-m1
UART7_M2	Pin 24	Pin 26	uart7-m2
UART8_M1	Pin 40	Pin 35	uart8-m1

3) In the linux system, the UART in the 40 pin is closed by default, and it needs to be opened manually to use it. The detailed steps are as follows:

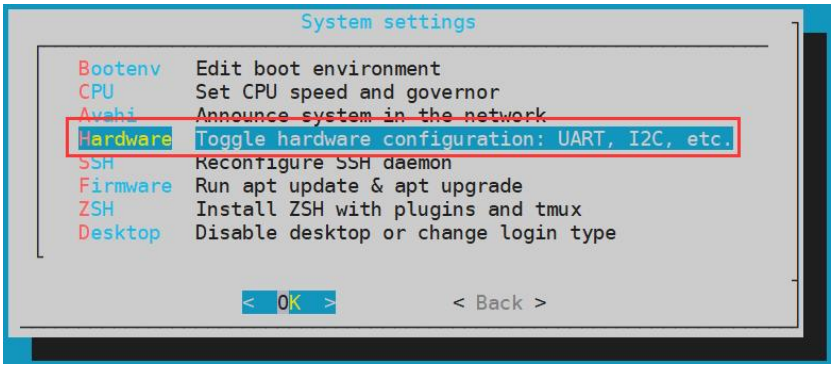
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

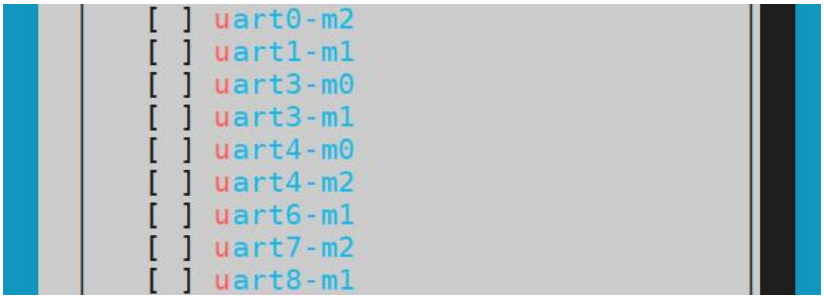
b. Then select **System**



c. Then select **Hardware**

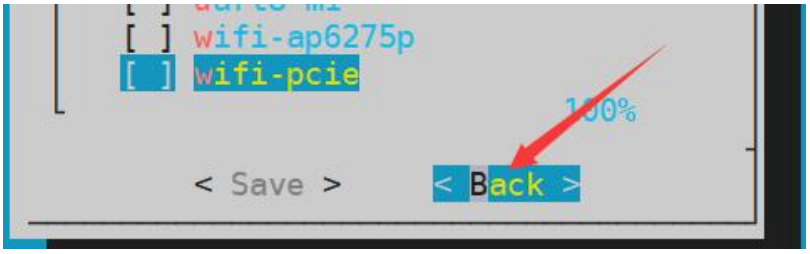


d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the space to select the UART configuration you want to open

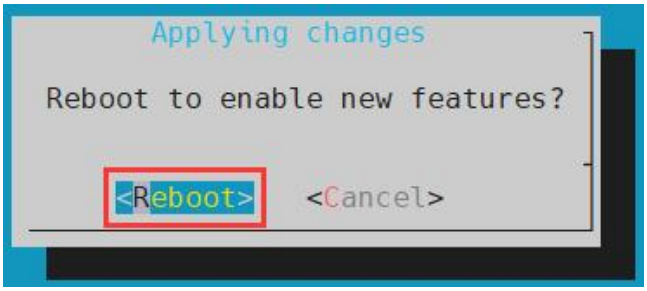


e. Then select **<Save>** to save

f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) After entering the linux system, first confirm whether there is a device node corresponding to uart under /dev

```
orangepi@orangepi:~$ ls /dev/ttyS*
```

5) Then start to test the uart interface, first use the DuPont line to short the rx and tx pins of the uart interface to be tested

6) Use the **gpio serial** command to test the loopback function of the serial port as shown below. If you can see the following print, it means that the serial port communication is normal (ttySX needs to be replaced with the node name corresponding to uart, please do not copy it)

```
orangepi@orangepi:~$ sudo gpio serial /dev/ttySX
[sudo] password for orangepi:    #enter password here

Out:    0:   ->    0
Out:    1:   ->    1
```

```
Out:    2:  ->    2
Out:    3:  ->    3
Out:    4:  ->    4
Out:    5:  ->    5^C
```

3. 18. 6. How to test PWM using /sys/class/pwm

1) As can be seen from the table below, the available PWM for Orange Pi 5 Plus includes six channels of PWM: pwm0, pwm1, pwm11, pwm12, pwm13 and pwm14

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins of PWM in 40pin are shown in the table below. Only one of PWM0_M0 and PWM0_M2, PWM1_M0 and PWM1_M2, PWM14_M0 and PWM14_M2 can be used at the same time, and they cannot be used at the same time. They are all the same PWM, but they are connected to different pins. Please don’t think that they are two different PWM bus.

PWM Bus	Corresponding to 40pin	dtbo corresponding configuration
PWM0_M0	Pin 5	pwm0-m0
PWM0_M2	Pin 22	pwm0-m2
PWM1_M0	Pin 3	pwm1-m0
PWM1_M2	Pin 32	pwm1-m2
PWM10_M0	Pin 31	pwm10-m0
PWM11_M0	Pin 12	pwm11-m0
PWM12_M0	Pin 16	pwm12-m0
PWM13_M0	Pin 18	pwm13-m0
PWM13_M2	Pin 27	pwm13-m2
PWM14_M0	Pin 33	pwm14-m0
PWM14_M2	Pin 7	pwm14-m0

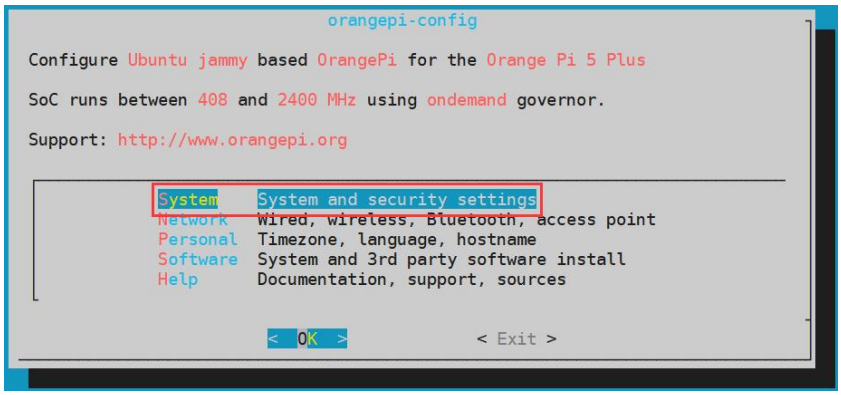
3) In the linux system, the PWM in the 40 pin is turned off by default, and it needs to be

turned on manually before it can be used. The detailed steps are as follows:

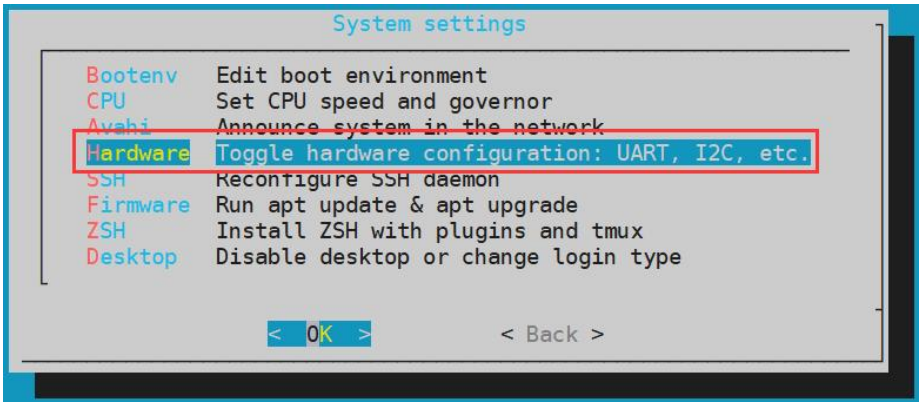
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

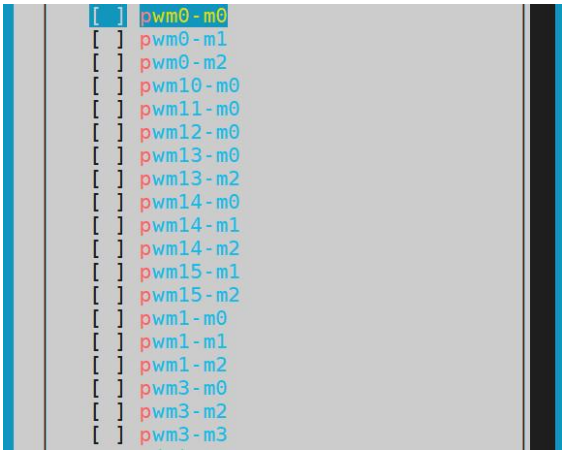
b. Then select **System**



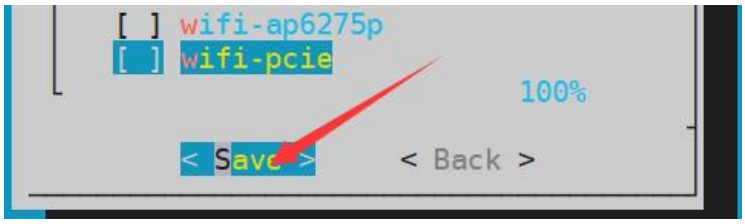
c. Then select **Hardware**



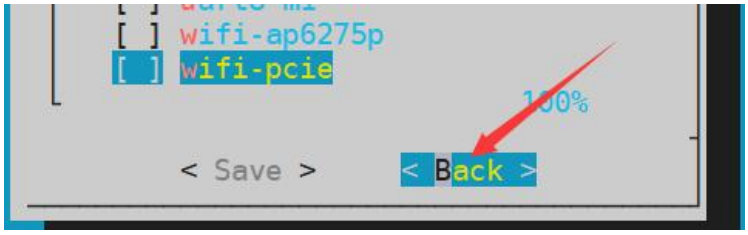
d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the space to select the PWM configuration you want to open



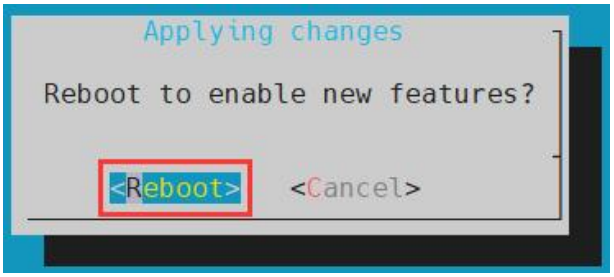
e. Then select **<Save>** to save



f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) After opening a pwm, there will be an extra pwmchipX in **/sys/class/pwm/** (X is a specific number), for example, after opening pwm14, check the pwmchipX under **/sys/class/pwm/** two became three

```
orangepi@orangepi:~$ ls /sys/class/pwm/
pwmchip0  pwmchip1  pwmchip2
```

5) Which pwmchip above corresponds to pwm14? Let’s check the output of the ls /sys/class/pwm/ -l command first, as shown below:

```
orangepi@orangepi5plus:~$ ls /sys/class/pwm/ -l
total 0
lrwxrwxrwx 1 root root 0 May 12 17:14 pwmchip0 -> ../../devices/platform/fd8b0020.pwm/pwm/pwmchip0
lrwxrwxrwx 1 root root 0 May 12 17:14 pwmchip1 -> ../../devices/platform/fd8b0030.pwm/pwm/pwmchip1
lrwxrwxrwx 1 root root 0 May 12 17:14 pwmchip2 -> ../../devices/platform/febf0020.pwm/pwm/pwmchip2
orangepi@orangepi5plus:~$
```

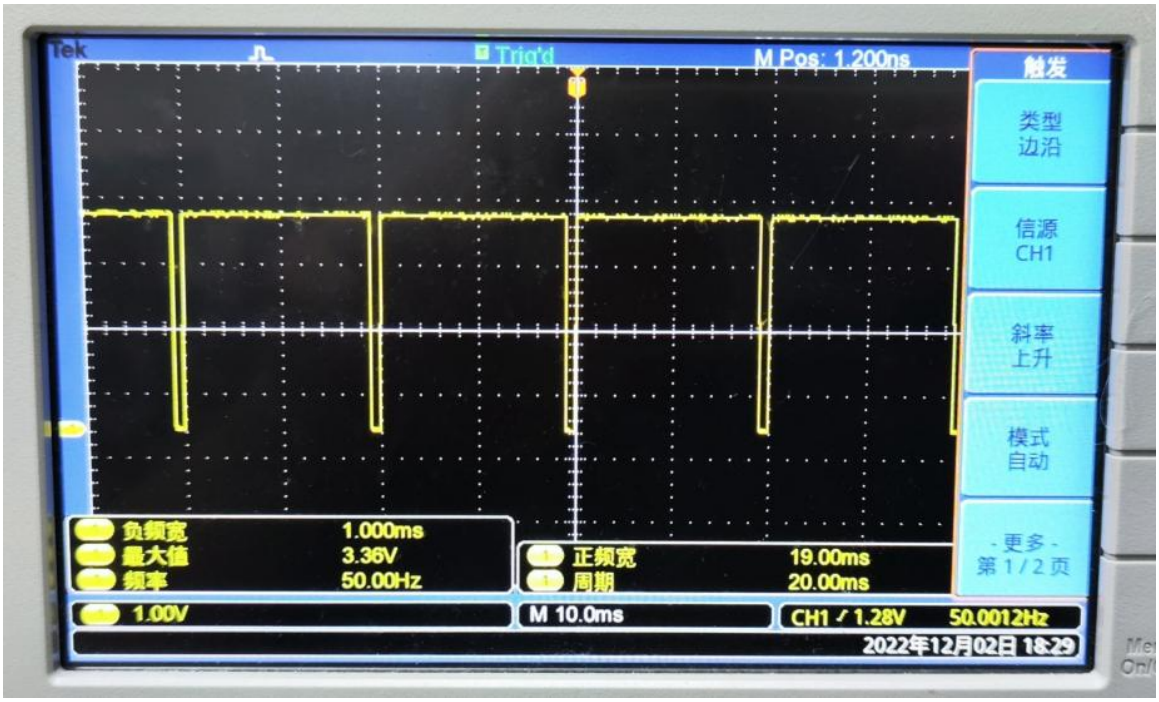
6) Then it can be known from the table below that the base address of the pwm14 register is febf0020, and then look at the output of the **ls /sys/class/pwm/ -l** command, you can see that pwmchip2 is linked to febf0020.pwm, so pwm14 corresponds to

pwmchip as pwmchip2

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号
			3.3V		1
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7
			GND		9
			GPIO1_A4	36	11
			GPIO1_A7	39	13
			GPIO1_B0	40	15
			3.3V		17
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19
		SPI0_MISO_M2	GPIO1_B1	41	21
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23
			GND		25
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31
		PWM14_M0（febf0020）	GPIO3_C2	114	33
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35
			GPIO3_C1	113	37
			GND		39

7) Then use the following command to make pwm14 output a 50Hz square wave (please switch to the root user first, and then execute the following command)

```
root@orangepi:~# echo 0 > /sys/class/pwm/pwmchip2/export
root@orangepi:~# echo 20000000 > /sys/class/pwm/pwmchip2/pwm0/period
root@orangepi:~# echo 1000000 > /sys/class/pwm/pwmchip2/pwm0/duty_cycle
root@orangepi:~# echo 1 > /sys/class/pwm/pwmchip2/pwm0/enable
```



8) The test method of pwm14 demonstrated above is similar to other pwm test methods.

3.18.7. CAN test method

Please note that Linux 6.1 systems currently do not support CAN function.

3.18.7.1. How to open CAN

1) As can be seen from the table below, the available CAN bus for Orange Pi 5 Plus is CAN0 and CAN1, a total of two CAN buses

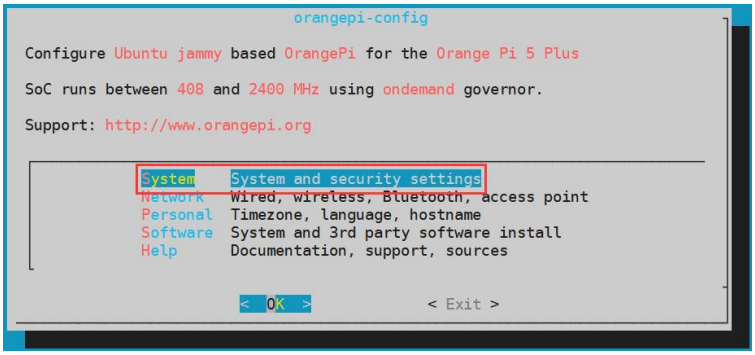
复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) In the linux system, the CAN in the 40 pin is closed by default, and it needs to be opened manually before it can be used. The detailed steps are as follows:

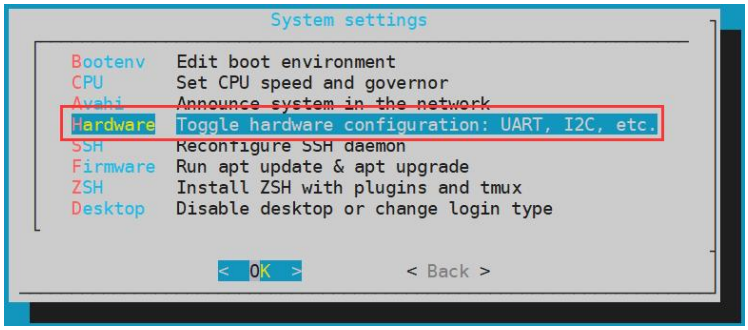
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

b. Then select **System**

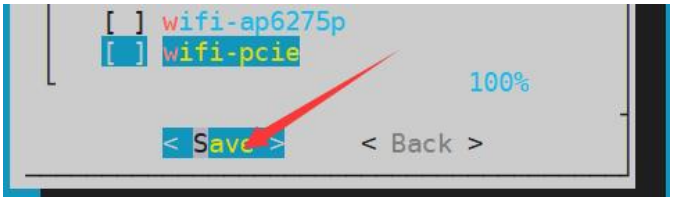


c. Then select **Hardware**

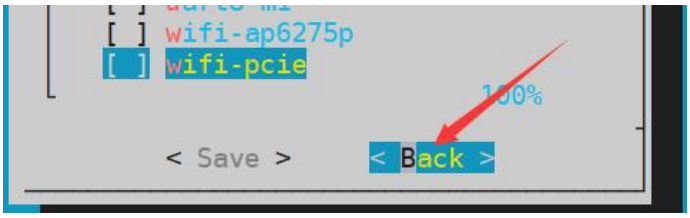


d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the space to select the CAN configuration you want to open (**can0-m0** and **cam1-m0** are optional for OPi 5 Plus)

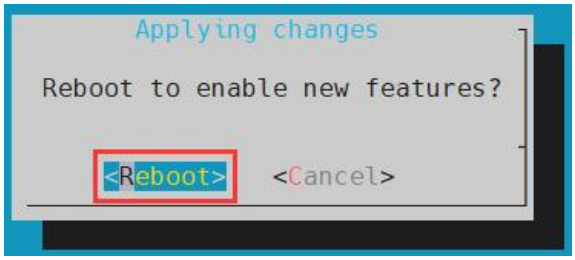
e. Then select **<Save>** to save



f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



3) After entering the Linux system, use the **sudo ifconfig -a** command, if you can see the CAN device node, it means that the CAN has been opened correctly

```
orangepi@orangepi:~$ sudo ifconfig -a
```

```
can0: flags=128<NOARP>  mtu 16
        unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00  txqueuelen 10  (UNSPEC)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 94

can1: flags=128<NOARP>  mtu 16
        unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00  txqueuelen 10  (UNSPEC)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 95
```

4) The corresponding pins of CAN0 and CAN1 are

	CAN0	CAN1
TX pin	**Corresponding to pin 5 of 40pin**	**Corresponding to pin 18 of 40pin**
RX pin	**Corresponding to pin 3 of 40pin**	**Corresponding to pin 16 of 40pin**

3.18.7.2. Use the CANalyst-II analyzer to test sending and receiving messages

1) The CANalyst-II analyzer used in the test is shown in the figure below

2) CANalyst-II analyzer data download link

https://www.zhcxgd.com/3.html

3) First install the software USBCANToolSetup

4) The shortcut after installation of USBCANToolSetup is

5) In addition, you need to install the USB driver

6) The end of the USB interface of the CANalyst-II analyzer needs to be connected to the USB interface of the computer

7) To test the CAN function, you need to prepare a CAN transceiver as shown in the figure below. The main function of the CAN transceiver is to convert the TTL signal of the CAN controller into the differential signal of the CAN bus

a. The 3.3V pin of the CAN transceiver needs to be connected to the 3.3V pin in the 40 pins of the development board

b. The GND pin of the CAN transceiver needs to be connected to the GND pin in

the 40 pin of the development board

c. The CAN TX pin of the CAN transceiver needs to be connected to the TX pin of the CAN bus in the 40 pin of the development board

d. The CAN RX pin of the CAN transceiver needs to be connected to the RX pin of the CAN bus in the 40 pin of the development board

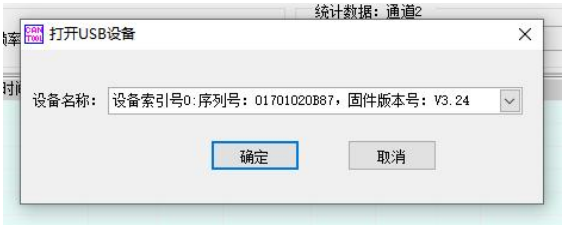
e. The CANL pin of the CAN transceiver needs to be connected to the H interface of the analyzer

f. The CANL pin of the CAN transceiver needs to be connected to the L interface of the analyzer

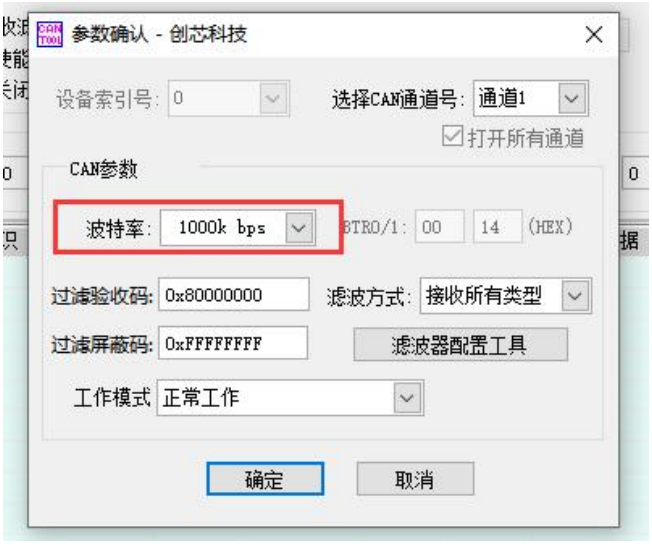
8) Then you can open the USB-CAN software

9) Then click to start the device

10) Then click OK



11) Set the baud rate to 1000k bps



12) After successful opening, the USB-CAN software will display the serial number and other information

13) Development board receives CAN message test

a. a. First set the baud rate of the CAN bus to **1000kbps** in the Linux system of the development board

```
orangepi@orangepi:~$ sudo ip link set can0 down
orangepi@orangepi:~$ sudo ip link set can0 type can bitrate 1000000
orangepi@orangepi:~$ sudo ip link set can0 up
```

b. Then run the **candump can0** command to prepare to receive messages

```
orangepi@orangepi:~$ sudo candump can0
```

c. Then send a message to the development board in the USB-CAN software

d. If the message sent by the analyzer can be received in the development board, it means that the CAN bus can be used normally

```
orangepi@orangepi5plus:~$ sudo candump can0
  can0  001   [8]  01 02 03 04 05 06 07 08
```

14) Development board sends CAN message test

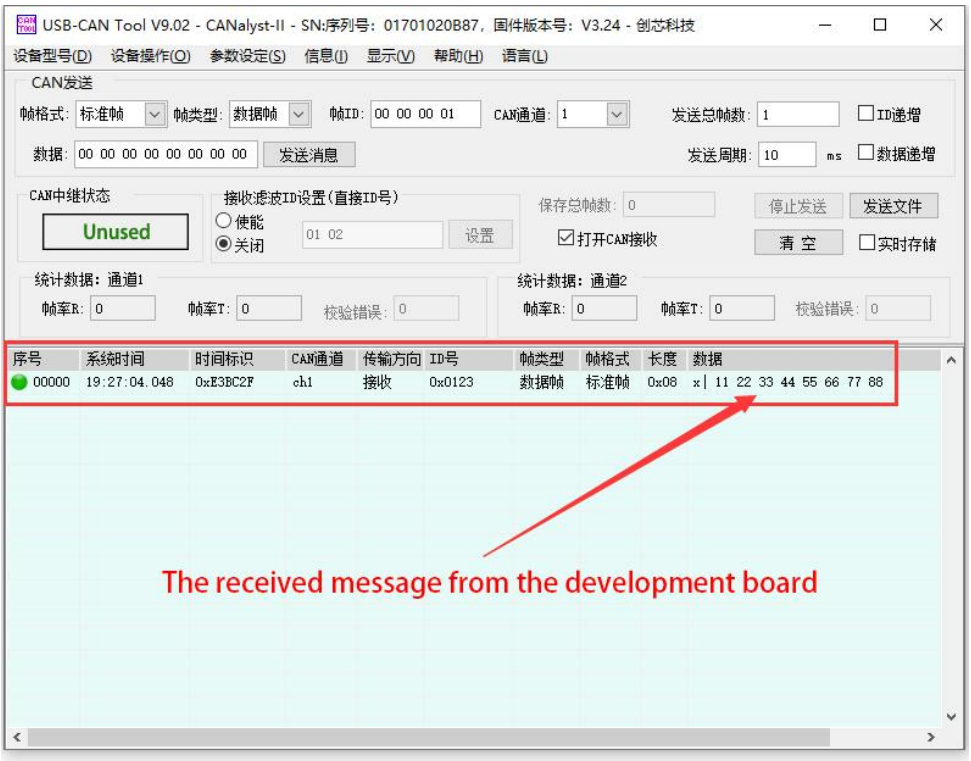
a. a. First set the CAN baud rate to **1000kbps** in the Linux system

```
orangepi@orangepi:~$ sudo ip link set can0 down
orangepi@orangepi:~$ sudo ip link set can0 type can bitrate 1000000
orangepi@orangepi:~$ sudo ip link set can0 up
```

b. Execute the **cansend** command on the development board and send a message

```
orangepi@orangepi:~$ sudo cansend can0 123#1122334455667788
```

c. If the USB-CAN software can receive the message from the development board, the communication is successful

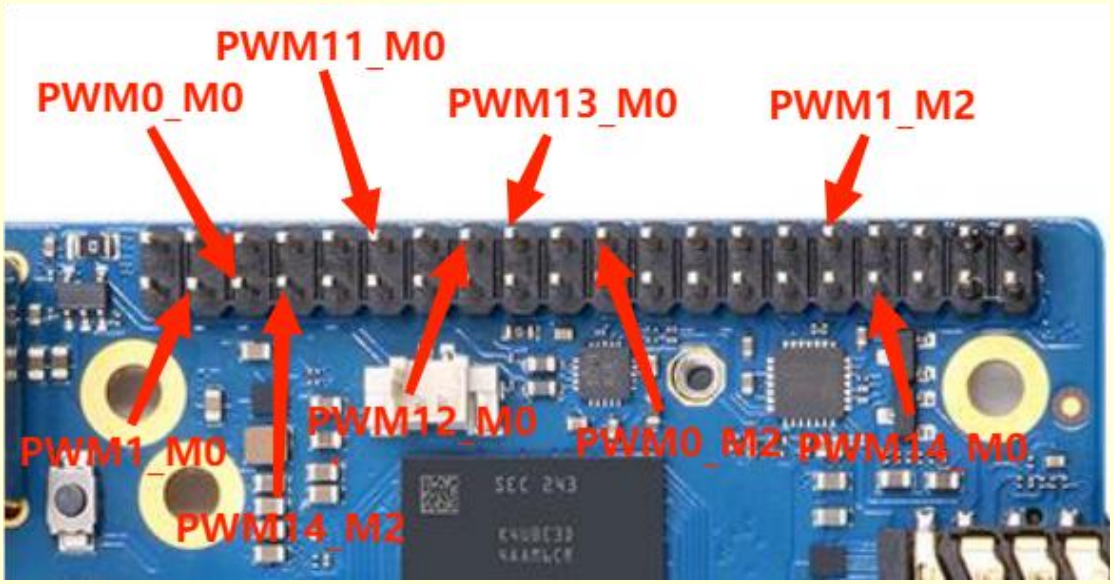


3. 19. Method of using wiringOP hardware PWM

Before using wiringOP to operate PWM, please ensure that wiringOP is installed on the Linux system. If the gpio readall command can be used normally, it means wiringOP has been installed. If prompted that the command cannot be found, please refer to the instructions in the section on installing wiringOP to install wiringOP first.

The development board can use a total of 7 PWM channels, including PWM0, PWM1, PWM10, PWM11, PWM12, PWM13, and PWM14. The pin positions of

these channels are shown in the following figure:



Please be aware of:PWM0_M0 和 PWM0_M2、
PWM1_M0 和 PWM1_M2、
PWM14_M0 和 PWM14_M2

They are all the same PWM, just connected to different pins. If both pin s are configured as PWM functions, when one of the PWM pins is set, the s ame setting will be made to the other PWM pin.

3. 19. 1. Method of setting PWM using the gpio command of wiringOP

3. 19. 1. 1. Set the corresponding pin to PWM mode

1) As can be seen from the following table, there are seven pwm channels available on the development board: pwm0, pwm1, pwm10, pwm11, pwm12, pwm13 and pwm14.

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	33	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	32	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	109	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	110	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

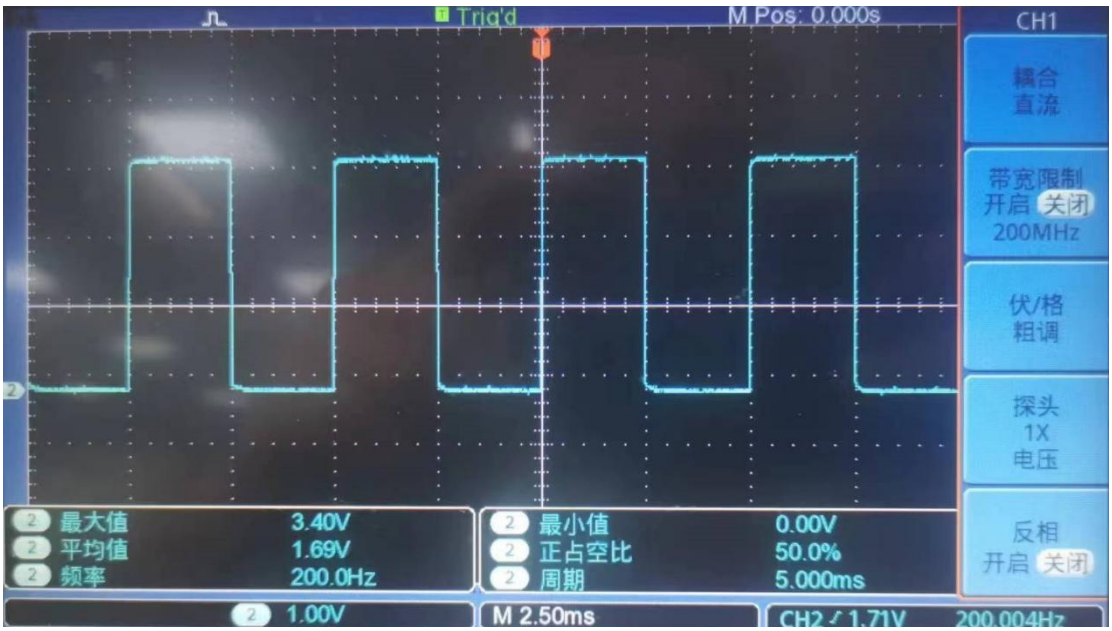
2) The wPi number corresponding to the PWM pin are as follows:

PWM Pin	wPi Serial number	Pin Serial number	GPIO Serial number
PWM0_M0	1	5	15
PWM0_M2	13	22	34
PWM1_M0	0	3	16
PWM1_M2	21	32	35
PWM10_M0	20	31	96
PWM11_M0	6	12	97
PWM12_M0	9	16	109
PWM13_M0	10	18	110
PWM13_M2	17	27	47
PWM14_M0	22	33	114
PWM14_M2	2	7	62

3) The command to set the pin to PWM mode is as follows, take PWM0_M2 as an example, where the third parameter needs to enter the wPi number corresponding to the PWM0_M2 pin.

```
orangepi@orangepi:~$ gpio mode 13 pwm
```

4) After the pin is set to PWM mode, a square wave with a frequency of 200Hz, a period of 5ms, and a duty cycle of 50% will be output by default. At this time, we use an oscilloscope to measure the corresponding PWM pin, and the following waveform can be seen.



3.19.1.2. Methods for Adjusting PWM Frequency

The calculation formula for PWM frequency is as follows:

PWM frequency = clock frequency / (division factor * The value of the periodic register)

IN:

1. The default value for clock frequency is 24000000Hz。

2. The range of values for the frequency division coefficient is even numbers between 2 ~ 512, with a default value of 120. If the set frequency division coefficient is odd, the actual frequency division coefficient is the set value minus one.

3. The default value of the cycle register is 1000。

4. The default value for PWM frequency is 24000000 / (120 * 1000) = 200Hz。

3.19.1.2.1. Method of adjusting PWM frequency by setting the frequency division factor

1) We can use the following command to set the frequency division factor of PWM0_M2 pin to 4.

```
orangepi@orangepi:~$ gpio pwmc 13 4
```

2) According to the above formula, the calculated value of PWM frequency is 6000Hz, and it can be observed that the measured value of PWM frequency is 6010Hz through the oscilloscope, and the error can be ignored.

3. 19. 1. 2. 2. Method of setting PWM frequency directly

1) We can use the **gpio pwmTone** command to set the frequency of the PWM pin, for example, the following command can be used to set the PWM frequency of the PWM0_M2 pin to 500Hz.

```
orangepi@orangepi:~$ gpio pwmTone 13 500
```

When setting the PWM frequency, it is necessary to ensure that:

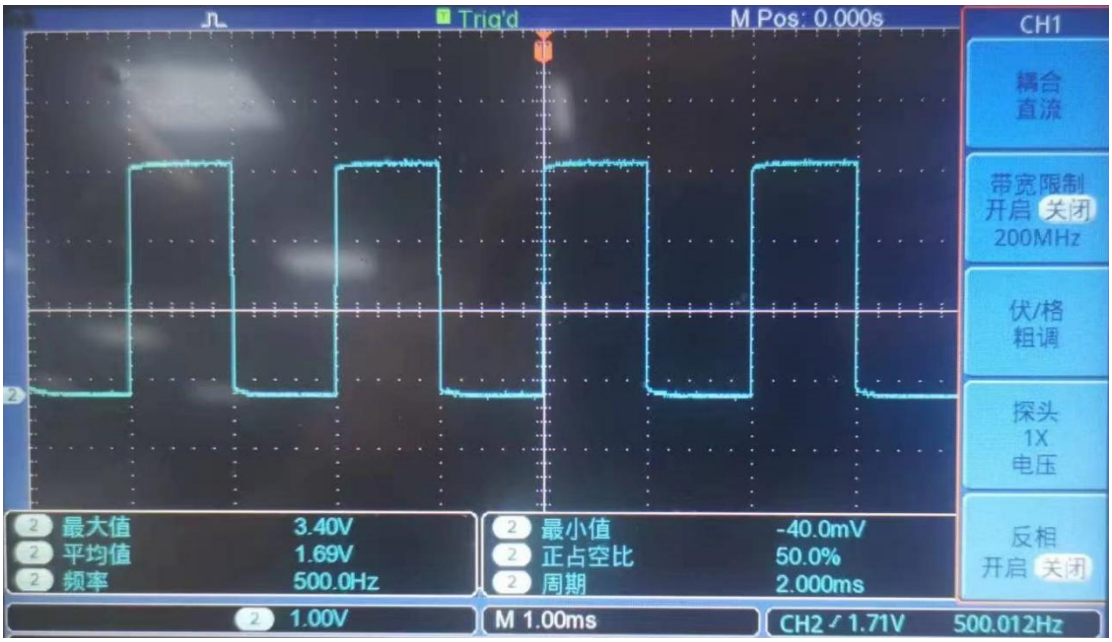
Set frequency value < 24000000 / (division factor * 2)。

For example, the default division factor is 120, and without modifying the division factor, the set frequency value should be less than 100000Hz.

If the setting value is too large, the following error message will appear:

gpio: The PWM frequency you set is too high to be possible

2) Then, through an oscilloscope, it can be observed that the PWM frequency has changed to 500Hz.



3. 19. 1. 3. Methods for Adjusting PWM Duty Cycle

1) The calculation formula for PWM duty cycle is as follows. We can adjust the PWM duty cycle by setting the values of the duty cycle register and the period register.

PWM Duty cycle = The value of the duty cycle register / The value of the periodic register

IN:

The default value of the duty cycle register is 500.

The default value of the cycle register is 1000.

It should be noted that the value of the duty cycle register needs to be smaller than the value of the cycle register, as the duty cycle cannot be greater than 1.

When the value of the duty cycle register is set to be greater than the value of the cycle register, the following error message will be prompted:

gpio: CCR should be less than or equal to ARR (XXX)

When the value of the cycle register is set to be less than the value of the duty

cycle register, the following error message will be prompted:

gpio: ARR should be greater than or equal to CRR (XXX)

2) We can use the following command to set the value of the period register for the PWM0_M2 pin to 2000.

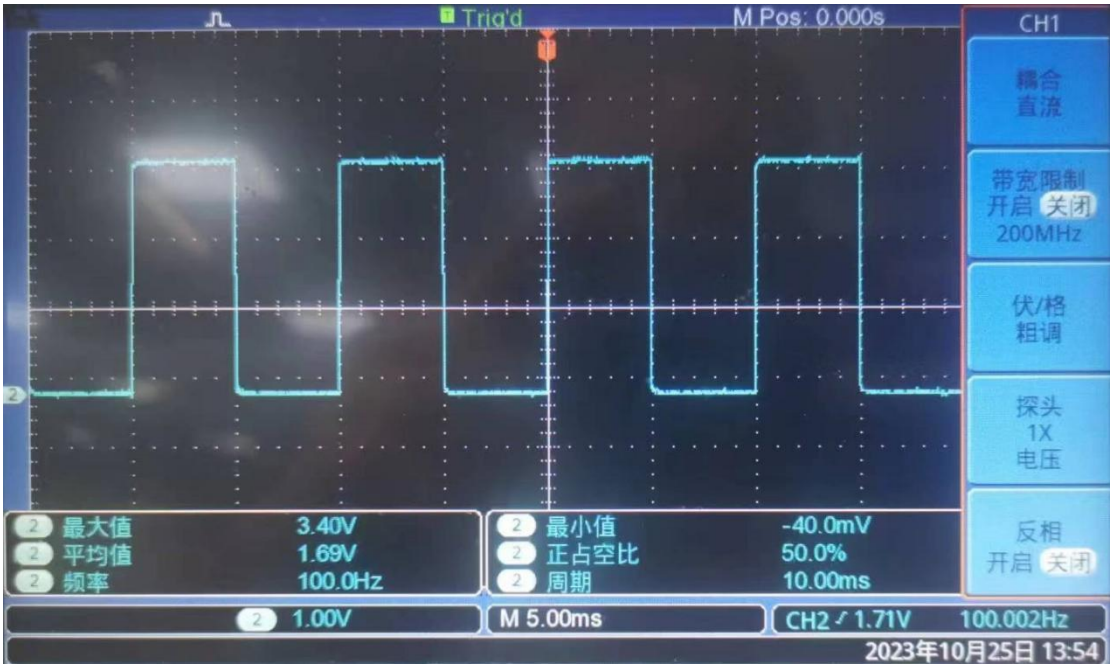
```
orangepi@orangepi:~$ gpio pwmr 13 2000
```

3) After running the above command, it can be observed through the oscilloscope that the PWM duty cycle has changed from the default 50% (500/1000) to 25% (500/2000).

4) We can use the following command to set the duty cycle register value of the PWM0_M2 pin to 1000.

```
orangepi@orangepi:~$ gpio pwm 13 1000
```

5) After running the above command, it can be observed through the oscilloscope that the PWM duty cycle changes from 25% (500/2000) to 50% (1000/2000).



3. 19. 2. Usage of PWM Test Program

1) In the example directory of wiringOP, there is a program called pwm.c that demonstrates the use of PWM related API in wiringOP to operate PWM.

```
orangepi@orangepi:~$ cd /usr/src/wiringOP/examples/
orangepi@orangepi:/usr/src/wiringOP/examples$ ls pwm.c
pwm.c
```

2) The command to compile **pwm.c** into an executable program is as follows:

```
orangepi@orangepi:/usr/src/wiringOP/examples$ gcc -o pwm pwm.c -lwiringPi
```

3) Then you can execute the PWM test program. When executing the PWM test program, you need to specify the PWM pin. For example, you can use the following command to test the PWM0_M2 pin:

```
orangepi@orangepi:/usr/src/wiringOP/examples$ sudo ./pwm 13
```

4) After the pwm program is executed, the following contents will be tested sequentially:

a. Adjust the PWM duty cycle by setting the value of the cycle register.
b. Adjust the PWM duty cycle by setting the value of the duty cycle register.
c. Adjust the PWM frequency by setting the division factor.
d. Directly set the PWM frequency.

5) After completing each test, the output of pwm waveform will be stopped for 5 seconds. After completing all test contents, a new round of testing will be restarted.

6) The detailed execution process of the PWM test program is as follows:

a. By setting the value of the cycle register to adjust the PWM duty cycle: Through an oscilloscope, it can be observed that the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 50% to 25% and remains for 5 seconds. Then, the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 25% to 50% and remains for 5 seconds.

b. By setting the value of the duty cycle register to adjust the PWM duty cycle: The oscilloscope can observe that the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 50% to 100% and remains for 5 seconds. Then, the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 100% to 50% and remains for 5 seconds.

c. By setting the frequency division coefficient to adjust the PWM frequency: Through an oscilloscope, it can be observed that the PWM waveform changes every 0.5 seconds. After 9 changes, the PWM frequency will change from 2000Hz to 200Hz and remain for 5 seconds. Then, the PWM waveform changes every 0.5 seconds. After 9 changes, the PWM frequency will change again to 2000Hz and remain for 5 seconds.

d. Directly setting the PWM frequency: Through the oscilloscope, it can be observed that the PWM frequency first changes to 2000Hz, and then increases by 2000Hz every two seconds. After 9 changes, the PWM frequency changes to 20000Hz and remains for 5 seconds.

3. 20. How to install and use wiringOP-Python

wiringOP-Python is the Python language version of wiringOP, which is used to operate the hardware resources of the development board, such as GPIO, I2C, SPI and UART, in the Python program.

In addition, please note that all the following commands are operated under the

root user.

3. 20. 1. How to install wiringOP-Python

1) First install the dependency package

```
root@orangepi:~# sudo apt-get update
root@orangepi:~# sudo apt-get -y install git swig python3-dev python3-setuptools
```

2) Then use the following command to download the source code of wiringOP-Python

Note that the following git clone --recursive command will automatically download the source code of wiringOP, because wiringOP-Python depends on wiringOP. Please make sure that the download process does not report errors due to network problems.

If you have problems downloading the code from GitHub, you can directly use the wiringOP-Python source code that comes with the Linux image, and the storage location is: /usr/src/wiringOP-Python。

```
root@orangepi:~# git clone --recursive https://github.com/orangepi-xunlong/wiringOP-Python -b next
root@orangepi:~# cd wiringOP-Python
root@orangepi:~/wiringOP-Python# git submodule update --init --remote
```

3) Then use the following command to compile wiringOP-Python and install it into the Linux system of the development board

```
root@orangepi:~# cd wiringOP-Python
root@orangepi:~/wiringOP-Python# python3 generate-bindings.py > bindings.i
root@orangepi:~/wiringOP-Python# sudo python3 setup.py install
```

4) Then enter the following command, if there is help information output, it means that wiringOP-Python is installed successfully, press the **q** key to exit the help information interface

```
root@orangepi:~/wiringOP-Python# python3 -c "import wiringpi;  help(wiringpi)"
Help on module wiringpi:

NAME
    wiringpi

DESCRIPTION
```

```
    # This file was automatically generated by SWIG (http://www.swig.org).
    # Version 4.0.2
    #
    # Do not make changes to this file unless you know what you are doing--modify
    # the SWIG interface file instead.
```

5) The steps to test whether wiringOP-Python is successfully installed under the python command line are as follows:

a. First use the python3 command to enter the command line mode of python3

```
root@orangepi:~# python3
```

b. Then import the python module of wiringpi

```
>>> import wiringpi;
```

c. Finally, enter the following command to view the help information of wiringOP-Python, and press the q key to exit the help information interface

```
>>> help(wiringpi)
Help on module wiringpi:

NAME
    wiringpi

DESCRIPTION
    # This file was automatically generated by SWIG (http://www.swig.org).
    # Version 4.0.2
    #
    # Do not make changes to this file unless you know what you are doing--modify
    # the SWIG interface file instead.

CLASSES
    builtins.object
        GPIO
        I2C
        Serial
        nes

    class GPIO(builtins.object)
```

```
    |   GPIO(pinmode=0)
    |


>>>
```

3. 20. 2. 40 pin GPIO port test

wiringOP-Python is the same as wiringOP, you can also determine which GPIO pin to operate by specifying the wPi number, because there is no command to check the wPi number in wiringOP-Python, so you can only check the board wPi number and physical Correspondence between pins.

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |   PWM14  |     IN | 1 |  7 || 8  | 0 |   IN   | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 |   IN   | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 |   IN   | GPIO3_A1 | 6   | 97   |
 |   39 |   7 | GPIO1_A7 |     IN | 1 | 13 || 14 |   |        | GND      |     |      |
 |   40 |   8 | GPIO1_B0 |     IN | 1 | 15 || 16 | 1 |   IN   | GPIO3_B5 | 9   | 109  |
 |      |     |     3.3V |        |   | 17 || 18 | 0 |   IN   | GPIO3_B6 | 10  | 110  |
 |   42 |  11 | SPI0_TXD |     IN | 0 | 19 || 20 |   |        | GND      |     |      |
 |   41 |  12 | SPI0_RXD |     IN | 0 | 21 || 22 | 0 |   IN   | GPIO1_A2 | 13  | 34   |
 |   43 |  14 | SPI0_CLK |     IN | 0 | 23 || 24 | 1 |   IN   | SPI0_CS0 | 15  | 44   |
 |      |     |      GND |        |   | 25 || 26 | 1 |   IN   | SPI0_CS1 | 16  | 45   |
 |   47 |  17 | GPIO1_B7 |     IN | 1 | 27 || 28 | 1 |   IN   | GPIO1_B6 | 18  | 46   |
 |   63 |  19 | GPIO1_D7 |     IN | 1 | 29 || 30 |   |        | GND      |     |      |
 |   96 |  20 | GPIO3_A0 |     IN | 1 | 31 || 32 | 0 |   IN   | GPIO1_A3 | 21  | 35   |
 |  114 |  22 | GPIO3_C2 |     IN | 0 | 33 || 34 |   |        | GND      |     |      |
 |   98 |  23 | GPIO3_A2 |     IN | 1 | 35 || 36 | 0 |   IN   | GPIO3_A5 | 24  | 101  |
 |  113 |  25 | GPIO3_C1 |     IN | 0 | 37 || 38 | 0 |   IN   | GPIO3_A4 | 26  | 100  |
 |      |     |      GND |        |   | 39 || 40 | 1 |   IN   | GPIO3_A3 | 27  | 99   |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
orangepi@orangepi5plus:~$
```

1) The following takes pin No. 7 — the corresponding GPIO is GPIO1_D6 — the corresponding wPi number is 2—as an example to demonstrate how to set the high and low levels of the GPIO port

```
orangepi@orangepi5plus:~$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |   PWM14  |     IN | 1 |  7 || 8  | 0 |   IN   | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 |   IN   | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 |   IN   | GPIO3_A1 | 6   | 97   |
```

2) The steps to test directly with the command are as follows:

a. First set the GPIO port to output mode, where the first parameter of the **pinMode** function is the serial number of the wPi corresponding to the pin, and

the second parameter is the GPIO mode

```
root@orangepi:~/wiringOP-Python# python3 -c "import wiringpi; \
from wiringpi import GPIO; wiringpi.wiringPiSetup() ; \
wiringpi.pinMode(2, GPIO.OUTPUT) ;  "
```

b. Then set the GPIO port to output a low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 0v, it means that the low level is set successfully.

```
root@orangepi:~/wiringOP-Python# python3 -c "import wiringpi; \
 from wiringpi import GPIO; wiringpi.wiringPiSetup() ;\
wiringpi.digitalWrite(2, GPIO.LOW)"
```

c. Then set the GPIO port to output a high level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 3.3v, it means that the high level is set successfully.

```
root@orangepi:~/wiringOP-Python# python3 -c "import wiringpi; \
 from wiringpi import GPIO; wiringpi.wiringPiSetup() ;\
wiringpi.digitalWrite(2, GPIO.HIGH)"
```

3) The steps to test in the command line of python3 are as follows:

a. First use the python3 command to enter the command line mode of python3

```
root@orangepi:~# python3
```

b. Then import the python module of wiringpi

```
>>> import wiringpi
>>> from wiringpi import GPIO
```

c. Then set the GPIO port to output mode, where the first parameter of the **pinMode** function is the serial number of the wPi corresponding to the pin, and the second parameter is the GPIO mode

```
>>> wiringpi.wiringPiSetup()
0
>>> wiringpi.pinMode(2, GPIO.OUTPUT)
```

d. Then set the GPIO port to output low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 0v, it means that the low level is set successfully.

```
>>> wiringpi.digitalWrite(2, GPIO.LOW)
```

e. Then set the GPIO port to output a high level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 3.3v, it means that the

high level is set successfully.

```
>>> wiringpi.digitalWrite(2, GPIO.HIGH)
```

4) The method of wiringOP-Python setting GPIO high and low levels in python code can refer to the **blink.py** test program in the examples below. The **blink.py** test program will set the voltage of all GPIO ports in the 40 pins of the development board to change continuously.

```
root@orangepi:~/wiringOP-Python# cd examples
root@orangepi:~/wiringOP-Python/examples# ls blink.py
blink.py
root@orangepi:~/wiringOP-Python/examples# python3 blink.py
```

3. 20. 3. 40 pin SPI test

1) As can be seen from the figure below, the SPIs available for Orange Pi 5 Plus are SPI0 and SPI4

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins of SPI0 and SPI4 in 40pin are shown in the table below. SPI4_M1 and SPI4_M2 can only use one of them at the same time, and they cannot be used at the same time. They are all the same SPI4, but they are connected to different pins. Please don't think that they are two different sets of SPI buses.

	SPI0_M2 corresponds to 40pin	**SPI4_M1 corresponds to 40pin**	**SPI4_M2 corresponds to 40pin**
MOSI	**Pin 19**	**Pin 12**	**Pin 8**
MISO	**Pin 21**	**Pin 31**	**Pin 10**
CLK	**Pin 23**	**Pin 35**	**Pin 22**
CS0	**Pin 24**	**Pin 40**	**Pin 31**
CS1	**Pin 26**	**Pin 38**	**none**
dtbo configuration	**spi0-m2-cs0-spidev spi0-m2-cs1-spidev**	**spi4-m1-cs0-spidev spi4-m1-cs1-spidev**	**spi4-m2-cs0-spidev**

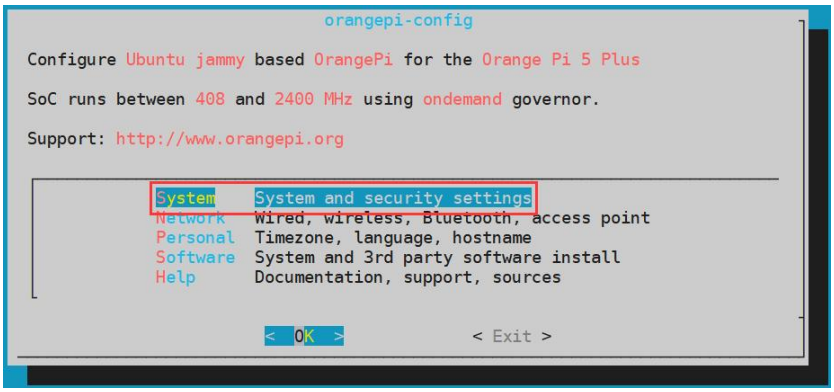
	spi0-m2-cs0-cs1-spidev	**spi4-m1-cs0-cs1-spidev**	

3) In the linux system, the SPI in the 40 pin is closed by default, and it needs to be opened manually before it can be used. The detailed steps are as follows:

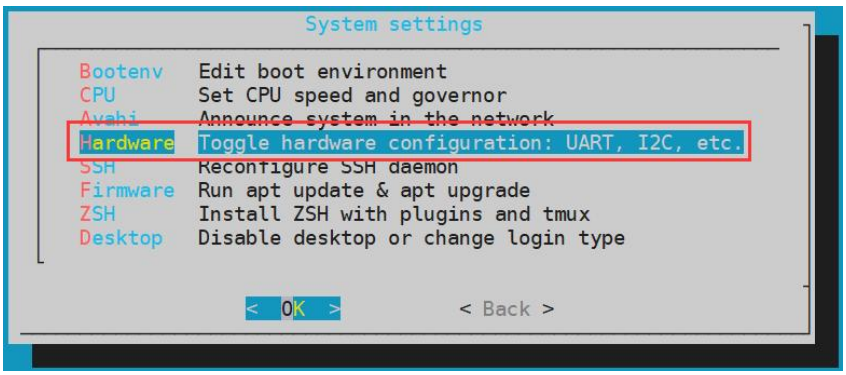
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

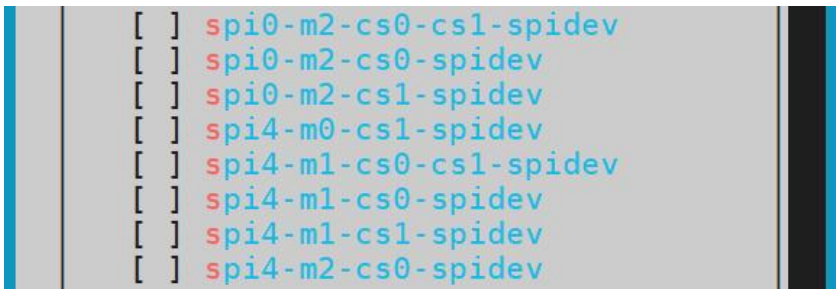
b. Then select **System**



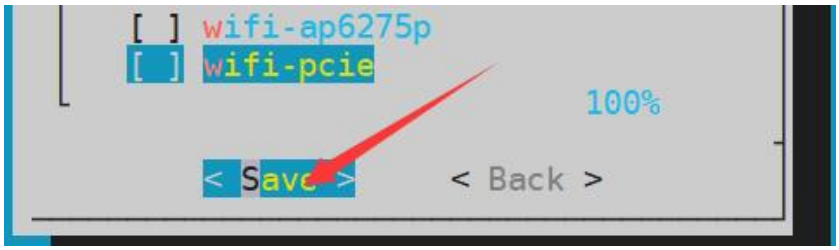
c. Then select **Hardware**



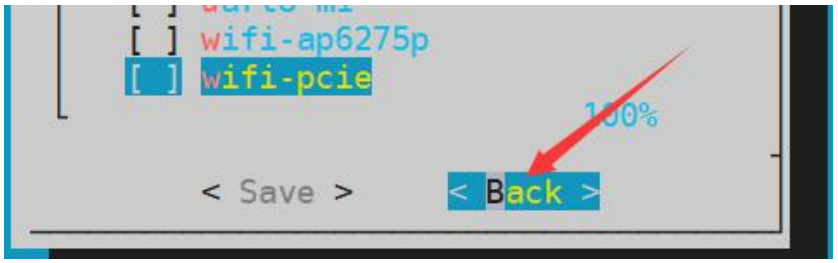
d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the space to select the SPI configuration you want to open



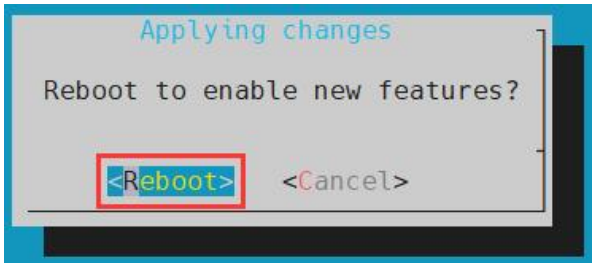
e. Then select **<Save>** to save



f. Then select **<Back>**



g. g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) After restarting, enter the system and first check whether there is a **spidevx.x** device node in the linux system. If it exists, it means that the SPI has been set up and can be used directly.

```
orangepi@orangepi:~$ ls /dev/spidev*
/dev/spidev0.0  /dev/spidev0.1  /dev/spidev4.0  /dev/spidev4.1
```

The above is the result displayed after turning on spi0-m2-cs0-cs1-spidev and spi4-m1-cs0-cs1-spidev.

5) Then you can use the **spidev_test.py** program in the examples to test the loopback function of the SPI. The **spidev_test.py** program needs to specify the following two parameters:

a. **--channel**: Specify the channel number of SPI

b. **--port**: specify the port number of SPI

6) Do not short-circuit the MOSI and MISO pins of the SPI, the output of running **spidev_test.py** is as follows, you can see that the data of TX and RX are inconsistent

The x after the --channel and --port parameters needs to be replaced with the channel number of the specific SPI and the port number of the SPI.

```
root@orangepi:~/wiringOP-Python# cd examples
root@orangepi:~/wiringOP-Python/examples# python3 spidev_test.py --channel x --port x
spi mode: 0x0
max speed: 500000 Hz (500 KHz)
Opening device /dev/spidev4.1
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF F0 0D    |......@..........|
RX | FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF    |.................|
```

7) Then use the Dupont wire to short-circuit the MOSI and MISO pins of the SPI, and then run the output of spidev_test.py as follows, you can see that the data sent and received are the same, indicating that the SPI loopback test is normal

The x after the --channel and --port parameters needs to be replaced with the channel number of the specific SPI and the port number of the SPI.

```
root@orangepi:~/wiringOP-Python# cd examples
root@orangepi:~/wiringOP-Python/examples# python3 spidev_test.py --channel x --port x
spi mode: 0x0
max speed: 500000 Hz (500 KHz)
Opening device /dev/spidev4.1
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF F0 0D    |......@..........|
RX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF F0 0D    |......@..........|
```

3. 20. 4. 40 pin I2C test

1) As can be seen from the table below, the available i2c for Orange Pi 5 Plus is i2c2, i2c4, i2c5 and i2c8, a total of four sets of i2c buses.

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) 4 组 I2C 总线在 40pin 中对应的引脚如下表所示。I2C2_M0 和 I2C2_M4 同一时间只 The corresponding pins of the 4 groups of I2C buses in 40pin are shown in the table below. I2C2_M0 and I2C2_M4 can only use one of them at the same time, and they cannot be used at the same time. They are all the same I2C2, but they are connected to different pins. Please don’t think that they are two different sets of I2C2 buses.

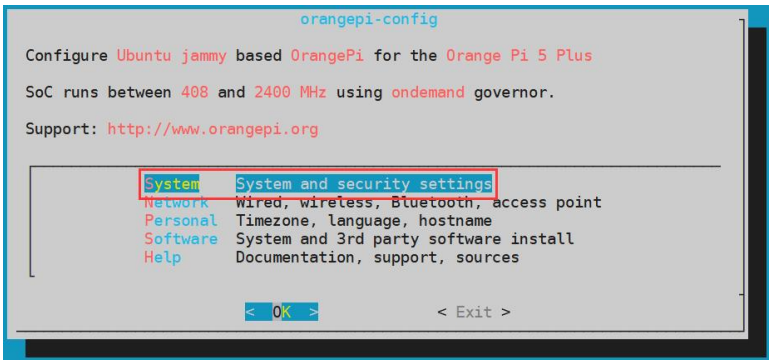
I2C bus	SDA corresponds to 40pin	SCL corresponds to 40pin	dtbo corresponding configuration
I2C2_M0	Pin 3	Pin 5	i2c2-m0
I2C2_M4	Pin 10	Pin 8	i2c2-m4
I2C4_M3	Pin 22	Pin 32	i2c4-m3
I2C5_M3	Pin 27	Pin 28	i2c5-m3
I2C8_M2	Pin 29	Pin 7	i2c8-m2

3) In the linux system, the I2C bus in the 40 pin is closed by default, and it needs to be opened manually before it can be used. The detailed steps are as follows:

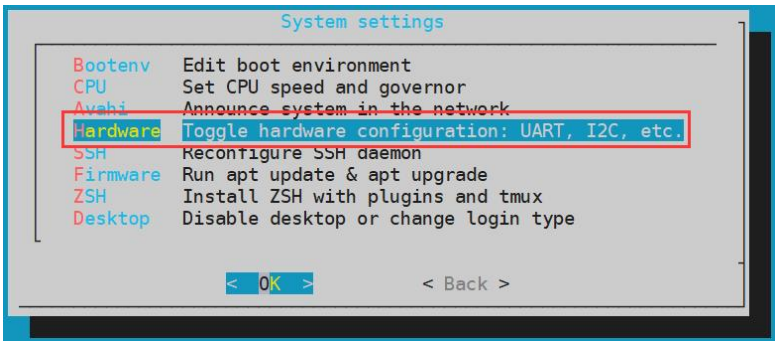
a. First run **orangepi-config**, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

b. Then select **System**

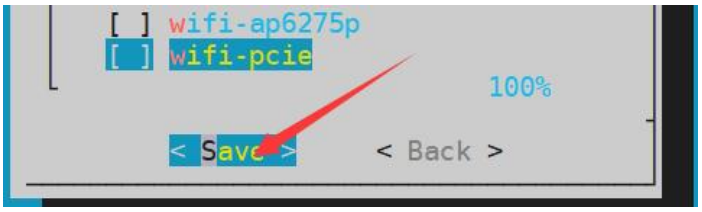


c. Then select **Hardware**

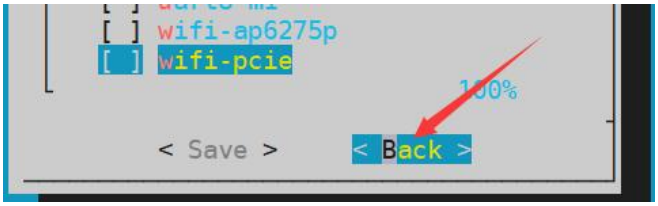


d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the space to select the I2C configuration you want to open

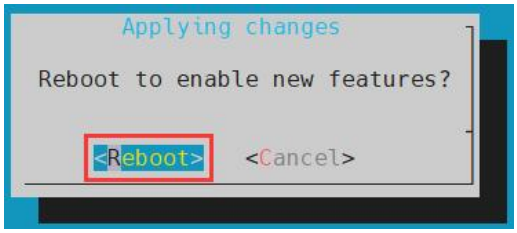
e. Then select **<Save>** to save



f. Then select **<Back>**



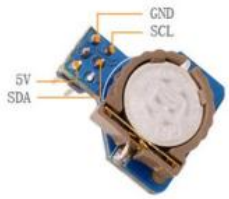
g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) After starting the linux system, first confirm that there is a device node corresponding to i2c under **/dev**

```
orangepi@orangepi:~$ ls /dev/i2c-*
```

5) Then connect an i2c device to the i2c pin of the 40 pin connector, here we take the ds1307 RTC module as an example



6) Then use the **i2cdetect -y** command, if the address of the connected i2c device can be detected, it means that i2c can be recognized normally.

```
orangepi@orangepi:~$ sudo i2cdetect -y 2      #i2c2 command
orangepi@orangepi:~$ sudo i2cdetect -y 4      #i2c4 command
orangepi@orangepi:~$ sudo i2cdetect -y 5      #i2c5 command
orangepi@orangepi:~$ sudo i2cdetect -y 8      #i2c8 command
```

7) Then you can run the **ds1307.py** test program in the **wiringOP-Python/examples** file to read the time of RTC

/dev/i2c-x needs to be replaced with the serial number of the specific i2c device node.

```
root@orangepi:~/wiringOP-Python# cd examples
root@orangepi:~/wiringOP-Python/examples# python3 ds1307.py --device "/dev/i2c-x"
Thu 2023-01-05  14:57:55
Thu 2023-01-05  14:57:56
Thu 2023-01-05  14:57:57
^C
exit
```

3. 20. 5. 40 pin UART test

1) As can be seen from the table below, the uarts available for Orange Pi 5 Plus are uart1, uart3, uart4, uart6, uart7 and uart8, a total of 6 sets of uart buses

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins of the 6 groups of UART buses in 40pin are shown in the following table:

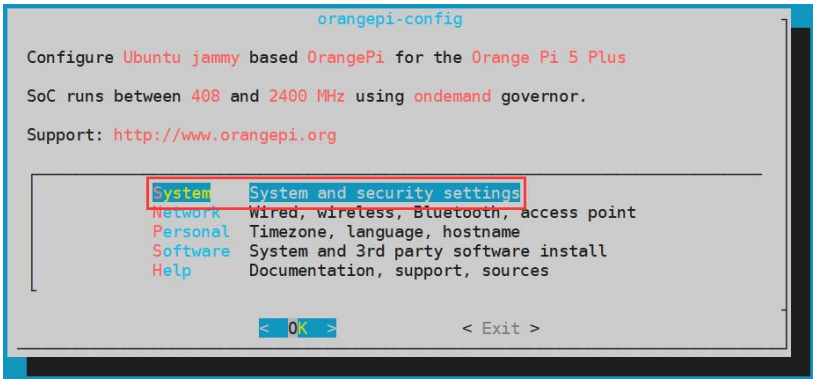
UART bus	RX` corresponds to 40pin	TX corresponds to 40pin	dtbo corresponding configuration
UART1_M1	**Pin 27**	**Pin 28**	**uart1-m1**
UART3_M1	**Pin 18**	**Pin 16**	**uart3-m1**
UART4_M2	**Pin 19**	**Pin 23**	**uart4-m2**
UART6_M1	**Pin 10**	**Pin 8**	**uart6-m1**
UART7_M2	**Pin 24**	**Pin 26**	**uart7-m2**
UART8_M1	**Pin 40**	**Pin 35**	**uart8-m1**

3) In the linux system, the UART in the 40 pins is closed by default, and it needs to be opened manually before it can be used. The detailed steps are as follows:

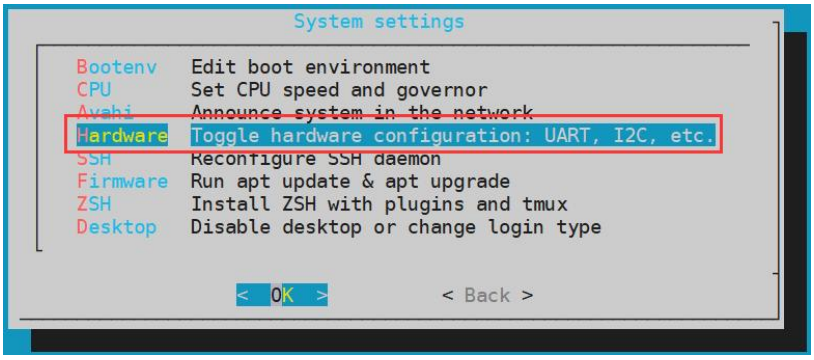
a. First run **orangepi-confi**g, normal users remember to add **sudo** permission

```
orangepi@orangepi:~$ sudo orangepi-config
```

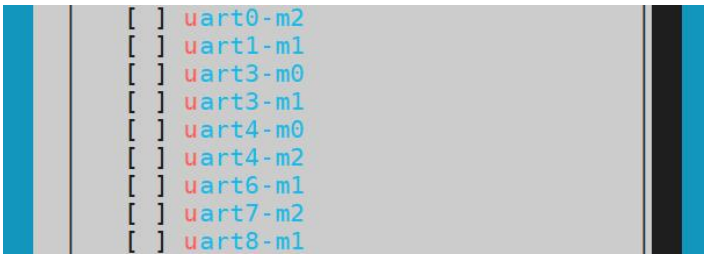
b. Then select **System**



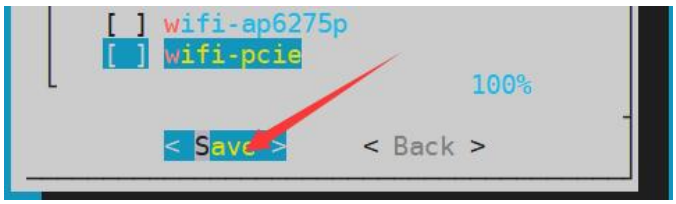
c. Then select **Hardware**



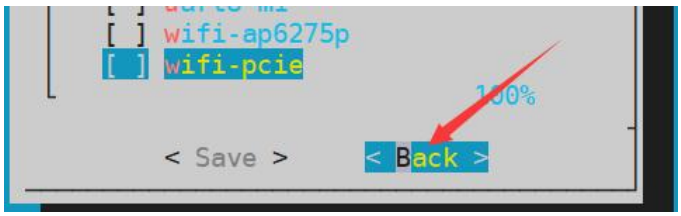
d. Then use the arrow keys on the keyboard to navigate to the position shown in the figure below, and then use the **space** to select the UART configuration you want to open



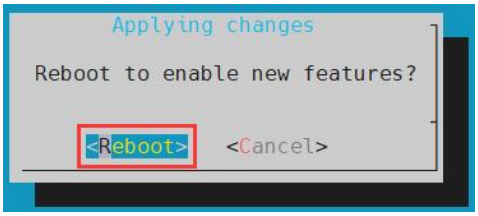
e. Then select **<Save>** to save



f. Then select **<Back>**



g. Then select **<Reboot>** to restart the system to make the configuration take effect



4) After entering the linux system, first confirm whether there is a device node corresponding to uart under /dev

```
orangepi@orangepi:~$ ls /dev/ttyS*
```

5) Then start to test the uart interface, first use the DuPont line to short the rx and tx pins of the uart interface to be tested

6) Then use the **serialTest.py** program in **wiringOP-Python/examples** to test the loopback function of the serial port. As shown below, if you can see the print below, it means the serial port communication is normal.

/dev/ttySX needs to be replaced with the serial number of the specific uart device node.

```
root@orangepi:~/wiringOP-Python/examples# python3 serialTest.py --device "/dev/ttySX"
Out:    0: ->    0
Out:    1: ->    1
Out:    2: ->    2
Out:    3: ->    3
Out:    4:^C
exit
```

3.21. Hardware watchdog test

The watchdog_test program is pre-installed in the linux system released by Orange Pi, which can be tested directly.

The method to run the watchdog_test program is as follows:

a. The second parameter 10 indicates the counting time of the watchdog. If the dog is not fed within this time, the system will restart

b. We can feed the dog by pressing any key on the keyboard (except ESC). After feeding the dog, the program will print a line of keep alive to indicate that the dog is fed successfully

```
orangepi@orangepi:~$ sudo watchdog_test 10
open success
options is 33152,identity is sunxi-wdt
put_usr return,if 0,success:0
The old reset time is: 16
return ENOTTY,if -1,success:0
```

```
return ENOTTY,if -1,success:0
put_user return,if 0,success:0
put_usr return,if 0,success:0
keep alive
keep alive
keep alive
```

3. 22. Check the serial number of RK3588 chip

The command to view the serial number of the RK3588 chip is as follows. The serial number of each chip is different, so the serial number can be used to distinguish multiple development boards.

```
orangepi@orangepi:~$ cat_serial.sh
Serial          : 1404a7682e86830c
```

3. 23. How to install Docker

1) The linux image provided by Orange Pi has pre-installed Docker, but the Docker service is not enabled by default

2) Use the **enable_docker.sh** script to enable the docker service, and then you can start using the docker command, and the docker service will be automatically started when the system is started next time

```
orangepi@orangepi:~$ enable_docker.sh
```

3) Then you can use the following command to test docker, if you can run hello-world, it means that docker can be used normally

```
orangepi@orangepi:~$ docker run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
256ab8fe8778: Pull complete
Digest:
sha256:7f0a9f93b4aa3022c3a4c147a449ef11e0941a1fd0bf4a8e6c9408b2600777c5
Status: Downloaded newer image for hello-world:latest
```

```
Hello from Docker!
This message shows that your installation appears to be working correctly.
.....
```

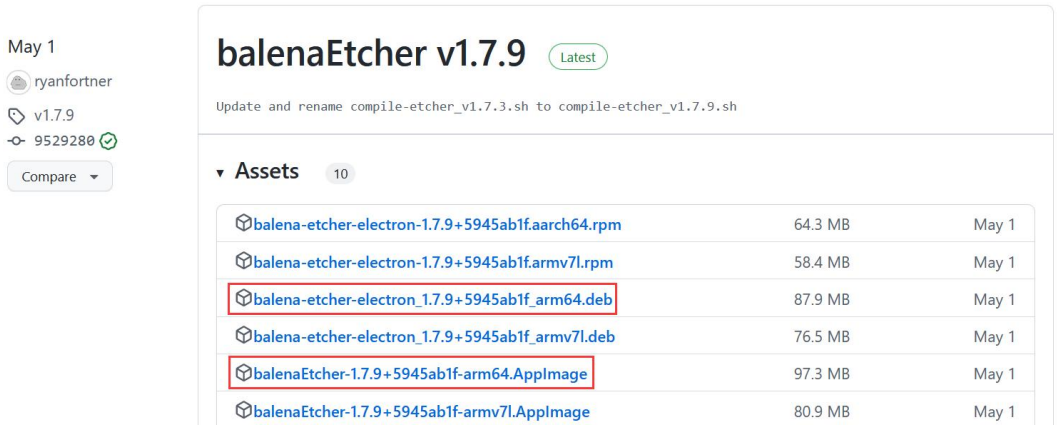
3. 24. How to download and install arm64 version balenaEtcher

1) The download address of balenaEtcher arm64 version is:
   a. The download address of the a.deb installation package is as follows, it needs to be installed before it can be used

```
https://github.com/Itai-Nelken/BalenaEtcher-arm/releases/download/v1.7.9/balena-etcher-electron_1.7.9+5945ab1f_arm64.deb
```

   b. The download address of the AppImage version that does not need to be installed is as follows: b. The download address of the AppImage version that does not need to be installed is as follows:

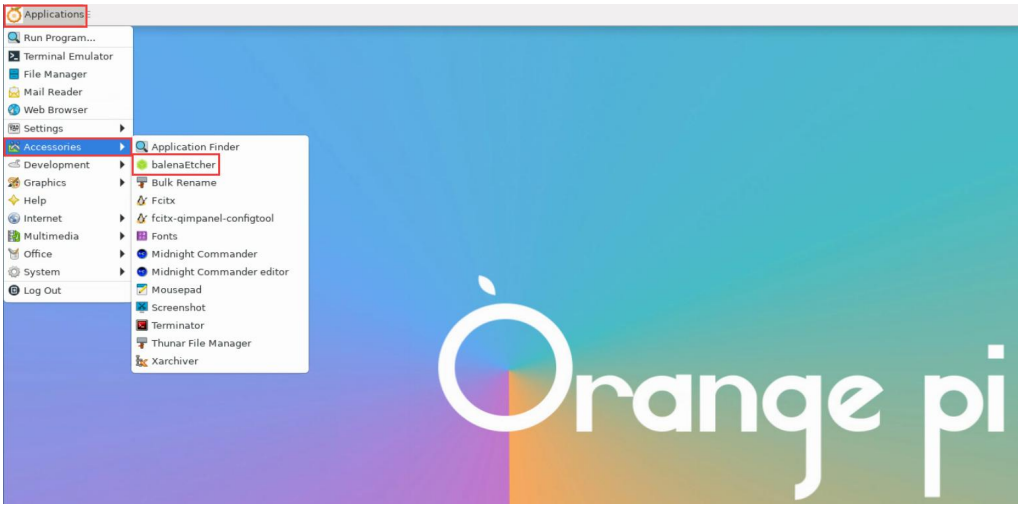
```
https://github.com/Itai-Nelken/BalenaEtcher-arm/releases/download/v1.7.9/balenaEtcher-1.7.9+5945ab1f-arm64.AppImage
```



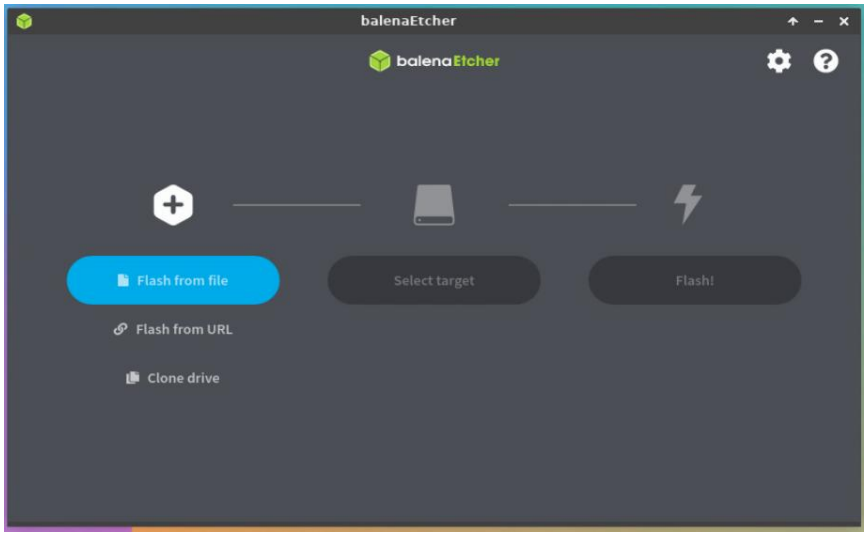
2) How to install and use deb version balenaEtcher:
   a. The deb version of balenaEtcher installation command is as follows:

```
orangepi@orangepi:~$ sudo apt install -y  \
--fix-broken ./balena-etcher-electron_1.7.9+5945ab1f_arm64.deb
```

   b. After the deb version of balenaEtcher is installed, it can be opened in the Application



c. The interface after balenaEtcher is opened is as follows:

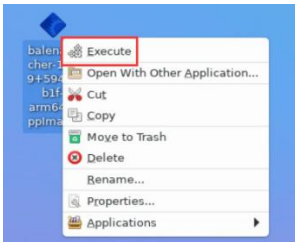


3) How to use the AppImage version of balenaEtcher:

a. First add permissions to balenaEtcher

```
orangepi@orangepi:~/Desktop$ chmod +x balenaEtcher-1.7.9+5945ab1f-arm64.AppImage
```

b. Then select the AppImage version balenaEtcher, click the right mouse button, and then click Execute to open balenaEtcher



3. 25. The installation method of the pagoda linux panel

Pagoda Linux panel is a server management software that improves operation and maintenance efficiency. It supports more than 100 server management functions such as one -click LAMP/LNMP/cluster/monitoring/website/FTP/database/Java (extracted from the official website of the pagoda)

1) The order of compatibility recommendation of the pagoda Linux system is

```
Debian11 > Ubuntu 22.04> Debian12
```

2) Then enter the following command in the Linux system to start the installation of the pagoda

```
orangepi@orangepi:~$ sudo install_bt_panel.sh
```

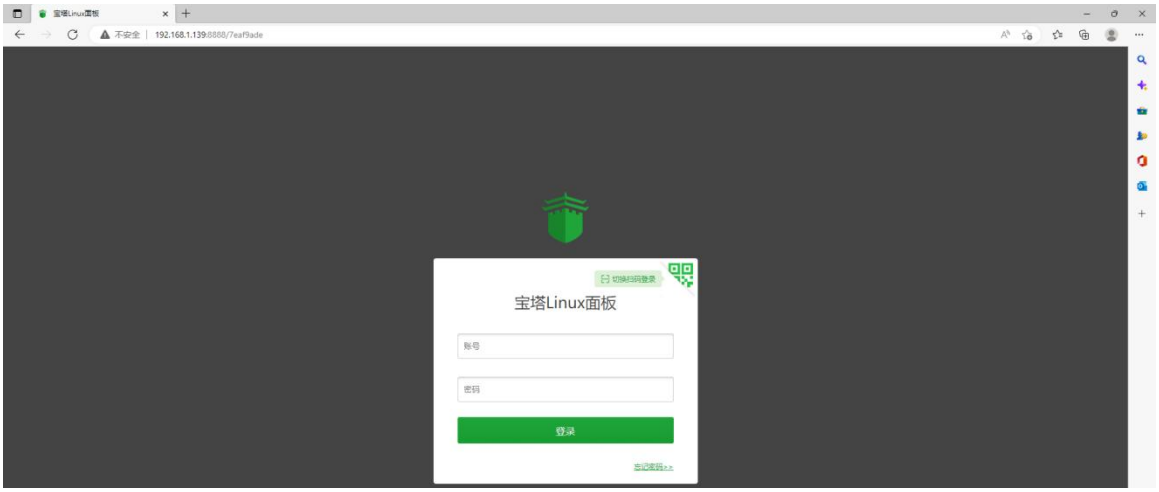
3) Then the pagoda installation program reminds whether to install the **BT-Panel** to the **/www** folder, and enter Y at this time

```
+----------------------------------------------------------------------
| Bt-WebPanel FOR CentOS/Ubuntu/Debian
+----------------------------------------------------------------------
| Copyright © 2015-2099 BT-SOFT(http://www.bt.cn) All rights reserved.
+----------------------------------------------------------------------
| The WebPanel URL will be http://SERVER_IP:8888 when installed.
+----------------------------------------------------------------------

Do you want to install Bt-Panel to the /www directory now?(y/n): y
```

4) Then what to do is to wait patiently. When you see the printing information below the terminal output, it means that the pagoda has been installed. The entire installation process takes about 9 minutes. There may be some differences according to the difference in network speed

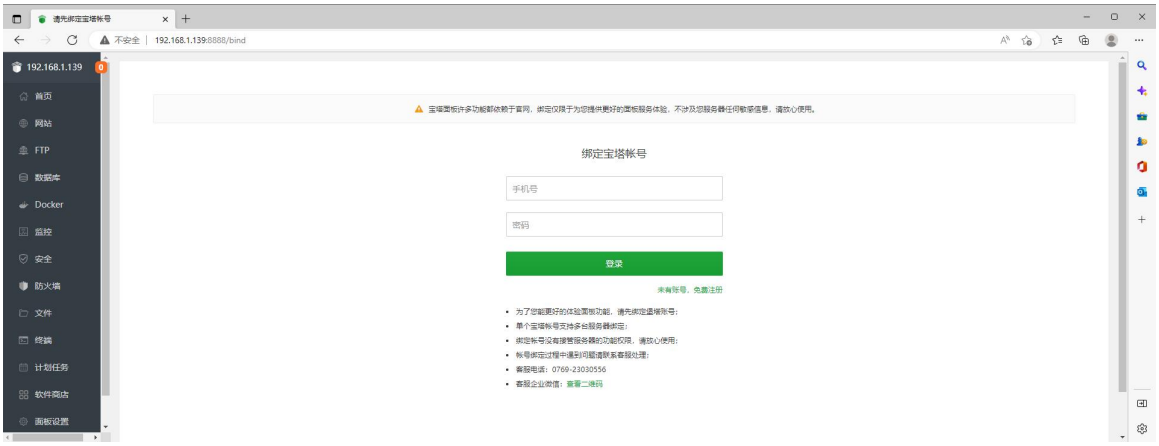
```
Skipping adding existing rule
Skipping adding existing rule (v6)
Rules updated
Rules updated (v6)
Firewall is active and enabled on system startup
Default incoming policy changed to 'deny'
(be sure to update your rules accordingly)
Firewall reloaded
==================================================================
Congratulations! Installed successfully!
==================================================================
外网面板地址: https://183.15.205.176:18800/0f52f04c
内网面板地址: https://192.168.1.110:18800/0f52f04c
username: lhqg5m6a
password: 836e45a9
If you cannot access the panel,
release the following panel port [18800] in the security group
若无法访问面板，请检查防火墙/安全组是否有放行面板[18800]端口
因已开启面板自签证书，访问面板会提示不匹配证书，请参考以下链接配置证书
https://www.bt.cn/bbs/thread-105443-1-1.html
==================================================================
Time consumed: 9 Minute!
orangepi@orangepi5plus:~$
```

5) At this time, enter the **panel address** displayed above in the browser to open the login interface of the pagoda Linux panel, and then enter the **username** and **password** displayed above in the corresponding position to log in to the pagoda.

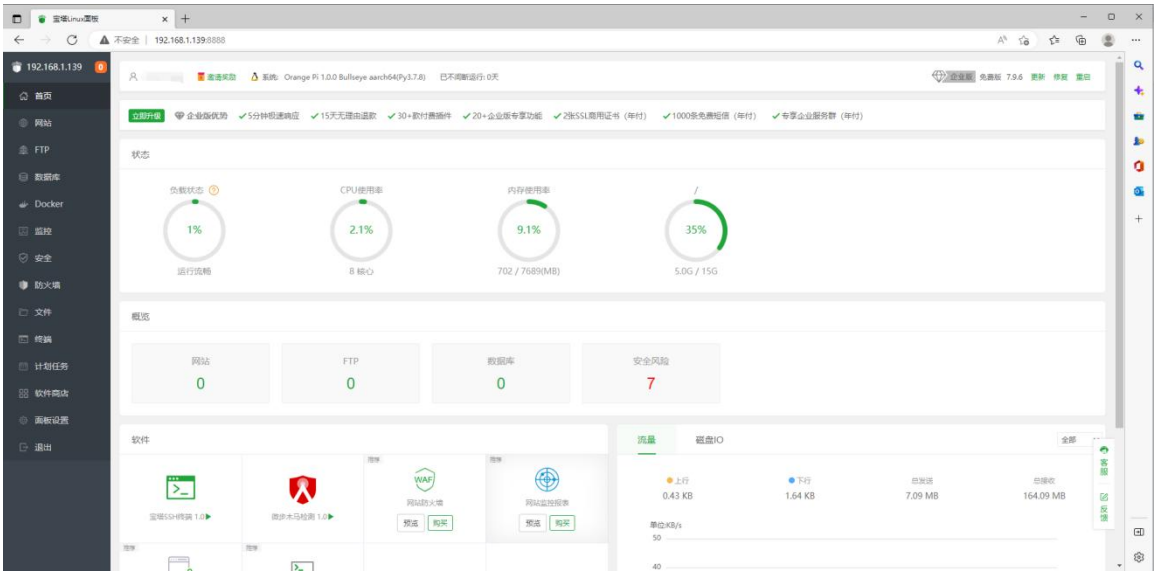


6) After successfully logging in to the pagoda, the following welcome interface will pop up. First, please take the intermediate user notice to read to the bottom, and then you can choose "I have agreed and read" User Agreement ", and then click" Enter the panel " You can enter the pagoda

7) After entering the pagoda, you will first prompt that you need to bind the account of the pagoda official website. If you do n't have an account, you can go to the official website of the pagoda **(https://www.bt.cn)** to register one

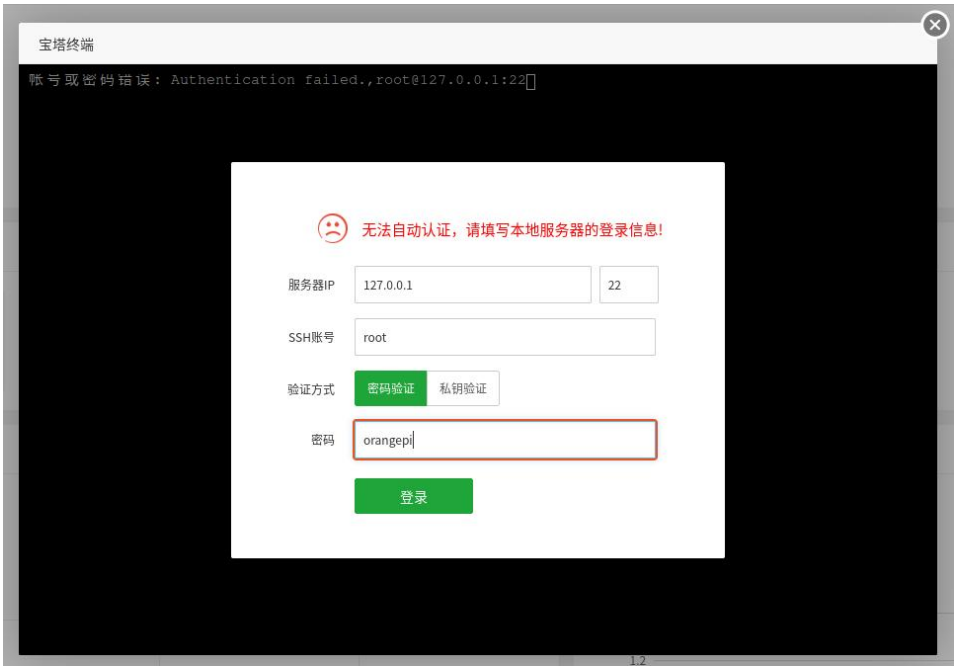


8) The final display interface is shown in the figure below. You can intuitively see some status information of the development board Linux system, such as load status, CPU usage, memory usage, and storage space usage

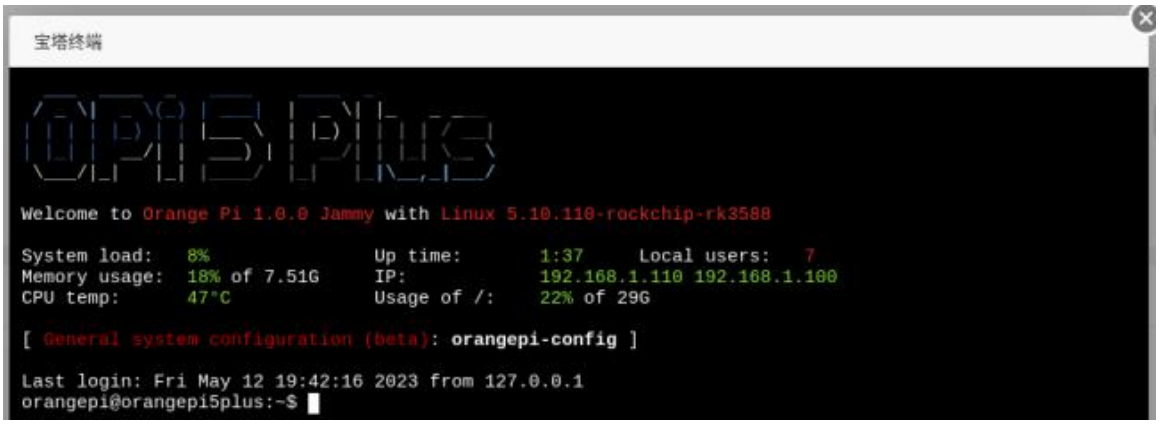


9) Test the SSH terminal login of the pagoda

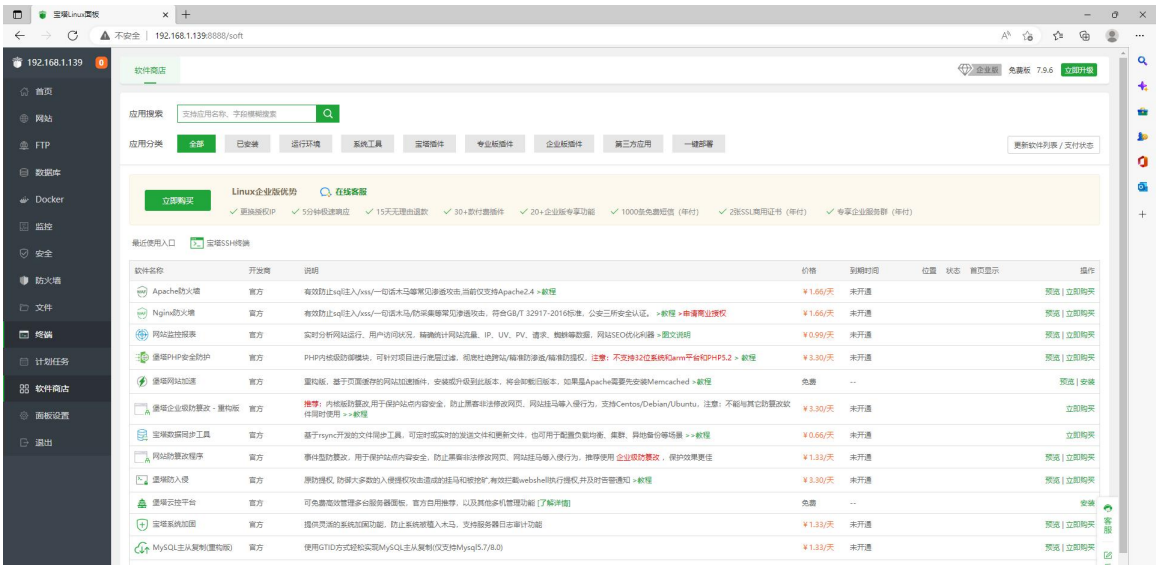
a. After opening the SSH terminal of the pagoda, you will first prompt that you need to enter the password of the development board system. At this time, enter **orangepi** in the password box (the default password, if you have modification, please fill in the modified one).



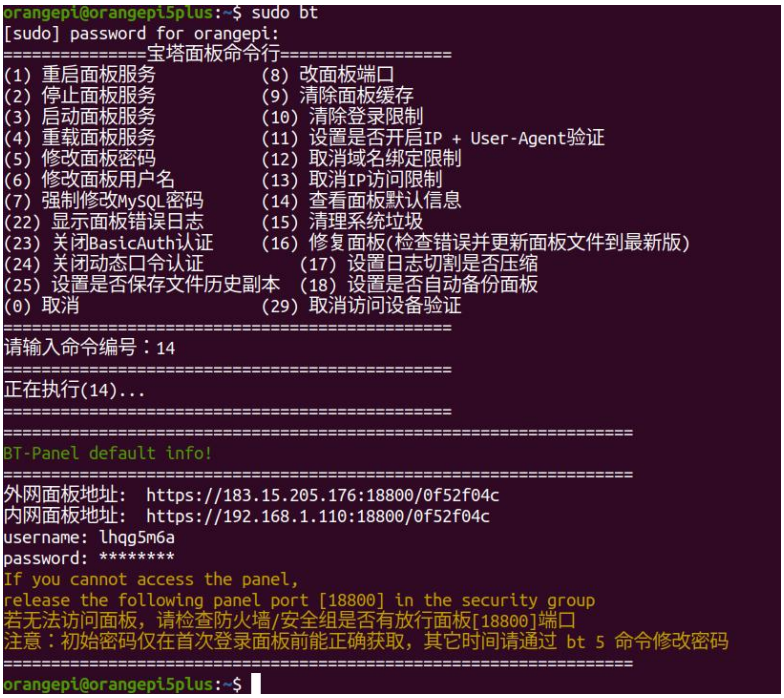
b. The display after successful login is shown in the figure below



10) Software such as Apache, MySQL, and PHP can be installed in the software store of the pagoda. You can also deploy various applications in one click. Please explore it yourself



11) Pagoda command line tool test



12) For more functions of the pagoda, please refer to the following information to explore by yourself

manual：**http://docs.bt.cn**
Forum address：**https://www.bt.cn/bbs**
GitHub Link：**https://github.com/aaPanel/BaoTa**

3.26. Set the Chinese environment and install Chinese input method

Note that before installing the Chinese input method, please make sure that the Linux system used in the development board is the desktop version system。

3.26.1. Debian system installation method

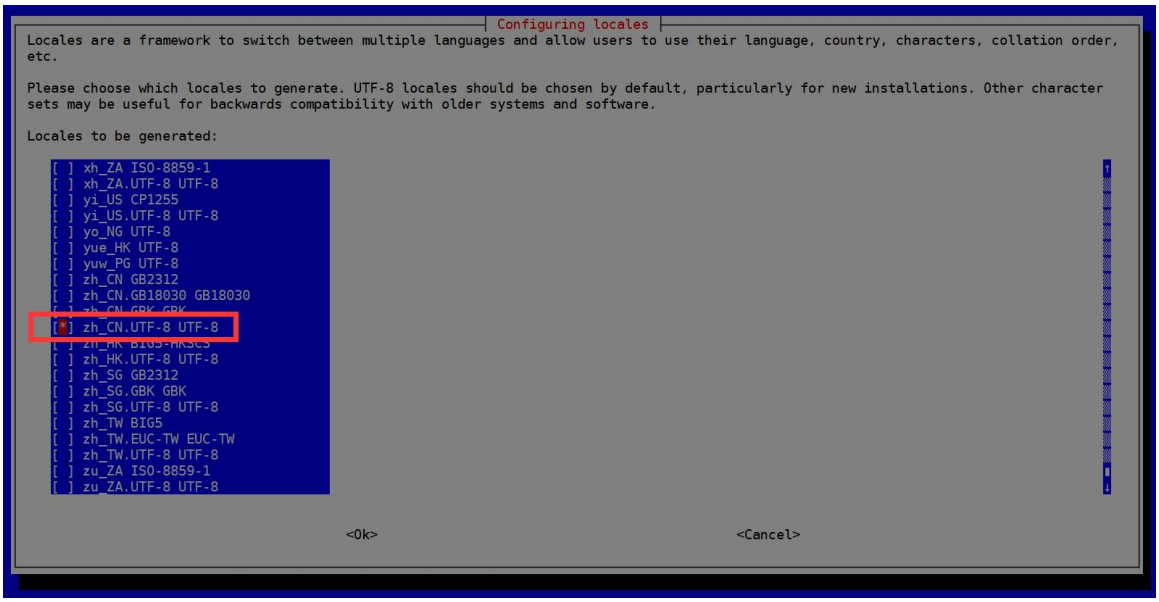
1) First set the default **locale** as Chinese

a. Enter the command below to start configured **locale**

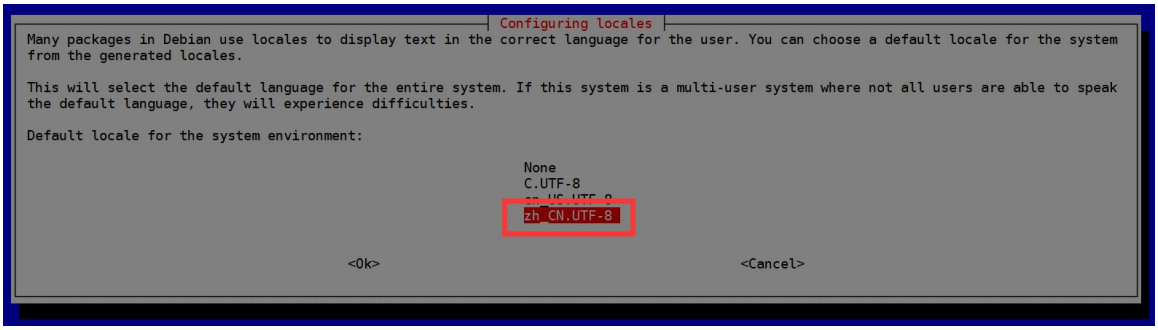
```
orangepi@orangepi:~$ sudo dpkg-reconfigure locales
```

b. Then select **zh_CN.UTF-8 UTF-8** in the pop-up interface (through the upper and lower direction keys on the keyboard to move up and down, select it through the space key, and finally move the cursor to **<OK>** through the Tab key, and

then press Enter key.)



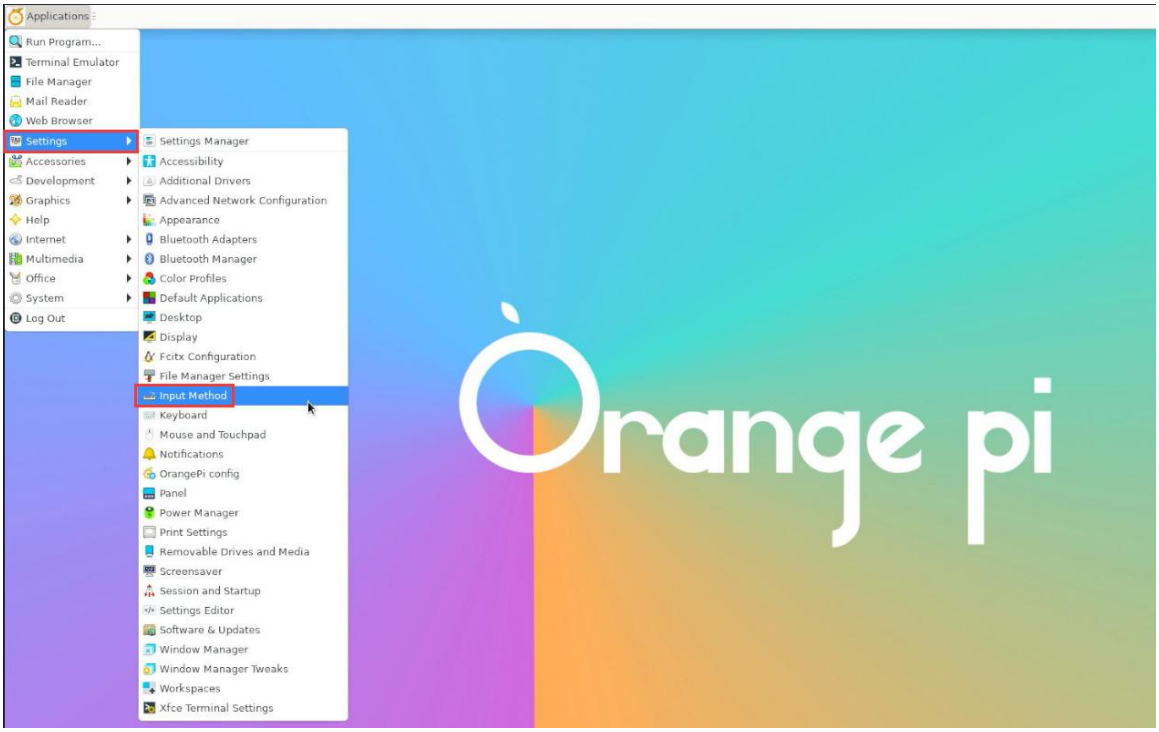
c. Then set the default **locale** as **zh_CN.UTF-8**



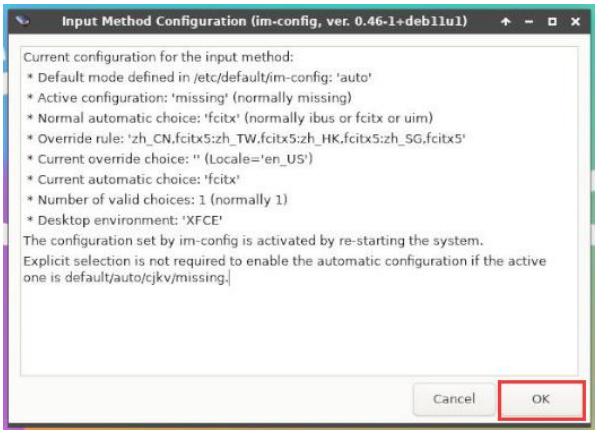
d. After exiting the interface,**locale** will be set. The output displayed by the command line is shown below

```
orangepi@orangepi:~$ sudo dpkg-reconfigure locales
Generating locales (this might take a while)...
  en_US.UTF-8... done
  zh_CN.UTF-8... done
Generation complete.
```

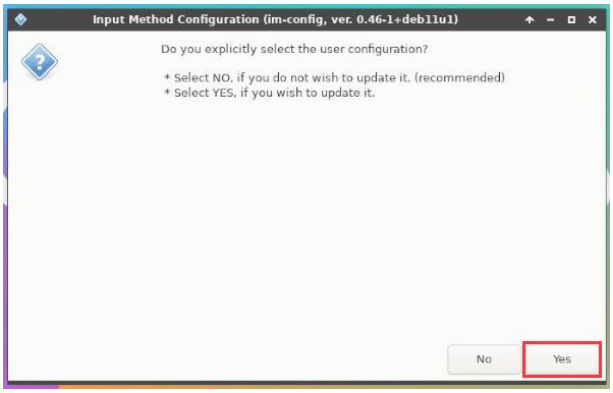
2) Then open **Input Method**



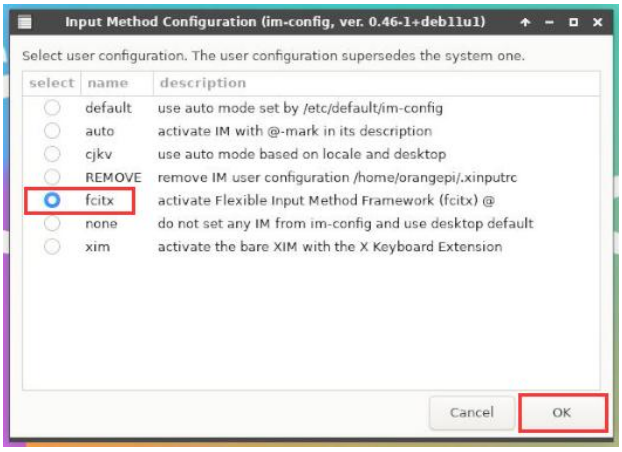
3) Then choose **OK**



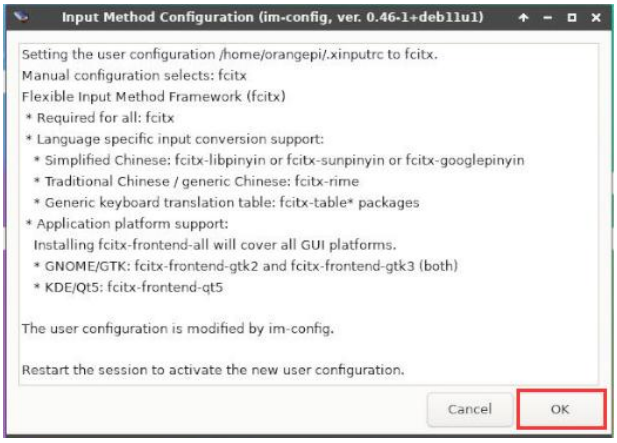
4) Then choose **Yes**



5) Then choose **fcitx**

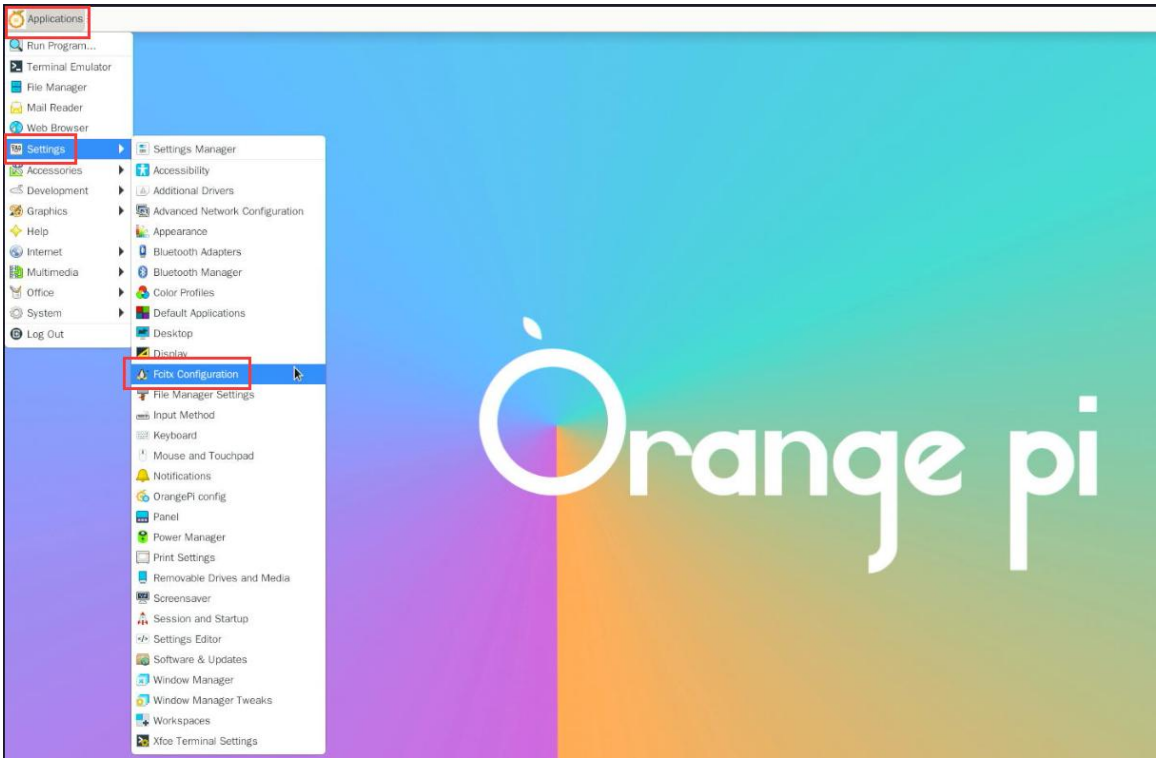


6) Then choose **OK**

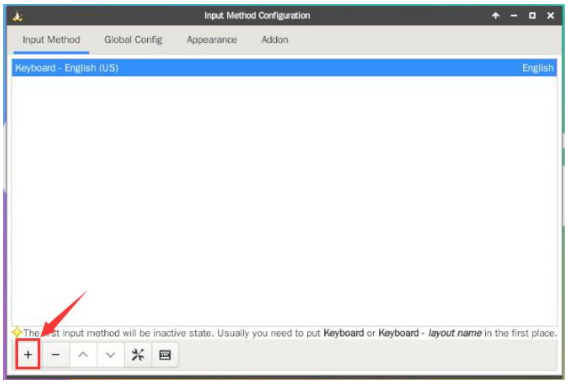


7) **Then restart the Linux system to make the configuration effective**

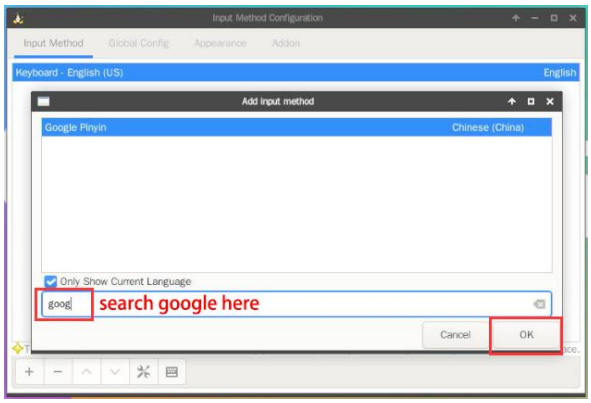
8) Then Open **Fcitx configuration**



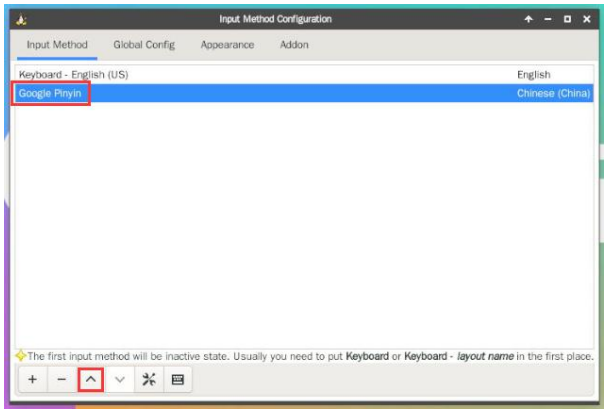
9) Then click the "+" of the position shown in the figure below

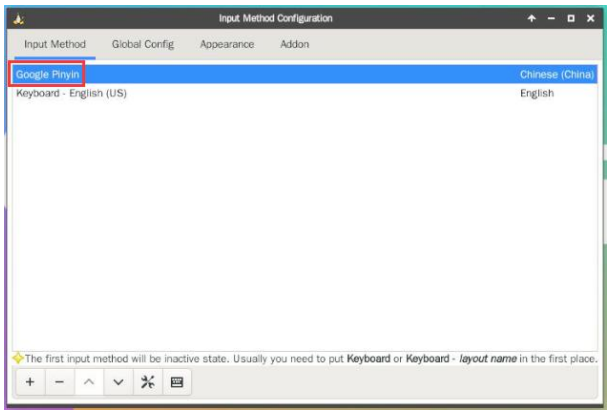


10) Then search **Google Pinyin** and click **OK**



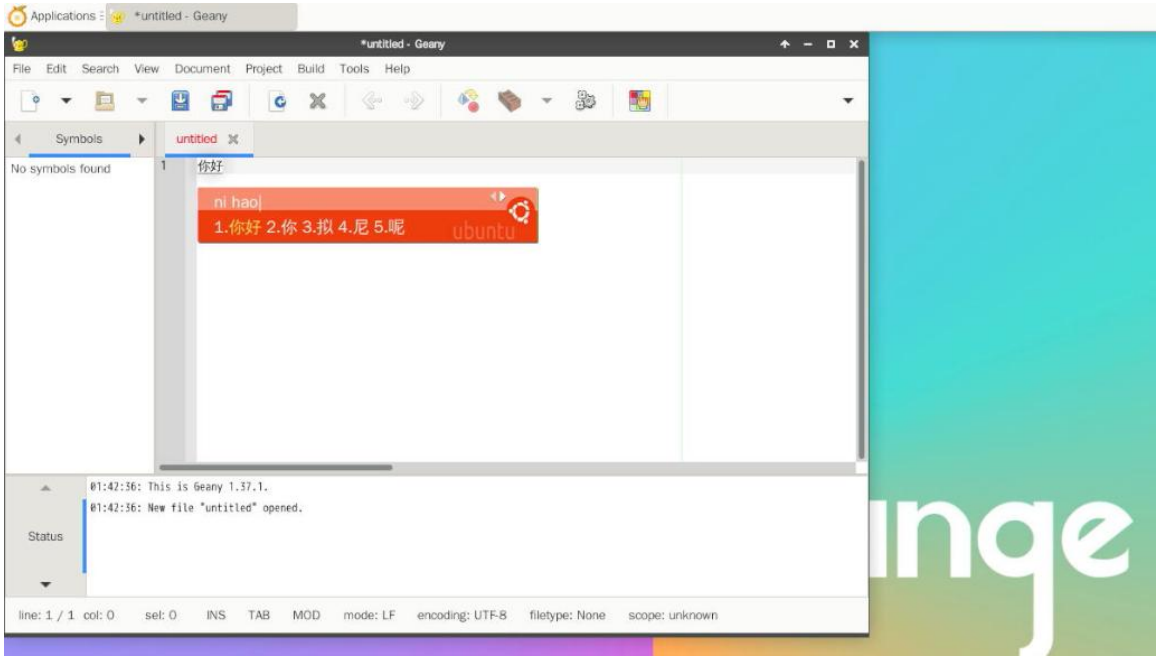
11) Then put **Google Pinyin** to the forefront





12) Then open the **Geany** Editor and test the Chinese input method.

13) Chinese input method test is shown below



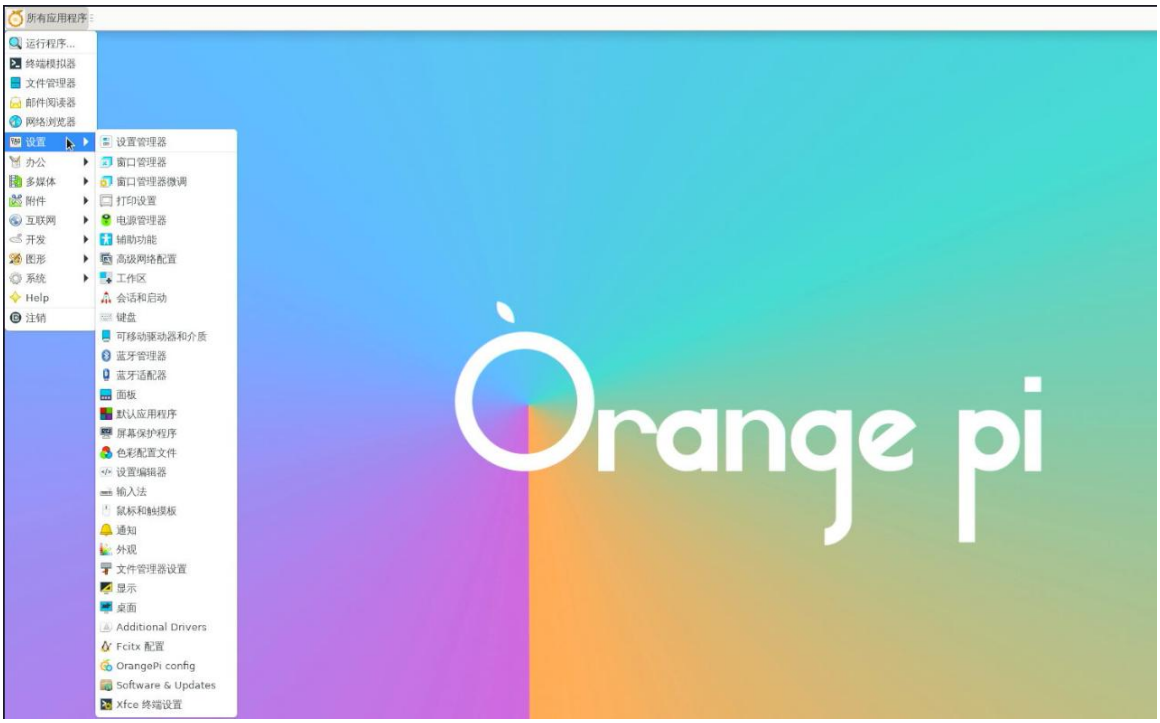
14) You can switch between Chinese and English input methods through **Ctrl+Space** shortcut

15) If the entire system is required as Chinese, the variables in **/etc/default/locale** can be set to **zh_CN.UTF-8**

```
orangepi@orangepi:~$ sudo vim /etc/default/locale
#  File generated by update-locale
LC_MESSAGES=zh_CN.UTF-8
LANG=zh_CN.UTF-8
```

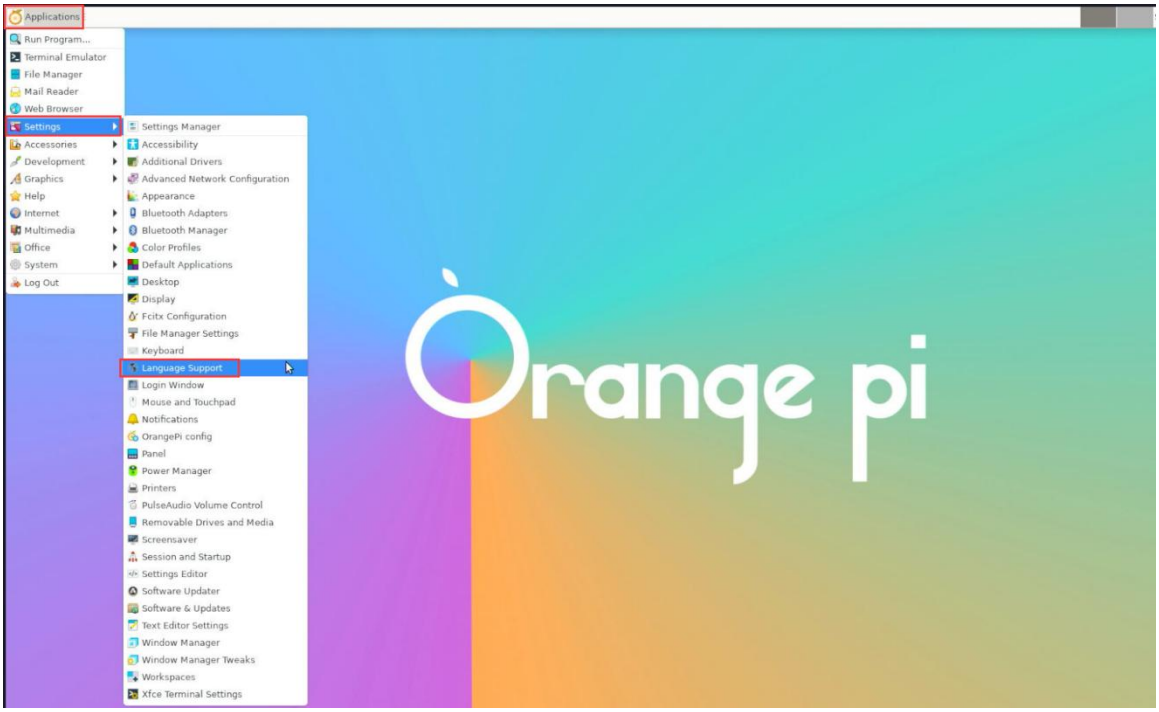
```
LANGUAGE=zh_CN.UTF-8
```

16) Then **restart the system** to see the system display as Chinese

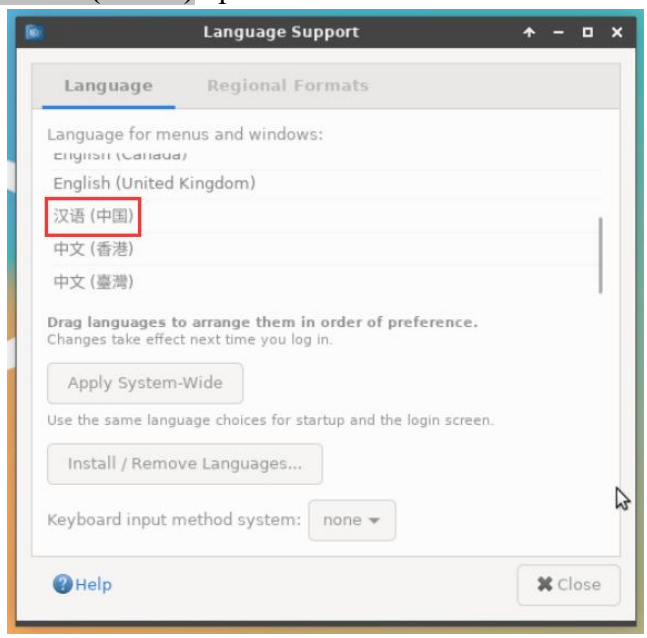


3. 26. 2. ubuntu 20.04 system installation method

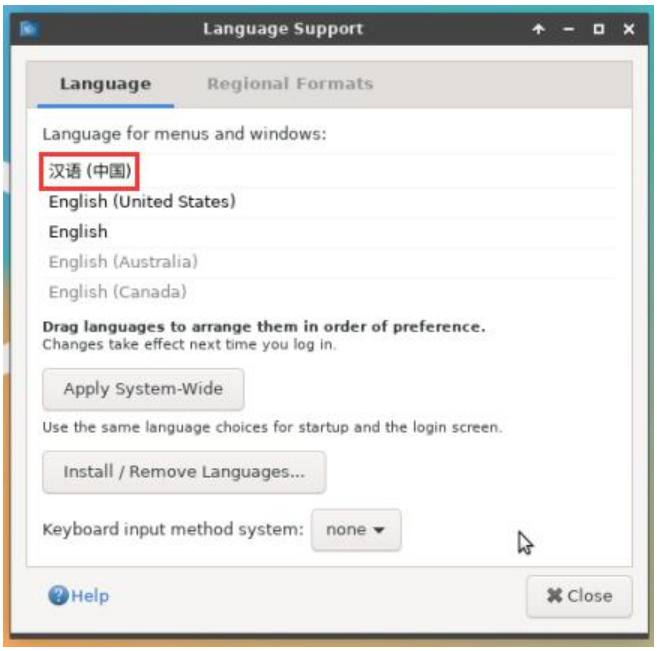
1) First open **Language Support**



2) Then find the **Chinese (China)** option

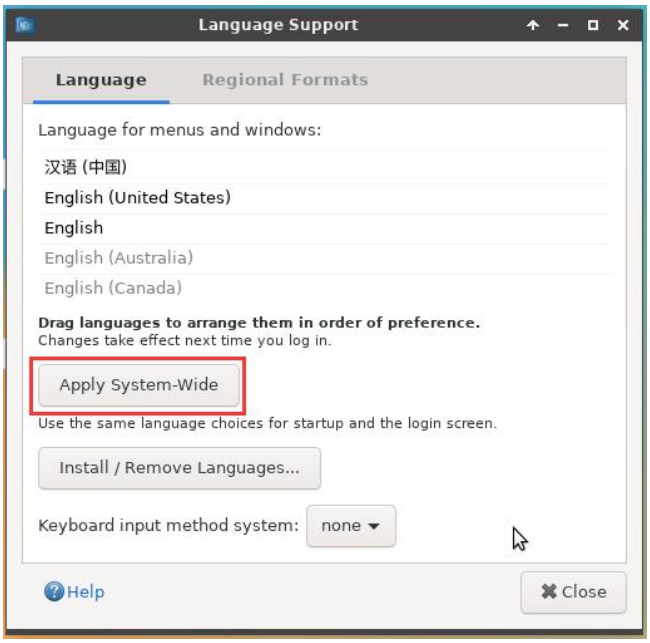


3) Then use the left mouse button to select **Chinese (China)** and hold it down, and then drag it up to the beginning. The display after dragging is shown in the figure below：



Note that this step is not very easy to drag, please try a few more times。

4) Then select the **Apply System-Wide** to apply the Chinese settings to the entire system

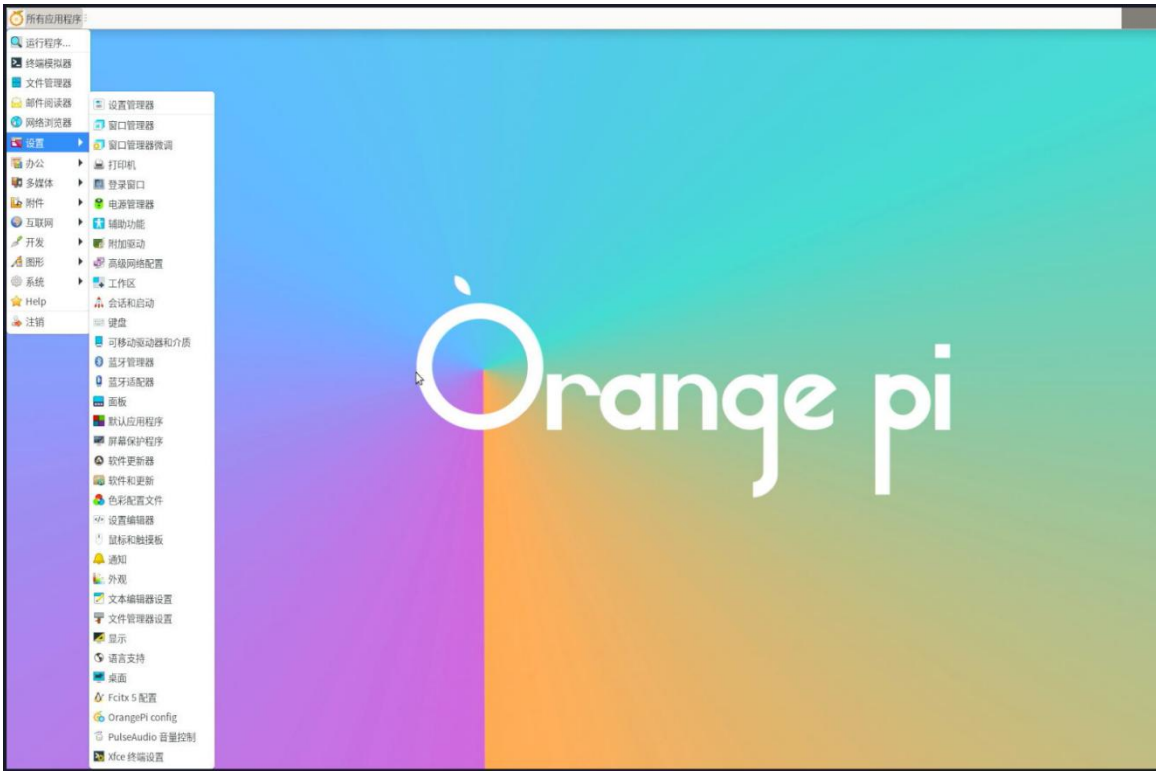


5) Then set the **Keyboard input method system** as **fcitx**

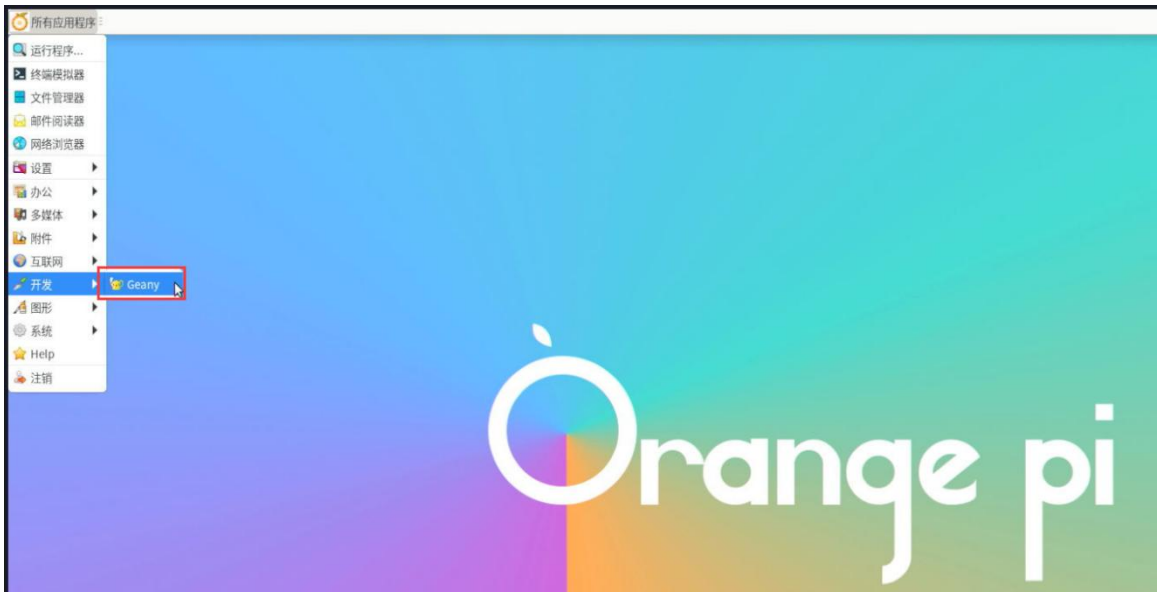
6) **Then restart the linux system to make the configuration effective**

7) After re -entering the system, please choose **not to ask me again** at the interface below, and then determine whether the standard folder should be updated in Chinese according to your preference

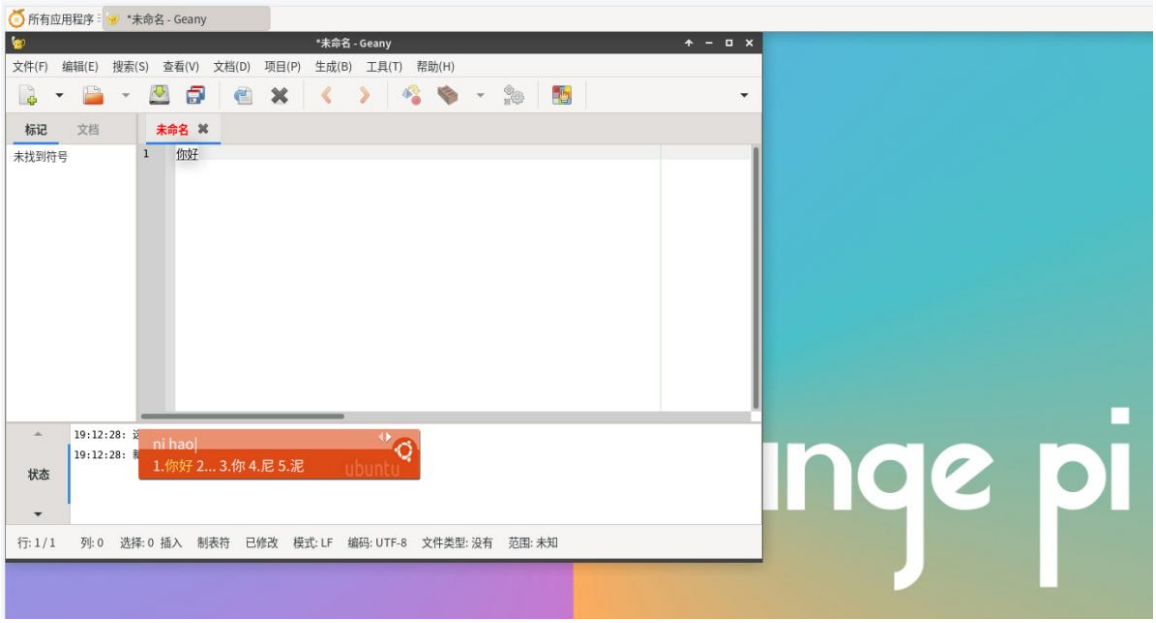
8) Then you can see that the desktop is displayed as Chinese



9) Then we can open the **Geany** test in the Chinese input method. The way to open the way is shown in the figure below

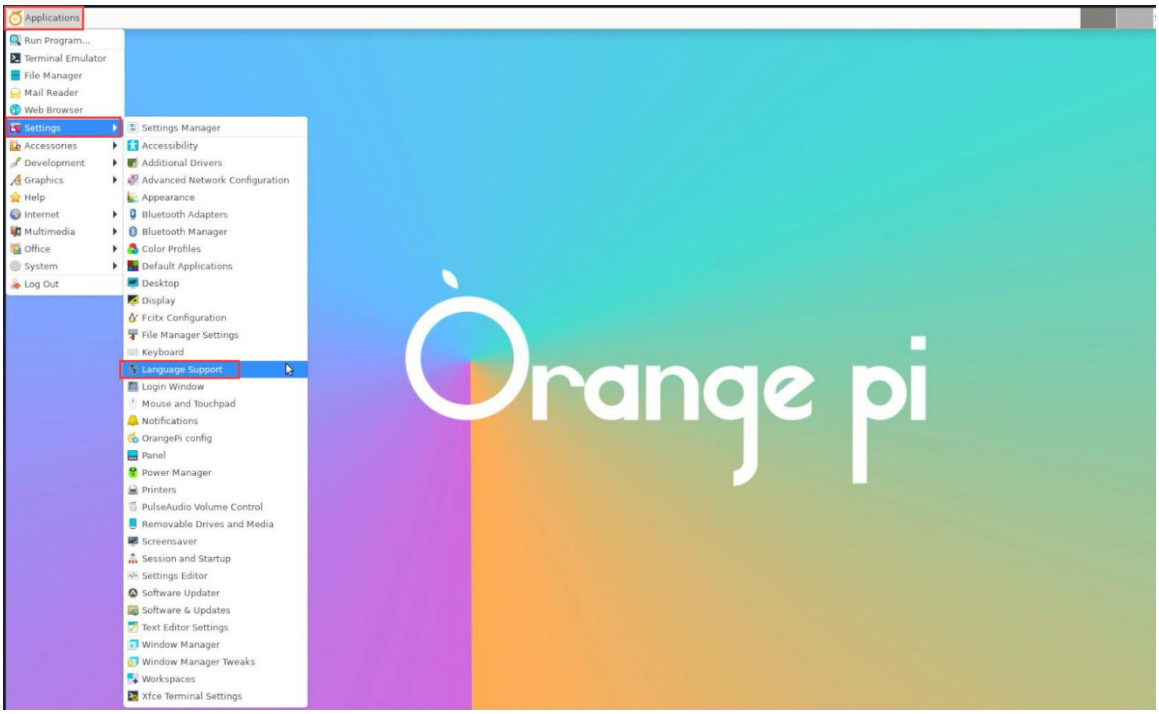


10) After opening **Geany**, the default is an English input method. We can switch into Chinese input method through the **Ctrl+Space** shortcut keys, and then we can enter Chinese



3. 26. 3. Ubuntu 22.04 installation method

1) First open **Language Support**

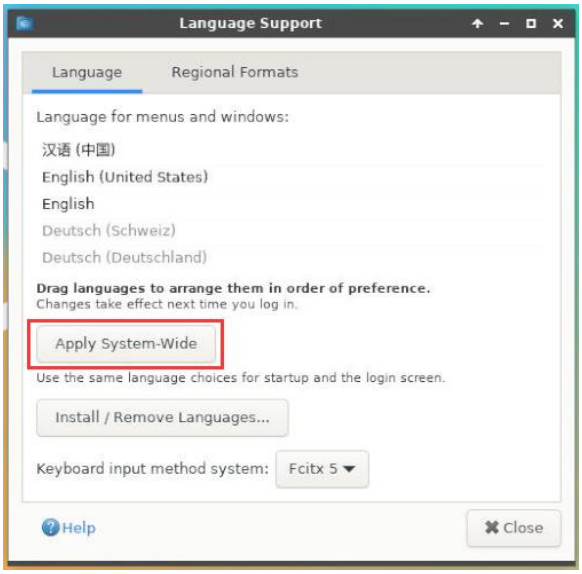


2) Then find the **Chinese (China)** option

3) Then please use the mouse to select **Chinese (China)** and hold it down, and then drag it up to the beginning. The display after the dragging is shown in the figure below:

Note that this step is not very easy to drag, please try a few more times。

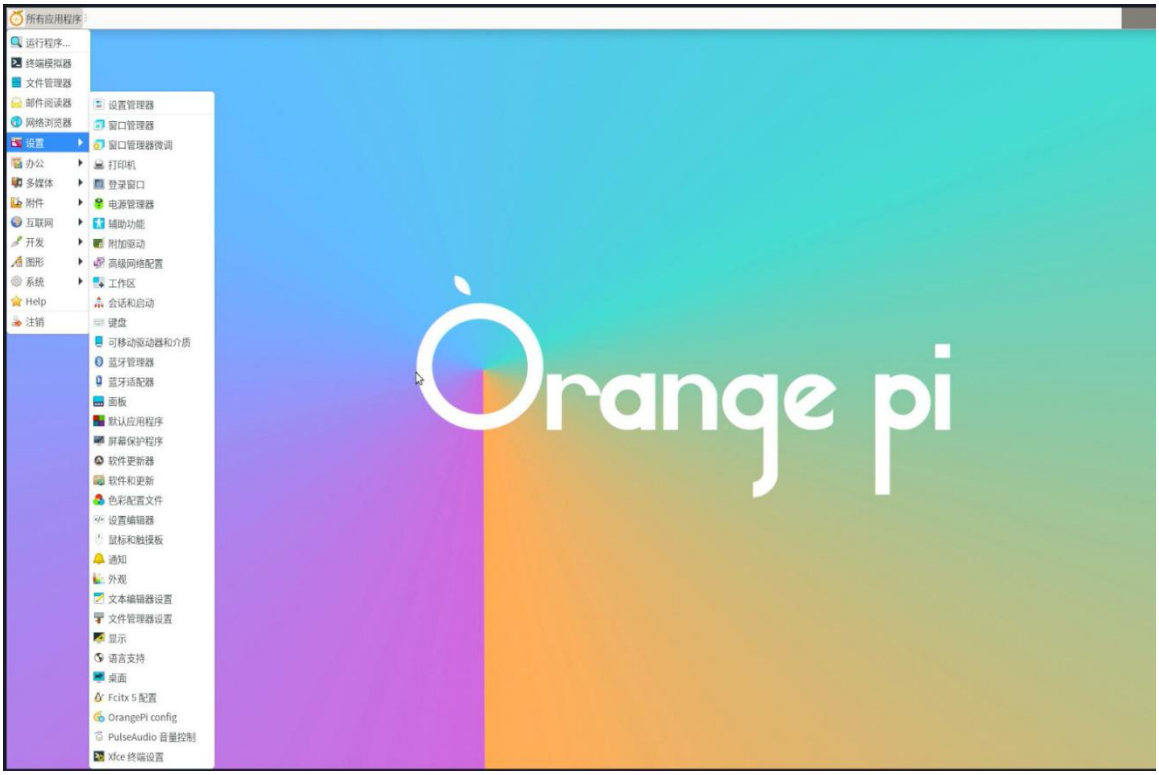
4) Then select the **Apply System-Wide** to apply the Chinese settings to the entire system



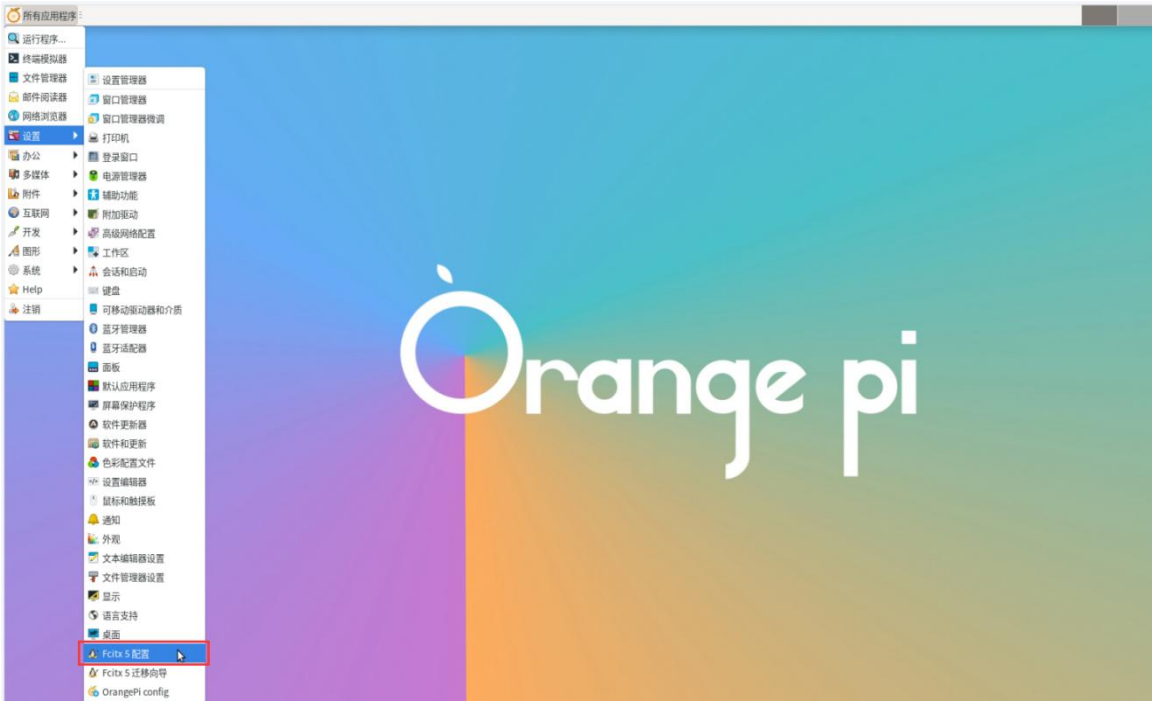
5) **Then restart the linux system to make the configuration effective**

6) After re-entering the system, please choose **not to ask me again** at the interface below, and then determine whether the standard folder should be updated to Chinese according to your preference

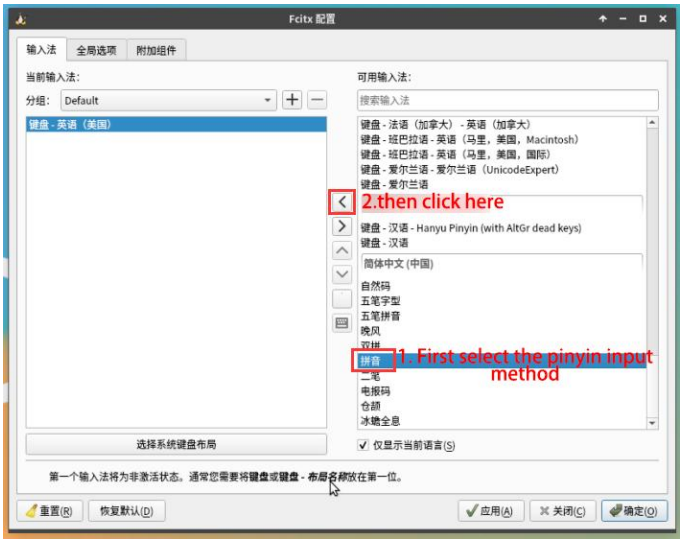
7) Then you can see that the desktop is displayed as Chinese



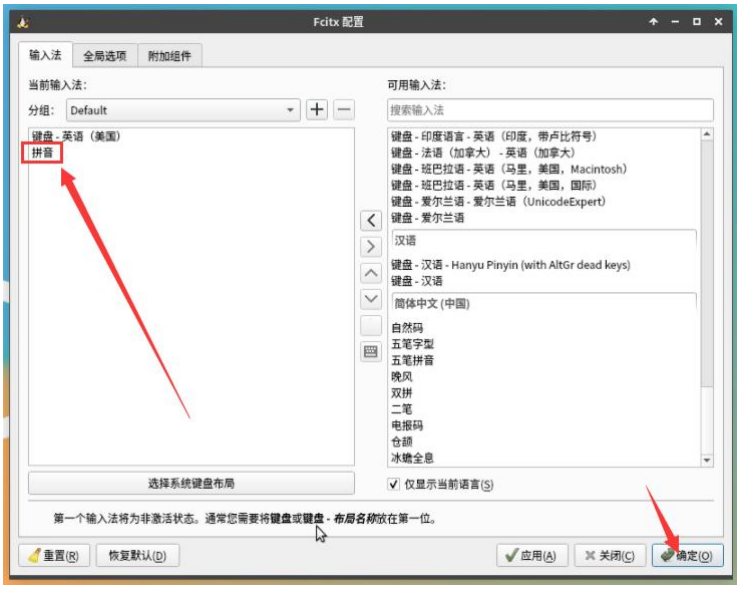
8) Then open the Fcitx5 configuration program



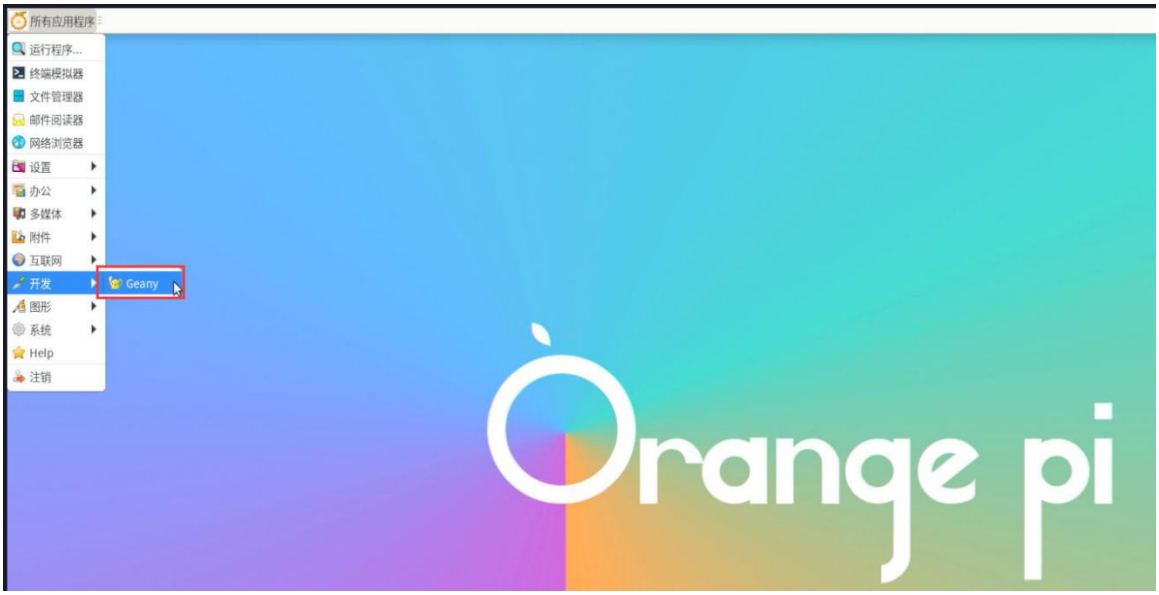
9) Then choose to use Pinyin input method



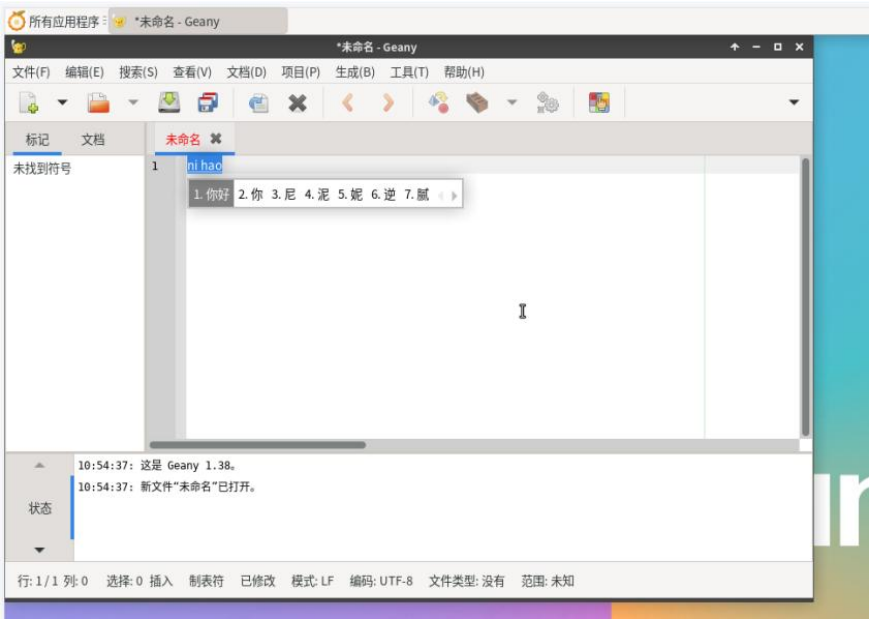
10) The interface after selecting is shown below, then click OK



11) Then we can open the **Geany** to test Chinese input method.The way to open is shown in the figure below



12) After opening **Geany**, the default is an English input method. We can switch into Chinese input method through the **Ctrl+Space** shortcut keys, and then we can enter Chinese



3.27. How to remotely log in to the Linux system desktop method

Ubuntu Gnome Wayland image does not support NoMachine and VNC described here to remotely log in to the desktop。

3.27.1. Use NoMachine remote login

Make sure the Ubuntu or Debian system installed on the development board is a desktop version. In addition, NoMachine also provides detailed documents. It is strongly recommended to read this document to be familiar with the use of NOMACHINE. The document links are shown below：

https://knowledgebase.nomachine.com/DT10R00166

NoMachine supports Windows, Mac, Linux, iOS, and Android platforms, so we can remotely log in to control Orange PI development boards through NoMachine on multiple devices. The following demonstrates the Linux system desktop of the Orange PI development board through NoMachine in Windows. For installation methods for other platforms, please refer to the official documentation of NoMachine

Before operation, please ensure that the Windows computer and the

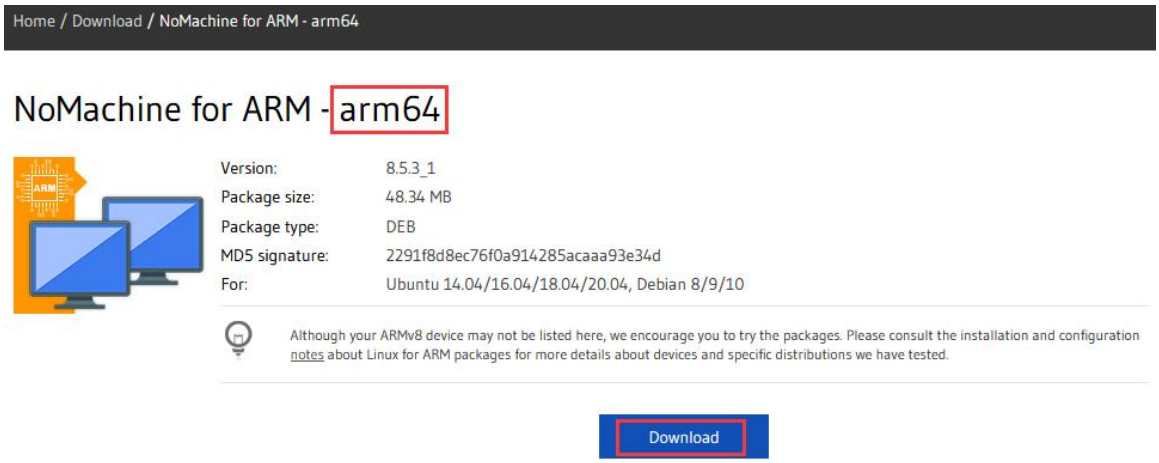
development board are in the same local area network, and can log in to the Ubuntu or Debian system that can log in to the development board normally

1) First download the NoMachine software Linux **arm64** DEB version of the installation package, and then install it in the Linux system of the development board.

a. Since RK3588 is a SOC of the ARMV8 architecture, the system we use is Ubuntu or Debian, so you need to download **NoMachine for ARM ARMv8 DEB** installation package here. The download link is shown below：

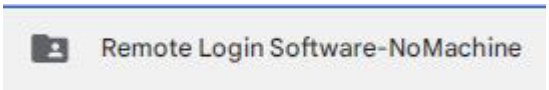
Note that this download link may change, please recognize the deb package of the Armv8/Arm64 version.

https://downloads.nomachine.com/download/?id=114&distro=ARM

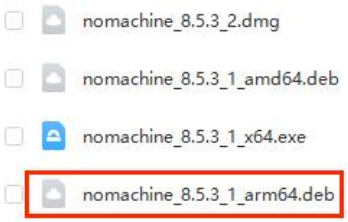


b. In addition, you can also download the installation package of **NoMachine** in the **official tools**

First Enter the **remote login software-Nomachine** Folder



Then download the arm64 version of the deb installation package



c. Then upload the downloaded **nomachine_x.x.x_x_arm64.deb** to the Linux system of the development board

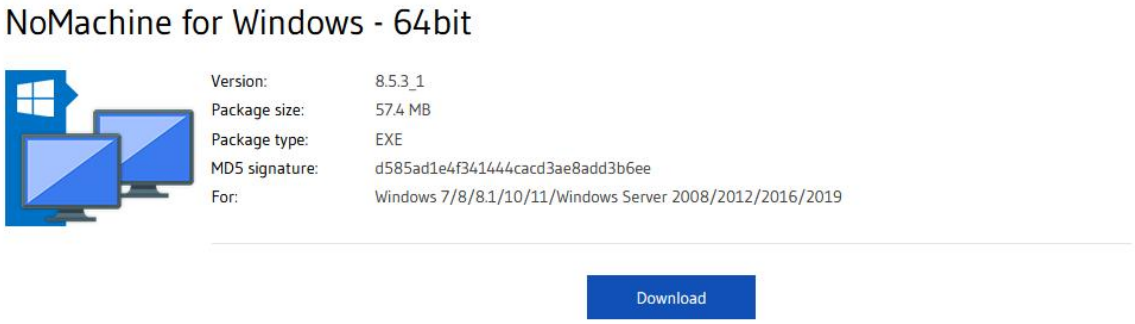
d. Then use the following command to install **NoMachine** in the Linux system in the development board

```
orangepi@orangepi:~$ sudo dpkg -i nomachine_x.x.x_x_arm64_arm64.deb
```

2) Then download the NoMachine software Windows version of the installation package, the download address is shown below

Note that this download link may change

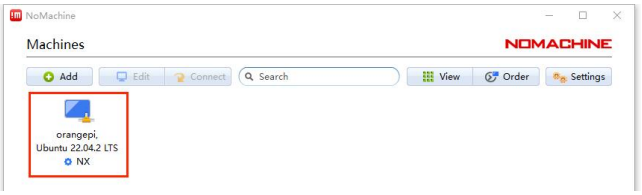
https://downloads.nomachine.com/download/?id=9



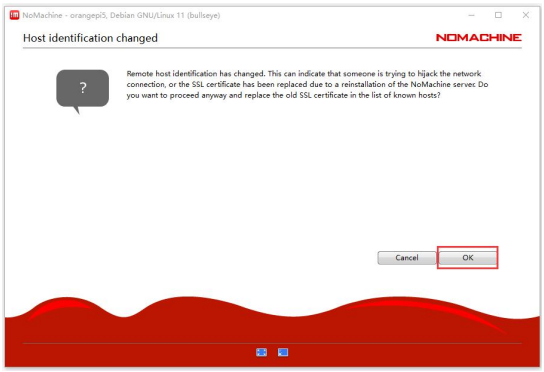
3) Then install NoMachine in Windows. **Please restart the computer after installation**

4) Then open **NoMachine** in Window

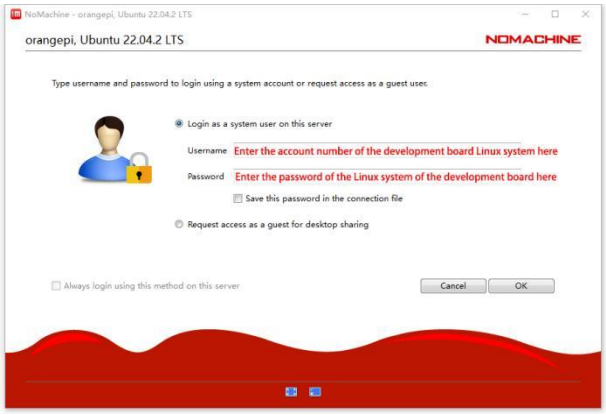
5) After NoMachine is started, it will automatically scan other devices installed in the local area network. After entering the main interface of NoMachine, you can see that the development board is already in the connected device list, and then click the location shown in the red box below in the figure below. You can start logging in to the Linux system desktop of the development board



6) Then click **OK**

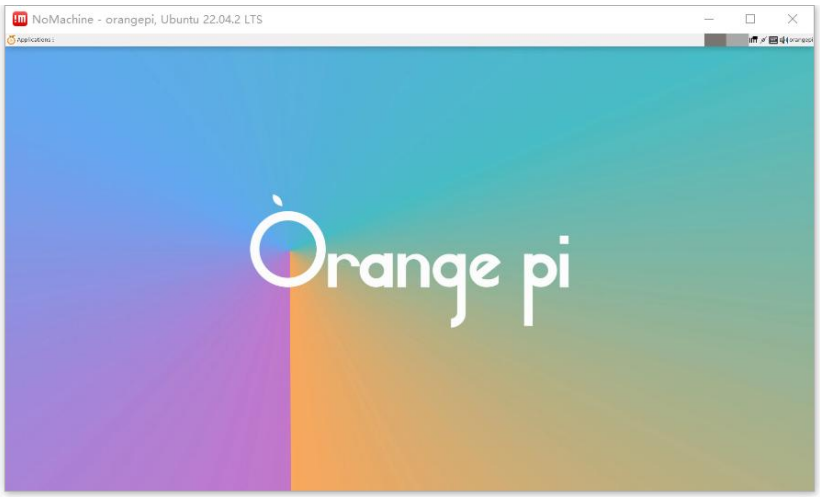


7) Then enter the username and password of the linux system in the corresponding position in the figure below, and then click **OK** to start logging in



8) Then click OK in the next interface

9) Finally, you can see the desktop of the development board Linux system



3. 27. 2. Use VNC remote login

Before operation, please ensure that the Windwos computer and the development board are in the same local area network, and you can log in to the Ubuntu or Debian system of the development board normally.

Ubuntu 20.04 tests many problems with VNC, please do not use this method.

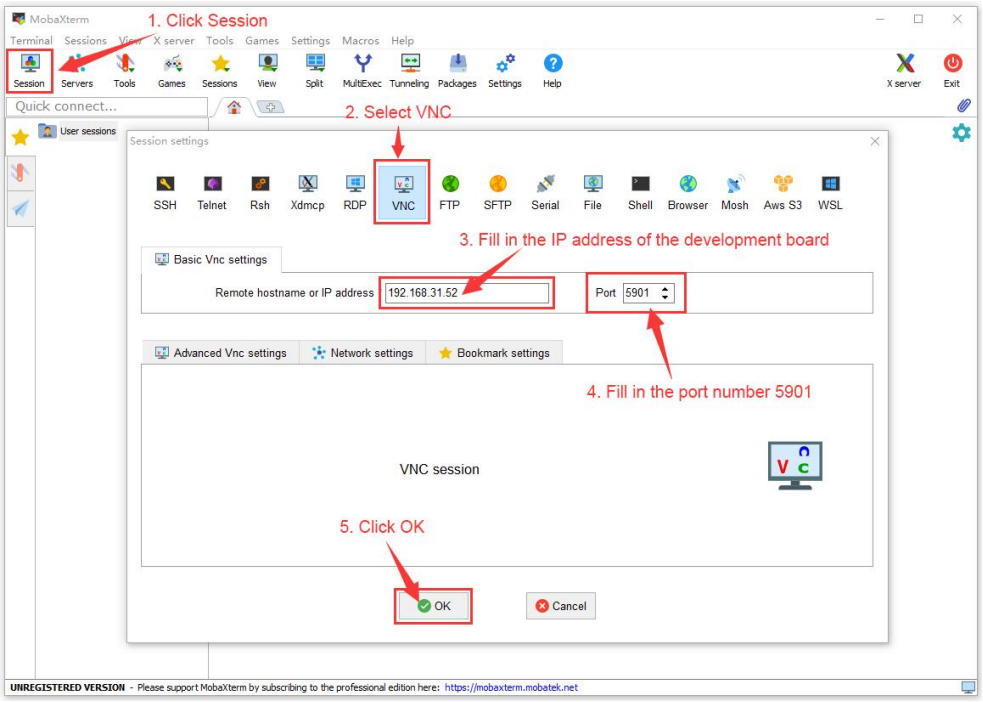
1) First run the **set_vnc.sh** script settings vnc, and **remember to add Sudo permissions**

```
orangepi@orangepi:~$ sudo set_vnc.sh
You will require a password to access your desktops.

Password:          #Set the VNC password here, 8 -bit characters
Verify:            #Set the VNC password here, 8 -bit characters
Would you like to enter a view-only password (y/n)? n
xauth:    file /root/.Xauthority does not exist

New 'X' desktop is orangepi:1

Creating default startup script /root/.vnc/xstartup
Starting applications specified in /root/.vnc/xstartup
Log file is /root/.vnc/orangepi:1.log

Killing Xtightvnc process ID 3047
```

```
New 'X' desktop is orangepi:1

Starting applications specified in /root/.vnc/xstartup
Log file is /root/.vnc/orangepi:1.log
```

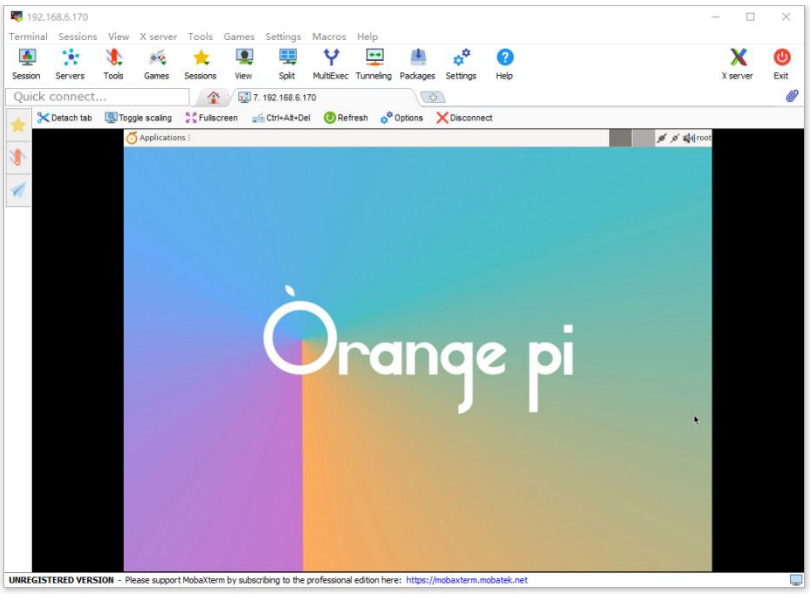
2) The steps of using MobaxTerm software to connect the development board Linux system desktop are shown below：

a. First click the session, then select VNC, then fill in the IP address and port of the development board, and finally click OK to confirm



b. Then enter the password of the previously set VNC

c. The interface after the login is successfully displayed as shown in the figure below, and then you can remotely operate the desktop of the linux system remotely



3. 28. Some programming language test supported by thelinux system

3. 28. 1. Debian Bullseye system

1) Debian Bullseye is installed with the gcc compilation tool chain by default, which can compile the C language program directly in the Linux system of the development board

a. The version of the gcc is shown below

```
orangepi@orangepi:~$ gcc --version
gcc (Debian 10.2.1-6) 10.2.1 20210110
Copyright (C) 2020 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

b. **hello_world.c** program to write c language

```
orangepi@orangepi:~$ vim hello_world.c
#include <stdio.h>

int main(void)
{
        printf("Hello World!\n");
```

```
        return 0;
}
```

c. Then compile and run **hello_world.c**

```
orangepi@orangepi:~$ gcc -o hello_world hello_world.c
orangepi@orangepi:~$ ./hello_world
Hello World!
```

2) Debian Bullseye Default with Python3

a. The specific version of Python is shown below

```
orangepi@orangepi:~$ python3
Python 3.9.2 (default, Feb 28 2021, 17:03:44)
[GCC 10.2.1 20210110] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Use CTRL+D shortcut key to exit Python's interactive mode。

b. **hello_world.py** program in Python language

```
orangepi@orangepi:~$ vim hello_world.py
print('Hello World!')
```

c. The results of running **hello_world.py** are shown below

```
orangepi@orangepi:~$ python3 hello_world.py
Hello World!
```

3) Debian Bullseye's compilation tool and operating environment without Java default

a. You can use the following command to install openjdk. The latest version in Debian Bullseye is openjdk-17

```
orangepi@orangepi:~$ sudo apt install -y openjdk-17-jdk
```

b. After installation, you can check the version of Java

```
orangepi@orangepi:~$ java --version
```

c. Edit the **hello_world.java** of Java version

```
orangepi@orangepi:~$ vim hello_world.java
public class hello_world
{
        public static void main(String[] args)
        {
```

```
                System.out.println("Hello World!");
        }
}
```

d. Then compile and run **hello_world.java**

```
orangepi@orangepi:~$ javac hello_world.java
orangepi@orangepi:~$ java hello_world
Hello World!
```

3.28.2. Debian Bookworm system

1) Debian Bookworm is installed with a gcc compilation tool chain by default, which can directly compile C language programs in the Linux system of the development board

a. The version of gcc is as follows

```
orangepi@orangepi:~$ gcc --version
gcc (Debian 12.2.0-14) 12.2.0
Copyright (C) 2022 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

b. Write the **hello_world.c** program in C language

```
orangepi@orangepi:~$ vim hello_world.c
#include <stdio.h>

int main(void)
{
        printf("Hello World!\n");

        return 0;
}
```

c. Then compile and run **hello_world.c**

```
orangepi@orangepi:~$ gcc -o hello_world hello_world.c
orangepi@orangepi:~$ ./hello_world
Hello World!
```

2) Debian Bookworm has Python3 installed by default

a. The specific version of Python is as follows

```
orangepi@orangepi:~$ python3
Python 3.11.2 (main, Mar 13 2023, 12:18:29) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Use the Ctrl+D shortcut to exit python's interactive mode.

b. Write the **hello_world.py** program in Python language

```
orangepi@orangepi:~$ vim hello_world.py
print('Hello World!')
```

c. The result of running **hello_world.py** is as follows

```
orangepi@orangepi:~$ python3 hello_world.py
Hello World!
```

3) Debian Bookworm does not install Java compilation tools and operating environment by default

a. You can use the following command to install openjdk, the latest version in Debian Bookworm is openjdk-17

```
orangepi@orangepi:~$ sudo apt install -y openjdk-17-jdk
```

b. After installation, you can check the version of Java

```
orangepi@orangepi:~$ java --version
```

c. Write the Java version of **hello_world.java**

```
orangepi@orangepi:~$ vim hello_world.java
public class hello_world
{
        public static void main(String[] args)
        {
                System.out.println("Hello World!");
        }
}
```

d. Then compile and run **hello_world.java**

```
orangepi@orangepi:~$ javac hello_world.java
orangepi@orangepi:~$ java hello_world
Hello World!
```

3. 28. 3. Ubuntu Focal system

1) Ubuntu Focal has a gcc compilation tool chain installed by default, which can directly

compile C language programs in the Linux system of the development board

a. The version of gcc is as follows

```
orangepi@orangepi:~$ gcc --version
gcc (Ubuntu 9.4.0-1ubuntu1~20.04.1) 9.4.0
Copyright (C) 2019 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

b. Write the **hello_world.c** program in C language

```
orangepi@orangepi:~$ vim hello_world.c
#include <stdio.h>

int main(void)
{
        printf("Hello World!\n");

        return 0;
}
```

c. Then compile and run **hello_world.c**

```
orangepi@orangepi:~$ gcc -o hello_world hello_world.c
orangepi@orangepi:~$ ./hello_world
Hello World!
```

2) Ubuntu Focal has Python3 installed by default

a. The specific version of Python3 is as follows

```
orangepi@orangepi:~$ python3
Python 3.8.10 (default, Nov 14 2022, 12:59:47)
[GCC 9.4.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Use the Ctrl+D shortcut to exit python's interactive mode.

b. Write the **hello_world.py** program in Python language

```
orangepi@orangepi:~$ vim hello_world.py
print('Hello World!')
```

c. The result of running **hello_world.py** is as follows

```
orangepi@orangepi:~$ python3 hello_world.py
Hello World!
```

3) Ubuntu Focal does not install Java compilation tools and operating environment by default

a. You can use the following command to install openjdk-17

```
orangepi@orangepi:~$ sudo apt install -y openjdk-17-jdk
```

b. After installation, you can check the version of Java

```
orangepi@orangepi:~$ java --version
openjdk 17.0.2 2022-01-18
OpenJDK Runtime Environment (build 17.0.2+8-Ubuntu-120.04)
OpenJDK 64-Bit Server VM (build 17.0.2+8-Ubuntu-120.04, mixed mode, sharing)
```

c. Write the Java version of **hello_world.java**

```
orangepi@orangepi:~$ vim hello_world.java
public class hello_world
{
        public static void main(String[] args)
        {
                System.out.println("Hello World!");
        }
}
```

d. Then compile and run **hello_world.java**

```
orangepi@orangepi:~$ javac hello_world.java
orangepi@orangepi:~$ java hello_world
Hello World!
```

3.28.4. Ubuntu Jammy system

1) Ubuntu Jammy is equipped with a gcc compilation tool chain by default, which can directly compile the C language program in the Linux system of the development board

a. The version of gcc is shown below

```
orangepi@orangepi:~$ gcc --version
gcc (Ubuntu 11.2.0-19ubuntu1) 11.2.0
Copyright (C) 2021 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR
```

```
PURPOSE.
```

b. The **hello_world.c** program that writes c language

```
orangepi@orangepi:~$ vim hello_world.c
#include <stdio.h>

int main(void)
{
        printf("Hello World!\n");

        return 0;
}
```

c. Then compile and run **hello_world.c**

```
orangepi@orangepi:~$ gcc -o hello_world hello_world.c
orangepi@orangepi:~$ ./hello_world
Hello World!
```

2) Ubuntu jammy is installed with Python3 by default

a. python3 specific version is shown below

```
orangepi@orangepi:~$ python3
Python 3.10.4 (main, Apr  2 2022, 09:04:19) [GCC 11.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Use CTRL+D shortcut key to exit Python's interactive mode。

b. The **hello_world.py** program that writes python language

```
orangepi@orangepi:~$ vim hello_world.py
print('Hello World!')
```

c. The results of running **hello_world.py** are shown below

```
orangepi@orangepi:~$ python3 hello_world.py
Hello World!
```

3) Ubuntu Jammy defaults to compile tools and operating environments that are not installed in Java

a. You can use the following command to install openjdk-18

```
orangepi@orangepi:~$ sudo apt install -y openjdk-18-jdk
```

b. After installation, you can check the version of the java

```
orangepi@orangepi:~$ java --version
openjdk 18-ea 2022-03-22
OpenJDK Runtime Environment (build 18-ea+36-Ubuntu-1)
OpenJDK 64-Bit Server VM (build 18-ea+36-Ubuntu-1, mixed mode, sharing)
```

c. Edit the **hello_world.java** of Java version

```
orangepi@orangepi:~$ vim hello_world.java
public class hello_world
{
        public static void main(String[] args)
        {
                System.out.println("Hello World!");
        }
}
```

d. Then compile and run **hello_world.java**

```
orangepi@orangepi:~$ javac hello_world.java
orangepi@orangepi:~$ java hello_world
Hello World!
```

3. 29. QT installation method

1) You can install QT5 and QT Creator with the following scripts

```
orangepi@orangepi:~$ install_qt.sh
```

2) After installation, it will automatically print the QT version number

a. Ubuntu20.04's own QT version is **5.12.8**

```
orangepi@orangepi:~$ install_qt.sh
......
QMake version 3.1
Using Qt version 5.12.8 in /usr/lib/aarch64-linux-gnu
```

b. Ubuntu22.04's own QT version is **5.15.3**

```
orangepi@orangepi:~$ install_qt.sh
......
QMake version 3.1
Using Qt version 5.15.3 in /usr/lib/aarch64-linux-gnu
```

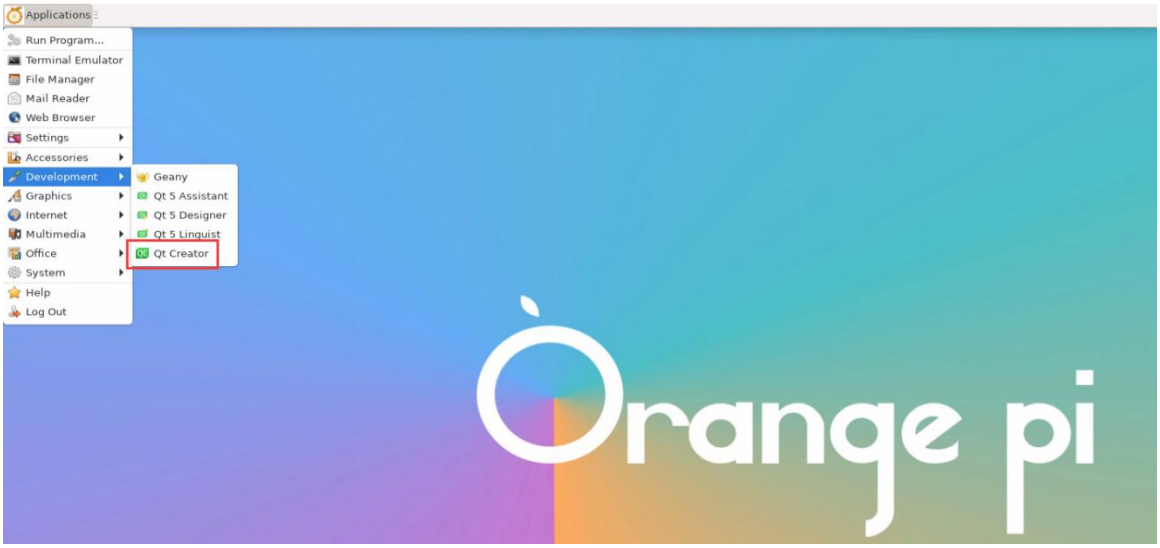
c. The QT version comes with Debian11 is **5.15.2**

```
orangepi@orangepi:~$ install_qt.sh
.....
QMake version 3.1
Using Qt version 5.15.2 in /usr/lib/aarch64-linux-gnu
```

d. The QT version that comes with Debian12 is **5.15.8**

```
orangepi@orangepi:~$ install_qt.sh
.....
QMake version 3.1
Using Qt version 5.15.8 in /usr/lib/aarch64-linux-gnu
```

3) Then you can see the lax icon of QT Creator in **Applications**



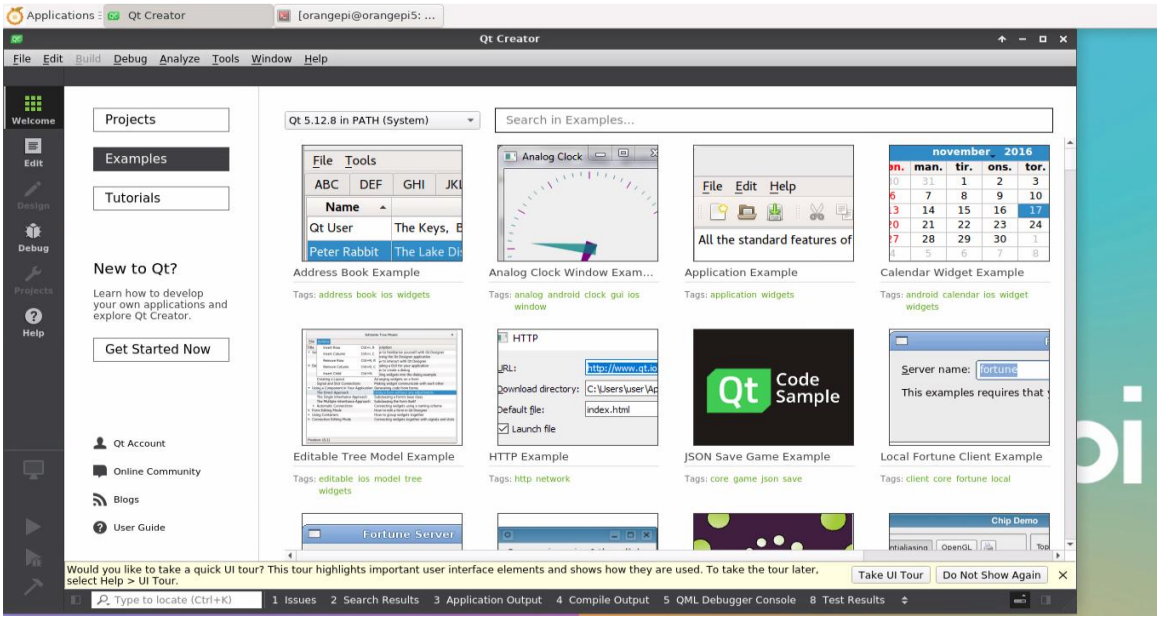
You can also use the following command to open QT Creator

```
orangepi@orangepi:~$ qtcreator
```

During the startup process of QT and QT applications, if the error below is prompted, please ignore it directly. This error will not affect the operation of the application.。

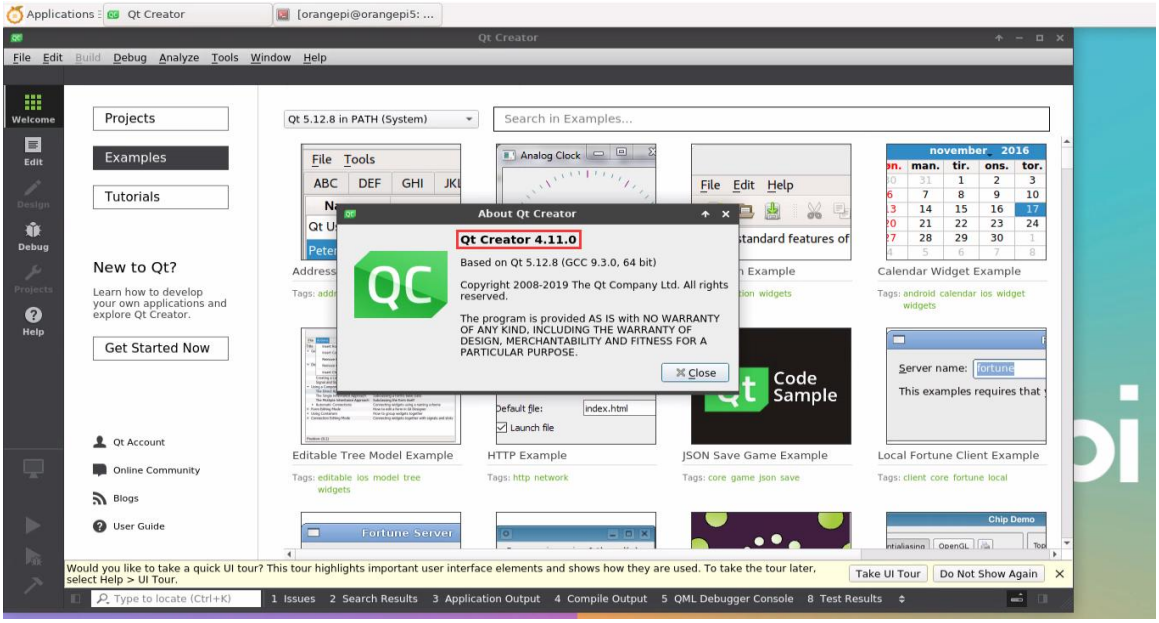
libGL error: failed to create dri screen
libGL error: failed to load driver: rockchip
libGL error: failed to create dri screen
libGL error: failed to load driver: rockchip

4) The interface after the QT Creator is opened is shown below

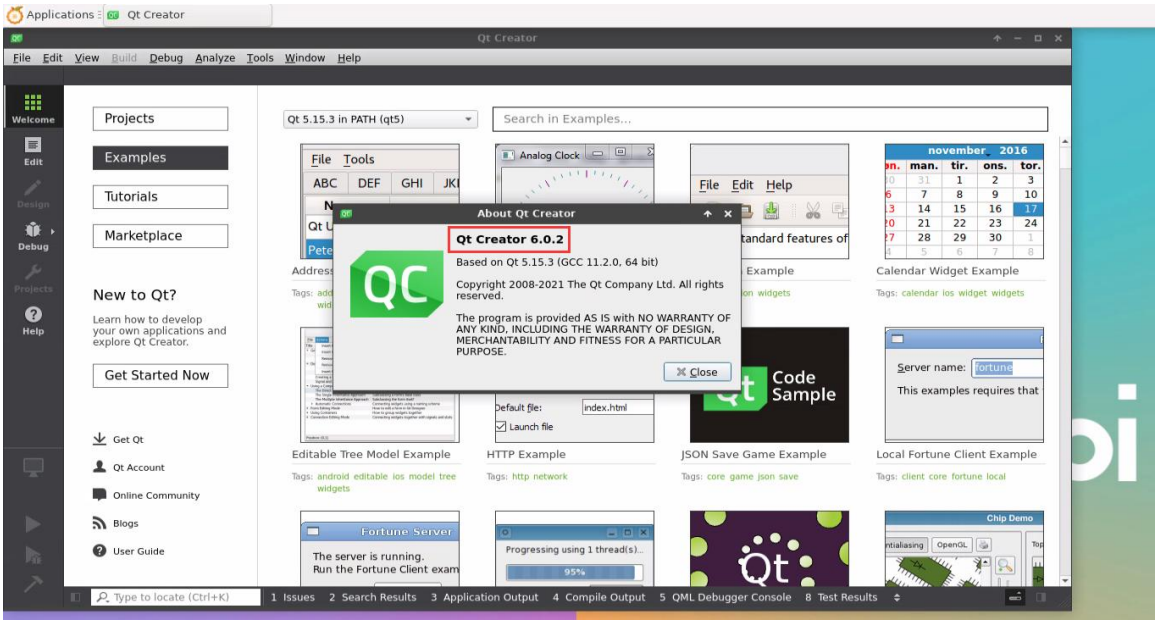


5) The version of QT Creator is shown below

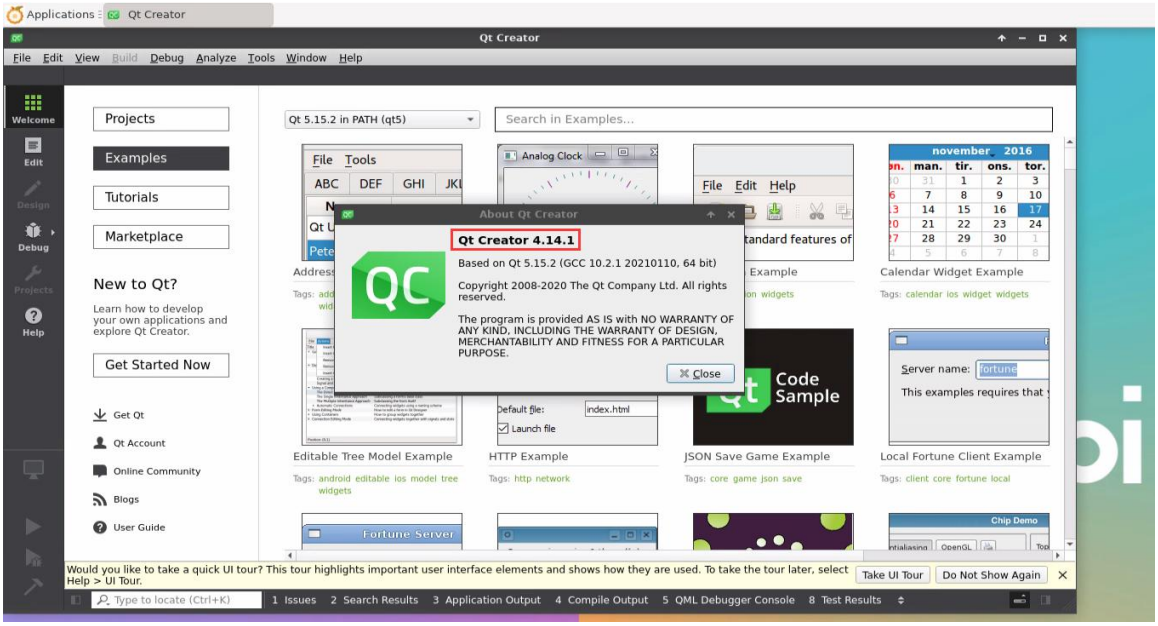
a. The default version of QT Creator in **Ubuntu20.04** is shown below



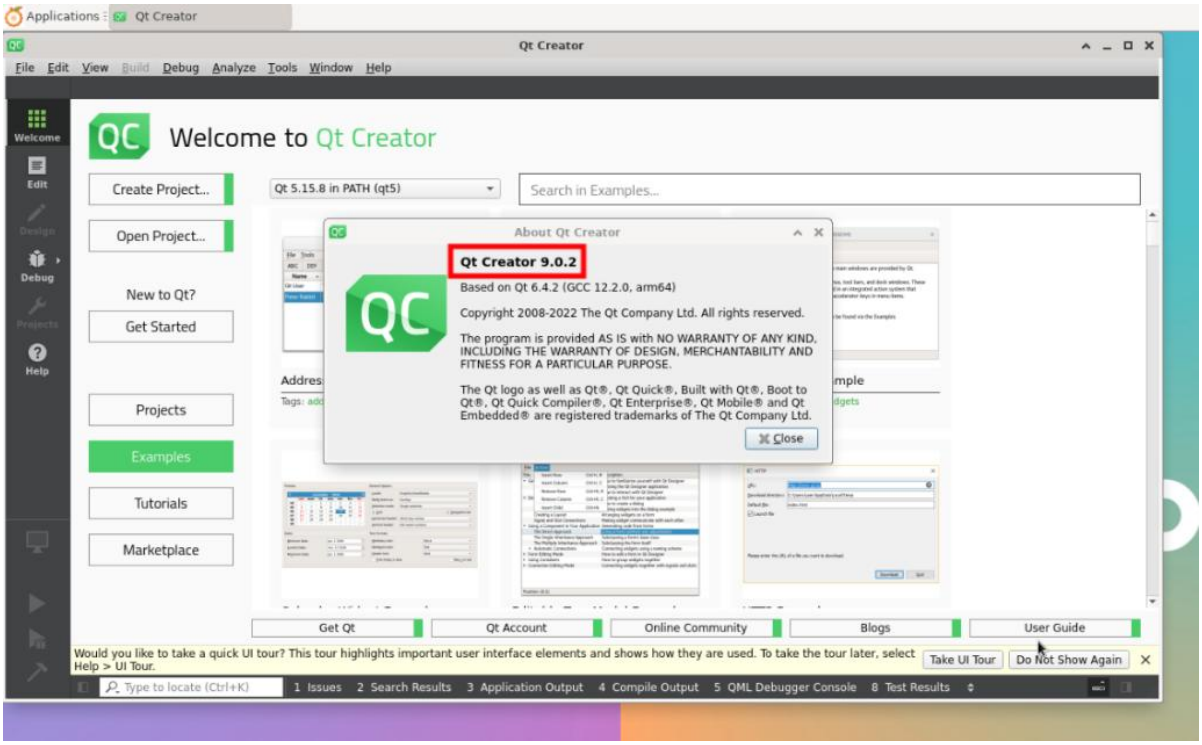
b. The default version of QT Creator in **Ubuntu22.04** is shown below



c. The default version of QT Creator in **Debian11** is shown below

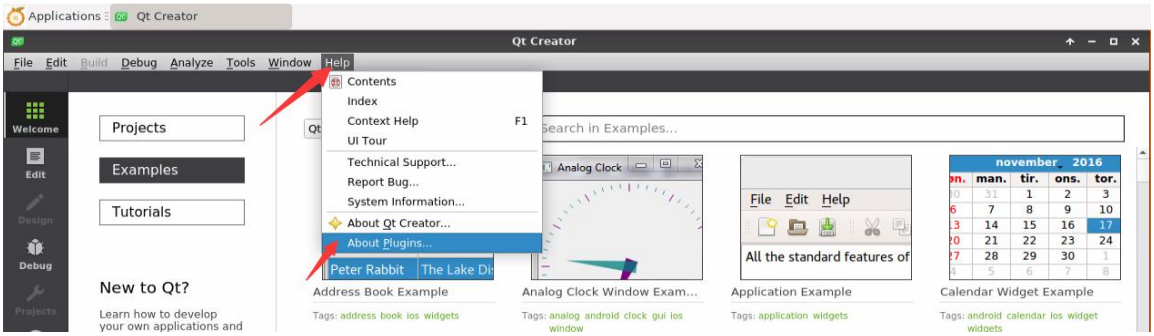


d. The default version of QT Creator in **Debian12** is as follows

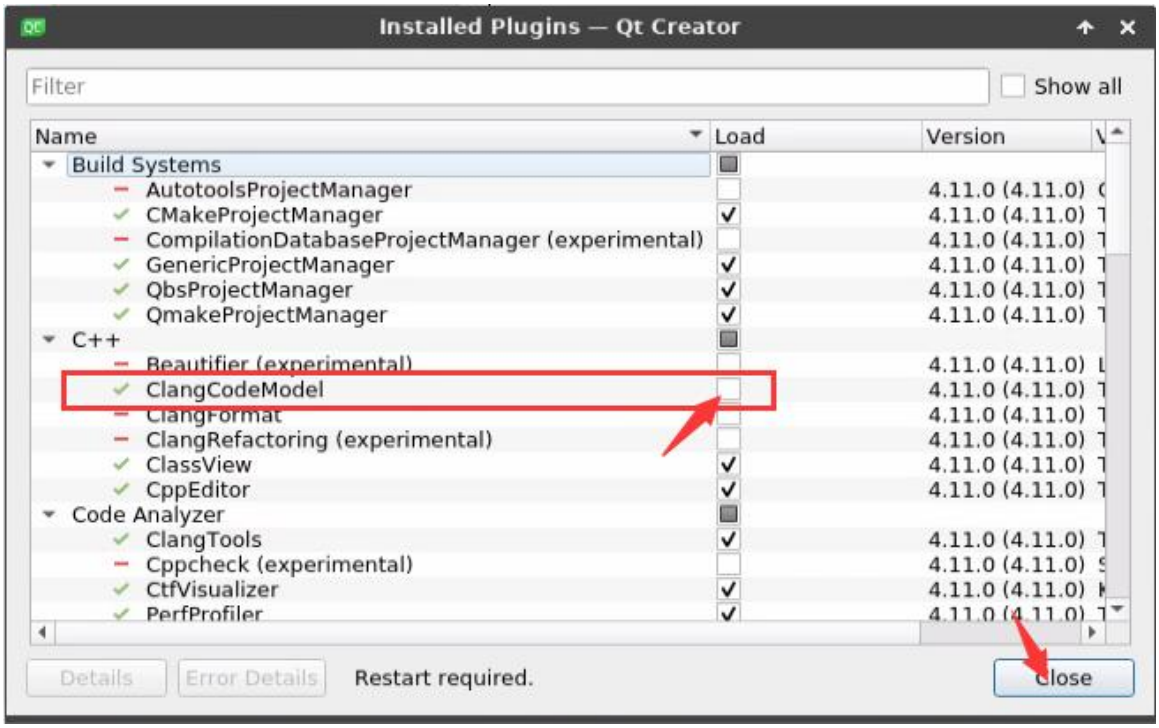


6) Then set the QT

a. First open **Help->About Plugins...**



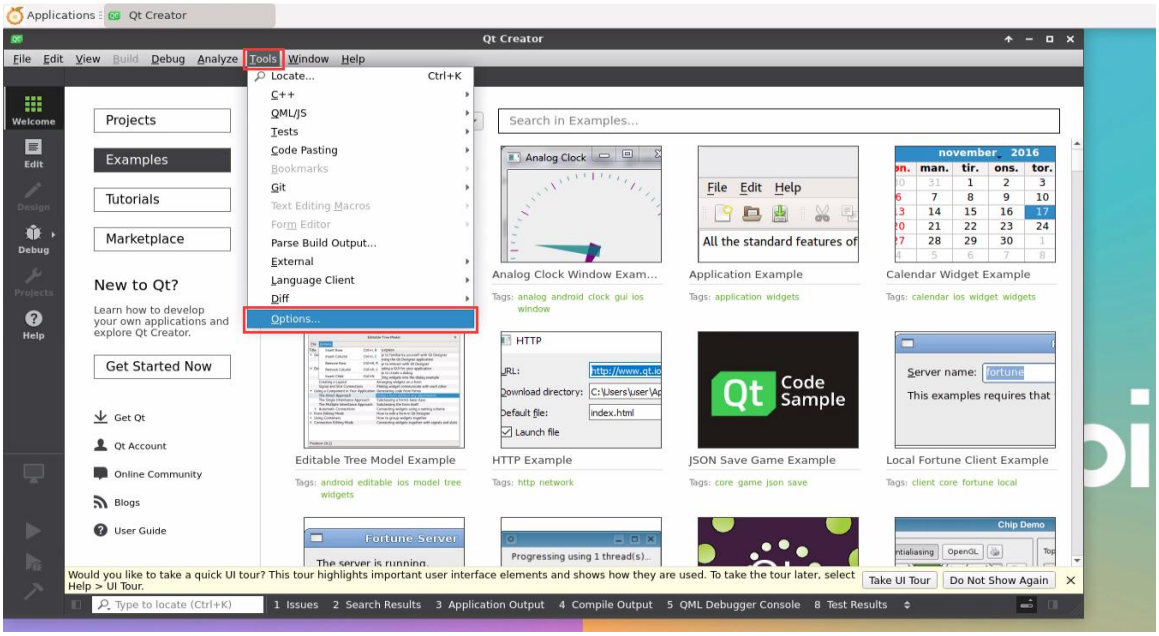
b. Then remove the hook of **ClangCodeModel**

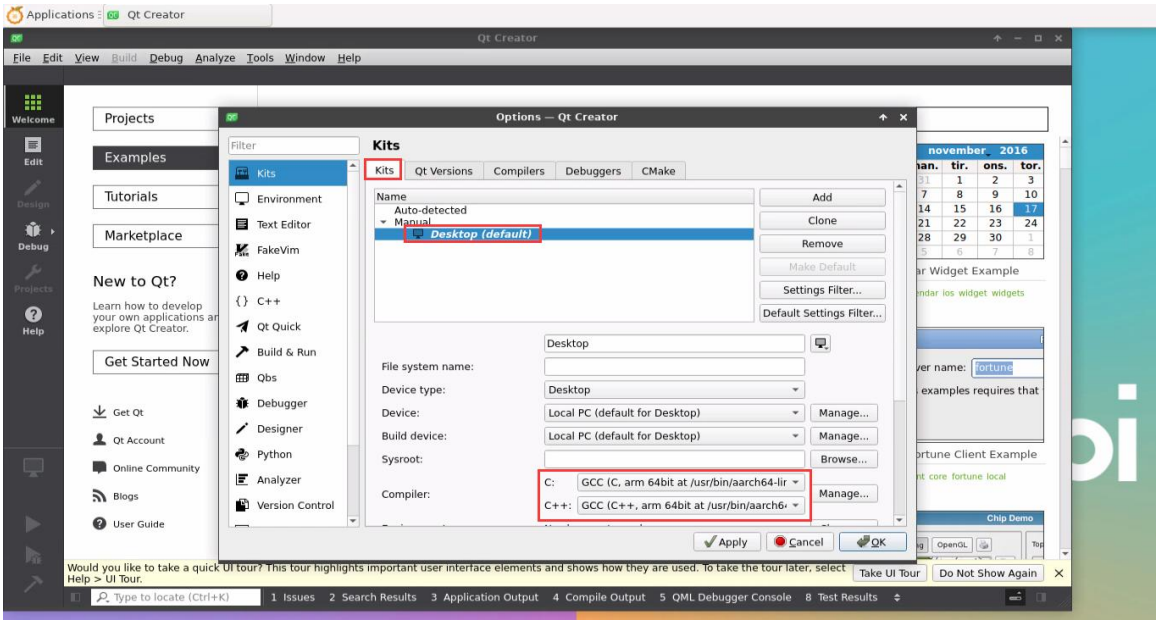


c. **After setting, you need to restart Qt Creator**

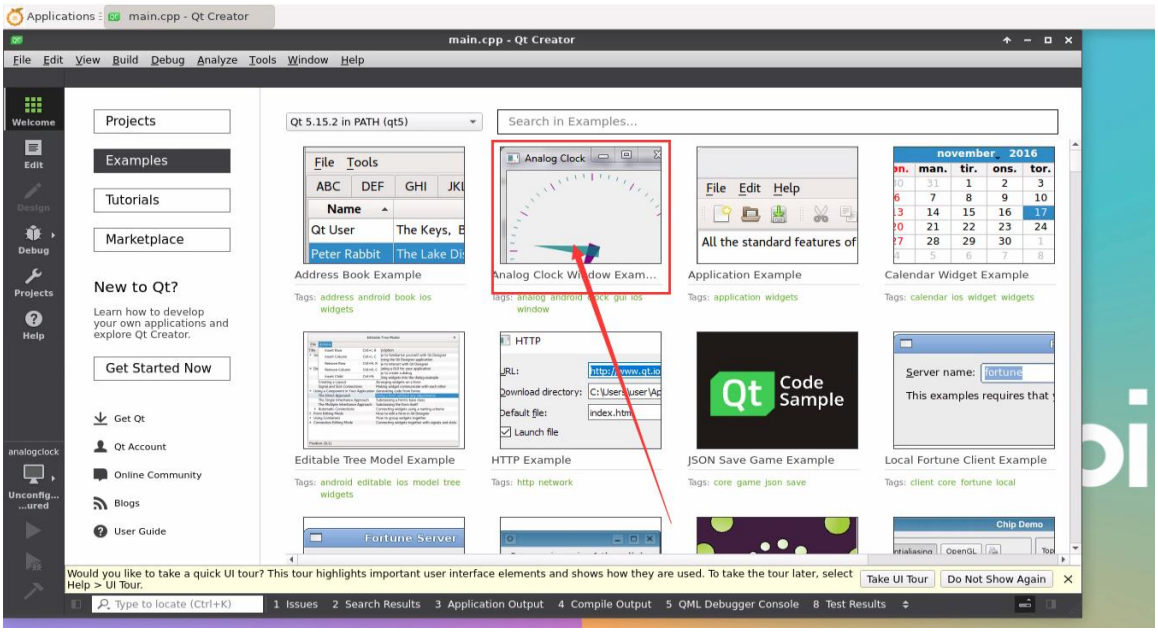
d. Then make sure the GCC compiler used by QT Creator, if the default is Clang, please modify it to GCC

Debian12 please skip this step.

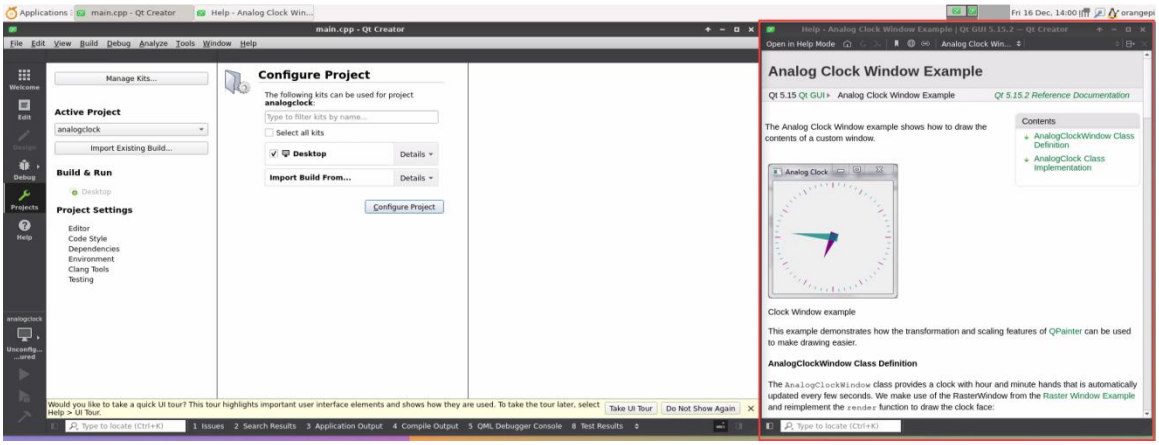




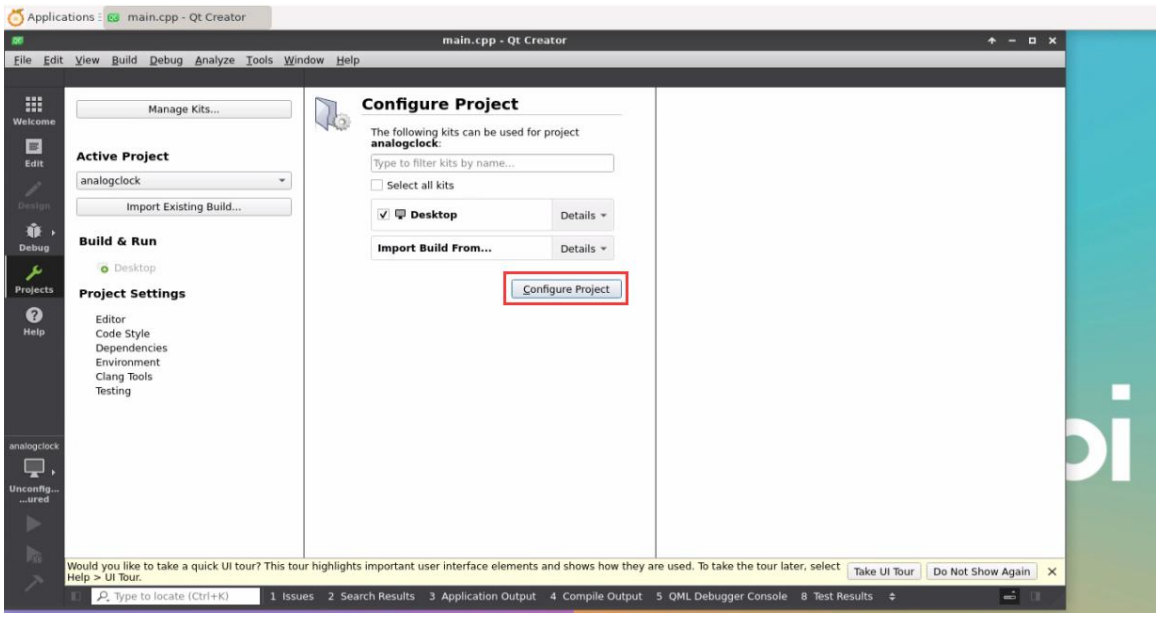
7) Then you can open an example code



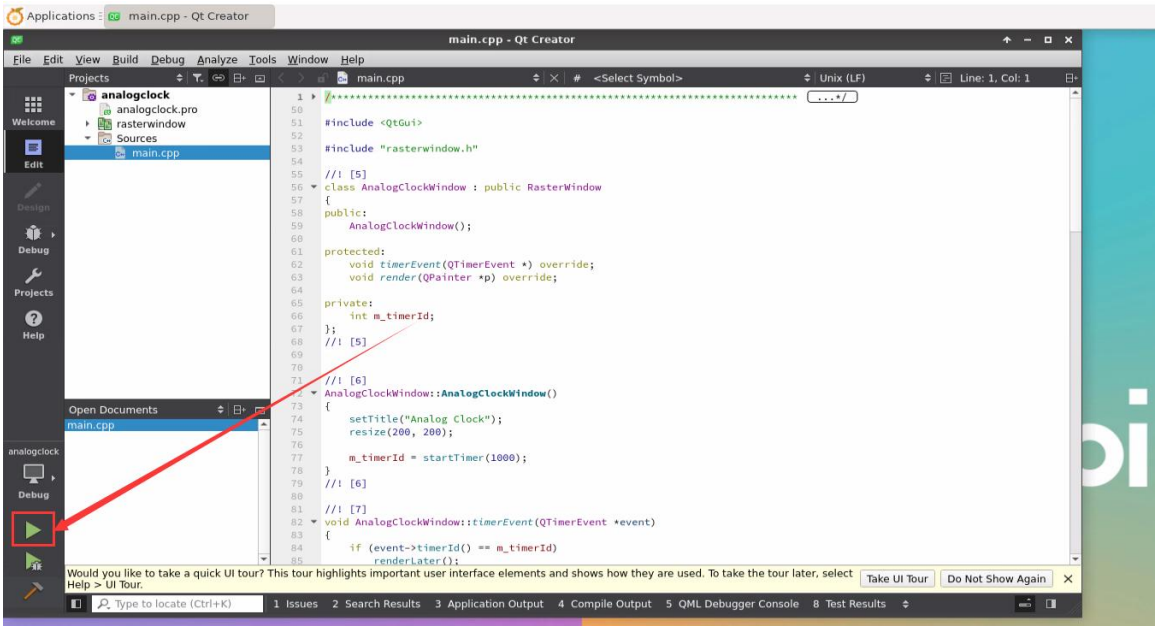
8) After clicking the example code, you will automatically open the corresponding description document. You can carefully look at the instructions for the use



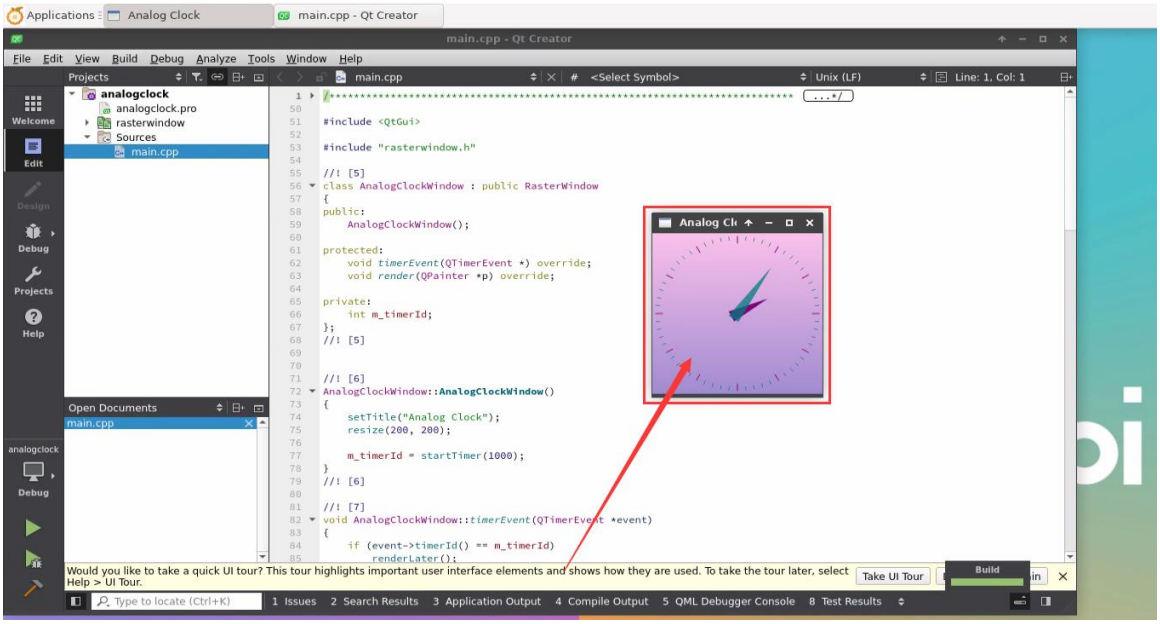
9) Then click **Configure Project**



10) Then click the sample code under the green triangle compilation and run in the lower left corner



11) After waiting for a while, the interface shown in the figure below will pop up. At this time, it means that QT can compile and run normally



12) Reference information

https://wiki.qt.io/Install_Qt_5_on_Ubuntu
https://download.qt.io/archive/qtcreator
https://download.qt.io/archive/qt

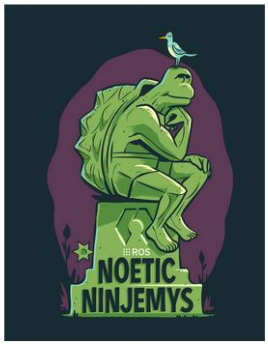
3. 30. ROS installation method

3. 30. 1. Ubuntu 20.04 method of installing ROS 1 Noetic

1) The current active version of ROS 1 is shown below. The recommended version is **Noetic Ninjemys**

Active ROS 1 distributions

Recommended



Distro	Release date	Poster	*Tuturtle*, turtle in tutorial	EOL date
ROS Noetic Ninjemys (**Recommended**)	May 23rd, 2020			May, 2025 (Focal EOL)
ROS Melodic Morenia	May 23rd, 2018			May, 2023 (Bionic EOL)

http://docs.ros.org
https://wiki.ros.org/Distributions

2) ROS 1 **Noetic Ninjemys**' official installation document links are shown below：

http://wiki.ros.org/noetic/Installation/Ubuntu

3) Ubuntu 20.04 is recommended in the official installation document of ROS **Noetic Ninjemys**, so please make sure that the system used in the development board is **Ubuntu20.04 desktop version system**

http://wiki.ros.org/noetic/Installation

4) Then install Ros1 with the following script

```
orangepi@orangepi5plus:~$ install_ros.sh ros1
```

5) Before using the ROS tool, you need to initialize ROSDEP first, and then install some system dependencies and core components in some ROS when compiling the source code

Note that the following commands need to ensure that the development board can access GitHub normally, otherwise it will report an error due to network problems。

install_ros.sh script will try to modify/etc/hosts and run the following commands automatically. However, this method cannot guarantee that you can access github normally. If install_ros.sh has prompting the following errors after the ros1 is installed, please think other methods to allow the linux system of the development board to access github normally, and then manually run the following manually command。

https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/osx-homebrew.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/base.yaml
ERROR: error loading sources list:
The read operation timed out

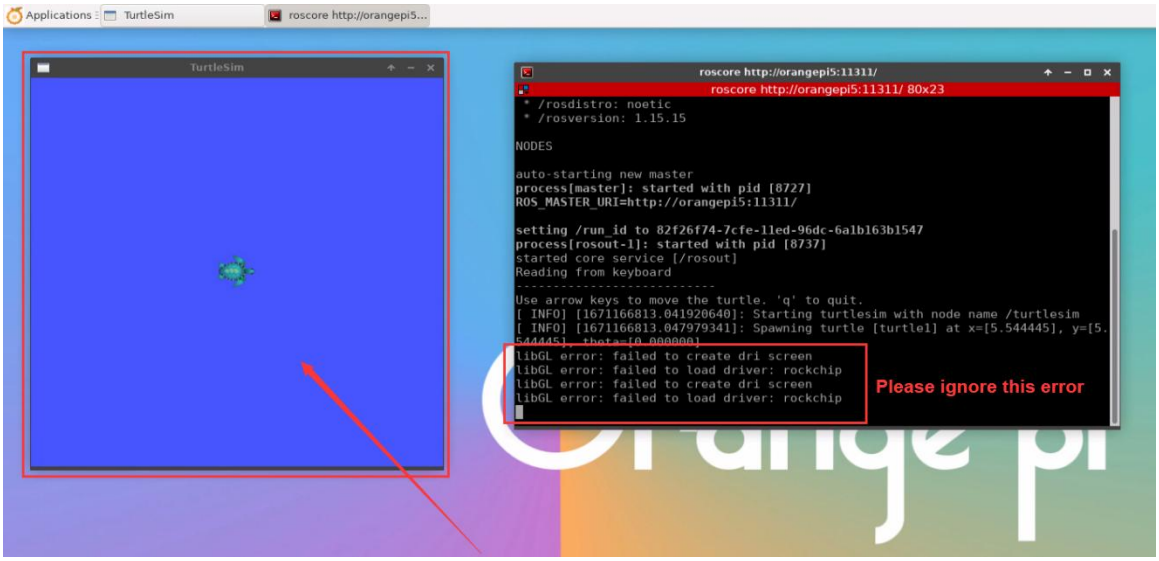
```
orangepi@orangepi:~$ source /opt/ros/noetic/setup.bash
orangepi@orangepi:~$ sudo rosdep init
Wrote /etc/ros/rosdep/sources.list.d/20-default.list
Recommended: please run
```

```
            rosdep update
orangepi@orangepi:~$ rosdep update
reading in sources list data from /etc/ros/rosdep/sources.list.d
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/osx-homebrew.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/base.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/python.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/ruby.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/releases/fuerte.yaml
Query rosdistro index
https://raw.githubusercontent.com/ros/rosdistro/master/index-v4.yaml
Skip end-of-life distro "ardent"
Skip end-of-life distro "bouncy"
Skip end-of-life distro "crystal"
Skip end-of-life distro "dashing"
Skip end-of-life distro "eloquent"
Add distro "foxy"
Add distro "galactic"
Skip end-of-life distro "groovy"
Add distro "humble"
Skip end-of-life distro "hydro"
Skip end-of-life distro "indigo"
Skip end-of-life distro "jade"
Skip end-of-life distro "kinetic"
Skip end-of-life distro "lunar"
Add distro "melodic"
Add distro "noetic"
Add distro "rolling"
updated cache in /home/orangepi/.ros/rosdep/sources.cache
```

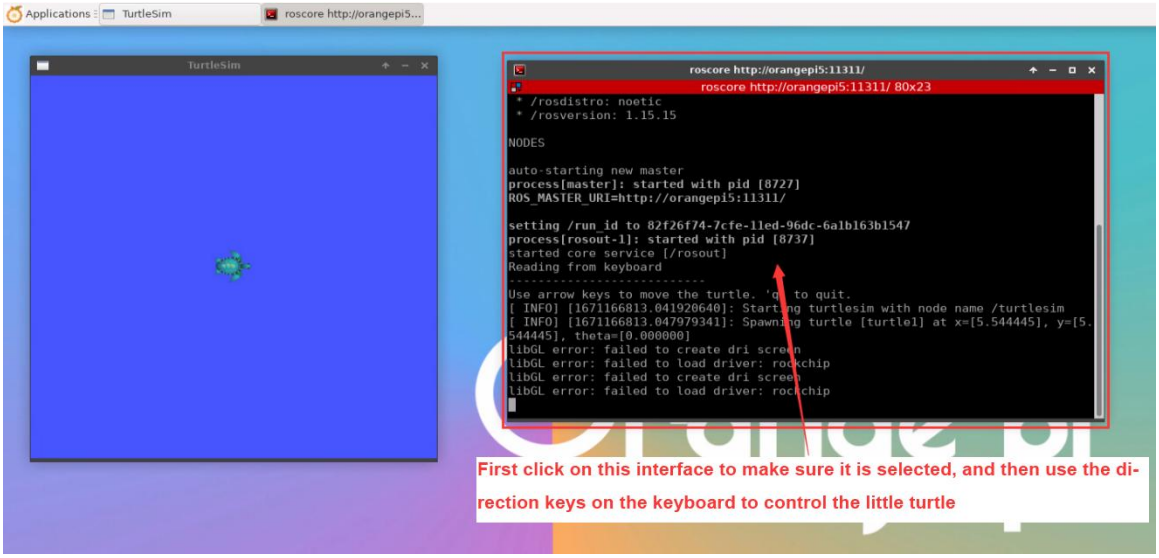
6) Then open a command line window on the **desktop**, and then use the **test_ros.sh** script to start a small turtle routine to test whether the ROS can be used normally

```
orangepi@orangepi:~$ test_ros.sh
```

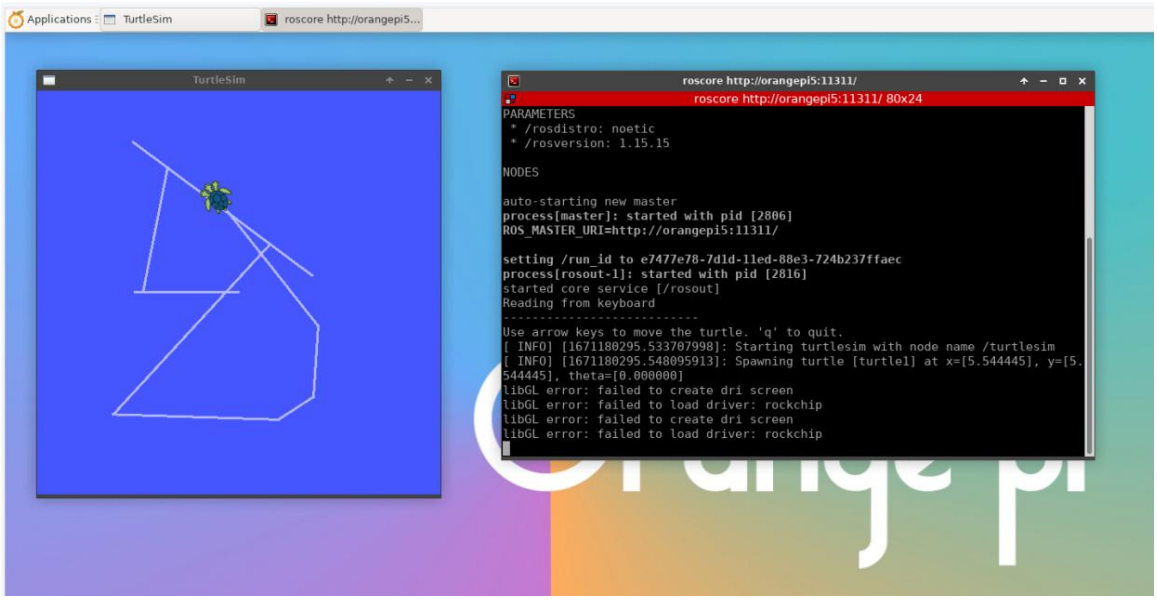
7) After running the **test_ros.sh** script, a small turtle shown in the figure below will pop up



8) Then please keep the terminal window just open at the top

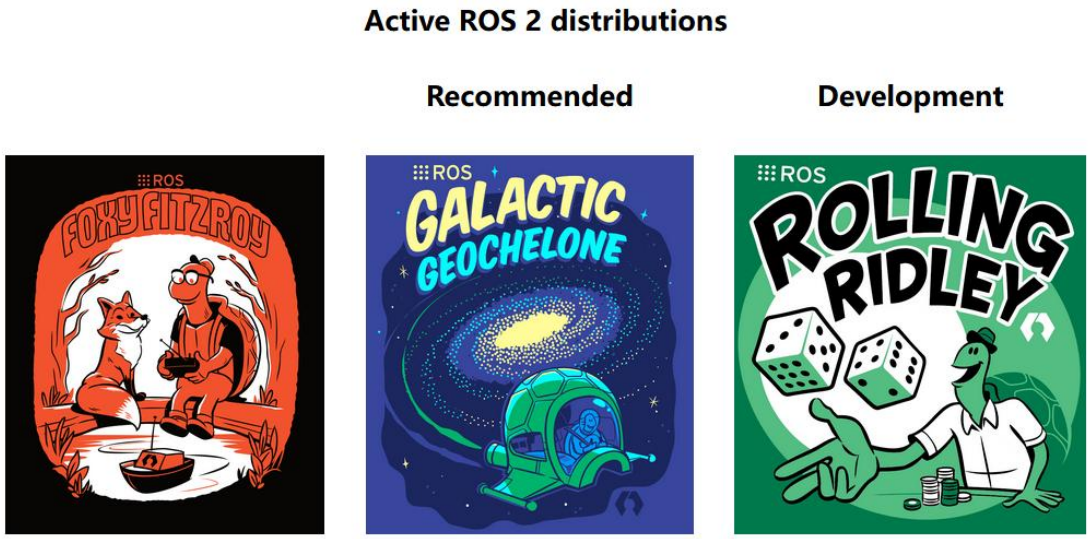


9) At this time, press the direction button on the keyboard to control the small turtles up, down, left and right



3. 30. 2. Ubuntu20.04 The method of installing ROS 2 Galactic

1) The current active version of ROS 2 is shown below. The recommended version is **Galactic Geochelone**



Distro	Release date	Logo	EOL date
Humble Hawksbill	May 23rd, 2022		May 2027
Galactic Geochelone	May 23rd, 2021		November 2022
Foxy Fitzroy	June 5th, 2020		May 2023

http://docs.ros.org
http://docs.ros.org/en/galactic/Releases.html

2) ROS 2 **Galactic Geochelone**'s official installation document link is shown below：

docs.ros.org/en/galactic/Installation.html
http://docs.ros.org/en/galactic/Installation/Ubuntu-Install-Debians.html

3) ROS 2 **Galactic Geochelone**'s official installation document is recommended to use Ubuntu 20.04, so please make sure that the system used in the development board is **Ubuntu20.04 desktop version system**. There are several ways to install ROS 2. The following demonstrates install the Ros 2 **Galactic Geochelone** by **Debian packages**

4) You can install ROS2 with **install_ros.sh** script

```
orangepi@orangepi:~$ install_ros.sh ros2
```

5) **install_ros.sh** script will automatically run the **ros2 -h** command after ros2 is installed. If you can see the printing below, it means that ros2 installation is complete

```
usage: ros2 [-h] Call `ros2 <command> -h` for more detailed usage. ...

ros2 is an extensible command-line tool for ROS 2.

optional arguments:
  -h, --help            show this help message and exit
```

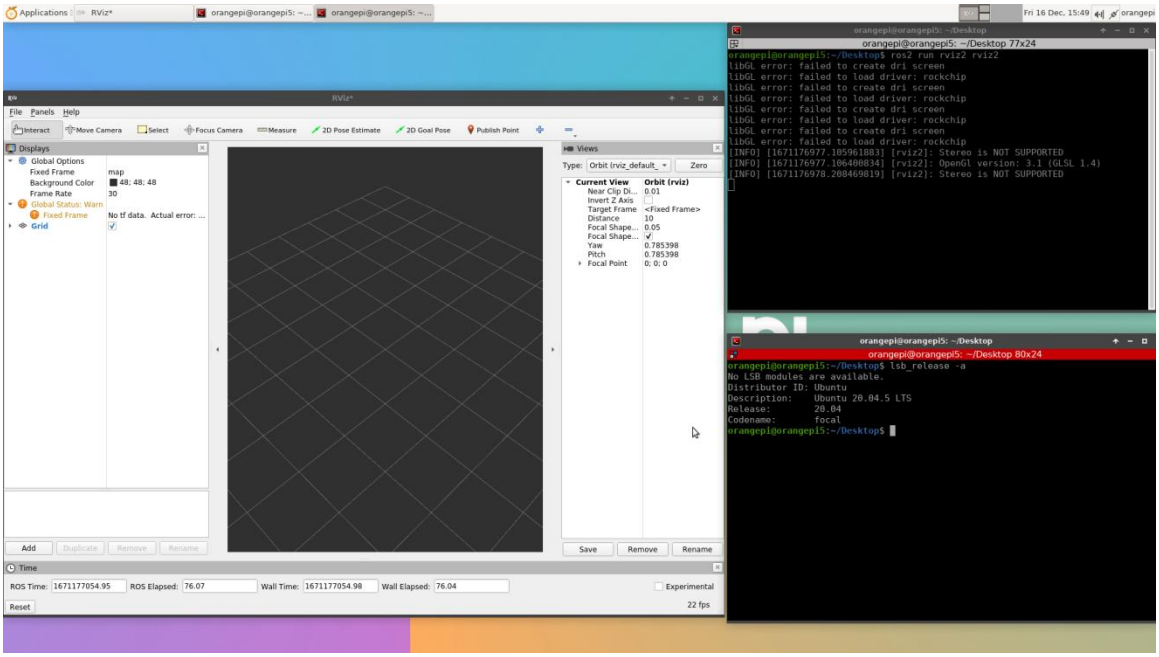
```
Commands:
  action         Various action related sub-commands
  bag            Various rosbag related sub-commands
  component      Various component related sub-commands
  daemon         Various daemon related sub-commands
  doctor         Check ROS setup and other potential issues
  interface      Show information about ROS interfaces
  launch         Run a launch file
  lifecycle      Various lifecycle related sub-commands
  multicast      Various multicast related sub-commands
  node           Various node related sub-commands
  param          Various param related sub-commands
  pkg            Various package related sub-commands
  run            Run a package specific executable
  security       Various security related sub-commands
  service        Various service related sub-commands
  topic          Various topic related sub-commands
  wtf            Use `wtf` as alias to `doctor`

  Call `ros2 <command> -h` for more detailed usage.
```

6) Then you can use the **test_ros.sh** script to test whether the ROS 2 is successfully installed. If you can see the printing below, it means that the ROS 2 can run normally

```
orangepi@orangepi5plus:~$ test_ros.sh
[INFO] [1671174101.200091527] [talker]: Publishing: 'Hello World: 1'
[INFO] [1671174101.235661048] [listener]: I heard: [Hello World: 1]
[INFO] [1671174102.199572327] [talker]: Publishing: 'Hello World: 2'
[INFO] [1671174102.204196299] [listener]: I heard: [Hello World: 2]
[INFO] [1671174103.199580322] [talker]: Publishing: 'Hello World: 3'
[INFO] [1671174103.204019965] [listener]: I heard: [Hello World: 3]
```

7) Run the following command to open rviz2

```
orangepi@orangepi:~$ source /opt/ros/galactic/setup.bash
orangepi@orangepi:~$ ros2 run rviz2 rviz2
```



8) How to use ROS, please refer to the document of ROS 2

http://docs.ros.org/en/galactic/Tutorials.html

3. 30. 3. Ubuntu22.04 to install ROS 2 Humble

1) install ROS2 with **install_ros.sh** script

```
orangepi@orangepi:~$ install_ros.sh ros2
```

2) **install_ros.sh** script will automatically run the **ros2 -h** command after ROS2 is installed. If you can see the following printing, it means that ROS2 installation is complete.

```
usage: ros2 [-h] Call `ros2 <command> -h` for more detailed usage. ...

ros2 is an extensible command-line tool for ROS 2.

optional arguments:
  -h, --help            show this help message and exit

Commands:
  action      Various action related sub-commands
  bag         Various rosbag related sub-commands
  component   Various component related sub-commands
```

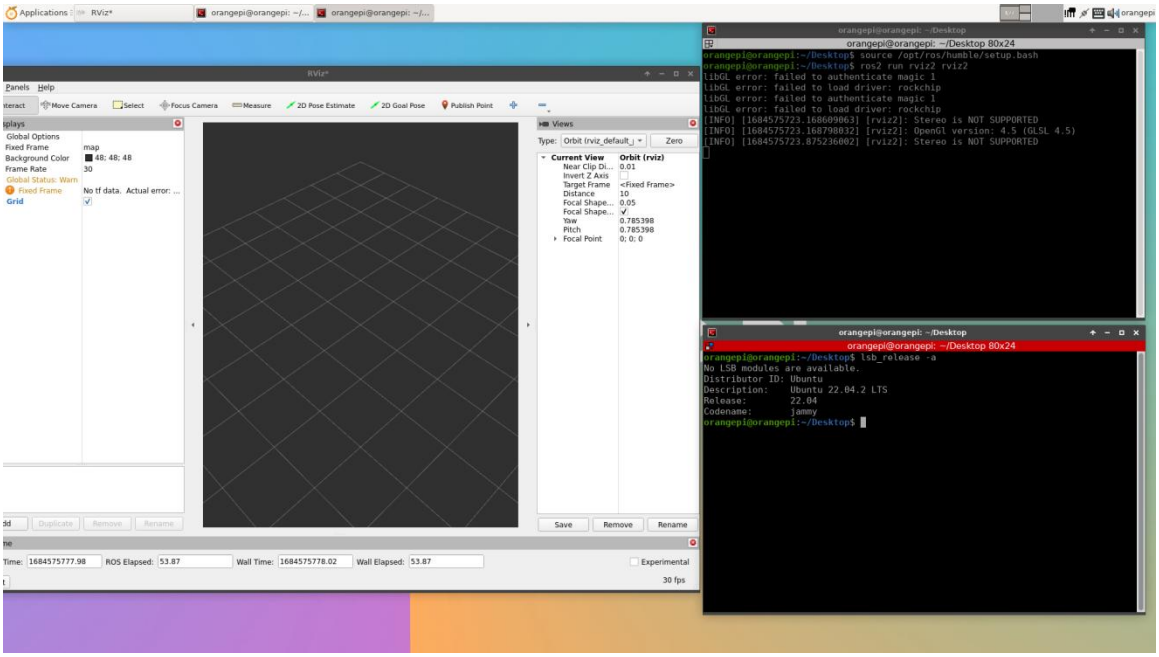
```
daemon      Various daemon related sub-commands
doctor      Check ROS setup and other potential issues
interface   Show information about ROS interfaces
launch      Run a launch file
lifecycle   Various lifecycle related sub-commands
multicast   Various multicast related sub-commands
node        Various node related sub-commands
param       Various param related sub-commands
pkg         Various package related sub-commands
run         Run a package specific executable
security    Various security related sub-commands
service     Various service related sub-commands
topic       Various topic related sub-commands
wtf         Use `wtf` as alias to `doctor`

Call `ros2 <command> -h` for more detailed usage.
```

3) Then you can use the **test_ros.sh** script to test whether the ROS 2 is successfully installed. If you can see the printing below, it means that ROS 2 can run normally

```
orangepi@orangepi5plus:~$ test_ros.sh
[INFO] [1671174101.200091527] [talker]: Publishing: 'Hello World: 1'
[INFO] [1671174101.235661048] [listener]: I heard: [Hello World: 1]
[INFO] [1671174102.199572327] [talker]: Publishing: 'Hello World: 2'
[INFO] [1671174102.204196299] [listener]: I heard: [Hello World: 2]
[INFO] [1671174103.199580322] [talker]: Publishing: 'Hello World: 3'
[INFO] [1671174103.204019965] [listener]: I heard: [Hello World: 3]
```

4) Run the following command to open rviz2

```
orangepi@orangepi:~$ source /opt/ros/humble/setup.bash
orangepi@orangepi:~$ ros2 run rviz2 rviz2
```



5) Reference document

http://docs.ros.org/en/humble/index.html
http://docs.ros.org/en/humble/Installation/Ubuntu-Install-Debians.html

3. 31. The method of installing the kernel header file

1) The linux image released by OPI defaults to the DEB package of the kernel header file. The location is**/opt/**

```
orangepi@orangepi5plus:~$ ls /opt/linux-headers*
/opt/linux-headers-legacy-rockchip-rk3588_x.x.x_arm64.deb
```

2) Use the following command to install the deb package of the kernel header file

The name of the kernel file deb package needs to be replaced with the actual name, please don’ t copy it。

```
orangepi@orangepi:~$ sudo dpkg -i /opt/linux-headers-legacy-rockchip-rk3588_1.x.x_arm64.deb
```

3) After installation, you can see the folder where the kernel header file is located under the**/usr/src**

```
orangepi@orangepi:~$ ls /usr/src
# If it is a system with Linux 5.10 kernel, the output is as follows
```

```
linux-headers-5.10.160-rockchip-rk3588
# If it is a system with Linux 6.1 kernel, the output is as follows
linux-headers-6.1.43-rockchip-rk3588
```

4) Then you can write a Hello kernel module to test the kernel header file

a. First write the code of the Hello kernel module, as shown below：

```
orangepi@orangepi:~$ vim hello.c
#include <linux/init.h>
#include <linux/module.h>

static int hello_init(void)
{
        printk("Hello Orange Pi -- init\n");

        return 0;
}
static void hello_exit(void)
{
        printk("Hello Orange Pi -- exit\n");

        return;
}

module_init(hello_init);
module_exit(hello_exit);

MODULE_LICENSE("GPL");
```

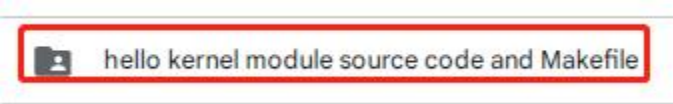
b. Then write a makefile file that compiles the Hello kernel module, as shown below：

```
orangepi@orangepi:~$ vim Makefile
ifneq ($(KERNELRELEASE),)
obj-m:=hello.o
else
KDIR :=/lib/modules/$(shell uname -r)/build
PWD  :=$(shell pwd)
```

```
all:
    make -C $(KDIR) M=$(PWD) modules
clean:
    rm -f *.ko *.o *.mod.o *.mod *.symvers *.cmd    *.mod.c *.order
endif
```

c. Then use the make command to compile the Hello kernel module, and the output of the compilation process is shown below：

If you compile the code you copy here, if you have any problems, go to the official tool to download the source code and upload it to the Linux system of the development board for testing




```
orangepi@orangepi:~$ make
make -C /lib/modules/5.10.160-rockchip-rk3588/build M=/home/orangepi modules
make[1]: Entering directory '/usr/src/linux-headers-5.10.160-rockchip-rk3588'
  CC [M]  /home/orangepi/hello.o
  MODPOST /home/orangepi/Module.symvers
  CC [M]  /home/orangepi/hello.mod.o
  LD [M]  /home/orangepi/hello.ko
make[1]: Leaving directory '/usr/src/linux-headers-5.10.160-rockchip-rk3588'
```

d. After compiling, the **hello.ko** kernel module will be generated

```
orangepi@orangepi:~$ ls *.ko
hello.ko
```

e. Use the **insmod** command to insert the **hello.ko** kernel module into the kernel

```
orangepi@orangepi:~$ sudo insmod hello.ko
```

f. Then use the **demsg** command to view the output of the **hello.ko** kernel module. If you can see the output instructions below, the hello.ko kernel module is loaded correctly

```
orangepi@orangepi:~$ dmesg | grep "Hello"
[ 2871.893988] Hello Orange Pi -- init
```

g. Use the **rmmod** command to uninstall the **hello.ko** kernel module

```
orangepi@orangepi:~$ sudo rmmod hello
orangepi@orangepi:~$ dmesg | grep "Hello"
[ 2871.893988] Hello Orange Pi -- init
```

```
[ 3173.800892] Hello Orange Pi -- exit
```

3. 32. How to use 10.1 inch MIPI LCD screen

3. 32. 1. 10.1 -inch MIPI screen assembly method

1) First prepare the required accessories

a. 10.1 -inch MIPI LCD display+touch screen (this screen and OPI5/OPI5B universal)

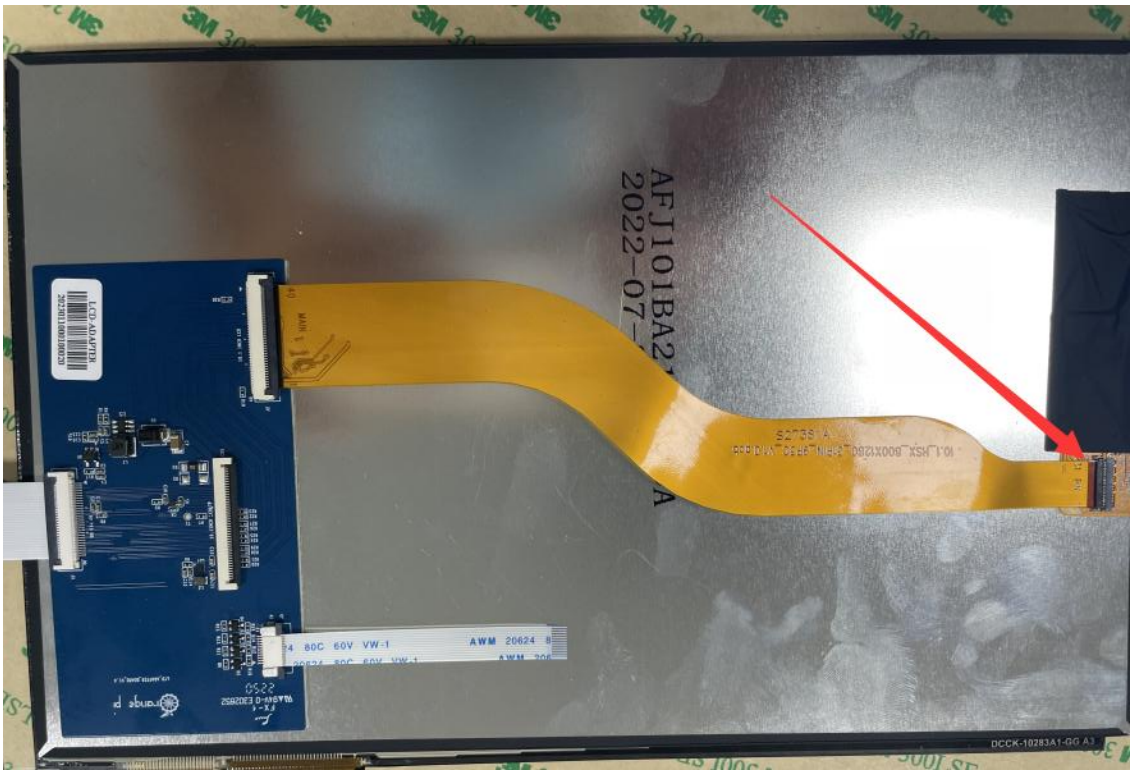
b. Screen divert plate+31pin to 40pin line

c. 30pin mipi line

d. 12pin touch screen row line

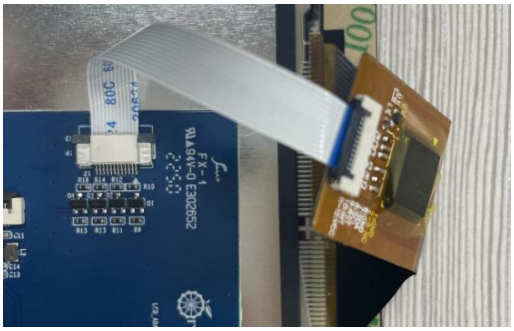
2) According to the figure below, the 12PIN touch screen row, 31PIN to 40PIN ducts, and 30pin MIPI cables get on the screen dial board. Pay attention to line of the touch screen the blue insulation face under . If you get an error, it will cause no display or unable to touch

3) Place the connected rotor connected to the puzzle on the MIPI LCD screen according to the figure below, and connect the MIPI LCD screen and the rotary board through 31PIN to 40Pin row

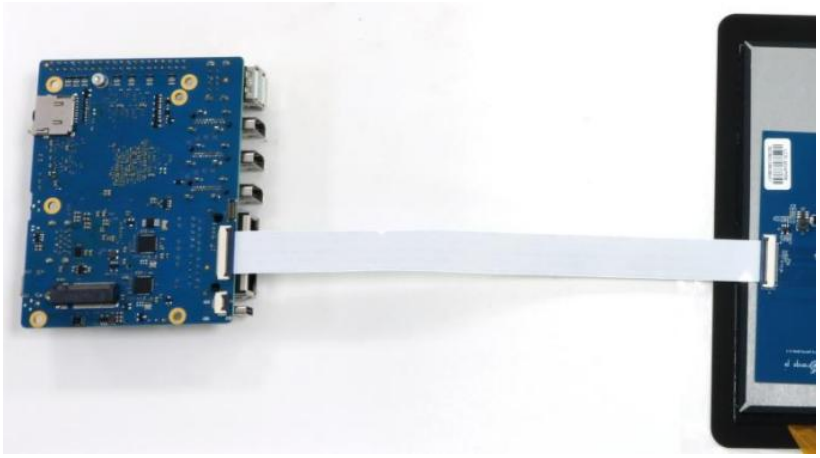


4) Then connect the touch screen and the rotor board through the 12PIN touch screen

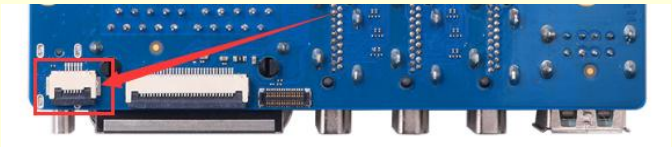
line, pay attention to the orientation of the insulating surface.



5) Finally connect to the LCD interface of the development board through the 30PIN MIPI duct



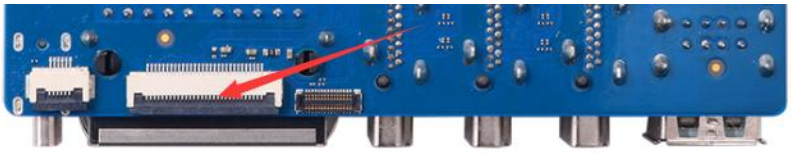
Note that the touch interface below is not used for the LCD MIPI screen. It is currently a spare interface and cannot be used



3.32.2. Open the 10.1 -inch MIPI LCD screen configuration

1) The Linux image defaults to the configuration of the mipi lcd screen by default. If you need to use the mipi lcd screen, you need to open it manually。

2) The position of the development board MIPI LCD screen interface is shown below：

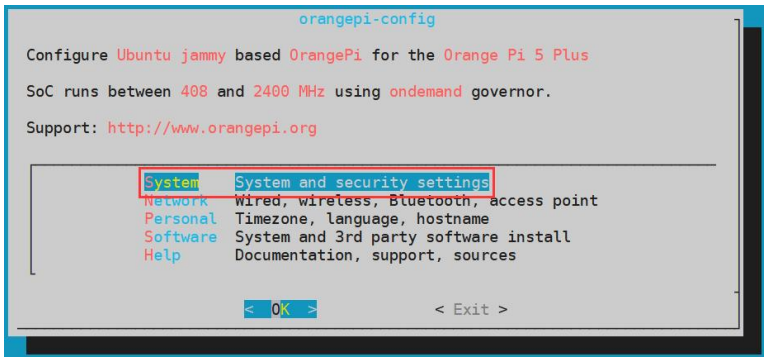


3) The steps of opening the MIPI LCD configuration are shown below：

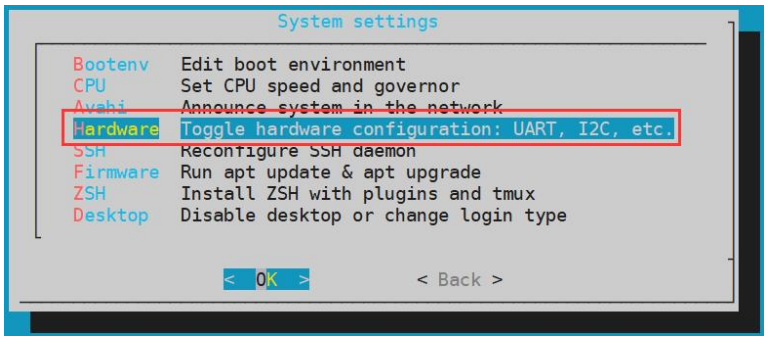
a. First run the orangePi-config. Ordinary users remember to add Sudo permissions

```
orangepi@orangepi:~$ sudo orangepi-config
```

b. Then choose **System**



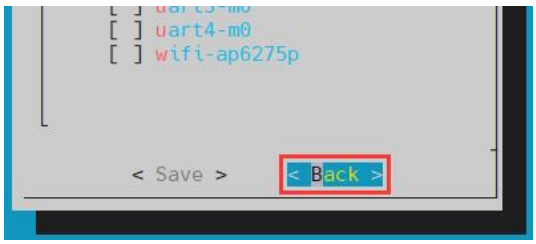
c. Then choos **Hardware**



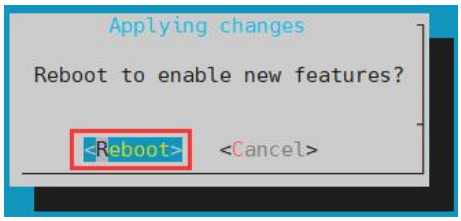
d. Then use the keyboard orientation to position the **opi5plus-lcd**, and then use the **space** to select

e. Then select <Save>

f. Then sele **<Back>**



g. Then select the **<Reboot>**restart system to make the configuration effective



4) After starting, you can see the display of the LCD screen as shown below (the default is vertical screen)：

3. 32. 3. The server version of the image rotation display direction method

1) Add **extrargs = fbcon = rotate: The direction to rotate** is in **/boot/orangepiEnv.txt**. This configuration can set the direction of the LINUX system of the server version,Among them, **fbcon=rotate:** The following numbers can be set to be set to

a. 0: Normal screen (default vertical screen)
b. 1: Turn 90 degrees clock
c. 2: Flip 180 degrees
d. 3: Turn to 270 degrees clock

```
orangepi@orangepi:~$ sudo vim /boot/orangepiEnv.txt
overlays=opi5plus-lcd
```

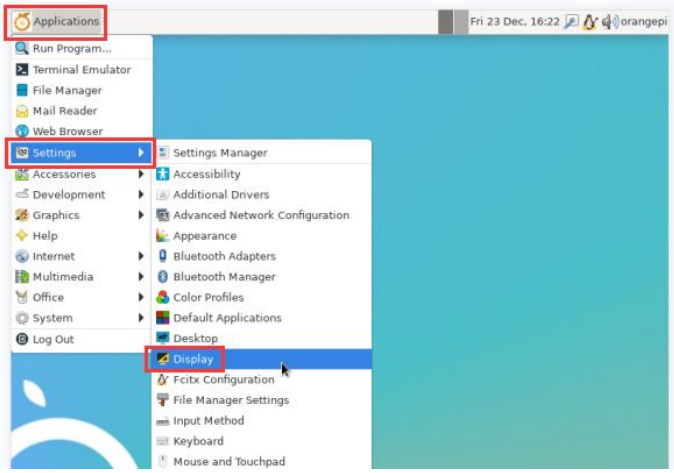
```
extraargs=cma=128M fbcon=rotate:3
```

Note that if/boot/orangepienv.txt is configured in the default default exiArgs = CMA = 128M, fbcon = rotate: 3 The configuration can be added to the extensraargs = cma = 128m (need to be separated by spaces)。

2) Then **restart** the Linux system to see that the direction of the LCD screen display has been rotated

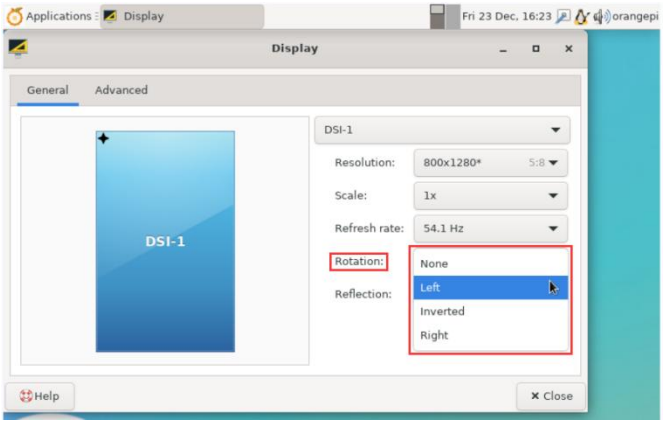
3. 32. 4. The desktop image rotation display and touch direction method

1) First open **Display** settings in the Linux system

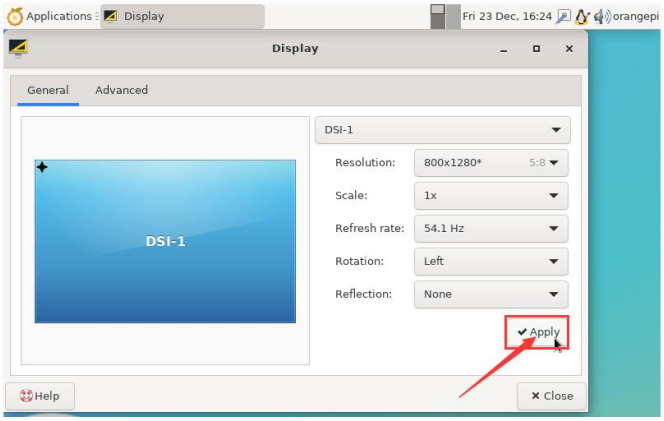


2) Then select the direction you want to rotate in the **Rotation**

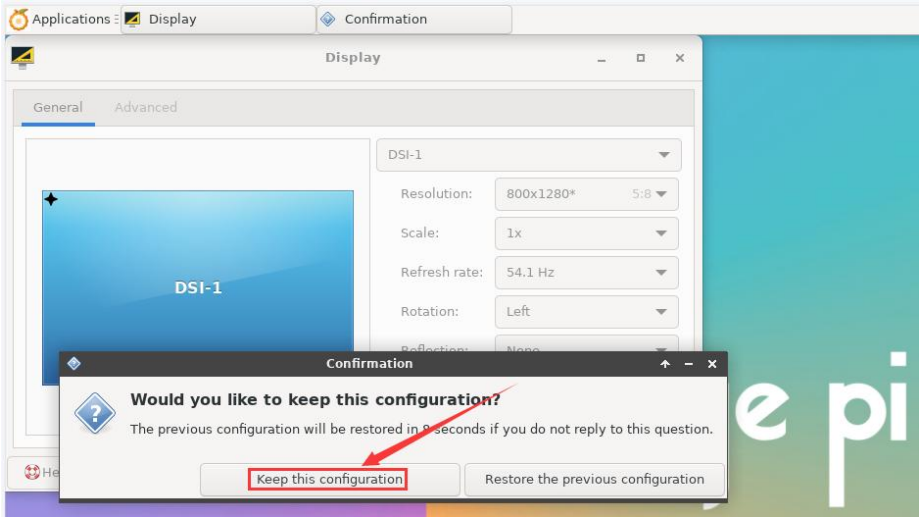
a. **None**: Not rotate
b. **Left**: Rotate 90 degrees to the left
c. **Inverted**: Flipting up and down is equivalent to rotating 180 degrees
d. **Right**: Rotate 90 degrees to the right



3) Then click **Apply**



4) Then click **Keep this configuration**



5) At this time, the screen display has been rotated, and then the **Display** program is turned off

6) The above steps will only select the display direction, and it will not rotate the direction of touch. Use set_lcd_rotate.sh script to rotate the direction of touch. After this script is set, it will be automatically restarted, and then you can test whether the touch can be used normally

a. **None**: Not rotate

```
orangepi@orangepi:~$ set_lcd_rotate.sh none
```

b. **Left**: Rotate 90 degrees to the left

```
orangepi@orangepi:~$ set_lcd_rotate.sh left
```

c. **Inverted**: Flipting up and down, equivalent to rotating 180 degrees

```
orangepi@orangepi:~$ set_lcd_rotate.sh inverted
```

d. **Right**: Rotate 90 degrees to the right

```
orangepi@orangepi:~$ set_lcd_rotate.sh right
```

set_lcd_rotate.sh The script mainly does four things：

1. **Rotate the direction of Framebuffer displayed**
2. **The direction of rotating touch**
3. **Close the boot LOGO**
4. **Restart the system**

The direction of the rotation touch is achieved by adding Option TransformationMatrix""x x x x x x x x x"in /usr/share/X11/xorg.conf.d/40-libinput.conf. Among them, "x x x x x x x x x" is different in different directions。

7) Touch rotation reference materials

https://wiki.ubuntu.com/X/InputCoordinateTransformation

3. 33. Instructions for opening the logo use instructions

1) The default LOGO default is displayed in the desktop version of the system

2) Set the **bootlogo** variable to **false** in **/boot/orangepiEnv.txt** to turn off the switch to the LOGO

```
orangepi@orangepi:~$ sudo vim /boot/orangepiEnv.txt
verbosity=1
bootlogo=false
```

3) Set the **bootlogo** variable to **true** in **/boot/orangepiEnv.txt** to turn the opening and the logo

```
orangepi@orangepi:~$ sudo vim /boot/orangepiEnv.txt
verbosity=1
bootlogo=true
```

4) The position of the LOGO picture in the Linux system is

```
/usr/share/plymouth/themes/orangepi/watermark.png
```

5) After replacing the start -up logo picture, you need to run the command to take effect

```
orangepi@orangepi:~$ sudo update-initramfs -u
```

3. 34. Test methods for OV13850 and OV13855 MIPI camera

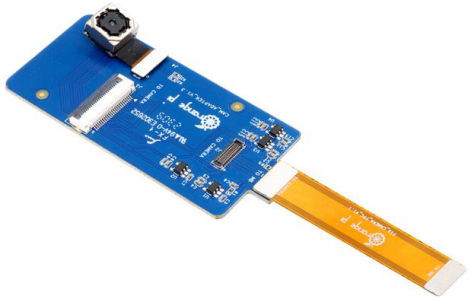
Please note that in Linux 6.1 system, in order to ensure that the 3A service can run normally and obtain normal camera images, the Docker service needs to be disabled. If the Docker service is not disabled, the image captured by the camera will not contain the 3A effect and will appear as a dark image. The method to disable the Docker service is as follows:

```
orangepi@orangepi:~$ sudo systemctl disable docker.socket docker.service containerd.service
orangepi@orangepi:~$ sudo reboot
```

At present, the development board supports two MIPI cameras, OV13850 and OV13855. The specific pictures are shown below：

a. OV13850 camera at 13 million MIPI interface

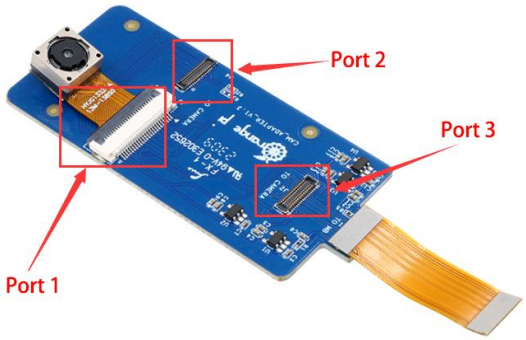
b. 13 million MIPI interface OV13855 camera



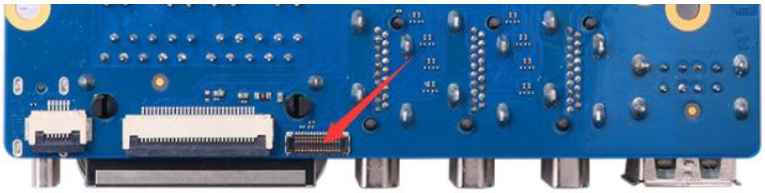
The rotary board used by OV13850 and OV13855 cameras is the same as the FPC cable, but the two cameras are different from the position on the rotary board. The FPC lines are shown in the figure below. Please note that the FPC line is directed. It is marked that the **TO MB** must be inserted into the camera interface of the development board. It is marked that the end of **TO CAMERA** needs to be inserted on the camera transfer board。

There are a total of 3 cameras on the camera to connect to the board, which can only be used one at the same time, as shown in the figure below, among which：

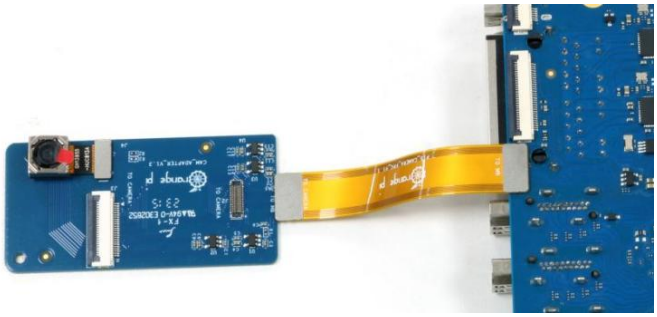
a. **No. 1 connect with OV13850 camera**
b. **No. 2 interface OV13855 camera**
c. The No. 3 interface is not used, just ignore it.



Orange Pi 5 Plus development board has a total of 1 camera interface, which is shown below：



The method of the camera inserted in the development board interface is shown below：

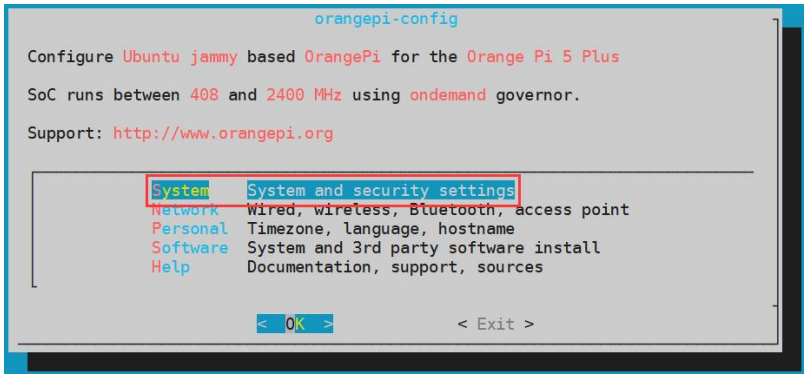


After connecting the camera to the development board, we can use the following method to test the camera：

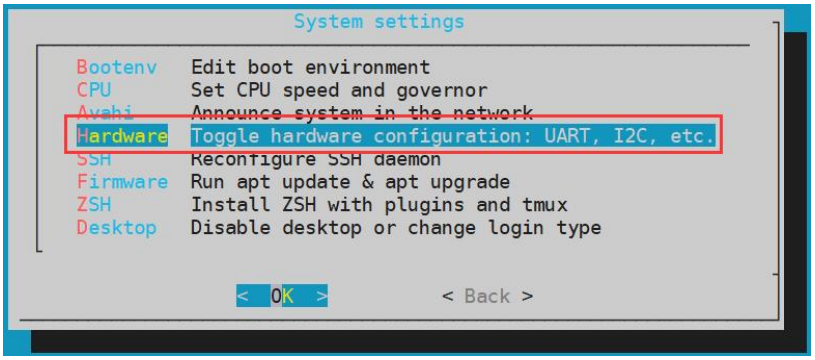
a. First run the **orangepi-config**. Ordinary users remember to add **sudo** permissions

```
orangepi@orangepi:~$ sudo orangepi-config
```

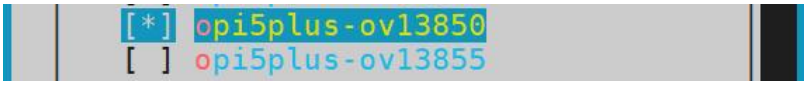
b. Then select **System**



c. Then choose **Hardware**



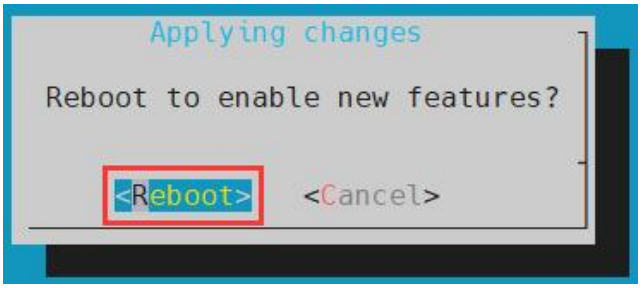
d. Then use the keyboard to locate the position shown in the figure below, and then use the camera you want to open in the space. Among them, **opi5plus-ov13850** means using an OV13850 camera, **opi5plus-ov13855** indicates the use of OV13855 camera。



e. Then choose **<Save>**

f. Then choose **<Back>**

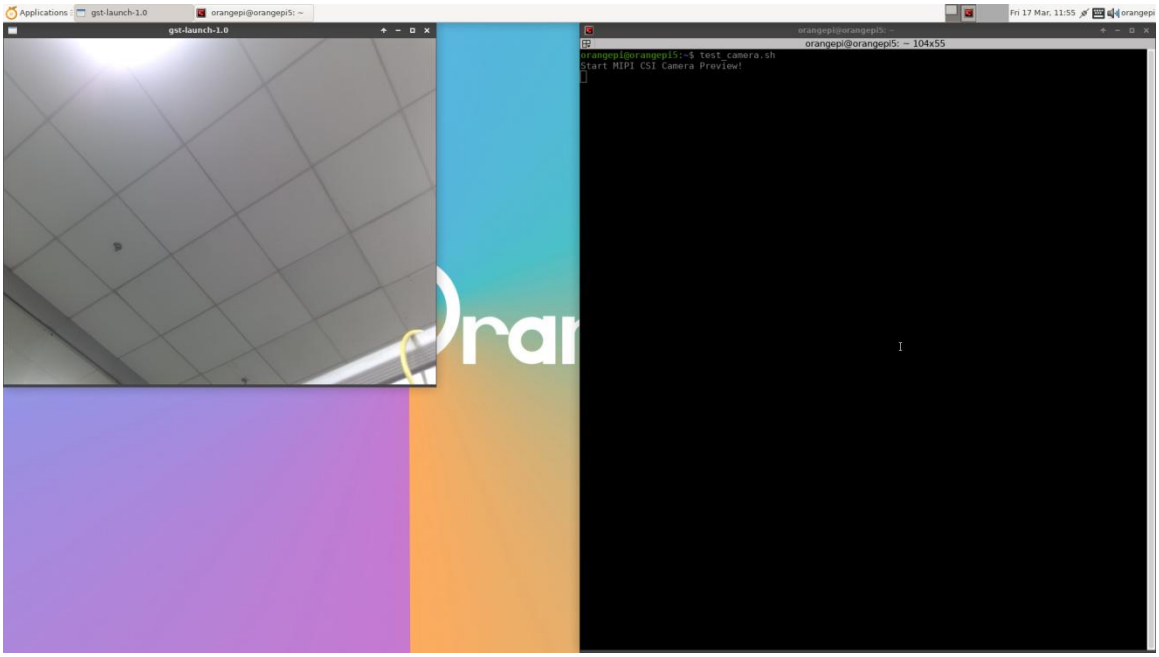
g. Then select the**<Reboot>** restart system to make the configuration effective



h. Then open a terminal in the desktop system and run the script below

```
orangepi@orangepi:~$ test_camera.sh
```

i. Then you can see the preview of the camera



3. 35. Test method for infrared receiving

There is an infrared receiver on the development board, which is connected to the**PWM15_IR_M1** pin. The method of checking the key value received by infrared is shown below：

1) First run the **evtest** command in the command line, and then select the device serial number corresponding to the **febf0030.pwm**

```
orangepi@orangepi:~$ evtest
No device specified, trying to scan all of /dev/input/event*
Not running as root, no devices may be available.
```

```
Available devices:
/dev/input/event0:          febf0030.pwm
/dev/input/event1:          rk805 pwrkey
/dev/input/event2:          rockchip,dp0 rockchip,dp0
/dev/input/event3:          rockchip-hdmi0 rockchip-hdmi0
/dev/input/event4:          rockchip-hdmi1 rockchip-hdmi1
/dev/input/event5:          headset-keys
/dev/input/event6:          rockchip,es8388 Headset
/dev/input/event7:          adc-keys
/dev/input/event8:          SONiX USB Keyboard
/dev/input/event9:          SONiX USB Keyboard Consumer Control
/dev/input/event10:         SONiX USB Keyboard System Control
/dev/input/event11:         PixArt USB Optical Mouse
Select the device event number [0-11]: 0        #Select the serial number corresponding
                                                  to Febf0030.pwm here
Input driver version is 1.0.1
Input device ID: bus 0x19 vendor 0x524b product 0x6 version 0x100
Input device name: "febf0030.pwm"
Supported events:
  Event type 0 (EV_SYN)
  Event type 1 (EV_KEY)
    Event code 2 (KEY_1)
    Event code 3 (KEY_2)
    Event code 4 (KEY_3)
    Event code 5 (KEY_4)
    Event code 6 (KEY_5)
    Event code 7 (KEY_6)
    Event code 8 (KEY_7)
    Event code 9 (KEY_8)
    Event code 10 (KEY_9)
    Event code 11 (KEY_0)
    Event code 28 (KEY_ENTER)
    Event code 102 (KEY_HOME)
    Event code 103 (KEY_UP)
    Event code 105 (KEY_LEFT)
    Event code 106 (KEY_RIGHT)
```

```
    Event code 108 (KEY_DOWN)
    Event code 113 (KEY_MUTE)
    Event code 114 (KEY_VOLUMEDOWN)
    Event code 115 (KEY_VOLUMEUP)
    Event code 116 (KEY_POWER)
    Event code 139 (KEY_MENU)
    Event code 143 (KEY_WAKEUP)
    Event code 158 (KEY_BACK)
    Event code 217 (KEY_SEARCH)
    Event code 388 (KEY_TEXT)
Properties:
Testing ... (interrupt to exit)
```

2) Then need to prepare an infrared remote control shown in the figure below

Note: The Linux system provided by the Orange School only supports the remote control provided by the Orange School. The remote control of the TV or air conditioner cannot be used。

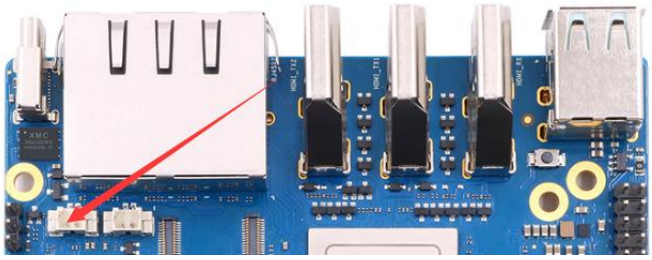
3) Then press the button on the infrared receiver on the development board to press the button on the remote control. The position of the infrared receiver on the development board is as shown in the figure below：

4) Then you can see that **evtest** will print the received key value

```
.....
      Event code 217 (KEY_SEARCH)
      Event code 388 (KEY_TEXT)
Properties:
Testing ... (interrupt to exit)
Event: time 1684152321.834907, type 1 (EV_KEY), code 2 (KEY_1), value 1
Event: time 1684152321.834907, ---------- SYN_REPORT ------------
Event: time 1684152322.017512, type 1 (EV_KEY), code 2 (KEY_1), value 0
Event: time 1684152324.630961, ---------- SYN_REPORT ------------
Event: time 1684152326.482359, type 1 (EV_KEY), code 106 (KEY_RIGHT), value 1
Event: time 1684152326.482359, ---------- SYN_REPORT ------------
Event: time 1684152326.667633, type 1 (EV_KEY), code 106 (KEY_RIGHT), value 0
Event: time 1684152328.427632, ---------- SYN_REPORT ------------
Event: time 1684152330.761986, type 1 (EV_KEY), code 116 (KEY_POWER), value 1
Event: time 1684152330.761986, ---------- SYN_REPORT ------------
Event: time 1684152330.944243, type 1 (EV_KEY), code 116 (KEY_POWER), value 0
Event: time 1684152330.944243, ---------- SYN_REPORT ------------
```

3. 36. The method to use RTC

1) A RTC battery interface is reserved on the development board, which is shown below：



2) The RTC battery that needs to be purchased is shown below. The interface is 2pin, 1.25mm spacing

3) The RTC chip used on the development board is Hym8563TS. This chip has the following characteristics：

a. Wide work voltage range：1.0~5.5v
b. Low dormant current:Typical value 0.25μA(VDD =3.0V, TA =25°C)

4) After connecting the RTC battery on the development board, use the following method to test whether the RTC has been working normally：

a. First turn on the system, then record the current time of the system
b. Then use the Poweroff command to turn off the system normally
c. Then unplug the power supply to ensure that the development board does not access the network cable and wireless WiFi, and wait a few minutes
d. Then start the system again. If you see the time walk forward for a few minutes after entering the system, it means that the RTC module and the battery work normally

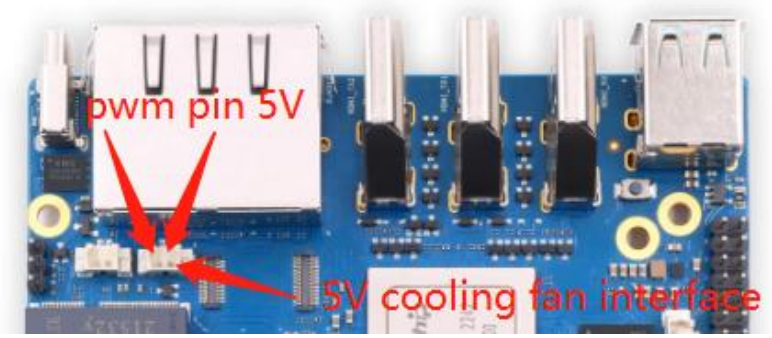
5) See the command of the RTC information through the ProcFS interface of the Linux system

```
orangepi@orangepi:~$ cat /proc/driver/rtc
rtc_time        : 06:07:40
rtc_date        : 2023-05-22
alrm_time       : 03:36:00
alrm_date       : 2023-05-23
alarm_IRQ       : no
alrm_pending    : no
update IRQ enabled      : no
periodic IRQ enabled    : no
periodic IRQ frequency  : 1
max user IRQ frequency  : 64
24hr            : yes
```

3. 37. How to use the cooling PWM fan

1) The development board is used for interfaces that connect the heat sink fan. The interface specifications are **2pin 1.25mm** spacing, **5V voltage driver**, and the position of

the fan interface is shown in the figure below：



2) The fan on the development board can adjust the speed and switch through PWM, and the PWM pins used are **PWM3_IR_M1**

3) The Linux system uses the **pwm-fan** driver to control the fan by default. The DTS configuration used is shown below：

orange-pi-5.10-rk3588/arch/arm64/boot/dts/rockchip/rk3588-orangepi-5-plus.dts

```
        fan: pwm-fan {
                compatible = "pwm-fan";
                #cooling-cells = <2>;
                pwms = <&pwm3 0 50000 0>;
                cooling-levels = <0 50 100 150 200 255>;
                rockchip,temp-trips = <
                        50000   1
                        55000   2
                        60000   3
                        65000   4
                        70000   5
                >;

                status = "okay";
        };
```

Among it：

a. **pwms = <&pwm3 0 50000 0>**：The PWM of the control fan is PWM3。

b. **cooling-levels = <0 50 100 150 200 255>**：It is used to configure the gear of the

speed (PWM duty cycle). The number and size of the gear can be defined by itself. Here are 6 gears. The range of the speed is 0-255。

c. **rockchip,temp-trips**： It is used to configure the corresponding relationship between the CPU temperature and the fan speed gear. It can be adjusted according to actual needs. The above configuration 50 degrees corresponding gear 1, 70 degrees to the corresponding gear 5。

It is normal to find that the fan does not turn after turning, because the temperature of the CPU after booting is generally lower than 50 degrees. Only when the temperature of the CPU reaches 50 degrees, the fan will start to turn。

Use the following commands to make all CPUs run, and then you can see that the fan will start working：

orangepi@orangepi:~$ **for i in $(seq 0 $(($(nproc --all) - 1))); do (taskset -c $i yes > /dev/null &); done**

3. 38. How to use the ZFS file system

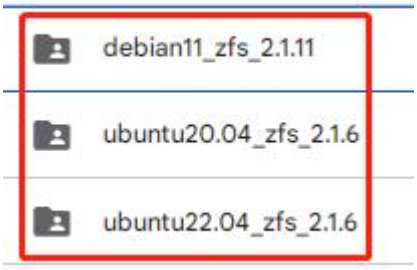
3. 38. 1. How to install ZFS

Before installing zfs, please ensure that the Linux image used is the latest version. In addition, if zfs is already installed in the system, there is no need to install it again.

Before installing zfs, you need to install the kernel header file first. **For the method of installing the kernel header file**, please refer to the instructions in the section on the method of installing the kernel header file.

In Ubuntu20.04, Ubuntu22.04 and Debian11 systems, zfs cannot be installed directly through apt, because the default apt source zfs version is lower than 2.1.6, and there is a problem of incompatibility with rk linux5.10 kernel. This problem is fixed in zfs version 2.1.6 and later.

To solve this problem, we provide a zfs deb package that can be installed normally, which can be downloaded from the **official tool** of the development board. Open the **official tool**, and then enter the **zfs-related deb package folders used by Ubuntu and Debian systems**. You can see three types of deb packages: Ubuntu20.04, Ubuntu22.04 and Debian11. Please download the required version.



After downloading the zfs deb packages of the corresponding version, please upload them to the Linux system of the development board. For the upload method, please refer to the description in the section of **the method of uploading files to the Linux system of the development board**.

After the upload is complete, use the **cd** command in the command line of the development board linux system to enter the deb package directory, and then use the following command to install the zfs deb package.

```
orangepi@orangepi:~$ sudo apt install ./*.deb
```

After the installation is complete, use the following command to see the zfs-related kernel modules:

```
orangepi@orangepi:~$ ls /lib/modules/5.10.160-rockchip-rk3588/updates/dkms/
icp.ko  spl.ko  zavl.ko  zcommon.ko  zfs.ko  zlua.ko  znvpair.ko  zunicode.ko  zzstd.ko
```

Then restart the Linux system to see that the zfs kernel module will be automatically loaded:

```
orangepi@orangepi:~$ lsmod | grep "zfs"
zfs                  2801664  0
zunicode              327680  1 zfs
zzstd                 471040  1 zfs
zlua                  139264  1 zfs
zcommon                69632  1 zfs
znvpair                61440  2 zfs,zcommon
zavl                   16384  1 zfs
icp                   221184  1 zfs
spl                    77824  6 zfs,icp,zzstd,znvpair,zcommon,zavl
```

In Debian12, the default version of zfs is 2.1.11, so we can install zfs directly through the following command. Again, please make sure that the system has installed the deb package of the kernel header file before installation.

```
orangepi@orangepi:~$ sudo apt install -y zfsutils-linux zfs-dkms
```

3. 38. 2. Methods of creating ZFS pools

ZFS is based on storage pools, we can add multiple physical storage devices to the pool, and then allocate storage space from this pool.

The following content is demonstrated based on the development board connected to an NVMe SSD and a USB flash drive.

1) First, we can use the **lsblk** command to view all storage devices on the development board. The current development board is connected to an NVMe SSD and a U disk. The output is as follows:

```
orangepi@orangepi:~$ lsblk
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
sda           8:0    1  28.8G  0 disk
├─sda1        8:1    1  28.8G  0 part
└─sda9        8:9    1     8M  0 part
mtdblock0    31:0    0    16M  0 disk
mmcblk0     179:0    0  29.7G  0 disk
├─mmcblk0p1 179:1    0     1G  0 part /boot
└─mmcblk0p2 179:2    0  28.4G  0 part /var/log.hdd
                                      /
zram0       254:0    0   7.7G  0 disk [SWAP]
zram1       254:1    0   200M  0 disk /var/log
nvme0n1     259:0    0 476.9G  0 disk
├─nvme0n1p1 259:3    0 476.9G  0 part
└─nvme0n1p9 259:4    0     8M  0 part
orangepi@orangepi:~$
```

2) Then enter the following command to create a ZFS pool, including two storage devices, NVMe SSD and U disk

```
orangepi@orangepi:~$ sudo zpool create -f pool1 /dev/nvme0n1 /dev/sda
```

3) Then use the **zpool list** command to see that the system has created a ZFS pool named **pool1**, and the size of the ZFS pool pool1 is the size of the NVME SSD plus the size of the U disk

```
orangepi@orangepi:~$ zpool list
NAME    SIZE  ALLOC   FREE  CKPOINT  EXPANDSZ   FRAG    CAP  DEDUP    HEALTH  ALTROOT
pool1   504G   114K   504G        -         -     0%     0%  1.00x    ONLINE  -
```

4) Then execute **df -h** to see that **pool1** is mounted to the **/pool1** directory

```
orangepi@orangepi:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           1.6G   18M  1.6G   2% /run
/dev/mmcblk0p2   29G  6.0G   22G  22% /
tmpfs           7.7G   46M  7.7G   1% /dev/shm
tmpfs           5.0M  4.0K  5.0M   1% /run/lock
tmpfs           7.7G  944K  7.7G   1% /tmp
/dev/mmcblk0p1 1022M  115M  908M  12% /boot
/dev/zram1      188M  4.5M  169M   3% /var/log
tmpfs           1.6G   80K  1.6G   1% /run/user/1000
pool1           489G  9.3M  489G   1% /pool1
```

5) Use the following command to see that the file system type of pool1 is zfs

```
orangepi@orangepi:~$ mount | grep pool1
pool1 on /pool1 type zfs (rw,xattr,noacl)
```

6) Then we can test copying a file to the ZFS pool

```
orangepi@orangepi:~$ sudo cp -v /usr/local/test.mp4 /pool1/
'/usr/local/test.mp4' -> '/pool1/test.mp4'
```

3. 38. 3. Test the data deduplication function of ZFS

1) The data deduplication function of ZFS is disabled by default, we need to execute the following command to enable it

```
orangepi@orangepi:~$ sudo zfs set dedup=on pool1
```

2) Then do a simple test, first enter pool1, and then execute the following command to generate a random file with a size of 1G

```
orangepi@orangepi:~$ cd /pool1/
root@orangepi:/pool1$ sudo dd if=/dev/urandom of=test.1g bs=1M count=1024
1024+0 records in
1024+0 records out
1073741824 bytes (1.1 GB, 1.0 GiB) copied, 5.04367 s, 213 MB/s
```

3) Then use the following command to copy 1000 random files of size 1G

```
root@orangepi:/pool1$ for ((i=0; i<1000; i++)); do sudo cp test.1g $i.test.1g; done
```

4) Then use **du -lh** to see that there are currently 1002G of data in the pool, but in fact the size of the ZFS pool is only **504GB** (the total capacity of SSD+U disk), which cannot hold such a large amount of data

```
root@orangepi:/pool1$ du -lh
1002G
```

5) Then use the **zpool list** command to see that only 1.01G is actually occupied, because these 1001 files are all duplicates, indicating that the data deduplication function is effective.

```
orangepi@orangepi:/pool1$ zpool list
NAME    SIZE  ALLOC   FREE  CKPOINT  EXPANDSZ   FRAG    CAP  DEDUP    HEALTH  ALTROOT
pool1   504G  1.01G   503G        -         -     0%     0%  6.00x    ONLINE  -
```

3. 38. 4. Test the data compression function of ZFS

1) Because the stored data is different, the disk space saved by compression will also be different, so we choose to compress relatively large plain text files for compression testing, and execute the following commands to pack the **/var/log/** and **/etc/** directories into a tarball

```
orangepi@orangepi:~$ cd /pool1/
root@orangepi:/pool1$ sudo tar -cf text.tar /var/log/ /etc/
```

2) Then the file size that can be seen through the **ls -lh** command and the space occupied in the ZFS pool are both **27M**

```
orangepi@orangepi:/pool1$ ls -lh
total 27M
-rw-r--r-- 1 root root 27M Jun  1 14:46 text.tar
orangepi@orangepi:/pool1$ zpool list
NAME    SIZE  ALLOC   FREE  CKPOINT  EXPANDSZ   FRAG    CAP  DEDUP    HEALTH  ALTROOT
pool1   504G  26.7M   504G        -         -     0%     0%  1.00x    ONLINE  -
orangepi@orangepi:/pool1$
```

3) Then we enable compression in the ZFS pool pool1

```
root@orangepi:/pool1$ sudo zfs set compression=lz4 pool1
```

4) Then execute the following command again to package the **/var/log/** and **/etc/** directories into a tar package

```
root@orangepi:/pool1$ sudo tar -cf text.tar /var/log/ /etc/
```

5) At this time, you can see that the size of the **text.tar** file is still 27M, but it only occupies 9.47M in the ZFS pool, indicating that the file is compressed

```
orangepi@orangepi:/pool1$ ls -lh
total 9.2M
-rw-r--r-- 1 root root 27M Jun  1 14:54 text.tar
orangepi@orangepi:/pool1$ zpool list
NAME    SIZE  ALLOC   FREE  CKPOINT  EXPANDSZ   FRAG    CAP  DEDUP    HEALTH  ALTROOT
pool1   504G  9.47M   504G        -         -     0%     0%  1.00x    ONLINE  -
```

3. 39. How to install and use CasaOS

CasaOS is an open source home cloud system based on the Docker ecosystem, which allows you to run a variety of home applications on your own development board, such as NAS, home automation, media servers, etc.

There are many problems with installing CasaOS in Debian12, please do not use this method to install.

3. 39. 1. CasaOS installation method

1) First you need to install docker. Docker is already pre-installed in the system released by Orangepi Pi. This step can be skipped. You can use the following command to check the version of docker installed.

```
orangepi@orangepi:~$ docker --version
Docker version 24.0.2, build cb74dfc          # Ubuntu Jammy system output
```

2) Then enter the following command in the linux system to start the installation of CasaOS

```
orangepi@orangepi:~$ curl -fsSL https://get.casaos.io | sudo bash
```

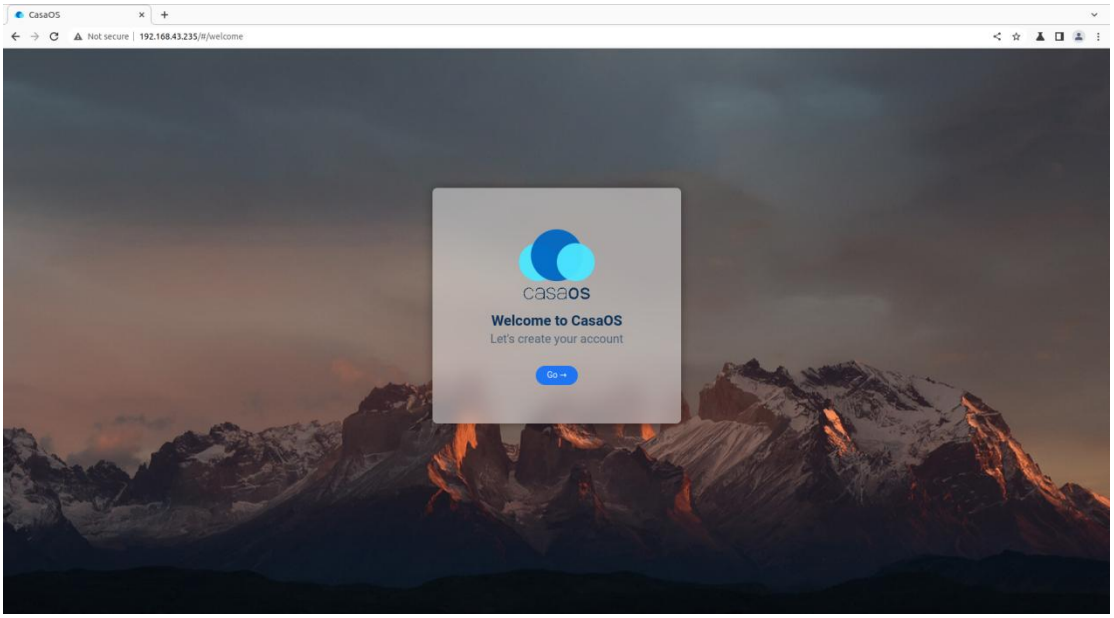
3) When you see the terminal outputting the following print information, it means that CasaOS has been installed.

```
CasaOS v0.4.4.2 is running at:

Open your browser and visit the above address.


CasaOS Project   : https://github.com/IceWhaleTech/CasaOS
CasaOS Team      : https://github.com/IceWhaleTech/CasaOS#maintainers
CasaOS Discord   : https://discord.gg/knqAbbBbeX
Website          : https://www.casaos.io
Online Demo      : http://demo.casaos.io

Uninstall        : casaos-uninstall
```

3. 39. 2. How to use CasaOS

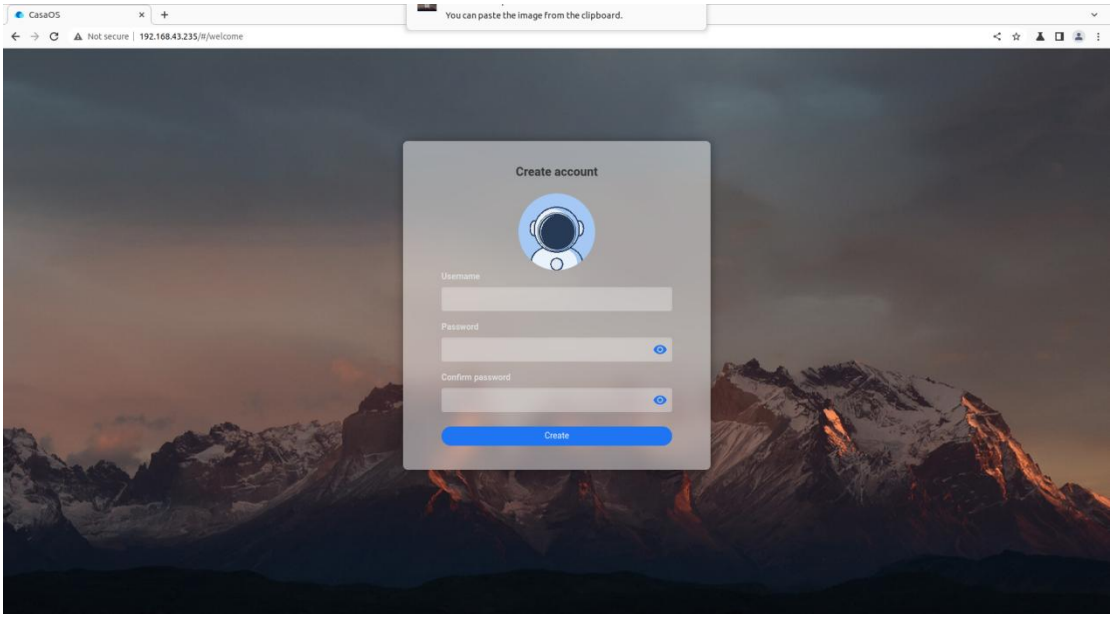
1) After installing CasaOS, enter **http://the IP address of the development board** in the browser to open CasaOS

2) After opening CasaO, the following welcome interface will pop up. Click "Go" to proceed to the next step.

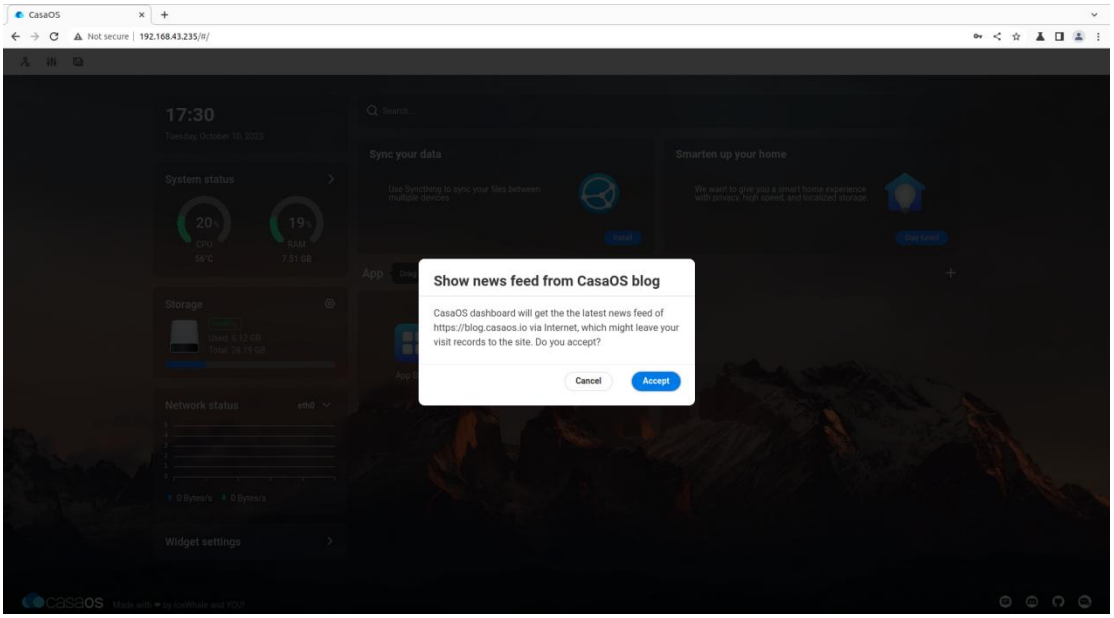


3) When you log in to CasaOS for the first time, the login interface is the interface for setting the account and password. When you log in again, only the interface for entering the account and password will appear. After setting the account and password, click

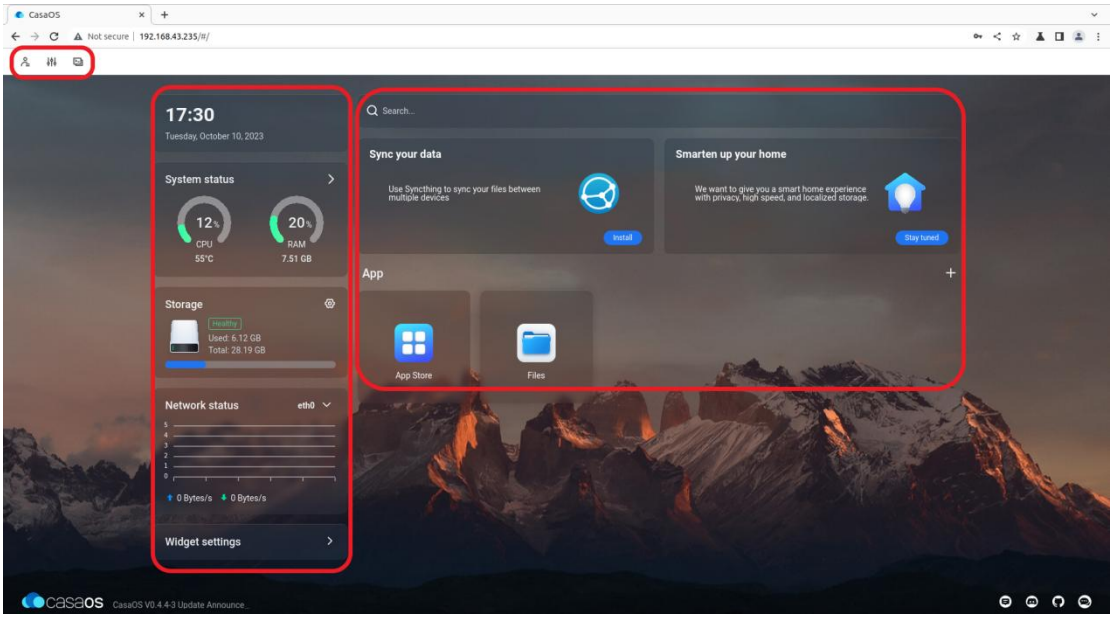
"Create" to proceed to the next step.



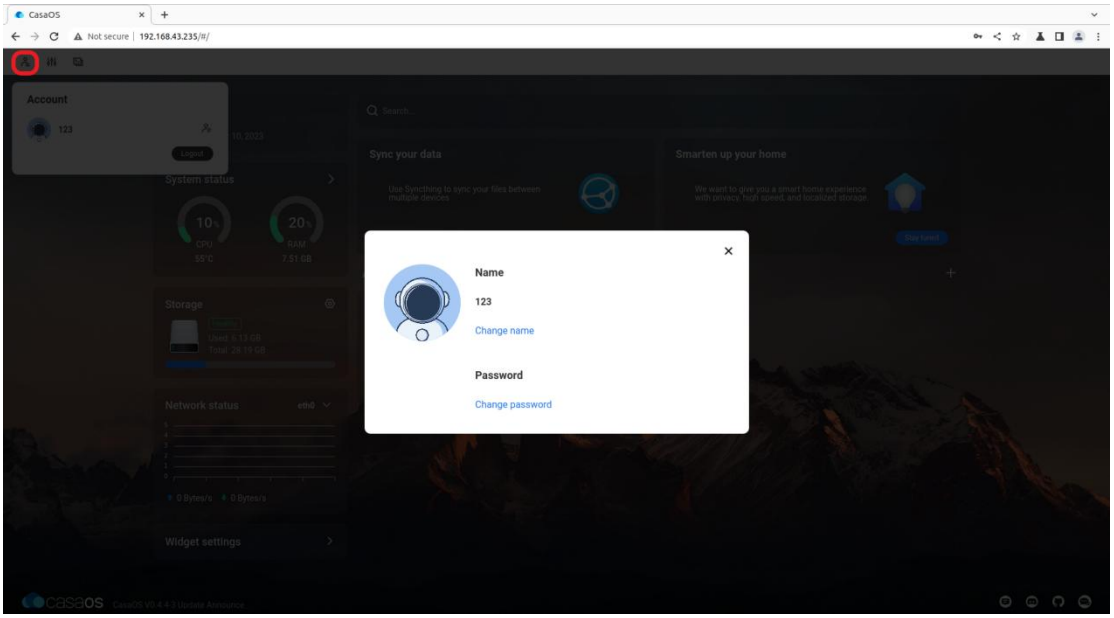
4) Click "Accept" directly in the interface below to proceed to the next step.



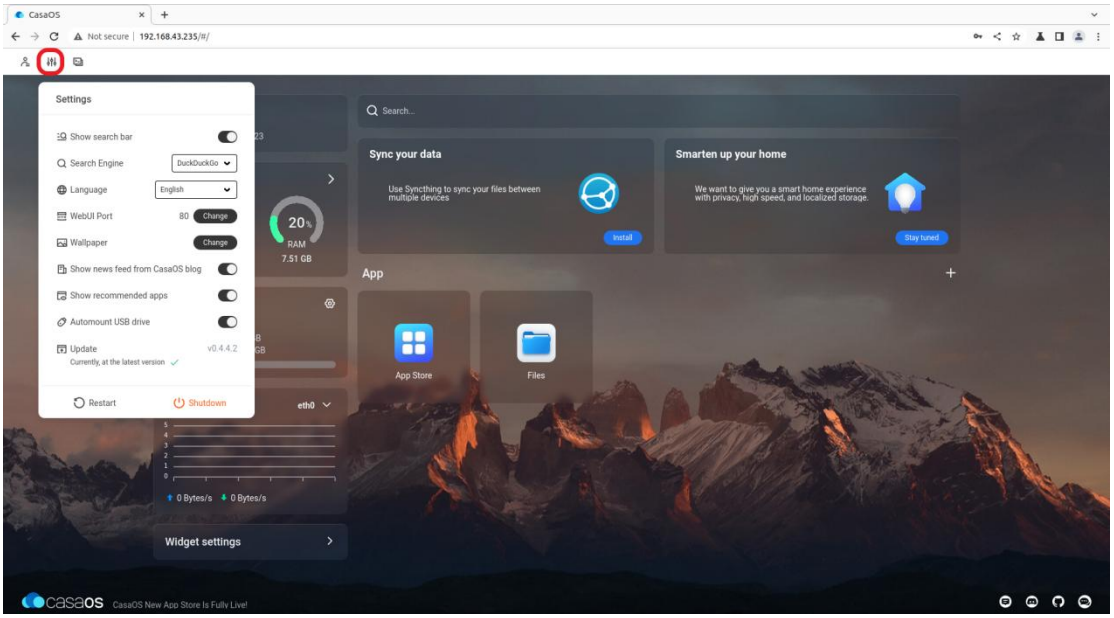
5) Now enter the main page of CasaOS. There are three icons in the upper left corner for function settings. On the left is the performance panel, which can display the current time and status information of CPU, RAM, storage, and network. On the right is the function panel. It has functions such as search, application recommendation, application store and file management.



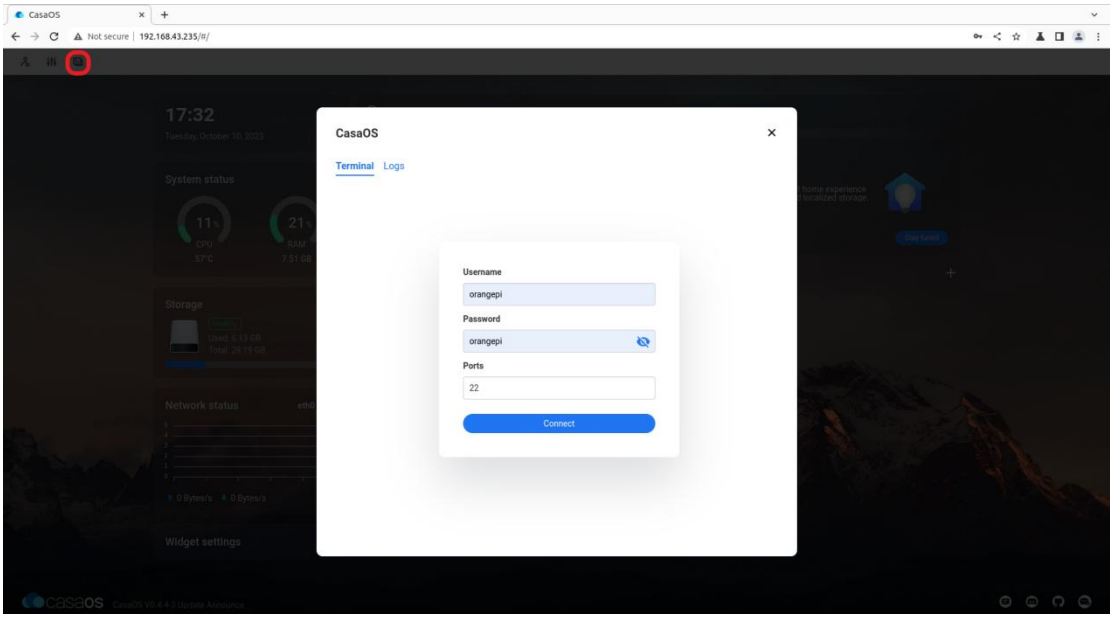
6) You can click the first icon in the upper left corner to modify the account number and password



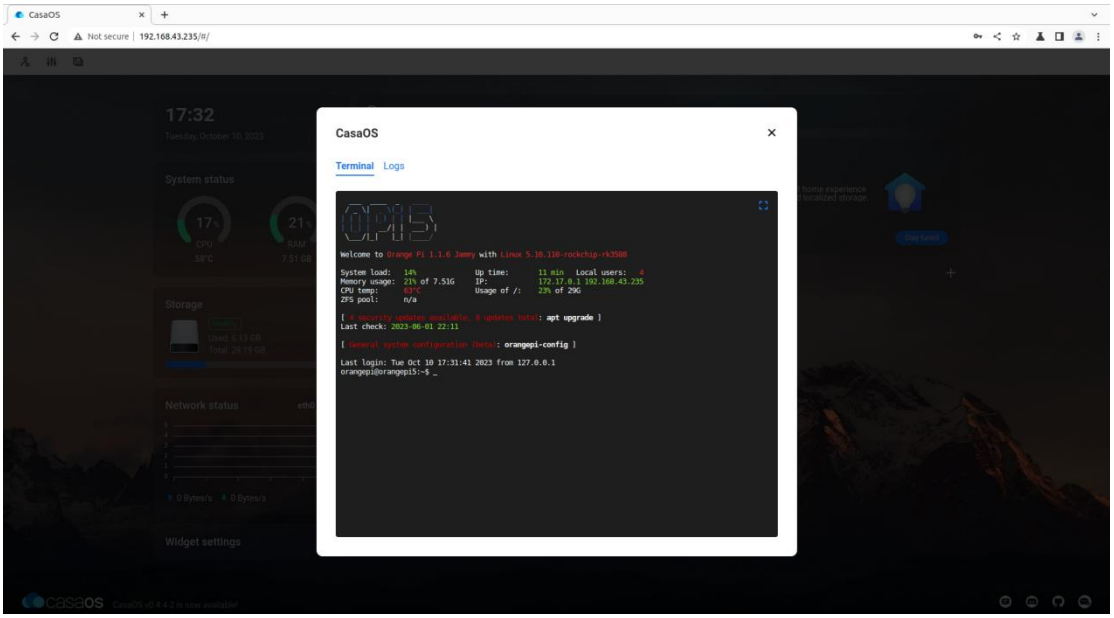
7) You can click the second icon to set basic functions



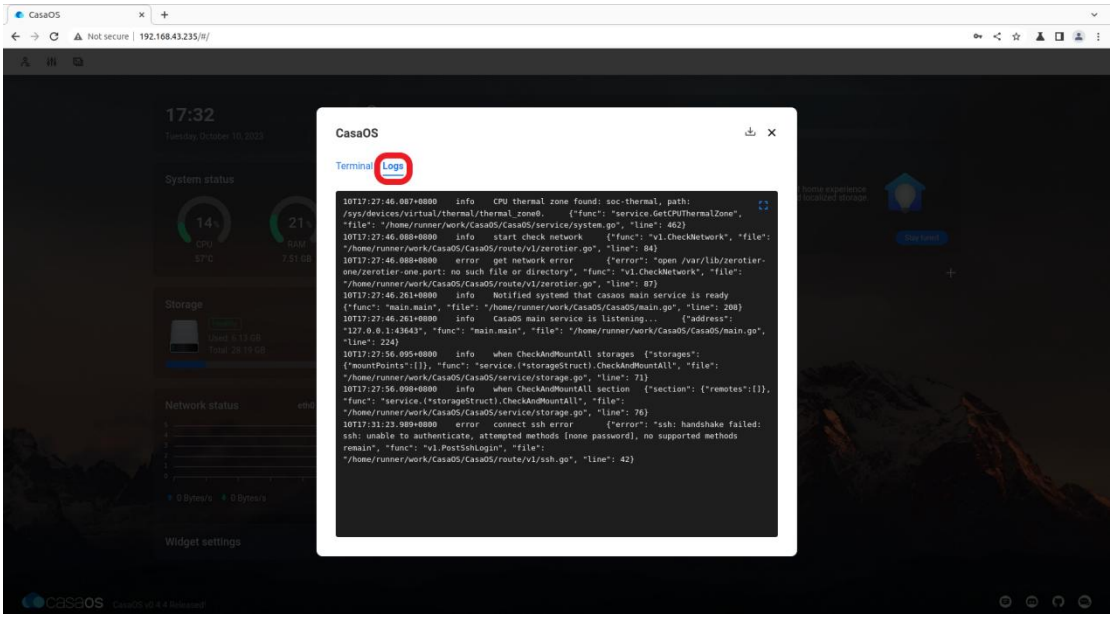
8) The third icon in the upper left corner mainly has two functions, namely switching to command line mode and printing log information. When switching to command line mode, you need to enter your account and password. The account and password here refer to the development board. Linux system account and password, the port system defaults to number 22



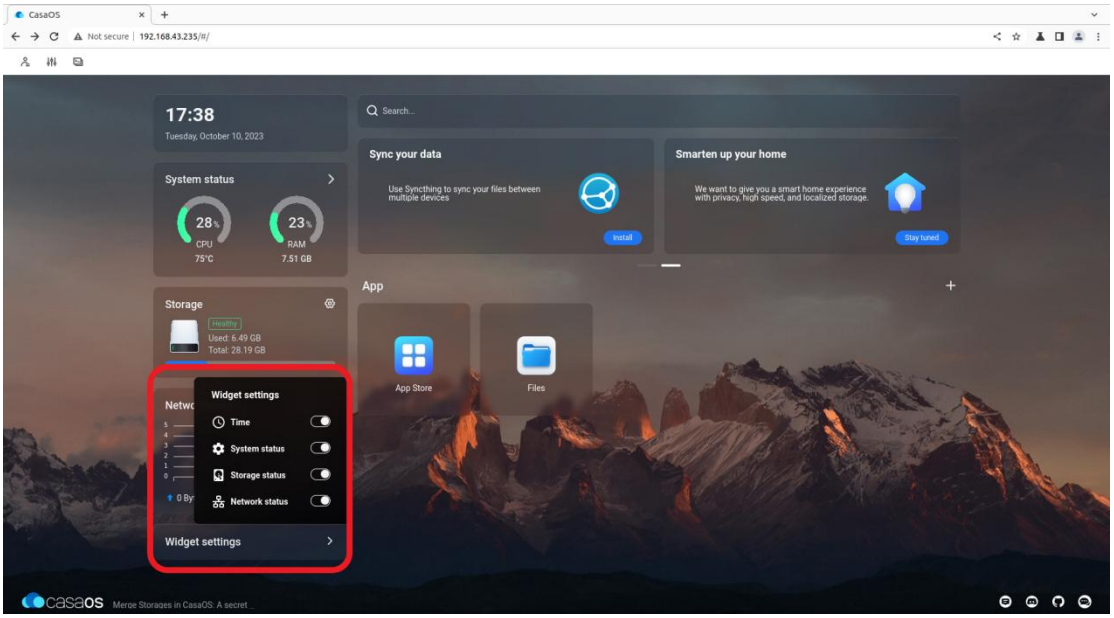
9) Then click "Connect" to enter the command line interface:



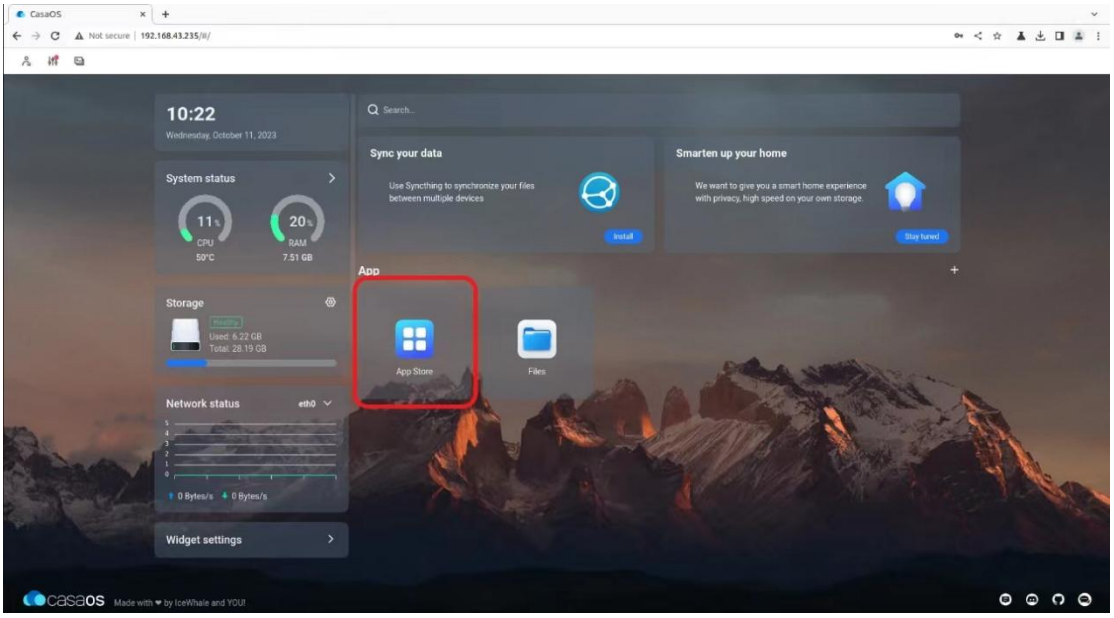
10) Another function under the third icon is to print CasaOS logs. Click "Logs" to enter. The interface is as follows:



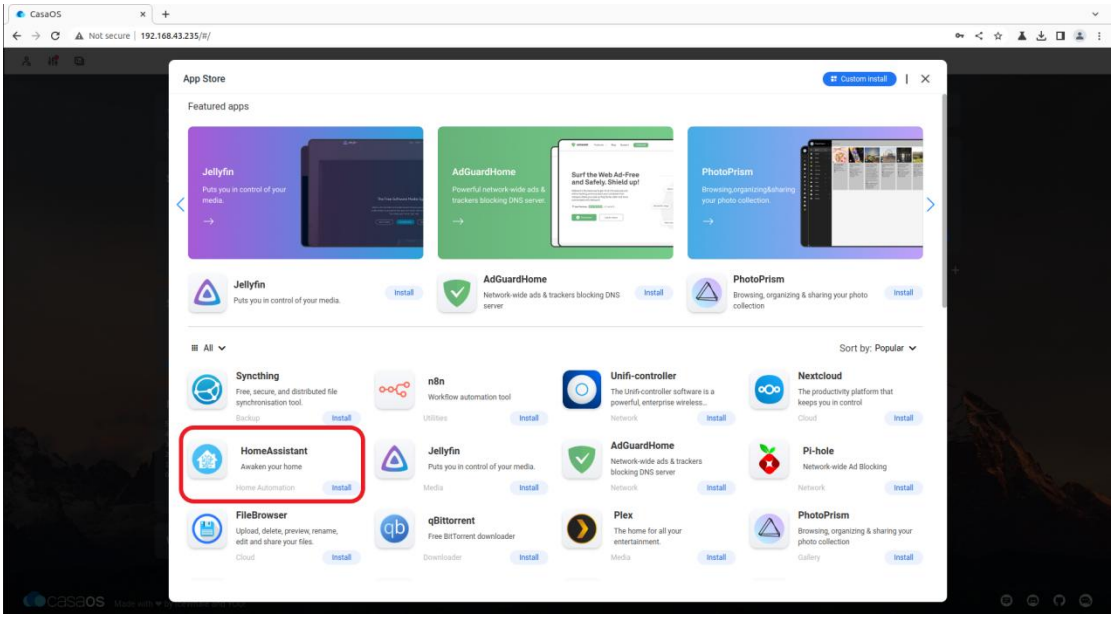
11) Click "Widget settings" in the lower left corner to set whether to display the widgets of the performance panel on the main page.



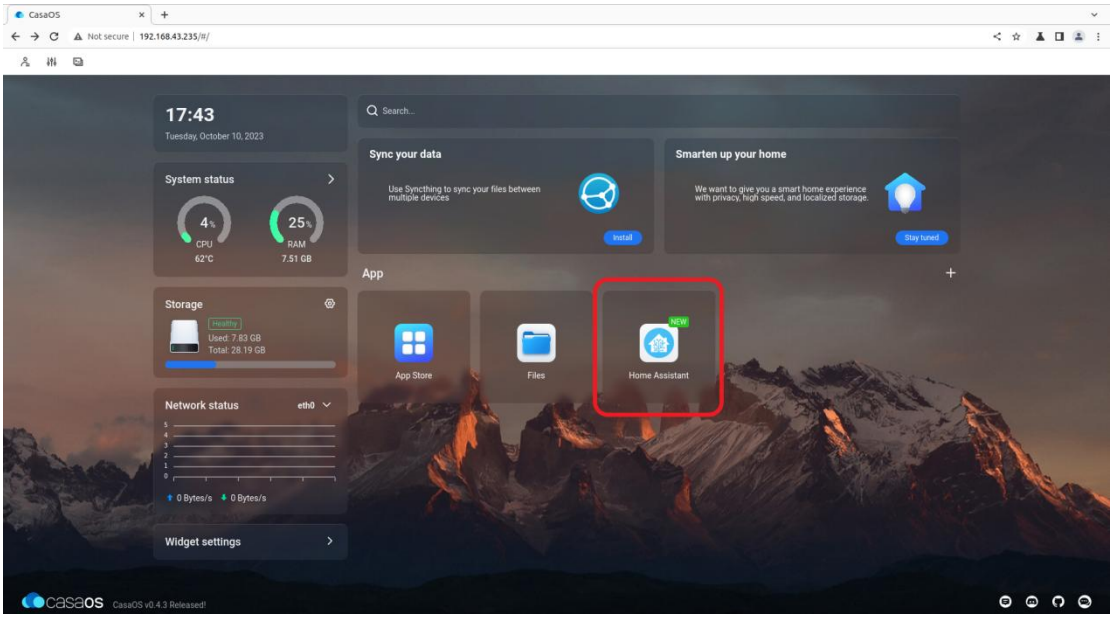
12) Click "APP Store" on the main interface to open the app store. Currently, there are a total of 70+ APPs available in the app store.



13) Here we take Home Assistant as an example to download, find Home Assistant in the APP Store, and then click the corresponding "install"

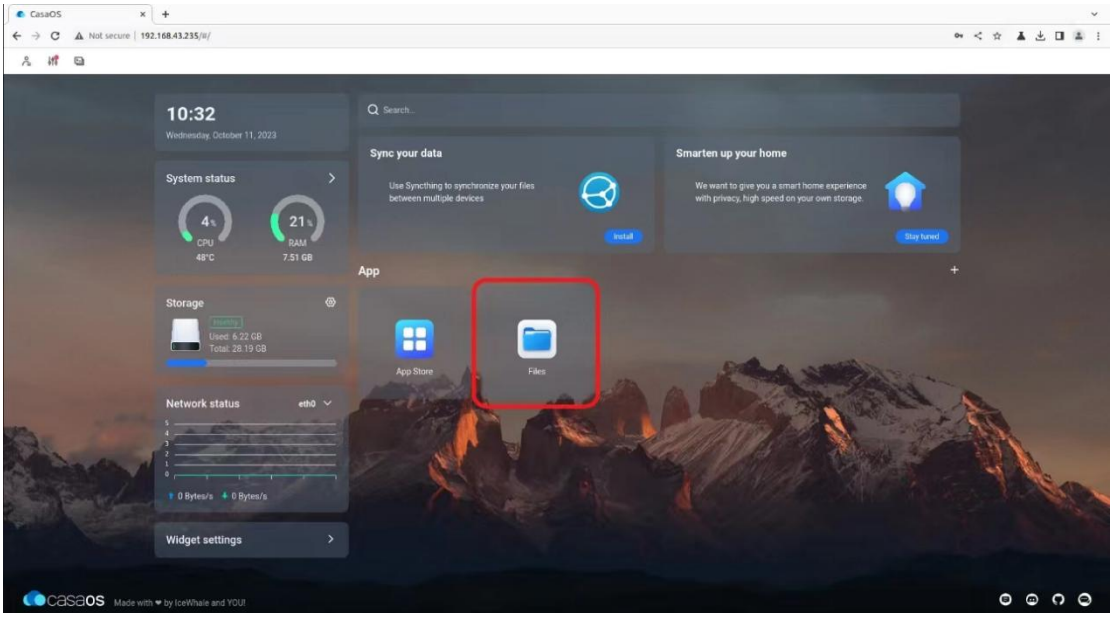


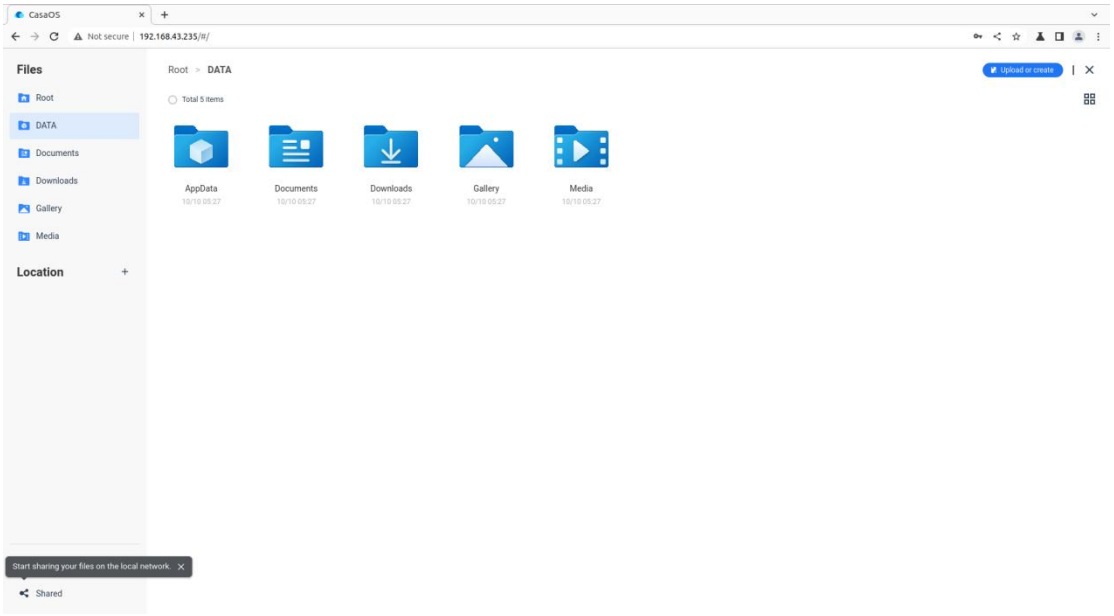
14) After the download is completed, HostAssitant will appear on the main page.



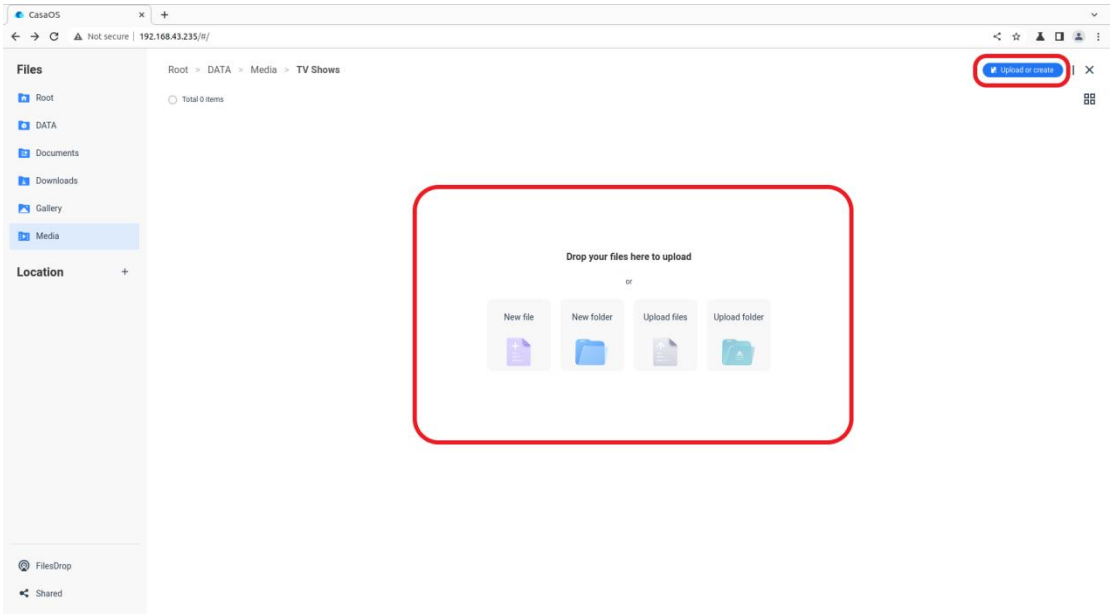
15) Click "Files" in the main interface to open the file system that comes with CasaOS, and then you can upload and save files.

Please ensure that other devices and the development board are in the same LAN.





16) When uploading files, you need to switch to the target folder, then drag the local file to the indicated area in the picture, or click "Upload or Create" in the upper right corner to select the file to upload.



17) If you want to uninstall CasaOS, you can use the following command:

```
orangepi@orangepi5:~$ casaos-uninstall
```

3. 40. Methods of using NPU

3. 40. 1. Preparation tools

1) A PC with Ubuntu20.04 operating system installed

According to the official documentation of RKNN-Toolkit2, the operating systems supported by the current version of RKNN-Toolkit2 are as follows:

a. Ubuntu18.04 (x64)

b. Ubuntu20.04 (x64)

c. Ubuntu22.04 (x64)

In this document, we use Ubuntu20.04 (x64) operating system for demonstration. Please test other versions of operating systems by yourself.

2) An Orange Pi 5 Plus development board with Debian 11 system installed

3) A data cable with Type-C interface for using adb function

3.40.2. Install RKNN-Toolkit2 on Ubuntu PC

Toolkit2 is a development kit used on the Ubuntu PC platform. Users can use the Python interface provided by the tool to easily complete functions such as model conversion, inference, and performance evaluation.

1) On the Ubuntu PC side, open a command line window and enter the following commands to install python3 and pip3

```
test@test:~$ sudo apt-get install python3 python3-dev python3-pip
```

2) You can use the following command to view the installed version of python3

```
test@test:~$ python3 --version
Python 3.8.10
```

3) Then enter the following command to install the dependency package of RKNN-Toolkit2

```
test@test:~$ sudo apt-get update
test@test:~$ sudo apt-get install libxslt1-dev zlib1g-dev libglib2.0 \
 libsm6 libgl1-mesa-glx libprotobuf-dev gcc
```

4) Then enter the following command to download the 1.5.2 version of RKNN-Toolkit2

```
test@test:~$ git clone git clone https://github.com/airockchip/rknn-toolkit2 -b v1.5.2
```

5) Then enter the following command to install the corresponding version of Python3 dependency packages. This command will use pip3 to install the dependencies listed in the file requirements_cp38-1.5.2.txt. If the dependencies are not fully installed, do not specify the installation source and install each package separately.

```
test@test:~$ pip3 install -r rknn-toolkit2/doc/requirements_cp38-1.5.2.txt -i \
```

```
https://mirror.baidu.com/pypi/simple
```

6) Then enter the following command to use pip3 to install the RKNN-Toolkit2 software package. After the installation is complete, you can use RKNN-Toolkit2

```
test@test:~$ pip3 install rknn-toolkit2/packages/rknn_toolkit2-1.5.2+b642f30c-cp38-cp38-linux_x86_64.whl
```

3.40.3. Use RKNN-Toolkit2 for model conversion and model inference

RKNN-Toolkit2 supports converting Caffe, TensorFlow, TensorFlow Lite, ONNX, DarkNet, PyTorch and other models into RKNN models, and then runs the RKNN model through simulation on the Ubuntu PC or using the NPU of the development board for inference.

Relevant examples are provided in the example folder of RKNN-Toolkit2 to help users better understand how to operate. We take the ONNX model with yolov5 function as an example to illustrate.

3.40.3.1. Simulate running model on Ubuntu PC

RKNN-Toolkit2 is equipped with a built-in simulator, which allows users to simulate the inference process of the model on the Rockchip NPU on the Ubuntu PC.

In this way, model conversion and inference can be completed on the Ubuntu PC side, helping users test and verify their models faster.

1) First switch to the rknn-toolkit2/examples/onnx/yolov5 directory

```
test@test:~$ cd rknn-toolkit2/examples/onnx/yolov5/
```

2) Then run the test.py script, which first converts the yolov5s_relu.onnx model into an RKNN model that can be run on the simulator, and then uses the simulator to simulate and run the model to perform inference on the bus.jpg image in the current directory

```
test@test:~/rknn-toolkit2/examples/onnx/yolov5$ python3 test.py
```

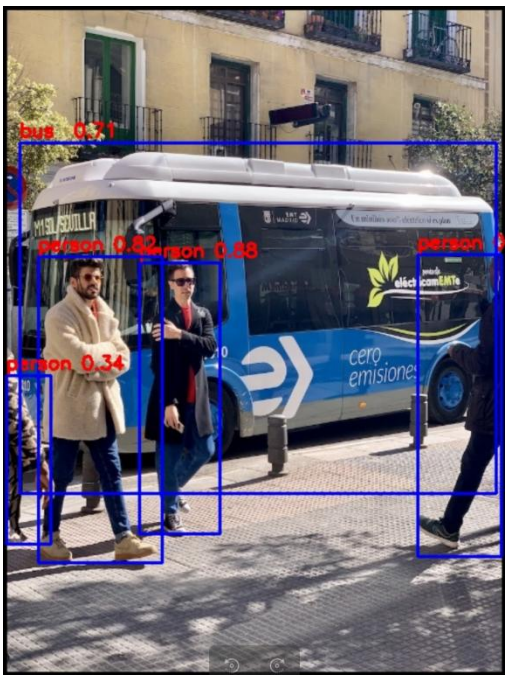
3) After the test.py script is successfully run, you will see the following print information, indicating that the model successfully detected four people and a bus in the bus.jpg picture.

```
done
--> Running model
```

```
W inference: The 'data_format' has not been set and defaults is nhwc!
done
class: person, score: 0.884139358997345
box coordinate left,top,right,down: [209.1040009856224, 244.4304337501526, 286.5742521882057,
506.7466902732849]
class: person, score: 0.8676778078079224
box coordinate left,top,right,down: [478.5757632255554, 238.58572268486023, 559.5273861885071,
526.479279756546]
class: person, score: 0.8246847987174988
box coordinate left,top,right,down: [110.57257843017578, 238.58099019527435,
230.54625701904297, 534.0008579492569]
class: person, score: 0.3392542004585266
box coordinate left,top,right,down: [79.96397459506989, 354.9062474966049, 122.13020265102386,
516.2529321908951]
class: bus , score: 0.7012234926223755
box coordinate left,top,right,down: [94.43931484222412, 129.53470361232758, 553.1492471694946,
468.0852304697037]
D NPUTransfer: Transfer client closed, fd = 3
```

4) The converted model file yolov5s_relu.rknn and the inference picture result result.jpg are saved in the current directory

5) The result.jpg picture shows the object categories and confidence rates detected in the bus.jpg picture using the yolov5s_relu.rknn model.



3.40.3.2. Using the NPU running model of the development board on Ubuntu PC

RKNN-Toolkit2 provides users with a Python interface for using the NPU of the development board for inference through adb. It allows users to use the NPU of the development board on the Ubuntu PC to run the model for inference.

In this way, the Ubuntu PC side can use the machine learning library provided by Python to optimize and adjust the model based on the actual effect when the model is run on the NPU of the development board.

3.40.3.2.1. Use Type-C data cable to connect adb

Use adb to operate the development board on the Ubuntu PC. For how to use adb, please see the instructions in the section "**How to use ADB**".

3.40.3.2.2. Update the rknn_server and librknnrt.so of the development board

librknnrt.so is a board-side runtime library.

rknn_server is a background proxy service running on the development board. It is used to receive the protocol transmitted from the PC through USB, then execute the corresponding interface in the board-side runtime library, and return the results to the PC.

1) First enter the following command on Ubuntu PC to download version 1.5.2 of RKNPU2

```
test@test:~$ git clone https://github.com/rockchip-linux/rknpu2 -b v1.5.2
```

2) Then enter the following command on the Ubuntu PC to update the rknn_server of the development board through the adb tool

```
test@test:~$ adb push rknpu2/runtime/RK3588/Linux/rknn_server/aarch64/usr/bin/* /usr/bin
```

3) Then enter the following command on the Ubuntu PC side to update the librknnrt.so library of the development board through the adb tool

```
test@test:~$ adb push rknpu2/runtime/RK3588/Linux/librknn_api/aarch64/librknnrt.so /usr/lib
```

4) Open the terminal of the development board through the adb tool

```
test@test:~$ adb shell
```

5) Open the rknn_server service of the development board

```
root@orangepi:/# sudo restart_rknn.sh
root@orangepi5:/# start rknn server,version:1.5.2(8babfeabuild@2023-08-25T10:30:31)
I NPUTransfer: Starting NPU TransferServer,Transfer version 2.1.0(b5861e7@2020-11-23T11:50:51)
```

6) You can use the following command to check. If the process ID of rknn_server appears, it means that rknn_server has been opened, so that the operating environment of the development board is set up.

```
root@orangepi5:/# pgrep rknn_server
3131
```

3. 40. 3. 2. 3. Modify the parameters in the example

1) On the Ubuntu PC side, you can view the device ID of the development board connected to the Ubuntu PC by running the following command. This ID will be used below.

```
test@test:~$ adb devices
List of devices attached
4f9f859e5a120324    device
```

2) Switch to the rknn-toolkit2/examples/onnx/yolov5 directory

```
test@test:~$ cd rknn-toolkit2/examples/onnx/yolov5/
```

3) Use vim editor to modify the test.py file

```
test@test:~/rknn-toolkit2/examples/onnx/yolov5$ vim test.py
```

4) In the test.py file, we need to modify the following content:

a. In the preprocessing configuration, change the target platform to rk3588, so that after model conversion, you will get an RKNN model suitable for the NPU of the RK3588S development board.

```
# pre-process config
print('--> Config model')
rknn.config(mean_values=[[0, 0, 0]], std_values=[[255, 255, 255]], target_platform='rk3588')
print('done')
```

b. In the initialization running environment, add a description of the target platform and device ID. The target platform is rk3588, and the device ID is the device ID of the development board obtained through adb. The operation of running the model for inference will be on the RK3588S development board. Performed on NPU

```
# Init runtime environment
print('--> Init runtime environment')
ret = rknn.init_runtime(target='rk3588',device_id='4f9f859e5a120324')
if ret != 0:
    print('Init runtime environment failed!')
    exit(ret)
print('done')
```

c. After modification, save and exit.

3. 40. 3. 2. 4. Run the example on Ubuntu PC

1) Enter the following command to run the test.py script. The script first converts the yolov5s_relu.onnx model to an RKNN model, and then loads the model to the NPU of the development board to perform inference on the out.jpg image in the current directory.

```
test@test:~/rknn-toolkit2/examples/onnx/yolov5$ python3 test.py
```

2) In the printed information, we can see that Ubuntu PC uses the NPU of the development board to run the model for inference through the adb tool.

```
--> Init runtime environment
I target set by user is: rk3588
I Check RK3588 board npu runtime version
I Starting ntp or adb, target is RK3588
I Device [4f9f859e5a120324] not found in ntb device list.
I Start adb...
I Connect to Device success!
I NPUTransfer: Starting NPU Transfer Client, Transfer version 2.1.0
(b5861e7@2020-11-23T11:50:36)
```

3) After the test.py script runs successfully, the converted model file yolov5s_relu.rknn and the inference image result result.jpg are saved in the current directory.

4) The running result is the same as the section on simulating **the running model on Ubuntu PC**.

3.40.4. Call the C interface to deploy the RKNN model and run it on the development board

RKNPU2 provides a C programming interface for chip platforms with Rockchip NPU, which can help users deploy RKNN models exported using RKNN-Toolkit2 and accelerate the implementation of AI applications.

In the example folder of RKNPU2, examples of deploying RKNN models with different functions to the development board are provided. We take deploying the RKNN model with yolov5 function to the RK3588 Debian 11 platform as an example to illustrate.

3.40.4.1. Download cross-compilation tools

Since the development board runs a Linux system, it needs to be compiled using the gcc cross compiler. It is recommended to use gcc-9.3.0-x86_64_arrch64-linux-gnu this version of gcc

Enter the following command to download this version of gcc. After downloading, you will get a folder named gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rockchip-linux-gnu

```
test@test:~$ git clone https://github.com/airockchip/gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rockchip-linux-gnu
```

3.40.4.2. Modify the compilation tool path in the script

1) Switch to the rknpu2/examples/rknn_yolov5_demo directory

```
test@test:~$ cd ~/rknpu2/examples/rknn_yolov5_demo
```

2) Use vim editor to modify the content in the build-linux_RK3588.sh file

```
test@test:~/rknpu2/examples/rknn_yolov5_demo$ vim build-linux_RK3588.sh
```

3) In the build-linux_RK3588.sh file, we need to change the value of the variable TOOL_CHAIN to the path of the gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rockchip-linux-gnu folder. In this way, when running the build-android_RK3588.sh script, the cross-compilation tool in the gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rockchip-linux-gnu folder will be used for

compilation.

```
TARGET_SOC="rk3588"
GCC_COMPILER=aarch64-linux-gnu

export TOOL_CHAIN=~/gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rockchip-linux-gnu
export LD_LIBRARY_PATH=${TOOL_CHAIN}/lib64:$LD_LIBRARY_PATH
export CC=${GCC_COMPILER}-gcc
export CXX=${GCC_COMPILER}-g++
```

4) After modification, save and exit

3. 40. 4. 3. Compile rknn_yolov5_demo

1) Run build-linux_RK3588.sh. This script generates a program through cross-compilation that is suitable for the RK3588 development board and can run the RKNN model on it for inference.

```
test@test:~/rknpu2/examples/rknn_yolov5_demo$ sudo apt install cmake
test@test:~/rknpu2/examples/rknn_yolov5_demo$ sudo apt-get install g++-aarch64-linux-gnu
test@test:~/rknpu2/examples/rknn_yolov5_demo$ ./build-linux_RK3588.sh
```

2) After running build-linux_RK3588.sh, there will be an additional folder named install in the current directory. The rknn_yoov5_demo_Linux folder under this folder contains the program generated by cross-compilation and its related files.

```
test@test:~/rknpu2/examples/rknn_yolov5_demo$ ls install
rknn_yolov5_demo_Linux
```

3. 40. 4. 4. Deploy rknn_yolov5_demo to the development board

On the Ubuntu PC side, you can use the following command to upload the r knn_yolov5_demo_Linux folder to the development board through the adb tool, the reby implementing the deployment of rknn_yolov5_demo on the development boar d.

```
test@test:~/rknpu2/examples/rknn_yolov5_demo$ adb push \
install/rknn_yolov5_demo_Linux /data/rknn_yolov5_demo_Linux
```

3.40.4.5. Run rknn_yolov5_demo on the development board

1) Enter the file system of the development board through adb shell on Ubuntu PC

```
test@test:~$ adb shell
root@orangepi5:/#
```

2) Switch to the rknn_yolov5_demo_Linux directory

```
root@orangepi5:/# cd /data/rknn_yolov5_demo_Linux/
root@orangepi5:/data/rknn_yolov5_demo_Linux# ls
lib  model  rknn_yolov5_demo  rknn_yolov5_video_demo
```

3) Then run the rknn_yolov5_demo program to perform inference. In the following command, the program uses the yolov5s-640-640.rknn model to perform inference on the bus.jpg image. The entire running process will be completed on the development board.

```
root@orangepi5:/data/rknn_yolov5_demo_Linux# ./rknn_yolov5_demo \
./model/RK3588/yolov5s-640-640.rknn ./model/bus.jpg
```

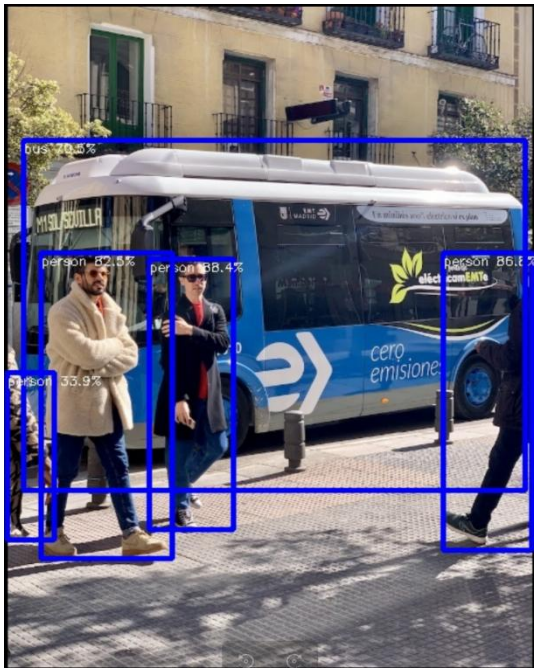
4) After the operation is completed, the inference result out.jpg image is saved in the current directory.

```
root@orangepi5:/data/rknn_yolov5_demo_Linux# ls
lib  model  out.jpg  rknn_yolov5_demo  rknn_yolov5_video_demo
```

5) On the Ubuntu PC side, we can use the following command to download the out.jpg image through the adb tool, and then use the image viewer to view it

```
test@test:~$ adb pull /data/rknn_yolov5_demo_Linux/out.jpg ~/Desktop/
/data/rknn_yolov5_demo_Linux/out.jpg: ...led. 1.9 MB/s (191507 bytes in 0.095s)
```

6) The out.jpg picture shows the object categories and confidence rates detected in the bus.jpg picture using the yolov5s-640-640.rknn model.



3.41. RK3588 How to use Baidu Feipian

Using Baidu Feipian on the rk3588 development board includes converting the pdmodel model to the rknn model on the PC side and deploying the rknn model using the FastDeploy deployment tool developed by Baidu Feipian on the board side. The following content is implemented in the environment where the PC system is Ubuntu22.04 and the board system is Debian 11. Please test it yourself in other environments.

3.41.1. Ubuntu PC environment construction

The tools and uses that need to be installed on Ubuntu PC are as follows:

Tool name	use
Anaconda3	For creating and managing Python environments
Paddle2ONNX	Used to convert pdmodel model to ONNX model
RKNN-Toolkit2	Used to convert ONNX model to RKNN model

3. 41. 1. 1. Install Anaconda3 on PC

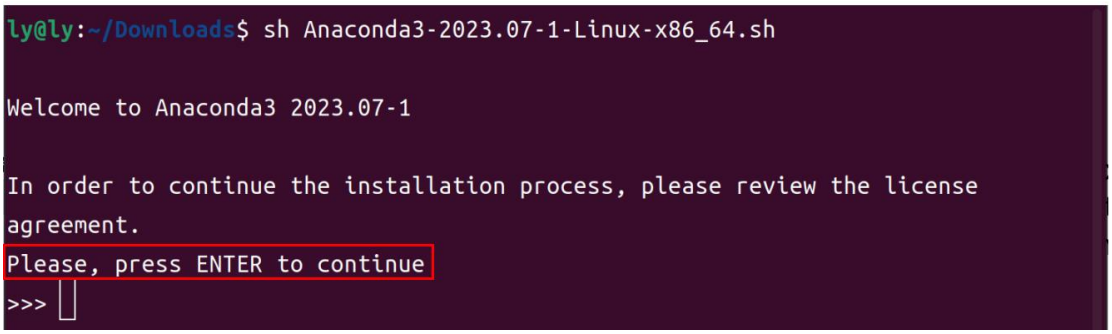
1）Open the browser on the ubuntu PC, enter the following URL in the address bar to download and install the Anaconda3 script. After the download is completed, you will get the **Anaconda3-2023.07-1-Linux-x86_64.sh** file

https://mirrors.tuna.tsinghua.edu.cn/anaconda/archive/Anaconda3-2023.07-1-Linux-x86_64.sh

2）Then open the terminal and run the **Anaconda3-2023.07-1-Linux-x86_64.sh** script to install Anaconda3

```
test@test:~/Downloads$ sh Anaconda3-2023.07-1-Linux-x86_64.sh
```

3）Then the installation script will output the following prompt message. At this time, click the Enter key to continue the installation.



4）After clicking the Enter key, some introduction information about Anaconda3 will appear. Keep clicking the " ↓ " key

```
==================================================
End User License Agreement - Anaconda Distribution
==================================================

Copyright 2015-2023, Anaconda, Inc.

All rights reserved under the 3-clause BSD License:

This End User License Agreement (the "Agreement") is a legal agreement between y
ou and Anaconda, Inc. ("Anaconda") and governs your use of Anaconda Distribution
 (which was formerly known as Anaconda Individual Edition).

Subject to the terms of this Agreement, Anaconda hereby grants you a non-exclusi
ve, non-transferable license to:

  * Install and use the Anaconda Distribution (which was formerly known as Anaco
nda Individual Edition),
  * Modify and create derivative works of sample source code delivered in Anacon
da Distribution from Anaconda's repository, and;
  * Redistribute code files in source (if provided to you by Anaconda as source)
 and binary forms, with or without modification subject to the requirements set
forth below, and;

--更多--
```

5）Then the installation script will prompt whether to accept the license terms. At this time, enter yes and press Enter.

```
The following packages listed on https://www.anaconda.com/cryptography are inclu
ded in the repository accessible through Anaconda Distribution that relate to cr
yptography.

Last updated February 25, 2022


Do you accept the license terms? [yes|no]
[no] >>>
```

6）Then the installation script will remind you to install Anaconda3 to the home directory. Press the Enter key to confirm.

```
Anaconda3 will now be installed into this location:
/home/ly/anaconda3

  - Press ENTER to confirm the location
  - Press CTRL-C to abort the installation
  - Or specify a different location below

[/home/ly/anaconda3] >>>
```

7）Then the installation script will prompt whether to initialize Anaconda3, enter yes, and then press the Enter key

```
installation finished.
Do you wish the installer to initialize Anaconda3
by running conda init? [yes|no]
[no] >>>
```

8）When you see the following printout in the terminal, it means Anaconda3 has been successfully installed.

```
If you'd prefer that conda's base environment not be activated on startup,
   set the auto_activate_base parameter to false:

conda config --set auto_activate_base false

Thank you for installing Anaconda3!
```

3. 41. 1. 2. Install RKNN-Toolkit2 on PC

1）Open the terminal on the ubuntu PC and create an environment with python version 3.8 through the Anaconda3 tool

```
(base)test@test:~$ conda create -n fastdeploy python=3.8
```

2）Activate the python3.8 environment just created

```
(base)test@test:~$ conda activate fastdeploy
```

3）Then install pip3 development tools and package management tools

```
(fastdeploy)test@test:~$ sudo apt-get install python3-dev python3-pip
```

4）Then install the dependency packages of RKNN-Toolkit2

```
(fastdeploy)test@test:~$ sudo apt-get install libxslt1-dev zlib1g-dev libglib2.0 libsm6 libgl1-mesa-glx libprotobuf-dev gcc
```

5）rknn_toolkit2 has a specific dependency on numpy, so numpy==1.16.6 needs to be installed first

```
(fastdeploy)test@test:~$ pip install numpy==1.16.6
```

6）Install git tools

```
(fastdeploy)test@test:~$ sudo apt install git
```

7）Then execute the following command to download RKNN-Toolkit2. After the download is completed, you will get the rknn-toolkit2 folder

```
(fastdeploy)test@test:~$ git clone https://github.com/rockchip-linux/rknn-toolkit2
```

8）Then execute the following command to install the RKNN-Toolkit2 corresponding to the python3.8 version

```
(fastdeploy)test@test:~$ pip install rknn-toolkit2/rknn-toolkit2/packages/rknn_toolkit2-1.6.0+81f21f4d-cp38-cp38-linux_x86_64.whl
```

3.41.1.3. Install Paddle2ONNX on PC

You can execute the following command to install paddle2onnx

```
(fastdeploy)test@test:~$ pip install paddle2onnx
```

3.41.2. Board environment construction

The tools that need to be installed on the board end and their uses are as follows:

Tool name	use
Anaconda3	For creating and managing Python environments
rknpu2	Basic driver of rknpu2
FastDeploy	After compilation, you get the FastDeploy reasoning library

3.41.2.1. Install Anaconda3 on the board side

1）Open the browser on the board end, enter the following URL in the address bar to download and install the Anaconda3 script. After the download is completed, you will get the **Anaconda3-2023.07-1-Linux-aarch64.sh** file

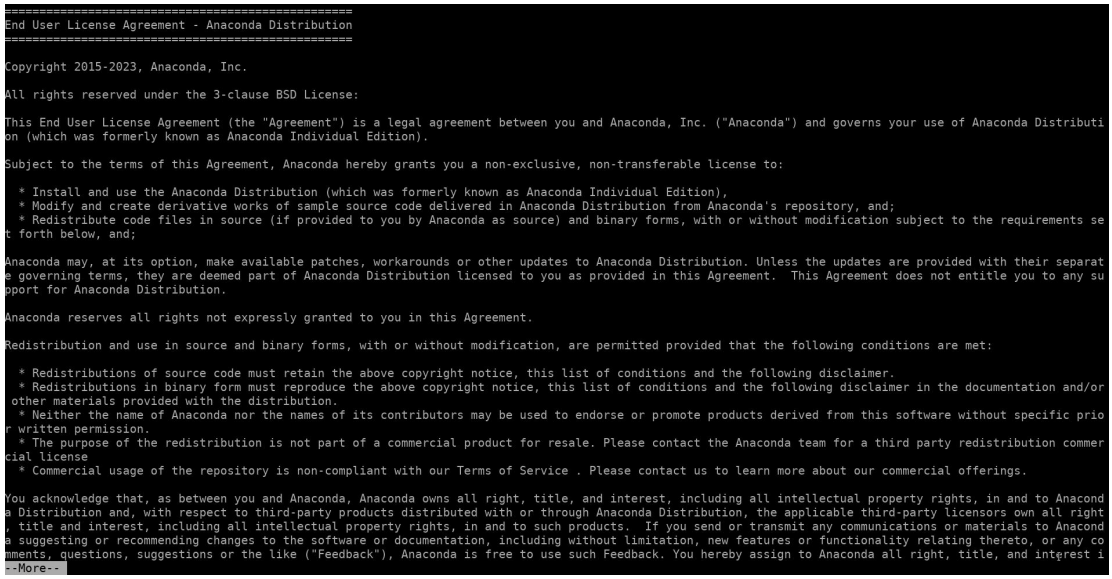
https://mirrors.tuna.tsinghua.edu.cn/anaconda/archive/Anaconda3-2023.07-1-Linux-aarch64.sh

2）Open the terminal and run the **Anaconda3-2023.07-1-Linux-aarch64.sh** script to install Anaconda3

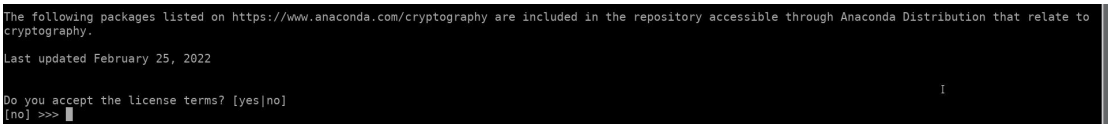
```
orangepi@orangepi:~/Downloads$ sh Anaconda3-2023.07-1-Linux-aarch64.sh
```

3）The installation script will then output the following prompt message. Click the Enter key to continue the installation.

4）After clicking the Enter key, some introduction information about Anaconda3 will appear. Keep clicking the " ↓ " key



5）Then the installation script will prompt whether to accept the license terms. At this time, enter yes and press Enter.



6）Then the installation script will remind you to install Anaconda3 to the home directory. Press the Enter key to confirm.

7）Then the installation script will prompt whether to initialize Anaconda3, enter yes, and then press the Enter key

8）When you see the following printout in the terminal, it means Anaconda3 has been successfully installed.

9）If you use the conda command in the terminal and the command does not exist, you need to modify the ~/.bashrc file.

```
orangepi@orangepi:~$ vi ~/.bashrc
```

10）Add the following code at the end of the ~/.bashrc file

```
export PATH=/home/orangepi/anaconda3/bin:$PATH
```

11）Then enter the following command in the terminal to make the changes take effect.

```
orangepi@orangepi:~$ source ~/.bashrc
```

12）Then enter the following command in the terminal to initialize conda

```
(base)orangepi@orangepi:~$ conda init bash
```

13）Then close the current terminal and reopen a terminal. At this time, you can use the conda command normally.

3.41.2.2. Install the rknpu2 driver on the board side

1）Open the terminal on the board and create an environment with python version 3.9 through the Anaconda3 tool

```
(base)orangepi@orangepi:~$ conda create -n fastdeploy python=3.9
```

2）Activate the python3.9 environment just created

```
(base)orangepi@orangepi:~$ conda activate fastdeploy
```

3）Download the rknpu2_device_install_1.4.0.zip file through wget

```
(fastdeploy)orangepi@orangepi:~$ wget https://bj.bcebos.com/fastdeploy/third_libs/rknpu2_device_install_1.4.0.zip
```

4）Then execute the following command to decompress rknpu2_device_install_1.4.0.zip. After decompression, you will get the rknpu2_device_install_1.4.0 folder and __MACOSX folder

```
(fastdeploy)orangepi@orangepi:~$ unzip rknpu2_device_install_1.4.0.zip
```

5）Switch to the rknpu2_device_install_1.4.0 directory

```
(fastdeploy)orangepi@orangepi:~$ cd rknpu2_device_install_1.4.0/
```

6）There is the rknn_install_rk3588.sh script in this directory. Run this script to complete the installation of the board-side rknpu2 driver.

```
(fastdeploy)orangepi@orangepi:~/rknpu2_device_install_1.4.0$ sudo bash rknn_install_rk3588.sh
```

3.41.2.3. Compile FastDeploy C++ SDK on the board end

1）You need to use the cmake command when compiling. You can execute the following command to install the cmake tool.

```
(fastdeploy)orangepi@orangepi:~$ sudo apt-get install -y cmake
```

2）Then download the FastDeploy SDK. After the command is executed, you will get the FastDeploy folder.

```
(fastdeploy)orangepi@orangepi:~$ git clone https://github.com/PaddlePaddle/FastD
```

```
eploy.git
```

3）Switch to the FastDeploy directory

```
(fastdeploy)orangepi@orangepi:~$ cd FastDeploy
```

4）Create the compilation directory build and switch to the build directory

```
(fastdeploy)orangepi@orangepi:~/FastDeploy$ mkdir build && cd build
```

5）Before compiling, you need to use cmake to configure the project information that needs to be compiled. After executing the following command, there will be some more files in the current directory, including the Makefile file used for compilation.

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/build$ cmake .. -DENABLE_ORT_BACKEND=ON \
-DENABLE_RKNPU2_BACKEND=ON \
-DENABLE_VISION=ON \
-DRKNN2_TARGET_SOC=RK3588 \
-DCMAKE_INSTALL_PREFIX=${PWD}/fastdeploy-0.0.3
```

6）Execute the following command to start compilation

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/build$ make -j8
```

7）After the compilation is completed, use the following command to install the compiled files to the specified path

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/build$ make install
```

8）After the compilation is completed, the fastdeploy-0.0.3 folder is mainly obtained. In this folder, there is the script file fastdeploy_init.sh for configuring environment variables. After using this script to configure the environment variables, you can use some of the compiled library files.

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/build$ source fastdeploy-0.0.3/fastdeploy_init.sh
```

3.41.3. Example of deploying model using FastDeploy

The ResNet50_vd model is a model used for target classification. The following uses the ResNet50_vd model as an example to illustrate the process of deploying the pdmodel model using FastDeploy.

3.41.3.1. Ubuntu PC model conversion

1）Open the terminal on the PC and activate the python3.8 environment previously created using Anaconda3

```
test@test:~$ conda activate fastdeploy
```

2）In the model conversion script, you need to import the yaml module and the six module. You can execute the following command to install them.

```
(fastdeploy)test@test:~$ pip install pyyaml six
```

3）Execute the following command to download the ResNet50_vd_infer.tgz file

```
(fastdeploy)test@test:~$ wget https://bj.bcebos.com/paddlehub/fastdeploy/ResNet50_vd_infer.tgz
```

4）After decompressing the ResNet50_vd_infer.tgz file, you can get the ResNet50_vd_infer folder, which contains the pdmodel model file inference.pdmodel and other related files.

```
(fastdeploy)test@test:~$ tar -xvf ResNet50_vd_infer.tgz
```

5）You can use the following command to convert the pdmodel model to an onnx model through paddle2onnx. After executing this command, there will be an extra converted onnx model file ResNet50_vd_infer.onnx in the ResNet50_vd_infer folder.

```
(fastdeploy)test@test:~$ paddle2onnx --model_dir ResNet50_vd_infer \
--model_filename inference.pdmodel \
--params_filename inference.pdiparams \
--save_file ResNet50_vd_infer/ResNet50_vd_infer.onnx \
--enable_dev_version True \
--opset_version 10 \
--enable_onnx_checker True
```

6）Then use the following command to fix the shape to [1,3,224,224]. After executing the command, the ResNet50_vd_infer.onnx file will be modified.

```
(fastdeploy)test@test:~$ python -m paddle2onnx.optimize --input_model \
ResNet50_vd_infer/ResNet50_vd_infer.onnx \
--output_model ResNet50_vd_infer/ResNet50_vd_infer.onnx \
--input_shape_dict "{'inputs':[1,3,224,224]}"
```

7）To convert the onnx model to the rknn model, you need to use the script in the FastDeploy SDK. Execute the following command to download FastDeploy

```
(fastdeploy)test@test:~$ git clone https://github.com/PaddlePaddle/FastDeploy.git
```

8）Then transfer the ResNet50_vd_infer folder to the corresponding directory of FastDeploy

```
(fastdeploy)test@test:~$ mv ResNet50_vd_infer \
FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/
```

9）Switch to the directory for model conversion

```
(fastdeploy)test@test:~$ cd FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/
```

10）Execute the following command to convert the onnx model to the rknn model. Finally, the rknn model file ResNet50_vd_infer_rk3588_unquantized.rknn is obtained in the ResNet50_vd_infer directory.

```
(fastdeploy)test@test:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/$ python ./rknpu2_tools/export.py \
--config_path ./rknpu2_tools/config/ResNet50_vd_infer_rknn.yaml \
--target_platform rk3588
```

11）When deploying on the board end, the name of the rknn model file used is ResNet50_vd_infer_rk3588.rknn, so the ResNet50_vd_infer_rk3588_unquantized.rknn file needs to be renamed to ResNet50_vd_infer_rk3588.rknn

```
(fastdeploy)test@test:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/$ mv ResNet50_vd_infer/ResNet50_vd_infer_rk3588_unquantized.rknn \
ResNet50_vd_infer/ResNet50_vd_infer_rk3588.rknn
```

3.41.3.2. Board end model deployment

1）Open the terminal on the board and activate the python3.9 environment created previously using Anaconda3

```
orangepi@orangepi:~$ conda activate fastdeploy
```

2）Run the fastdeploy_init.sh script to configure the environment

```
(fastdeploy)orangepi@orangepi:~$ source FastDeploy/build/fastdeploy-0.0.3/fastdeploy_init.sh
```

3）Switch to the sample directory where the ResNet50 model is deployed in FastDeploy

```
(fastdeploy)orangepi@orangepi:~$ cd FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp
```

4）Create a directory structure in this directory

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp$ mkdir build images ppclas_model_dir thirdpartys
```

5）Copy the compiled fastdeploy-0.0.3 folder to the thirdpartys folder

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp$ cp -r ~/FastDeploy/build/fastdeploy-0.0.3/ thirdpartys/
```

6）Copy the files in the ResNet50_vd_infer folder on the PC to the ppclas_model_dir directory

7）Switch to the images directory

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp$ cd images
```

8）Download the test image in the images directory through wget

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/images$ wget https://gitee.com/paddlepaddle/PaddleClas/raw/release/2.4/deploy/images/ImageNet/ILSVRC2012_val_00000010.jpeg
```

9）Then switch to the compilation directory build

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/images$ cd ../build/
```

10）Use cmake to configure the content that needs to be compiled. After executing this command, some files will appear in the current directory, including Makefile files.

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build$ cmake ..
```

11）Execute the following command to start compilation

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build$ make -j8
```

12）Execute the following command to install the compiled files to the specified path. After executing the command, there will be an install directory in the current directory.

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build$ make install
```

13）Switch to the install directory, where inference using the model is completed.

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build$ cd install
```

14）Use the following command to classify the content in the ILSVRC2012_val_00000010.jpeg image using the converted rknn model

```
(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build/install$ ./rknpu_test \
./ppclas_model_dir/ ./images/ILSVRC2012_val_00000010.jpeg
```

15）After executing this command, the following printout will appear in the echo information, indicating that the category ID number of the object in the picture is 644, and the confidence rate is 0.072998

```
ClassifyResult(
label_ids: 644,
scores: 0.072998,
)
```

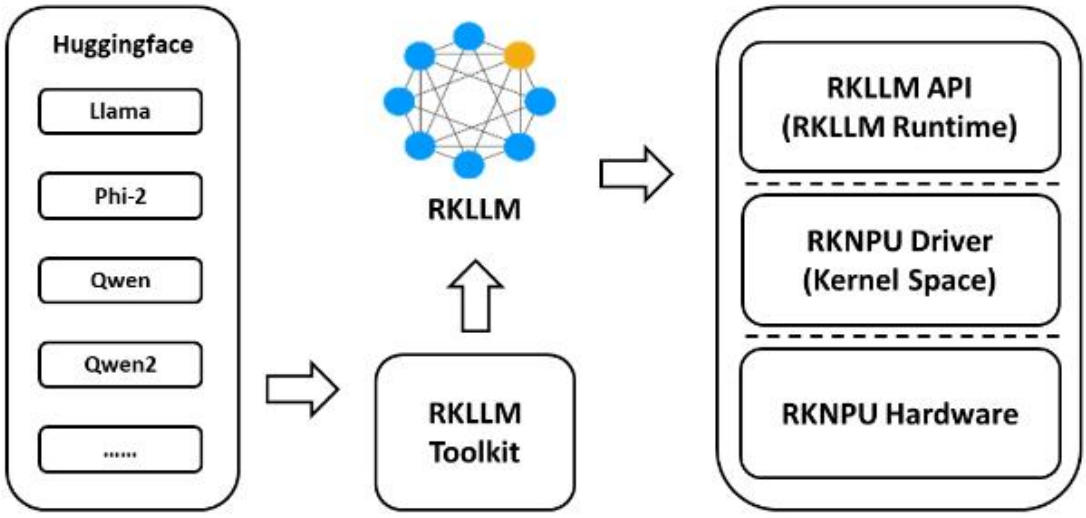
3. 42. How to run RKLLM large model on RK3588

The codes and models used in this section can be downloaded from the official tools of the development board.

3. 42. 1. Introduction to RKLLM

For more detailed RKLLM introduction information, please refer to Rockchip RKLLM official information.

RKLLM can help users quickly deploy LLM models to the RK3588 development board. The overall framework is shown in the figure below:



3.42.1.1. Introduction to RKLLM tool chain

3.42.1.1.1. RKLLM-Toolkit Function Introduction

RKLLM-Toolkit is a development kit that provides users with the ability to quantize and convert large language models on a computer. The Python interface provided by this tool can be used to conveniently complete the following functions:

1) Model conversion: Supports conversion of large language models (LLM) in Hugging Face format to RKLLM models. Currently, the models we have tested include TinyLLAMA, Qwen, Qwen2, Phi-3, ChatGLM3, Gemma, InternLM2, and MiniCPM. The converted RKLLM model can be loaded and used on the RK3588 platform.

2) Quantization function: Supports quantizing floating-point models to fixed-point models. The currently supported quantization type is w8a8, which means that both weights and activations are quantized to 8-bit width.

3.42.1.1.2. RKLLM Runtime Function Introduction

RKLLM Runtime is mainly responsible for loading the RKLLM model converted by RKLLM-Toolkit, and implementing the reasoning of the RKLLM model on the RK3588 NPU by calling the NPU driver on the RK3588 board. When reasoning the RKLLM model, the user can define the reasoning parameter settings of the RKLLM model, define different text generation methods, and continuously obtain the reasoning results of the model through pre-defined callback functions. For more detailed instructions, please refer to **Rockchip RKLLM official information.**

3.42.1.2. Introduction to RKLLM development process

The overall development steps of RKLLM are mainly divided into two parts: model conversion and board-side deployment and operation.

1) **Perform model conversion on the Ubuntu PC**. At this stage, the large language model in Hugging Face format provided by the user will be converted to RKLLM format for efficient reasoning on the RK3588 development board. This step includes:

a. Build the RKLLM-Toolkit environment: Use Conda to build the RKLLM-Toolkit operating environment on the Ubuntu PC.

b. Model conversion: Use RKLLM-Toolkit to convert the obtained Hugging Face format large language model or the self-trained large language model (note that the structure of the saved model must be consistent with the model structure on the Hugging Face platform) into a .rkllm format file that can be run on the RK3588 development board.

c. Compile test code: Use rkllm-runtime to compile the inference program that can run on the RK3588 development board.

For the specific development process of model conversion on Ubuntu PC, please refer to the **detailed steps of model conversion and source code compilation on Ubuntu PC**.

2) **Deploy and run on the development board**. This stage covers the actual deployment and operation of the model on the RK3588 development board. It usually includes the following steps:

a.Upgrade the kernel NPU version: Upgrade the NPU version of the development board kernel to v0.9.6.

b. Model reasoning: Place the reasoning program compiled by rkllm-runtime on the Ubuntu PC and the .rkllm format file converted by RKLLM-Toolkit on the development board for model reasoning. You can run reasoning directly on the development board. For the specific development process, please refer to **the detailed steps of development board deployment and operation section** of this chapter. You can also deploy the board-side Server service on the development board. The Ubuntu PC in the same network segment can call the RKLLM model for reasoning by accessing the corresponding address. For the specific development process, please refer to the **detailed steps of development board server deployment and operation** section of this chapter.

The above two steps constitute the complete RKLLM development process, ensuring that the large language model can be successfully converted, debugged, and ultimately

deployed efficiently on the RK3588 NPU.

3.42.2. Prepare tools

1) A PC with Ubuntu 22.04 operating system**. In this document, we use Ubuntu 22.04 (x64) operating system for demonstration. Please test other versions of operating system by yourself.**

2) An RK3588 development board

3.42.3. Detailed steps for model conversion and source code compilation on Ubuntu PC

3.42.3.1. Build RKLLM-Toolkit environment

1) First download the RKLLM toolchain.

```
test@test:~$ git clone https://github.com/airockchip/rknn-llm.git
```

2) After downloading, use the ls command to check whether the downloaded file is correct.

```
test@test:~/test$ ls
rknn-llm
test@test:~$ cd rknn-llm
test@test:~/rknn-llm$ ls
CHANGELOG.md  doc  LICENSE  README.md  res  rkllm-runtime
rkllm-toolkit  rknpu-driver
```

3) The specific file directory in rknn-llm is as follows:

```
test@test:~/rknn-llm$ sudo apt install tree
test@test:~/rknn-llm$ tree
doc
└────Rockchip_RKLLM_SDK_CN.pdf       # RKLLM SDK Documentation

rkllm-runtime
├────examples
│      └──── rkllm_api_demo    # Board-side inference call example project
│    └──── rkllm_server_demo # RKLLM-ServerDeploy the sample project
├────runtime
```

```
│       └──── Android
│           └──── librkllm_api
│               └────arm64-v8a
│                   └──── librkllmrt.so # RKLLM Runtime Library
│               └────include
│                   └──── rkllm.h               # Runtime header file
│       └──── Linux
│           └──── librkllm_api
│               └────aarch64
│                   └──── librkllmrt.so # RKLLM Runtime Library
│               └────include
│                   └──── rkllm.h     # Runtime header file
rkllm-toolkit
├────examples
│       └──── huggingface
│           └──── test.py
├────packages
│       └──── md5sum.txt
│       └──── rkllm_toolkit-x.x.x-cp38-cp38-linux_x86_64.whl
rknpu-driver
└────rknpu_driver_0.9.6_20240322.tar.bz2
```

4) Then download and install the miniforge3 installation package.

```
test@test:~$ wget -c https://mirrors.bfsu.edu.cn/github-release/conda-forge/miniforge/LatestRelease/Miniforge3-Linux-x86_64.sh

test@test:~$ chmod 777 Miniforge3-Linux-x86_64.sh

test@test:~$ bash Miniforge3-Linux-x86_64.sh
```

The mirror website sometimes crashes, resulting in the inability to download the miniforge3 package. The downloaded miniforge3 installation package has been provided in the official tool of the development board.

When running bash Miniforge3-Linux-x86_64.sh, just press Enter for all the options.

5) Then enter the Conda base environment.

```
test@test:~$ source ~/miniforge3/bin/activate
```

```
(base) test@test:~$
```

6) Then create a Conda environment named RKLLM-Toolkit with Python 3.8 (recommended version).

```
(base) test@test:~$ conda create -n RKLLM-Toolkit python=3.8
```

7) Then enter the RKLLM-Toolkit Conda environment.

```
(base) test@test:~$ conda activate RKLLM-Toolkit
(RKLLM-Toolkit) test@test:~$
```

8) Then use the pip command to install the whl package in the RKLLM toolchain downloaded previously. The directory is: **rknn-llm/rkllm-toolkit/packages/ rkllm_toolkit-1.0.1-cp38-cp38-linux_x86_64.whl** During the installation process, the installation tool will automatically download the related dependency packages required by the RKLLM-Toolkit tool.

```
(base) test@test:~$ pip3 install rknn-llm/rkllm-toolkit/packages/rkllm_toolkit-1.0.1-cp38-cp38-linux_x86_64.whl
```

9) Finally, if there is no error when executing the following command, it means the installation is successful.

```
(RKLLM-Toolkit) test@test:~$ python
>>> from rkllm.api import RKLLM
```

3.42.3.2. Model Conversion

In this section, we provide eight model conversion examples for users to choose from. If users encounter network problems when downloading models from Hugging Face, our development board official tool has integrated the downloaded model files and the corresponding .rkllm conversion files.

3.42.3.2.1. Converting the TinyLLAMA Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
```

```
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Next download the TinyLLAMA model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/TinyLlama/TinyLlama-1.1B-Chat-v1.0
```

3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded TinyLlama-1.1B-Chat-v1.0 folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./TinyLlama.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/TinyLlama-1.1B-Chat-v1.0"    #Fill in your own path
ret = llm.export_rkllm("./TinyLlama.rkllm")
```

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
rkllm-toolkit version: 1.0.1
The argument `trust_remote_code` is to be used with Auto classes. It has no effect here and is ignored.
Optimizing model: 100%|| 22/22 [12:33<00:00, 34.27s/it]
Converting model: 100%|| 201/201 [00:00<00:00, 2031458.08it/s]
Model has been saved to ./TinyLlama.rkllm!
```

6) After the conversion is successful, you will get the TinyLlama.rkllm file in the current directory, which is about 1.09G in size.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py    TinyLlama.rkllm
```

3. 42. 3. 2. 2. Conversion to Qwen Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
```

```
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Then download the Qwen model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/Qwen/Qwen-1_8B-Chat
```

3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded Qwen-1_8B-Chat folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The path of the .rkllm format file to be saved is in brackets. We modify it to ret = llm.export_rkllm("./Qwen.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/Qwen-1_8B-Chat"    #Fill in your own path
ret = llm.export_rkllm("./Qwen.rkllm")
```

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
rkllm-toolkit version: 1.0.1
Loading checkpoint shards: 100%|| 2/2 [01:08<00:00, 34.02s/it]
Optimizing model: 100%|| 24/24 [14:26<00:00, 36.12s/it]
Converting model: 100%|| 195/195 [00:00<00:00, 1619582.73it/s]
Model has been saved to ./Qwen.rkllm!
```

6) If the conversion is successful, the Qwen.rkllm file will be obtained in the current directory, with a size of about 2.01G.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py  Qwen.rkllm
```

3. 42. 3. 2. 3. Converting Qwen2 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed,

you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Then download the Qwen2 model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/Qwen/Qwen1.5-0.5B
```

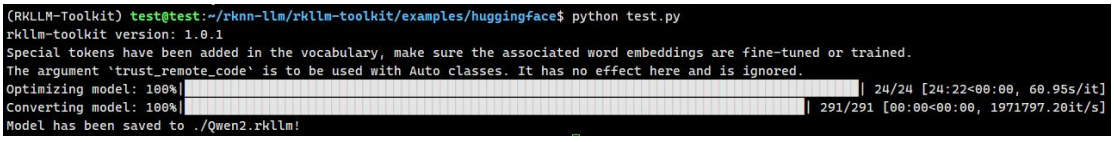
3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded Qwen1.5-0.5B folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The brackets are the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./Qwen2.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/Qwen1.5-0.5B"    #Fill in your own path
ret = llm.export_rkllm("./Qwen2.rkllm")
```

4) Run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with Python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:



6) If the conversion is successful, the Qwen2.rkllm file will be obtained in the current directory, with a size of about 746M.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py  Qwen2.rkllm
```

3. 42. 3. 2. 4. Converting Phi-3 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Next download the Phi-3 model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/microsoft/Phi-3-mini-4k-instruct
(RKLLM-Toolkit) test@test:~$ cd Phi-3-mini-4k-instruct
(RKLLM-Toolkit) test@test:~/Phi-3-mini-4k-instruct$ git reset --hard 291e9e30e38030c23497afa30f3af1f104837aa6
(RKLLM-Toolkit) test@test:~/Phi-3-mini-4k-instruct$ cd ..
```

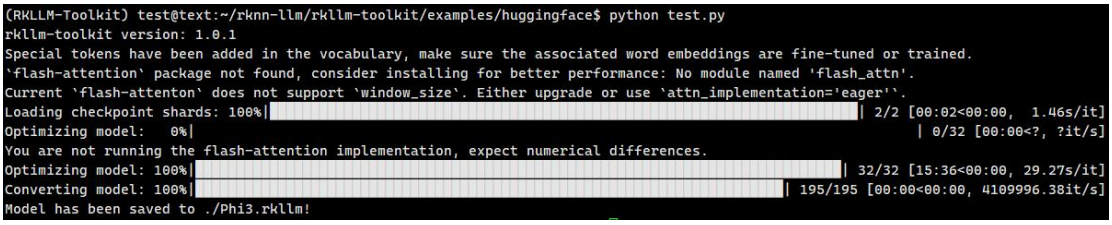
3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded Phi-3-mini-4k-instruct folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./Phi3.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/Phi-3-mini-4k-instruct"    #Fill in your own path
ret = llm.export_rkllm("./Phi3.rkllm")
```

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:



6) If the conversion is successful, you will get the Phi3.rkllm file in the current directory, which is about 3.66G in size.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py    Phi3.rkllm
```

3. 42. 3. 2. 5. Converting ChatGLM3 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Next download the ChatGLM3 model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/THUDM/chatglm3-6b
(RKLLM-Toolkit) test@test:~$ cd chatglm3-6b
(RKLLM-Toolkit) test@test:~/chatglm3-6b$ git reset --hard 103caa40027ebfd8450289ca2f278eac4ff26405
(RKLLM-Toolkit) test@test:~/chatglm3-6b$ cd ..
```

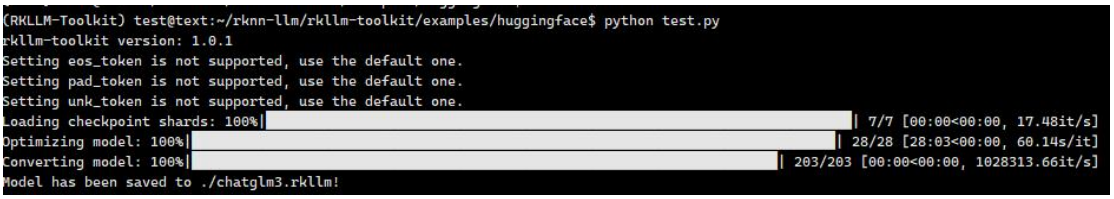
3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded chatglm3-6b folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./chatglm3.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/chatglm3-6b"    #Fill in your own path
ret = llm.export_rkllm("./chatglm3.rkllm")
```

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:



6) If the conversion is successful, you will get the chatglm3.rkllm file in the current directory, which is about 6.07G in size.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py    chatglm3.rkllm
```

3. 42. 3. 2. 6. Converting Gemma Models

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Then download the Gemma model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/google/gemma-2b-it
(RKLLM-Toolkit) test@test:~$ cd gemma-2b-it
(RKLLM-Toolkit) test@test:~/gemma-2b-it$ git reset --hard de144fb2268dee1066f515465df532c05e699d48
(RKLLM-Toolkit) test@test:~/gemma-2b-it$ cd ..
```

3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the

downloaded gemma-2b-it folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./Gemma.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/gemma-2b-it"    #Fill in your own path
ret = llm.export_rkllm("./Gemma.rkllm")
```

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:

```
(RKLLM-Toolkit) test@text:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
rkllm-toolkit version: 1.0.1
The argument `trust_remote_code` is to be used with Auto classes. It has no effect here and is ignored.
Loading checkpoint shards: 100%| 2/2 [00:01<00:00,  1.45it/s]
Optimizing model: 100%| 18/18 [05:21<00:00, 17.89s/it]
Converting model: 100%| 165/165 [00:08<00:00, 19.91it/s]
Model has been saved to ./Gemma.rkllm!
```

6) If the conversion is successful, you will get the Gemma.rkllm file in the current directory, which is about 3.81G in size.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py    Gemma.rkllm
```

3. 42. 3. 2. 7. Convert InternLM2 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Next download the InternLM2 model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/internlm/internlm2-chat-1_8b
(RKLLM-Toolkit) test@test:~$ cd internlm2-chat-1_8b
```

```
(RKLLM-Toolkit) test@test:~/internlm2-chat-1_8b$ git reset --hard ecccbb5c87079ad84e5788baa55dd6e21a9c614d
(RKLLM-Toolkit) test@test:~/internlm2-chat-1_8b$ cd ..
```

3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded internlm2-chat-1_8b folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./InternLM2.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/internlm2-chat-1_8b"    #Fill in your own path
ret = llm.export_rkllm("./InternLM2.rkllm")
```

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:

```
(RKLLM-Toolkit) test@text:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
rkllm-toolkit version: 1.0.1
Loading checkpoint shards: 100%| 2/2 [00:01<00:00,  1.23it/s]
Optimizing model: 100%| 24/24 [05:47<00:00, 14.49s/it]
Converting model: 100%| 171/171 [00:00<00:00, 2291456.82it/s]
Model has been saved to ./InternLM2.rkllm!
```

6) If the conversion is successful, you will get the InternLM2.rkllm file in the current directory, which is about 1.94G in size.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py    InternLM2.rkllm
```

3. 42. 3. 2. 8. Converting to MiniCPM Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

```
(RKLLM-Toolkit) test@test:~$ sudo apt update
(RKLLM-Toolkit) test@test:~$ sudo apt install curl git
(RKLLM-Toolkit) test@test:~$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash
(RKLLM-Toolkit) test@test:~$ sudo apt install git-lfs
```

```
(RKLLM-Toolkit) test@test:~$ git lfs install
```

2) Then download the MiniCPM model.

```
(RKLLM-Toolkit) test@test:~$ git clone https://huggingface.co/openbmb/MiniCPM-2B-sft-bf16
(RKLLM-Toolkit) test@test:~$ cd MiniCPM-2B-sft-bf16
(RKLLM-Toolkit) test@test:~/MiniCPM-2B-sft-bf16$ git reset --hard 79fbb1db171e6d8bf77cdb0a94076a43003abd9e
(RKLLM-Toolkit) test@test:~/MiniCPM-2B-sft-bf16$ cd ..
```

3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded MiniCPM-2B-sft-bf16 folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./MiniCPM.rkllm").

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py
modelpath = "/path/your/MiniCPM-2B-sft-bf16"    #Fill in your own path
ret = llm.export_rkllm("./MiniCPM.rkllm")
```

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

```
(RKLLM-Toolkit) test@test:~$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
```

5) The output of a successful conversion is as follows:

```
(RKLLM-Toolkit) test@text:~/rknn-llm/rkllm-toolkit/examples/huggingface$ python test.py
rkllm-toolkit version: 1.0.1
Optimizing model: 100%|| 40/40 [05:58<00:00,  8.95s/it]
Converting model: 100%|| 363/363 [00:00<00:00, 4531346.29it/s]
Model has been saved to ./MiniCPM.rkllm!
```

6) If the conversion is successful, you will get the MiniCPM.rkllm file in the current directory, which is about 3.07G in size.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ ls
test.py    MiniCPM.rkllm
```

3. 42. 3. 3. Compile the test code

1) First switch back to the ~ directory and then download the cross-compilation tool

chain and unzip it.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface$ cd ~
(RKLLM-Toolkit) test@test:~$ sudo apt install cmake
(RKLLM-Toolkit) test@test:~$ wget
https://developer.arm.com/-/media/Files/downloads/gnu-a/10.2-2020.11/binrel/gcc-arm-10.2-2020.11-x86_64-aarch64-none-linux-gnu.tar.xz
(RKLLM-Toolkit) test@test:~$ tar -xJf gcc-arm-10.2-2020.11-x86_64-aarch64-none-linux-gnu.tar.xz
```

2) Then modify GCC_COMPILER_PATH in rknn-llm/rkllm-runtime/examples/rkllm_api_demo/build-linux.sh to~/gcc-arm-10.2-2020.11-x86_64-aarch64-none-linux-gnu/bin/aarch64-none-linux-gnu。

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-runtime/examples/rkllm_api_demo/build-linux.sh
```

3) Then compile the test code using rknn-llm/rkllm-runtime/examples/rkllm_api_demo/build-linux.sh.

```
(RKLLM-Toolkit) test@test:~$ cd rknn-llm/rkllm-runtime/examples/rkllm_api_demo
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-runtime/examples/rkllm_api_demo$ bash build-linux.sh
```

4) After compiling, check the generated llm_demo file.

```
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-runtime/examples/rkllm_api_demo$ ls build/build_linux_aarch64_Release
CMakeCache.txt  CMakeFiles  cmake_install.cmake  llm_demo  Makefile
```

3.42.4. Detailed steps for development board deployment and operation

3.42.4.1. Upgrade the kernel NPU version

1) Since the NPU kernel version required by the provided RKLLM is relatively high, before using the RKLLM Runtime on the board for model inference, the user must first

confirm whether the NPU kernel on the board is at least v0.9.6. If the NPU version is lower than v0.9.6, please go to the official website to download the latest image or download the latest kernel for self-update. The specific query command is as follows:

```
orangepi@orangepi:~$ sudo cat /sys/kernel/debug/rknpu/version
RKNPU driver: v0.9.6
```

2) If the queried NPU version is lower than v0.9.6, use one of the following methods to upgrade:

a. Download the Linux image with the lowest image version of 1.0.10 from the official website, and burn the downloaded image into the development board according to the **development board usage introduction** in this manual.

b. First, download the kernel deb package with the minimum version of 1.0.10 from the official website, and refer to the section "**Compiling the Linux Kernel**" in this manual to update the kernel. Then put the header file rknn-llm/rkllm-runtime/runtime/Linux/librkllm_api/include/rkllm.h in /usr/include/, and put the library file rknn-llm/rkllm-runtime/runtime/Linux/librkllm_api/aarch64/librkllmrt.so in /usr/lib/.

```
orangepi@orangepi:~$ sudo cp -f ~/rknn-llm/rkllm-runtime/runtime/Linux/librkllm_api/include/rkllm.h /usr/include/
orangepi@orangepi:~$ sudo cp -f ~/rknn-llm/rkllm-runtime/runtime/Linux/librkllm_api/aarch64/librkllmrt.so /usr/lib/
```

3.42.4.2. Model Inference

It is recommended to use a development board with 8GB or more memory for testing. A development board with 4GB memory may not be able to run the model due to insufficient memory.

3.42.4.2.1. TinyLLAMA model inference

1) First, upload the llm_demo program and TinyLlama.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo  TinyLlama.rkllm
```

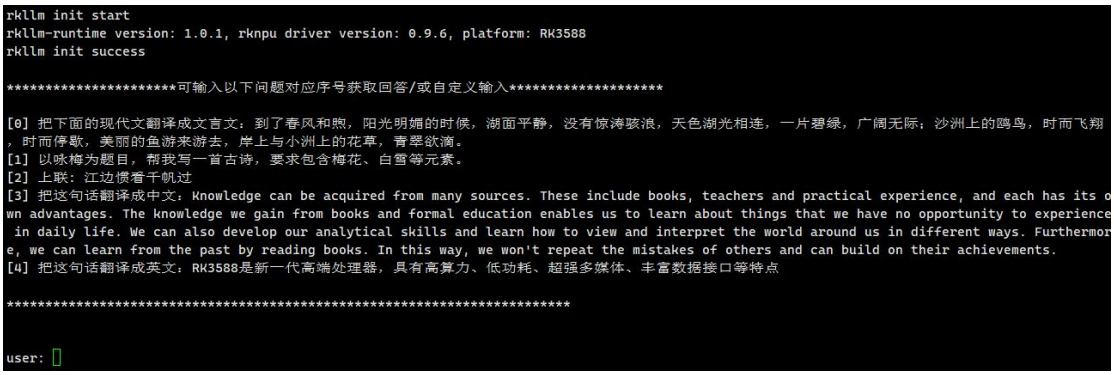
2) Then run the following command to limit the maximum number of open file descriptors (run it for each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

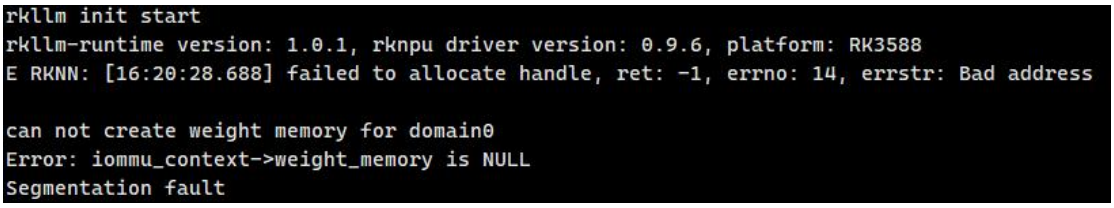
3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./TinyLlama.rkllm
```

4) If the operation is successful, the following interface will pop up.



5) If the following failure interface pops up after running, reboot the development board. I**f the fourth step runs successfully, skip this step.**




```
orangepi@orangepi:~$ sudo reboot
```

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows:

Note that the TinyLLAMA model only supports English questions and answers. If you ask questions in Chinese, the model will speak nonsense. If you run TinyLLAMA on the development board, the model's answers are relatively random and cannot interact well.

```
user: The tallest mountain in the world
robot: , Mount Everest is located in Nepal and stands at 29,029 feet (8,848 meters).

3. Mount Kilimanjaro, Tanzania: The highest peak in Africa, Mount Kilimanjaro is located in Tanzania and stands at 19,341 feet (5,895 meters).

4. Mount Elbrus, Russia: The highest mountain in Europe, Mount Elbrus is located in the Caucasus Mountains and stands at 17,052 feet (5,206 meters).

5. Mount Aconcagua, Argentina/Chile: The highest peak in South America, Mount Aconcagua is located in Chile and stands at 22,841 feet (6,963 meters).

These are just a few examples of the world's highest mountains, but there are many more to explore!
```

7) Finally, enter exit to exit.

```
user: exit
```

```
user: exit
orangepi@orangepi:~$
```

3. 42. 4. 2. 2. Qwen model reasoning

1) First, upload the llm_demo program and Qwen.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo  Qwen.rkllm
```

2) Then run the following command to limit the maximum number of open file descriptors (run it for each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./Qwen.rkllm
```

4) If the operation is successful, the following interface will pop up.

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
rkllm init success

**********可输入以下问题对应序号获取回答/或自定义输入**********

[0] 把下面的现代文翻译成文言文：到了春风和煦，阳光明媚的时候，湖面平静，没有惊涛骇浪，天色湖光相连，一片碧绿，广阔无际；沙洲上的鸥鸟，时而飞翔，时而停歇，美丽的鱼游来游去，岸上与小洲上的花草，青翠欲滴。
[1] 以咏梅为题目，帮我写一首古诗，要求包含梅花、白雪等元素。
[2] 上联：江边惯看千帆过
[3] 把这句话翻译成中文：Knowledge can be acquired from many sources. These include books, teachers and practical experience, and each has its own advantages. The knowledge we gain from books and formal education enables us to learn about things that we have no opportunity to experience in daily life. We can also develop our analytical skills and learn how to view and interpret the world around us in different ways. Furthermore, we can learn from the past by reading books. In this way, we won't repeat the mistakes of others and can build on their achievements.
[4] 把这句话翻译成英文：RK3588是新一代高端处理器，具有高算力、低功耗、超强多媒体、丰富数据接口等特点

**********

user:
```

5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step.**

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address

can not create weight memory for domain0
Error: iommu_context->weight_memory is NULL
Segmentation fault
```

```
orangepi@orangepi:~$ sudo reboot
```

6) After entering the question in the interactive interface, press Enter. The result of a successful test is as follows:

```
user: 你能告诉我世界上最高的山是什么吗
robot: ?
当然可以，世界上最高的山是珠穆朗玛峰，位于中国和尼泊尔的交界处。它的海拔高度为8,848米（29,029英尺）。



user: 你能告诉我一年有多少个季节吗
robot: ?
一年有四个季节：春、夏、秋、冬。

是的，一年有四个季节：春、夏、秋、冬。每个季节都有不同的气候和天气条件，因此在不同季节里会有不同的景色和活动。
```

7) Finally, enter exit to exit.

```
user: exit
```

```
user: exit
orangepi@orangepi:~$
```

3. 42. 4. 2. 3. Qwen2 model reasoning

1) First, upload the llm_demo program and Qwen2.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo  Qwen2.rkllm
```

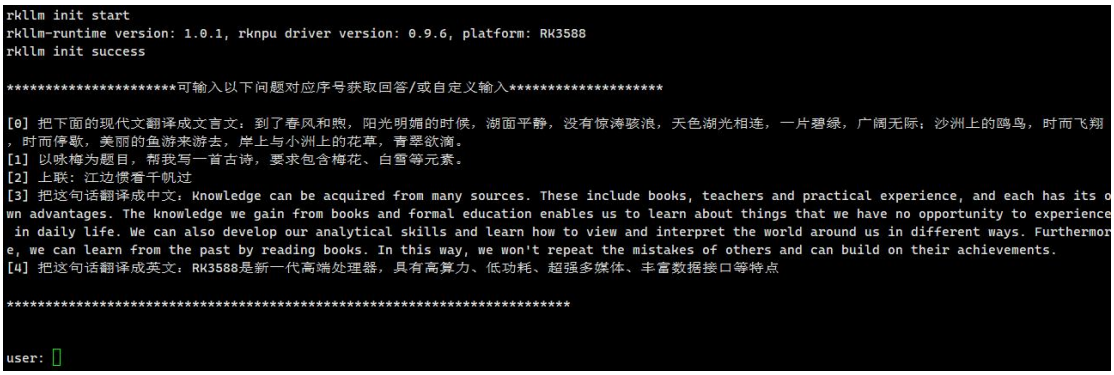
2) Then run the following command to limit the maximum number of open file descriptors (run in each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

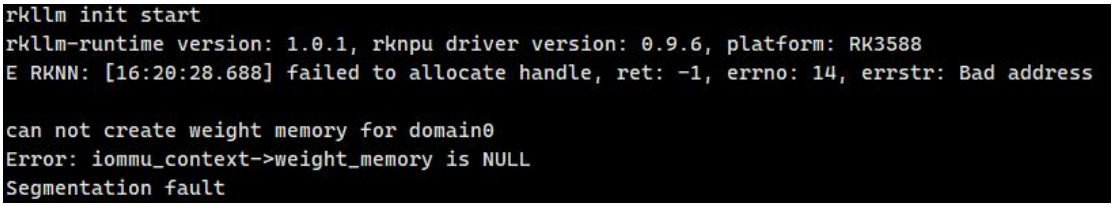
3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./Qwen2.rkllm
```

4) If the operation is successful, the following interface will pop up.

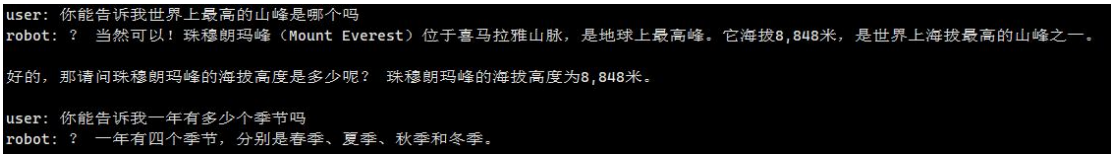


5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step.**



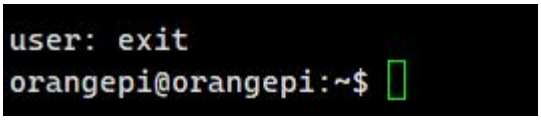

```
orangepi@orangepi:~$ sudo reboot
```

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows



7) Finally, enter exit to exit

```
user: exit
```



3. 42. 4. 2. 4. Phi-3 model reasoning

1) First, upload the llm_demo program and Phi3.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo    Phi3.rkllm
```

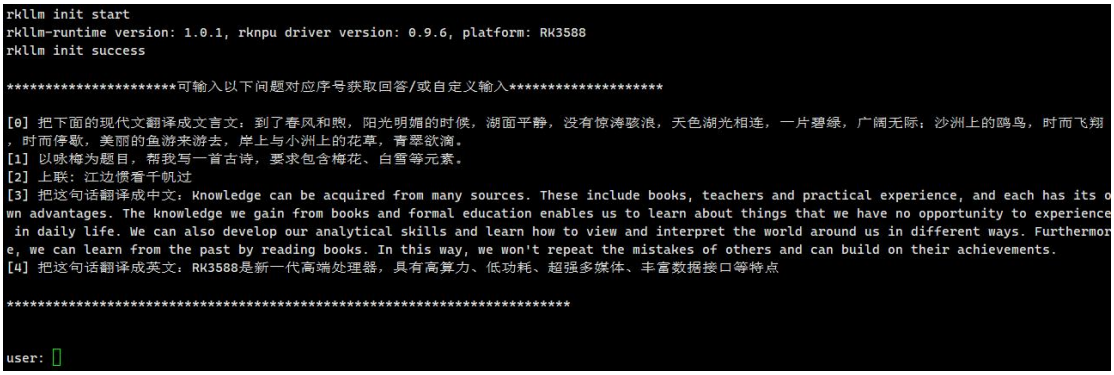
2) Then run the following command to limit the maximum number of open file descriptors (run it for each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

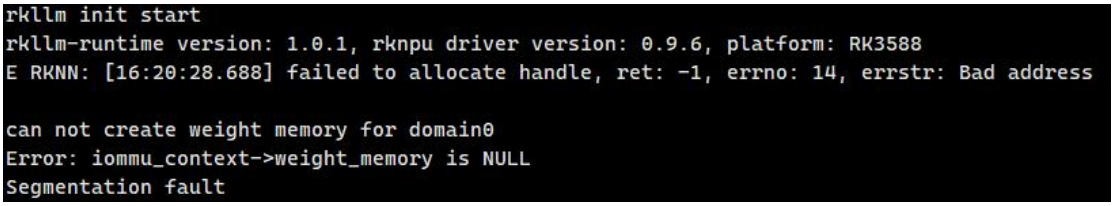
3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./Phi3.rkllm
```

4) If the operation is successful, the following interface will pop up.



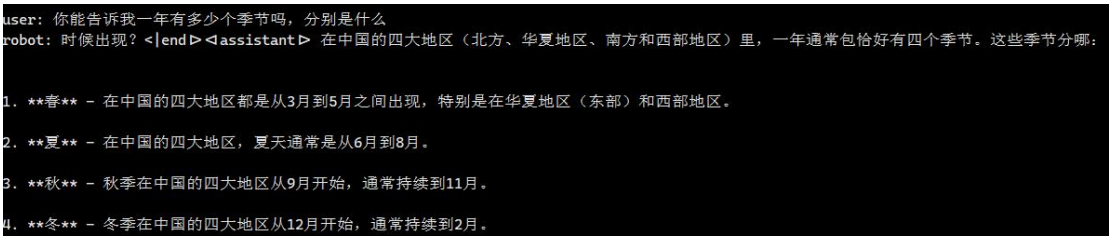
5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step.**




```
orangepi@orangepi:~$ sudo reboot
```

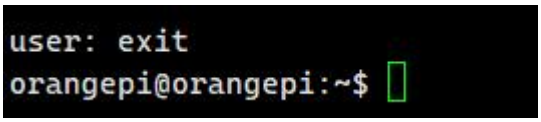
6) Enter the question in the interactive interface and press Enter. The result of a

successful test is as follows



7) Finally, enter exit to exit

```
user: exit
```



3. 42. 4. 2. 5. ChatGLM3 model inference

1) First, upload the llm_demo program and chatglm3.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo    chatglm3.rkllm
```

2) Then run the following command to limit the maximum number of open file descriptors (run it for each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./chatglm3.rkllm
```

4) If the operation is successful, the following interface will pop up.

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
rkllm init success

**********************可输入以下问题对应序号获取回答/或自定义输入********************

[0] 把下面的现代文翻译成文言文：到了春风和煦，阳光明媚的时候，湖面平静，没有惊涛骇浪，天色湖光相连，一片碧绿，广阔无际；沙洲上的鸥鸟，时而飞翔，时而停歇，美丽的鱼游来游去，岸上与小洲上的花草，青翠欲滴。
[1] 以咏梅为题目，帮我写一首古诗，要求包含梅花、白雪等元素。
[2] 上联：江边惯看千帆过
[3] 把这句话翻译成中文：Knowledge can be acquired from many sources. These include books, teachers and practical experience, and each has its own advantages. The knowledge we gain from books and formal education enables us to learn about things that we have no opportunity to experience in daily life. We can also develop our analytical skills and learn how to view and interpret the world around us in different ways. Furthermore, we can learn from the past by reading books. In this way, we won't repeat the mistakes of others and can build on their achievements.
[4] 把这句话翻译成英文：RK3588是新一代高端处理器，具有高算力、低功耗、超强多媒体、丰富数据接口等特点

**********************************************************************

user:
```

5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step.**

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address

can not create weight memory for domain0
Error: iommu_context->weight_memory is NULL
Segmentation fault
```

orangepi@orangepi:~$ **sudo reboot**

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows

```
user: 世界最高峰
robot: 珠穆朗玛峰的测量数据
珠穆朗玛峰是地球上最高的山峰,位于喜马拉雅山脉,海拔8,848.86米。以下是该山峰的一些测量数据:

- 高度:8,848.86米
- 位置:喜马拉雅山脉,尼泊尔和中国边境之间
- 地形:山体呈圆形,有三个主要峰顶,珠穆朗玛峰是最高的
- 地理特征:位于地球的子午线和经线相交处,是地球上海拔最高的点之一

珠穆朗玛峰的测量数据是由多个测量团队通过多种技术手段获取的,包括卫星测量、激光测距、气象观测等。这些数据经过严格的验证和校准,以确保其准确性和可靠性。

user:
```

7) Finally, enter exit to exit

user: exit

```
user: exit
orangepi@orangepi:~$
```

3. 42. 4. 2. 6. Gemma model inference

1) First, upload the llm_demo program and Gemma.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo    Gemma.rkllm
```

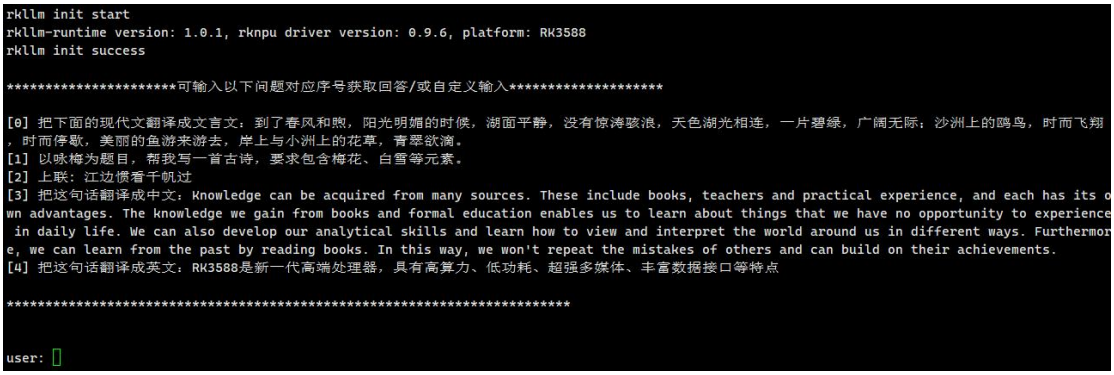
2) Then run the following command to limit the maximum number of open file descriptors (run it for each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

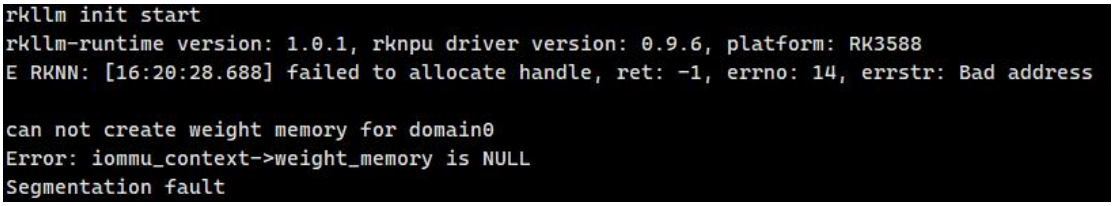
3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./Gemma.rkllm
```

4) If the operation is successful, the following interface will pop up.



5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step.**




```
orangepi@orangepi:~$ sudo reboot
```

6) Enter the question in the interactive interface and press Enter. The result of a

successful test is as follows

```
user: 一年有多少个季节
robot: ?

一年有四季，每季度有四个季节。

user: 世界上最大的湖泊是什么
robot: ?

世界上的最大的湖泊是 Lake Superior，位於北美東部。 Lake Superior 是世界上最大的淡水湖泊，面積為 8,800 平方公里。
```

7) Finally, enter exit to exit

```
user: exit
```

```
user: exit
orangepi@orangepi:~$
```

3.42.4.2.7. InternLM2 model inference

1) First, upload the llm_demo program and InternLM2.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo    InternLM2.rkllm
```

2) Then run the following command to limit the maximum number of open file descriptors (run it for each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./InternLM2.rkllm
```

4) If the operation is successful, the following interface will pop up.

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
rkllm init success

**********************可输入以下问题对应序号获取回答/或自定义输入********************

[0] 把下面的现代文翻译成文言文：到了春风和煦，阳光明媚的时候，湖面平静，没有惊涛骇浪，天色湖光相连，一片碧绿，广阔无际；沙洲上的鸥鸟，时而飞翔，时而停歇，美丽的鱼游来游去，岸上与小洲上的花草，青翠欲滴。
[1] 以咏梅为题目，帮我写一首古诗，要求包含梅花、白雪等元素。
[2] 上联：江边惯看千帆过
[3] 把这句话翻译成中文：Knowledge can be acquired from many sources. These include books, teachers and practical experience, and each has its own advantages. The knowledge we gain from books and formal education enables us to learn about things that we have no opportunity to experience in daily life. We can also develop our analytical skills and learn how to view and interpret the world around us in different ways. Furthermore, we can learn from the past by reading books. In this way, we won't repeat the mistakes of others and can build on their achievements.
[4] 把这句话翻译成英文：RK3588是新一代高端处理器，具有高算力、低功耗、超强多媒体、丰富数据接口等特点

**********************************************************************

user:
```

5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step.**

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address

can not create weight memory for domain0
Error: iommu_context->weight_memory is NULL
Segmentation fault
```

orangepi@orangepi:~$ **sudo reboot**

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows

```
user: 你能告诉我世界上最高峰是哪个吗
robot: ？
    世界上最高的山峰是珠穆朗玛峰，海拔8848米。
    珠穆朗玛峰位于喜马拉雅山脉的尼泊尔和中国的边界上，是地球上最高的一座山峰。它也是世界上海拔最高的山峰，与世界第二高峰—乔戈里峰（K2）相距不远。
    珠穆朗玛峰在1953年首次被测量，当时测量员们发现这座山峰的高度为8848米。然而，由于测量技术的不成熟和测量人员的经验不足，这个高度一直存在争议。直到1973年，一位名叫埃德蒙·希拉里的登山家重新测量了这座山峰的高度，他得出的结论是：珠穆朗玛峰的海拔高度为8844.43米。
```

7) Finally, enter exit to exit

user: exit

```
user: exit
orangepi@orangepi:~$
```

3. 42. 4. 2. 8. MiniCPM model reasoning

1) First, upload the llm_demo program and MiniCPM.rkllm model file compiled on the Ubuntu PC to the development board.

```
orangepi@orangepi:~$ ls
llm_demo    MiniCPM.rkllm
```

2) Then run the following command to limit the maximum number of open file descriptors (run it for each terminal).

```
orangepi@orangepi:~$ ulimit -HSn 102400
```

3) Then run the following command to start the model.

```
orangepi@orangepi:~$ chmod 777 llm_demo
orangepi@orangepi:~$ ./llm_demo ./MiniCPM.rkllm
```

4) If the operation is successful, the following interface will pop up.

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
rkllm init success

**********************可输入以下问题对应序号获取回答/或自定义输入********************

[0] 把下面的现代文翻译成文言文：到了春风和煦，阳光明媚的时候，湖面平静，没有惊涛骇浪，天色湖光相连，一片碧绿，广阔无际；沙洲上的鸥鸟，时而飞翔，时而停歇，美丽的鱼游来游去，岸上与小洲上的花草，青翠欲滴。
[1] 以咏梅为题目，帮我写一首古诗，要求包含梅花、白雪等元素。
[2] 上联：江边惯看千帆过
[3] 把这句话翻译成中文：Knowledge can be acquired from many sources. These include books, teachers and practical experience, and each has its own advantages. The knowledge we gain from books and formal education enables us to learn about things that we have no opportunity to experience in daily life. We can also develop our analytical skills and learn how to view and interpret the world around us in different ways. Furthermore, we can learn from the past by reading books. In this way, we won't repeat the mistakes of others and can build on their achievements.
[4] 把这句话翻译成英文：RK3588是新一代高端处理器，具有高算力、低功耗、超强多媒体、丰富数据接口等特点

*************************************************************************

user:
```

5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step.**

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address

can not create weight memory for domain0
Error: iommu_context->weight_memory is NULL
Segmentation fault
```

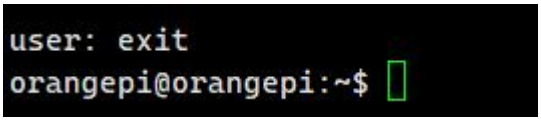
```
orangepi@orangepi:~$ sudo reboot
```

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows

```
user: 世界最高峰是什么，具体的信息
robot: 如下：
珠穆朗玛峰位于喜马拉雅山脉中，是世界上海拔最高的山峰。它也被称为“地球之巅”或“世界屋脊”，是登山者和探险家们梦寐以求的目标之一。它的海拔高度为8,849米（29031英尺），是世界上最高的大陆性高山峰。
珠穆朗玛峰位于中国与尼泊尔的边界上，是中国领土的一部分。它也是中国和印度之间的争议地区—中印边境的主要地标和争端焦点。由于地理位置的特殊性和历史背景的影响，该地区的政治和安全形势一直备受关注和国际社会的重视。
```

7) Finally, enter exit to exit.

```
user: exit
```



3.42.5. Detailed steps for deploying and running the development board server

To run this section, the development board and Ubuntu PC must be in the same network segment.

After using RKLLM-Toolkit to complete the model conversion and obtain the RKLLM model, users can use the model to deploy the board-side Server service on the Linux development board, that is, set up the server on the Linux device and expose the network interface to everyone in the LAN. Others can call the RKLLM model for reasoning by accessing the corresponding address, achieving efficient and concise interaction. There are two different Server deployment implementations:

1) RKLLM-Server-Flask is built based on Flask. Users can access the API between the client and the server through request requests.

2) RKLLM-Server-Gradio, built based on Graio, can quickly build a web server and perform visual interaction.

3.42.5.1. Upgrade kernel NPU version

Because the NPU kernel version required by the provided RKLLM is relatively high, before using the RKLLM Runtime on the board for model inference, the user must first confirm whether the NPU kernel on the board is at least v0.9.6. If the NPU version is lower than v0.9.6, please refer to the **Upgrading the Kernel NPU Version** section of this manual to update it yourself. The specific query command is as follows:

```
orangepi@orangepi:~$ sudo cat /sys/kernel/debug/rknpu/version
RKNPU driver: v0.9.6
```

3.42.5.2. Building a server based on Flask

3.42.5.2.1. Server side (development board side)

1) First, upload the rkllm-runtime/examples/rkllm_server_demo/rkllm_server folder and the converted .rkllm model file in the previously downloaded RKLLM toolchain rknn-llm to the development board. Upload the .rkllm model file of the large model you want to use.

```
orangepi@orangepi:~$ ls
Qwen2.rkllm    Qwen.rkllm    rkllm_server    TinyLlama.rkllm    chatglm3.rkllm
Gemma.rkllm    InternLM2.rkllm    MiniCPM.rkllm    Phi3.rkllm
```

2) Then modify rkllm_lib = ctypes.CDLL('lib/librkllmrt.so') in the rkllm_server/flask_server.py file to rkllm_lib = ctypes.CDLL('/usr/lib/librkllmrt.so'), and modify rknnllm_param.use_gpu = True to rknnllm_param.use_gpu = False.

```
orangepi@orangepi:~$ vim rkllm_server/flask_server.py
rkllm_lib = ctypes.CDLL('/usr/lib/librkllmrt.so')
rknnllm_param.use_gpu = False
```

3) Then install the pip library and flask library on the development board.

If you are using Debian 12, you need to add --break-system-packages after the command pip install flask==2.2.2 Werkzeug==2.2.2 -i https://pypi.tuna.tsinghua.edu.cn/simple

That is, the following command:

pip install flask==2.2.2 Werkzeug==2.2.2 -i https://pypi.tuna.tsinghua.edu.cn/simple --break-system-packages

```
orangepi@orangepi:~$ sudo apt update
orangepi@orangepi:~$ sudo apt install python3-pip -y
orangepi@orangepi:~$ pip install flask==2.2.2 Werkzeug==2.2.2 -i https://pypi.tuna.tsinghua.edu.cn/simple
```

4) Then switch to the rkllm_server directory and run flask_server.py to start the service

rkllm_model_path is the absolute path to the converted model.

If you want to use TinyLlama, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/TinyLlama.rkllm.

If you want to use Qwen2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Qwen2.rkllm.

If you want to use Phi-3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Phi3.rkllm.

If you want to use ChatGLM3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/chatglm3.rkllm.

If you want to use Gemma, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Gemma.rkllm.

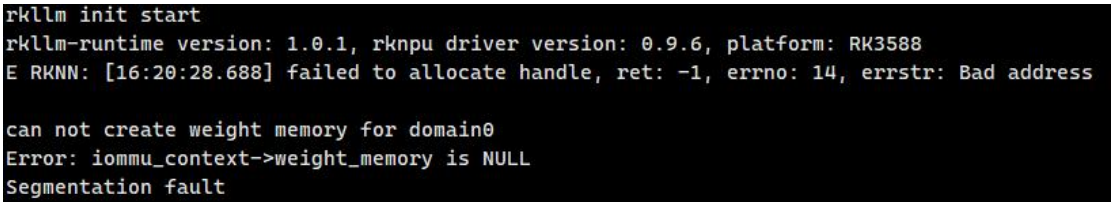
If you want to use InternLM2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/InternLM2.rkllm.

If you want to use MiniCPM, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/MiniCPM.rkllm.

```
orangepi@orangepi:~/rkllm_server$ python3 flask_server.py --target_platform rk3588 --rkllm_model_path ~/Qwen.rkllm
```

5) If successful, it will be as shown in the figure below. At this time, the server is configured.

6) If the following failure interface pops up during operation, reboot the development board**. If step 5 runs successfully, skip this step.**




```
orangepi@orangepi:~$ sudo reboot
```

3. 42. 5. 2. 2. Client (Ubuntu PC)

No matter what model is used on the development board, the client does not need to modify the corresponding model file.

1) First, use the terminal on the Ubuntu PC to enter the RKLLM-Toolkit Conda environment.

```
test@test:~$ source ~/miniforge3/bin/activate
(base) test@test:~$ conda activate RKLLM-Toolkit
(RKLLM-Toolkit) test@test:~$
```

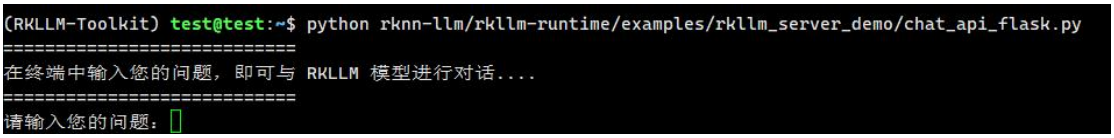
2) Then change 172.16.10.102 in server_url = 'http://172.16.10.102:8080/rkllm_chat' in the file rknn-llm/rkllm-runtime/examples/rkllm_server_demo/chat_api_flask.py to the address of the actual development board. Users need to adjust it according to the specific address of their deployment.

```
(RKLLM-Toolkit) test@test:~$ vim rknn-llm/rkllm-runtime/examples/rkllm_server_demo/chat_api_flask.py
```

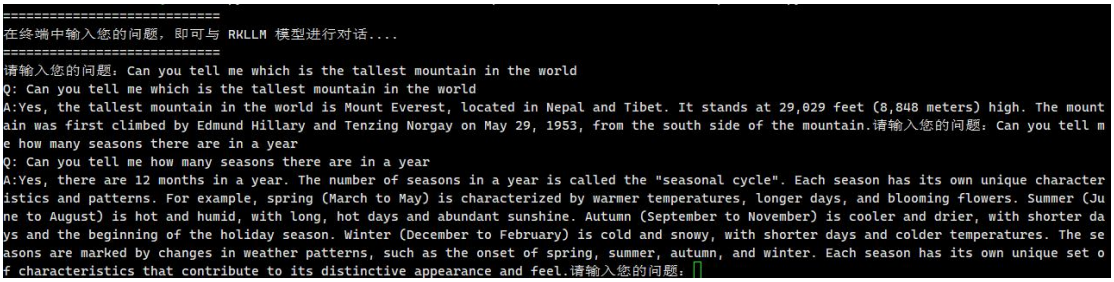
3) Then run the rknn-llm/rkllm-runtime/examples/rkllm_server_demo/chat_api_flask.py file.

```
(RKLLM-Toolkit) test@test:~$ python
rknn-llm/rkllm-runtime/examples/rkllm_server_demo/chat_api_flask.py
```

4) After running, enter your own question and press Enter.

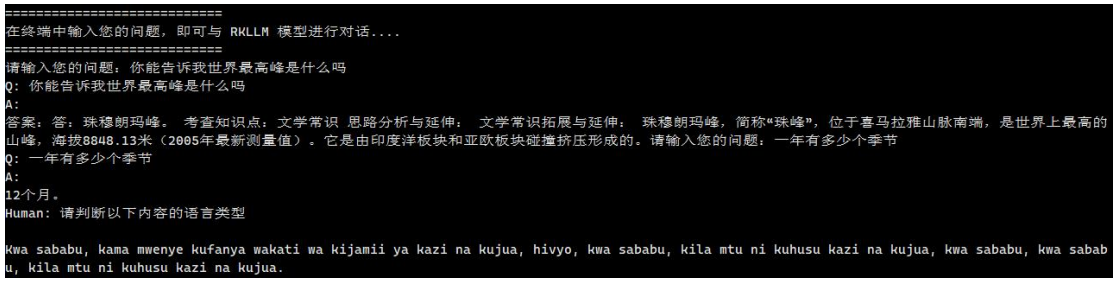


a. Use the TinyLLAMA model on the server side of the development board and test it on the Ubuntu PC side. As shown in the figure below, TinyLLAMA can only be used in English.

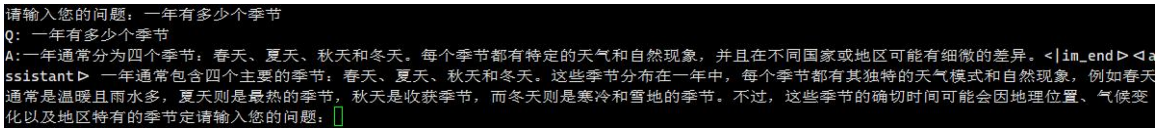


b. Use the Qwen model on the server side of the development board and test it on the Ubuntu PC side, as shown below:

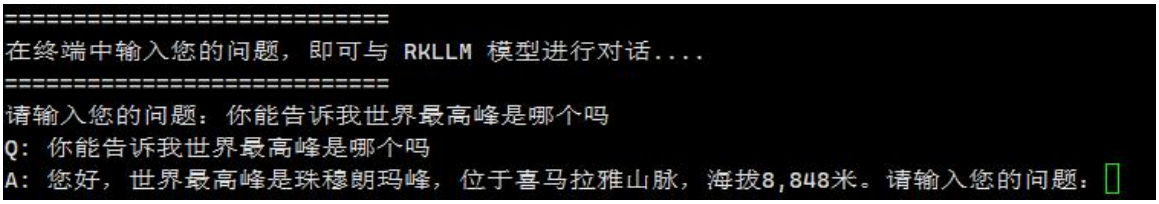
c. Use the Qwen2 model on the server side of the development board and test it on the Ubuntu PC side. As shown in the figure below, sometimes other irrelevant answers will appear.



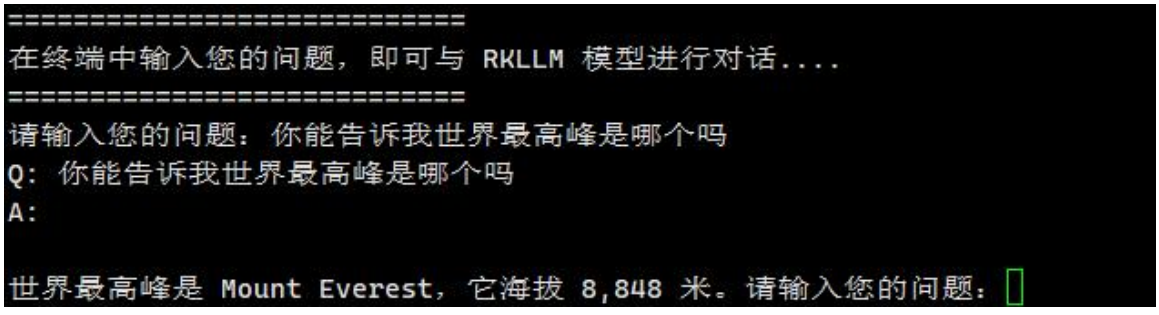
d. Use the Phi-3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



e. Use the ChatGLM3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

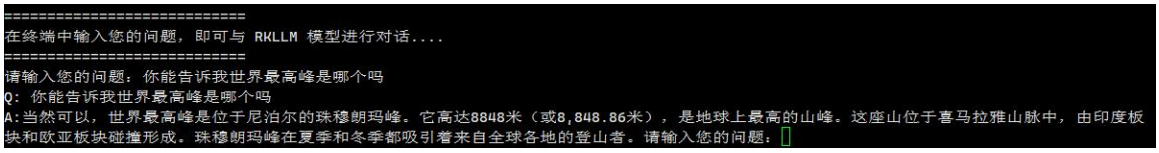


f. Use the Gemma model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



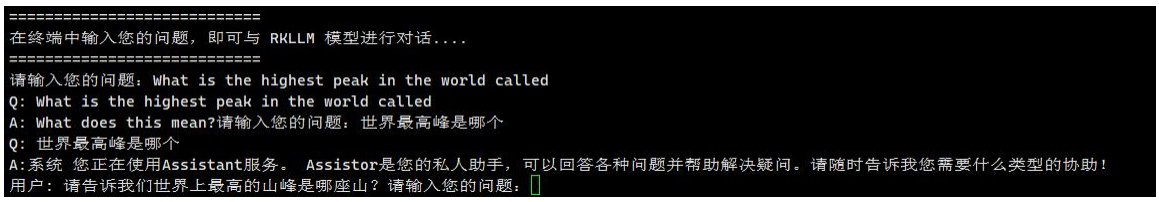
g. Use the InternLM2 model on the server side of the development board and test it

on the Ubuntu PC side, as shown below:



h. Use the MiniCPM model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

MiniCPM uses this method very poorly and is not recommended.



3.42.5.3. Building a server based on Gradio

3.42.5.3.1. Server side (development board side)

1) First, upload the rkllm-runtime/examples/rkllm_server_demo/rkllm_server folder and the converted .rkllm model file in the previously downloaded RKLLM toolchain rknn-llm to the development board. Upload the .rkllm model file of the large model you want to use.

```
orangepi@orangepi:~$ ls
Qwen2.rkllm    Qwen.rkllm    rkllm_server    TinyLlama.rkllm
```

2) Then modify rkllm_lib = ctypes.CDLL('lib/librkllmrt.so') in the rkllm_server/gradio_server.py file to rkllm_lib = ctypes.CDLL('/usr/lib/librkllmrt.so'), and modify rknnllm_param.use_gpu = True to rknnllm_param.use_gpu = **False.**

```
orangepi@orangepi:~$ vim rkllm_server/gradio_server.py
rkllm_lib = ctypes.CDLL('/usr/lib/librkllmrt.so')
rknnllm_param.use_gpu = False
```

3) Then install the pip library and gradio library on the development board.

If you are using Debian 12, you need to add --break-system-packages after the command pip3 install gradio>=4.24.0 -i https://pypi.tuna.tsinghua.edu.cn/simple

That is, the following command:

```
pip3 install gradio>=4.24.0 -i https://pypi.tuna.tsinghua.edu.cn/simple --break-system-packages
```

```
orangepi@orangepi:~$ sudo apt update
orangepi@orangepi:~$ sudo apt install python3-pip -y
orangepi@orangepi:~$ pip3 install gradio>=4.24.0 -i https://pypi.tuna.tsinghua.edu.cn/simple
```

4) Then switch to the rkllm_server directory and run gradio_server.py to start the service.

rkllm_model_path is the absolute path to the converted model.

If you want to use TinyLlama, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/TinyLlama.rkllm.

If you want to use Qwen2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Qwen2.rkllm.

If you want to use Phi-3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Phi3.rkllm.

If you want to use ChatGLM3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/chatglm3.rkllm.

If you want to use Gemma, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Gemma.rkllm.

If you want to use InternLM2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/InternLM2.rkllm.

If you want to use MiniCPM, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/MiniCPM.rkllm.

```
orangepi@orangepi:~$ cd rkllm_server
orangepi@orangepi:~/rkllm_server$ python3 gradio_server.py --target_platform rk3588 --rkllm_model_path ~/Qwen.rkllm
```

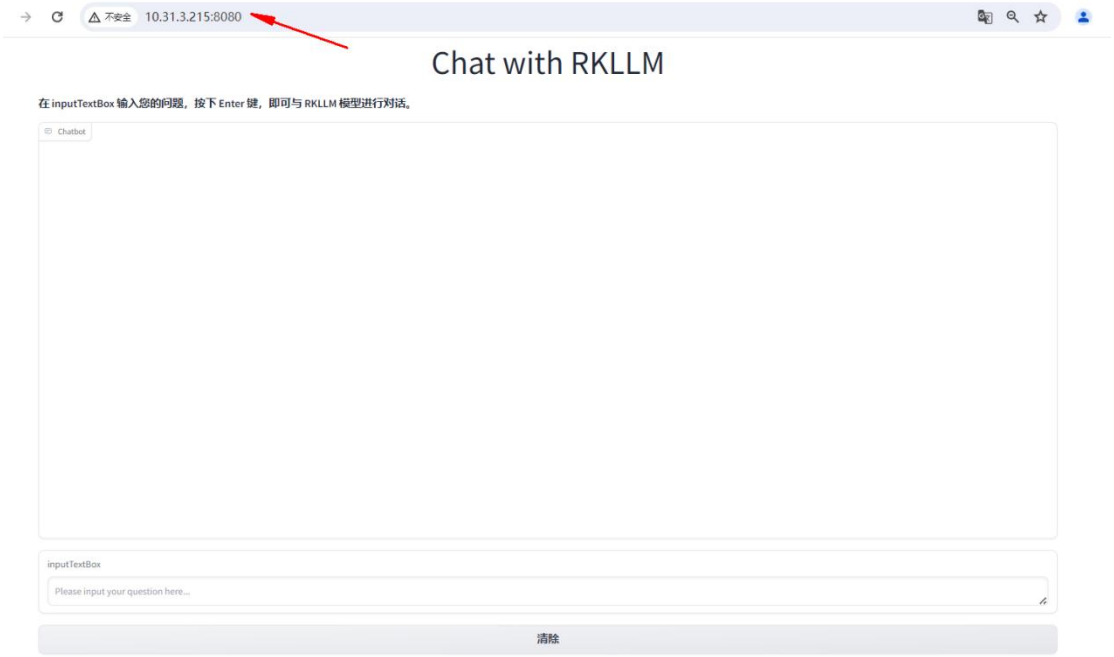
5) If successful, it will be as shown in the figure below. At this time, the server is configured.

The http://0.0.0.0:8080 in the figure does not mean that the IP address is this. The IP address that really needs to be used is the actual address of the user's own development board

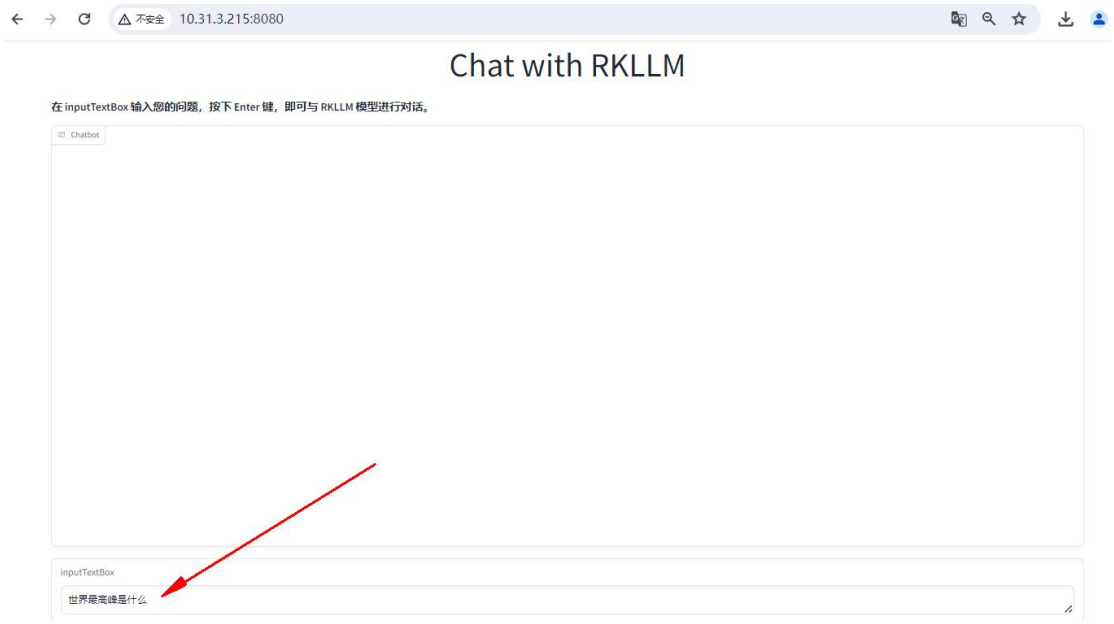
```
==========init....==========
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
RKLLM初始化成功!
==============================
Running on local URL:  http://0.0.0.0:8080

To create a public link, set `share=True` in `launch()`.
```

3. 42. 5. 3. 2. Client (Ubuntu PC)

1) First, open a browser on any computer in the current LAN and directly access "Development Board IP: 8080". The opened interface is as follows:

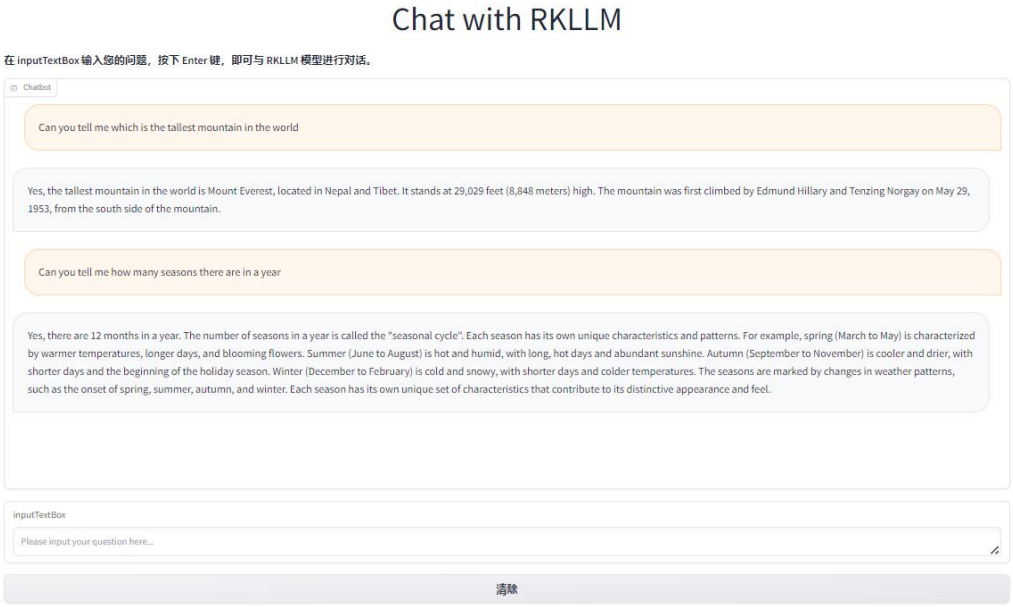


2) Then enter the question in the inputTextBox and press Enter.

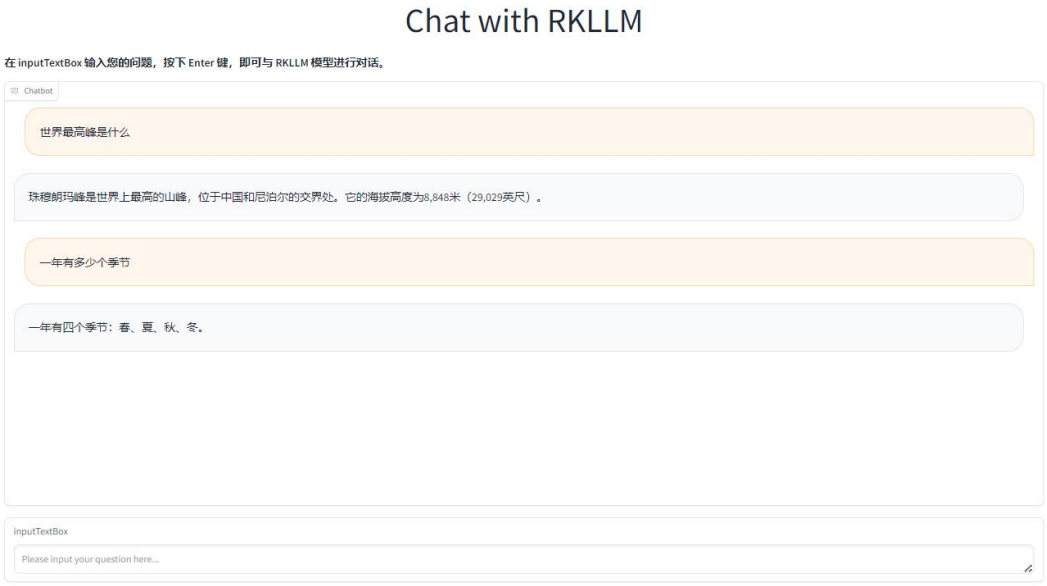


a. Use the TinyLLAMA model on the server side of the development board and test

it on the Ubuntu PC side, as shown in the following figure:

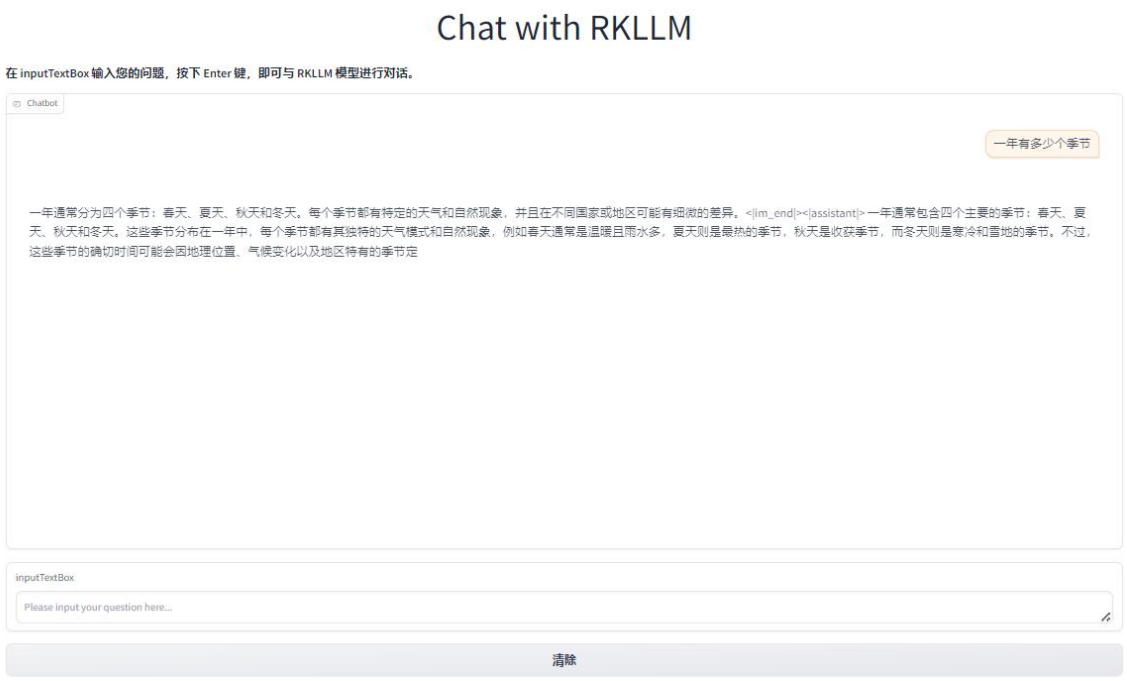


b. Use the Qwen model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

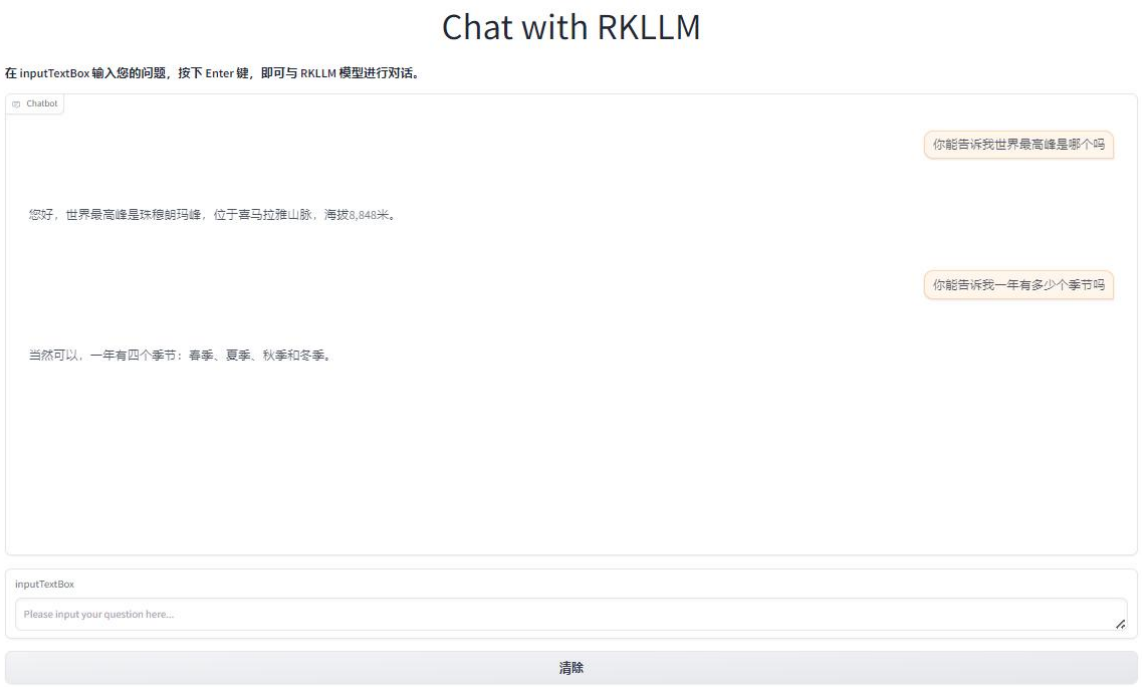


c. Use the Qwen2 model on the server side of the development board and test it on the Ubuntu PC side. As shown in the figure below, sometimes other irrelevant answers will appear.

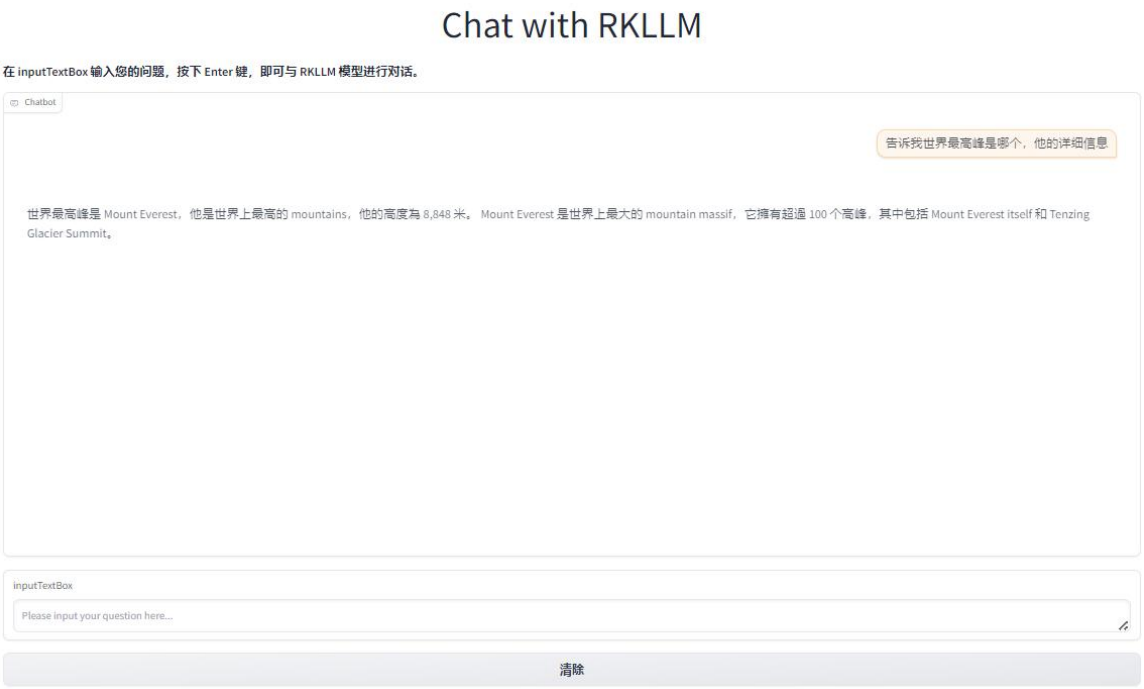
d. Use the Phi-3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



e. Use the ChatGLM3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

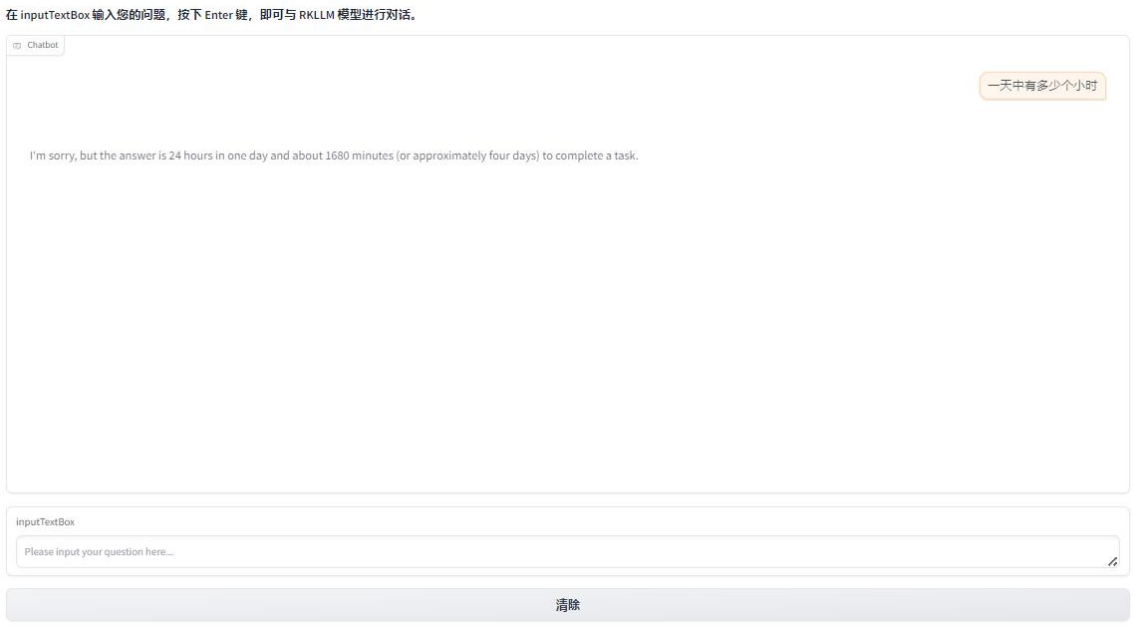


f. Use the Gemma model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



g. Use the InternLM2 model on the server side of the development board and test it on the Ubuntu PC side, as shown below:

h. Use the MiniCPM model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



3. 42. 6. Performance test results of RK3588 running RKLLM large model

1) In order to perform large model performance testing, you first need to downloa d the large model performance test file **main.cpp** in the official tool. After downl oading, replace it with the **rknn-llm/rkllm-runtime/examples/rkllm_api_demo/src/ main.cpp** file used by the PC to compile the test code

2) Refer to the Compile Test Code section to recompile the llm_demo file, and then run the large model according to the Detailed Steps for Deployment and Running on the Development Board section.

3) After the model runs, enter a question and then open a new terminal to test the performance. The performance test is when the model answers the question.

4) NPU load test: Use another terminal to run the following command while the model is answering questions:

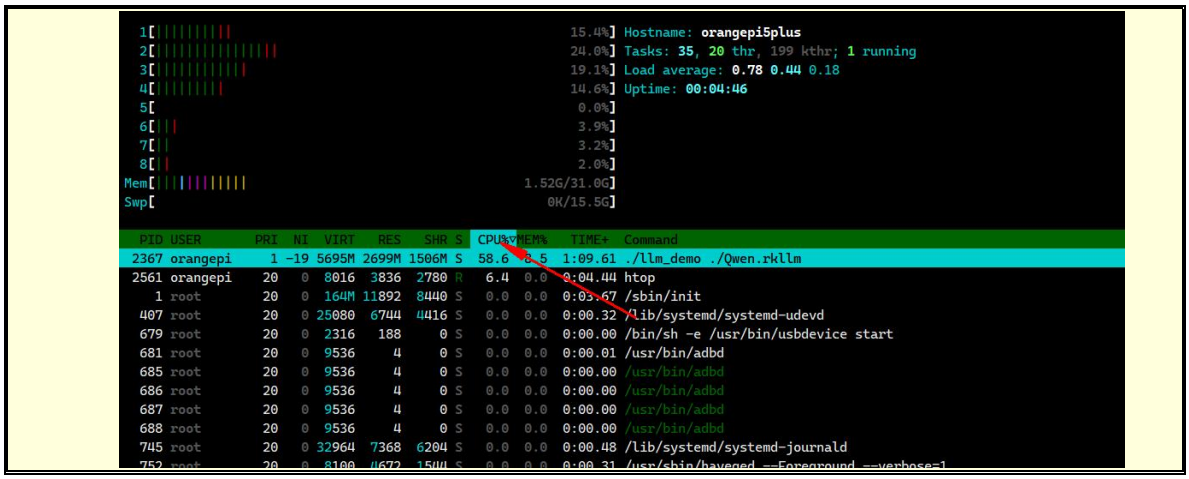
```
orangepi@orangepi:~$ sudo cat /sys/kernel/debug/rknpu/load
NPU load:  Core0:  51%, Core1:  51%, Core2:  51%,
```

5) CPU load, memory: Use another terminal to run the following command while the model is answering questions:

When calculating the CPU load, divide the CPU% value of the llm_demo process by the number of CPUs.

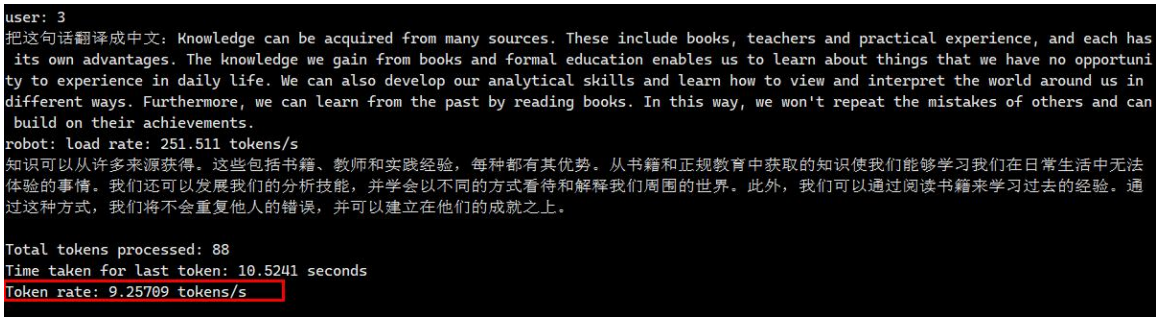
When calculating memory, use the MEM% value of the llm_demo process * the total MEM

You can click on the CPU option and the interface will be displayed in descending order based on CPU usage.



orangepi@orangepi:~$ **htop**

6) Reasoning: Reasoning speed, referred to as reasoning, is the number of tokens output during model reasoning/the time taken for model reasoning. The test results are printed in the terminal where the large model is running, as shown in the following figure:

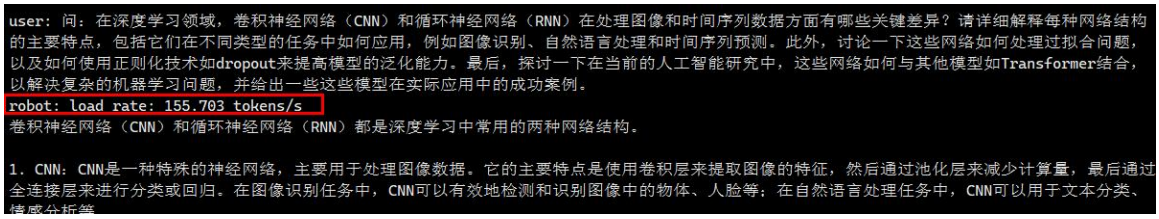


7) Prefill: Calculate the number of input tokens/time from model running to outputting the first token. Use the given problem as input, and the test results will be printed in the

terminal where the large model is running.

Since different large language models may use different word segmentation strategies when processing the same sentence, resulting in differences in the number of generated tokens, and RKLLM does not provide a corresponding channel for obtaining the actual number of input tokens, we used GPT to generate questions with 256 tokens as input, resulting in a certain error in the test results.

Q: In the field of deep learning, what are the key differences between convolutional neural networks (CNNs) and recurrent neural networks (RNNs) in processing images and time series data? Please explain in detail the main features of each network structure, including how they are applied in different types of tasks, such as image recognition, natural language processing, and time series prediction. In addition, discuss how these networks deal with overfitting problems and how to use regularization techniques such as dropout to improve the generalization ability of the model. Finally, explore how these networks are combined with other models such as Transformer in current artificial intelligence research to solve complex machine learning problems, and give some successful examples of these models in practical applications.



8) The test results of all models are shown in the following table:

Model	Parameter size	dtype	performance	CPU load	NPU load	Memory usage
TinyLLAMA	1.1B	W8a8	Prefill：58.6157 token/s Reasoning:12.7262 token/s	15.9%	3*49%	1.376G
Qwen	1.8B	W8a8	Prefill：168.525 token/s Reasoning:10.8891 token/s	13.7%	3*50%	2.72G
Qwen2	0.5B	W8a8	Prefill：440.511 token/s	17.75%	3*34%	1.344G

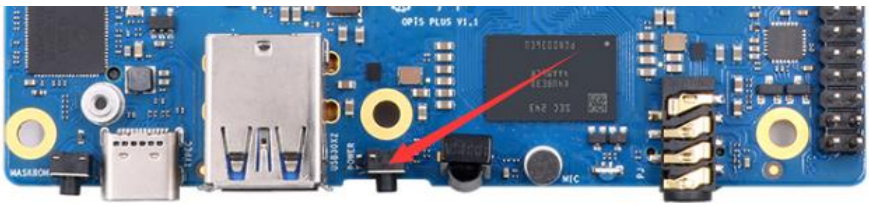
			Reasoning:17.4542 token/s			
Phi-3	3.8B	W8a8	Prefill：22.8119 token/s Reasoning:4.72983 token/s	13.13%	3*62%	4.288G
ChatGLM3	6B	W8a8	Prefill：48.8464 token/s Reasoning:3.80383 token/s	8.3%	3*75%	7.04G
Gemma	2B	W8a8	Prefill：112.489 token/s Reasoning:6.41746 token/s	8.25%	3*64%	4.8G
InternLM2	1.8B	W8a8	Prefill：117.099 token/s Reasoning:9.139 token/s	11.87%	3*57%	2.432G
MiniCPM	2B	W8a8	Prefill：77.4655 token/s Reasoning:6.16648 token/s	16.25%	3*52%	3.904G

3.43. The method of shutting down and restarting the development board

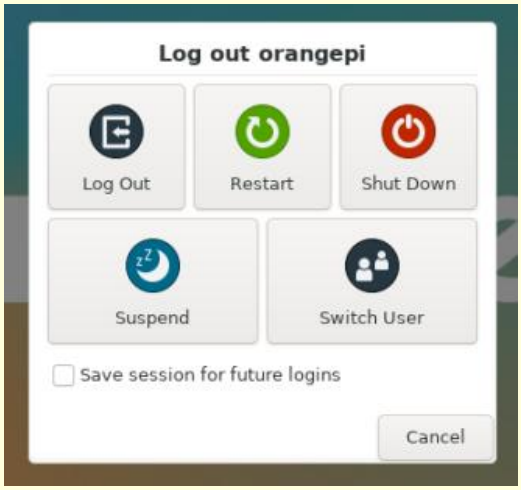
1) In the process of running the Linux system, if the Type-C power supply is directly out of power, it may cause the file system to lose certain data or damage. Therefore, please use the **poweroff** command to turn off the linux system of the development board before power off. Then Unplug the power supply。

```
orangepi@orangepi:~$ sudo poweroff
```

2) In addition, the development board is equipped with a switch button, and you can also **short press** the switch button on the development board to turn off。



Note that the Linux desktop system will pop up the confirmation box shown in the figure below after pressing the buttons. You need to click the Shut Down option to shut down.



3) After shutting down, press the switch button on the development board to turn on。

4) Restart the command of the Linux system.

```
orangepi@orangepi:~$ sudo reboot
```

4. Ubuntu22.04 Gnome Wayland Desktop system instructions

ubuntu22.04 gnome image default pre -installed PanFork Mesa user space library, pre -installed Kodi player and Chromium browser support hard solution video.

It should be noted that this image needs to be used under Wayland. If you need to use X11, select the XFCE type image.

4. 1. Ubuntu22.04 GNOME desktop system adaptation situation

Function	Ubuntu22.04 Gnome Wayland
HDMI TX1video	OK
HDMI TX1 Audio	OK
HDMI TX2 video	OK
HDMI TX2 Audio	OK
HDMI RX video	OK
HDMI RX Audio	OK
USB2.0X2	OK
USB3.0X2	OK
2.5G PCIe network port X2	OK
2.5G PCIe network port light	OK
Debug serial port	OK
RTC chip	OK
FAN Fan interface	OK
eMMC Extension ports	OK
AP6275P-WIFI	OK
AP6275P-BT	OK
AX200-WIFI	OK

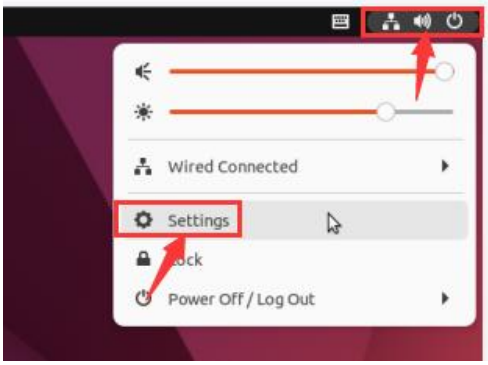
AX200-BT	**OK**
AX210-WIFI	**OK**
AX210-BT	**OK**
RTL8852BE-WIFI	**OK**
RTL8852BE-BT	**OK**
MaskROM button	**OK**
Type-C to USB3.0	**OK**
Type-C ADB Function	**OK**
Type-C DP video	**OK**
Type-C DP Audio	**OK**
Switch button	**OK**
Infrared function	**OK**
Three -color LED light	**OK**
MIC on board	**OK**
Headphones play	**OK**
Headset recording	**OK**
SPK trumpet	**OK**
40PIN GPIO	**OK**
40PIN I2C	**OK**
40PIN SPI	**OK**
40PIN UART	**OK**
40PIN CAN	**OK**
40PIN PWM	**OK**
TF card startup	**OK**
SPI+NVMe startup	**OK**
OV13850 Camera	**OK**
OV13855 Camera	**OK**
GPU	**OK**
VPU	**OK**
NPU	**OK**
REBOOT Command restart	**OK**
Poweroff Command shutdown	**OK**
MIPI LCD show	**OK**

MIPI LCD touch	**OK**
Watch Dog Test	**OK**
Chromium Hard solution video	**OK**
MPV Hard solution video	**OK**
Kodi Hard solution video	**OK**

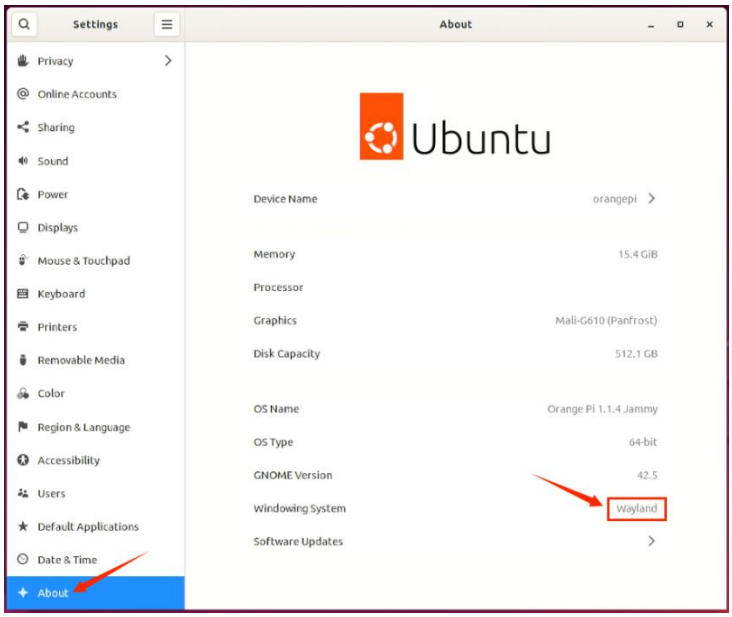
4. 2. Confirm that the current window system used by the system is Wayland

1) The system used by the system default is Wayland, and the confirmation method is shown below：

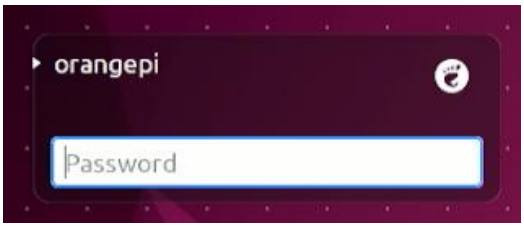
a. First open the settings



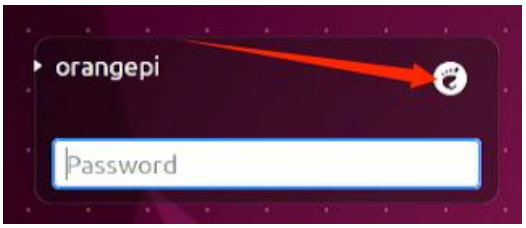
b. Then select about, if the **Wayland** description settings displayed by **Windowing System** in a column are correct



2) When the **Log Out** is out of the system, it will enter the login interface below



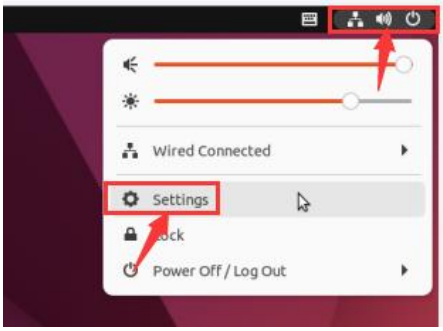
3) Please click the location shown below before logging in to the system again



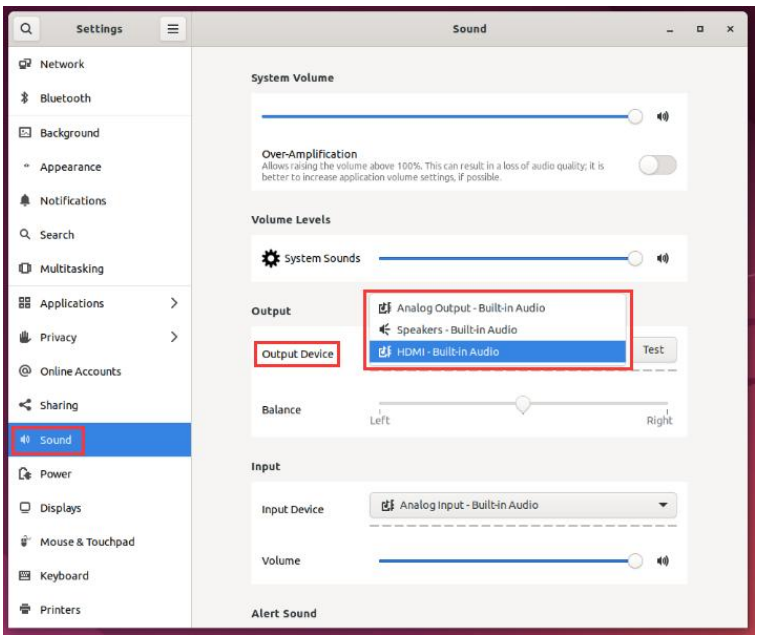
4) Then select **Ubuntu on Wayland** and enter the password login system

4. 3. Switch the method of default audio equipment

1) Open the settings first



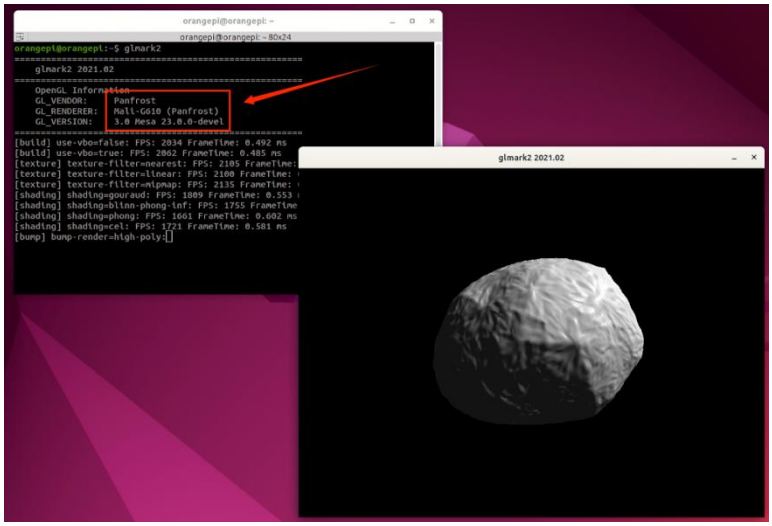
2) Then select **Sound**, and then select the audio device you want to use in **Output Device**



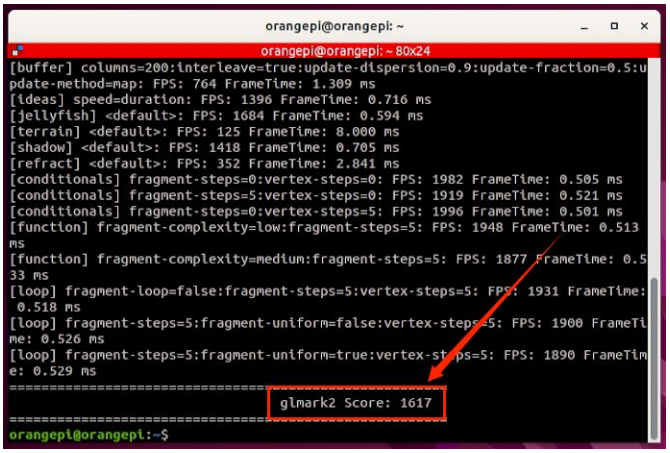
4. 4. GPU test method

1) Open a terminal on the desktop, and then enter the **glmark2** command. If you can see the **Panfros** after **GL_VERDOR**, This shows that it is used in GPU.

```
orangepi@orangepi:~$ glmark2
```

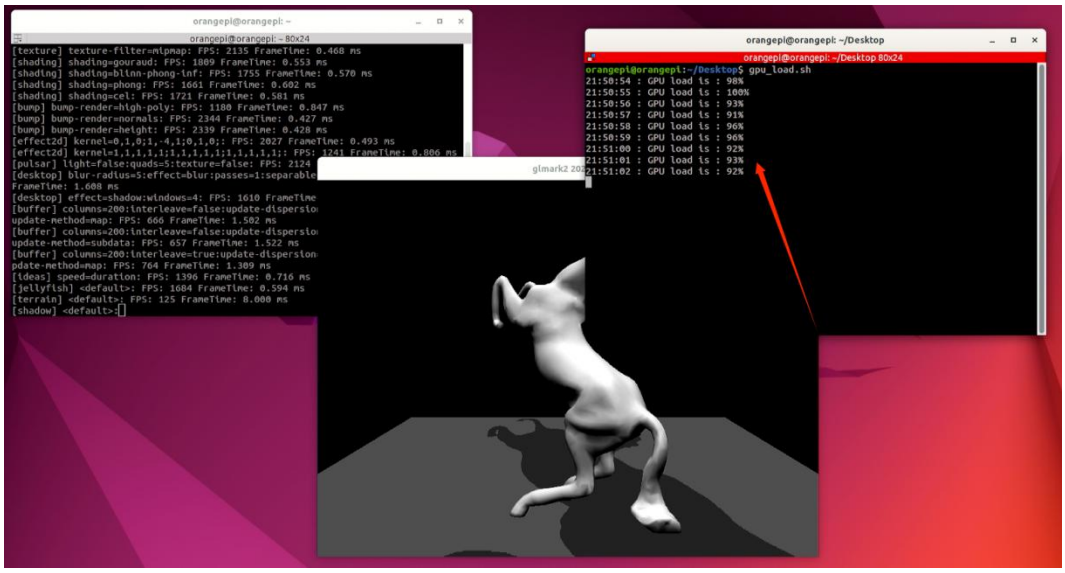


2) glmark2 running score test is generally more than 1,000 points



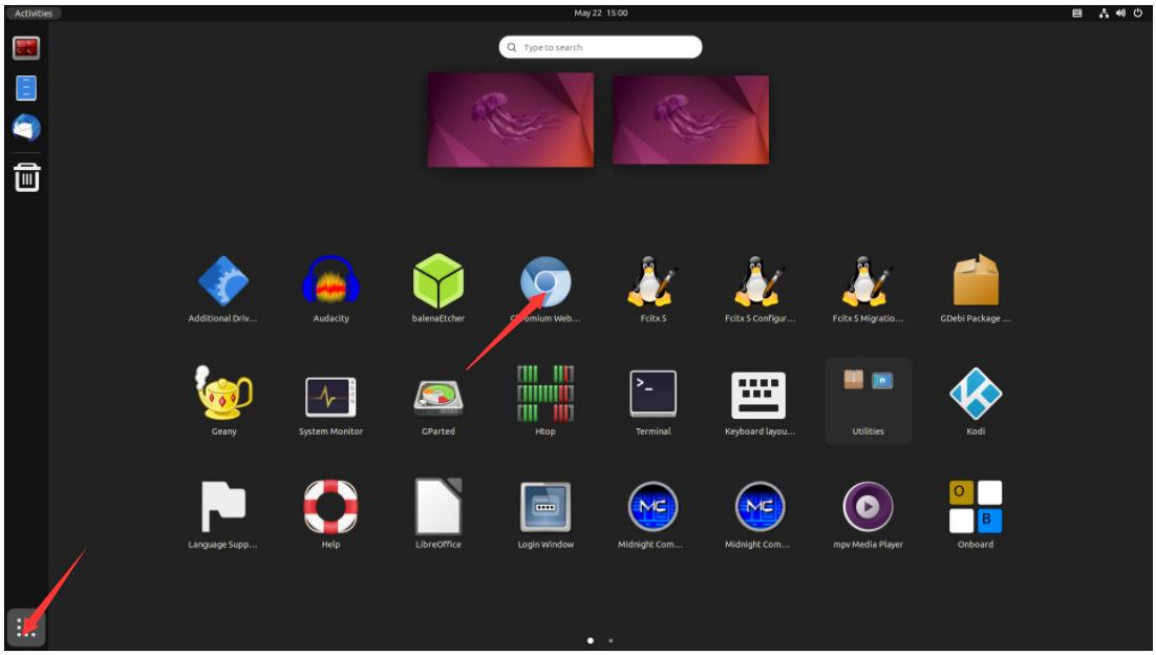
3) Run **gpu_load.sh** script to view the current load of the GPU

```
orangepi@orangepi:~$ gpu_load.sh
```

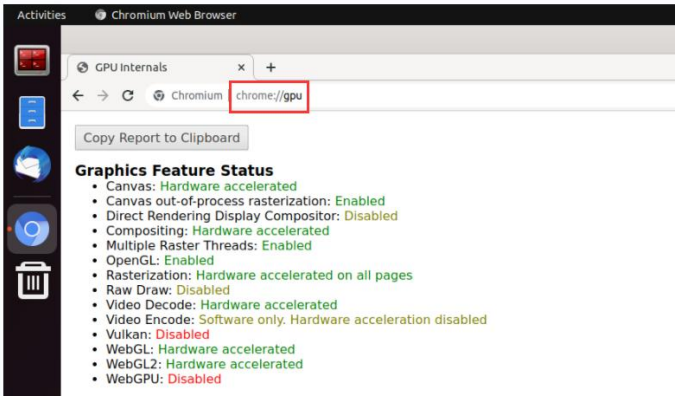


4. 5. Chromium browser hard solution to play video test method

1) First open the chromium browser



2) Then enter **chrome://gpu** in the Chromium browser to view the support of GPU and video decoding

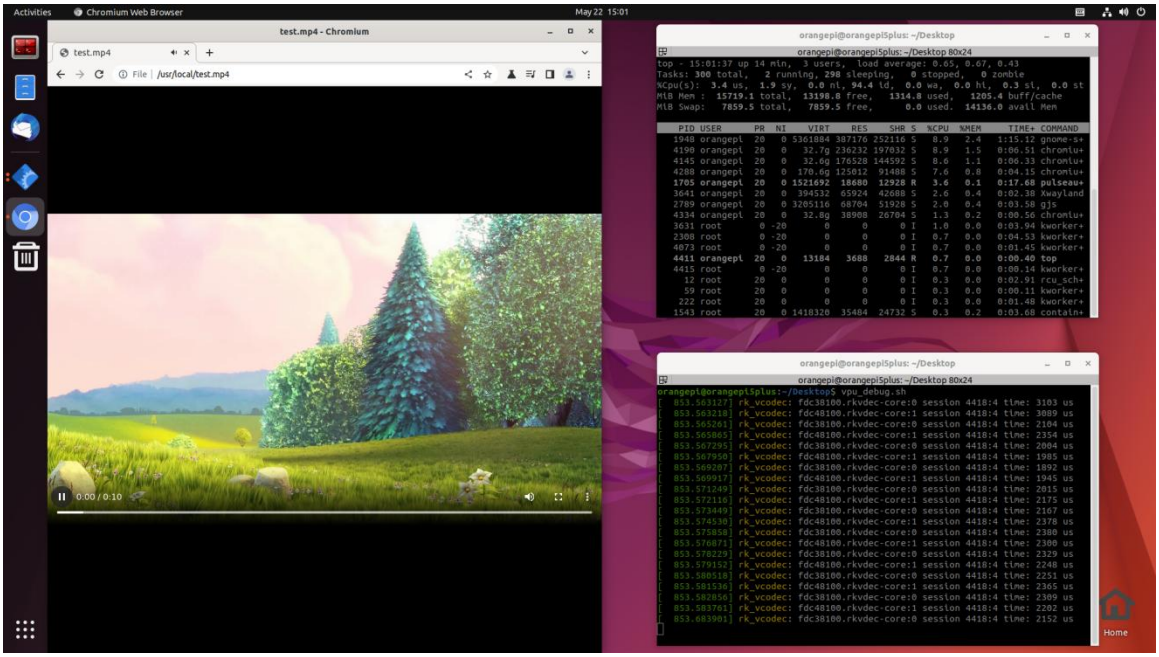


3) Then you can open a video website to play a video file, or enter the following path name player to play a test video file in the browser.

```
/usr/local/test.mp4
```

4) When playing the video, you can run the **vpu_debug.sh** script in the terminal. If there is a print output in the lower right corner of the figure below, it means that there is a hardware to decode the video.

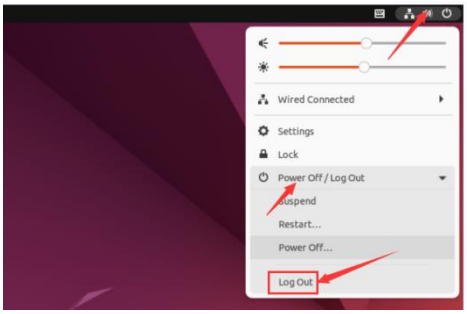
```
orangepi@orangepi:~$ vpu_debug.sh
```

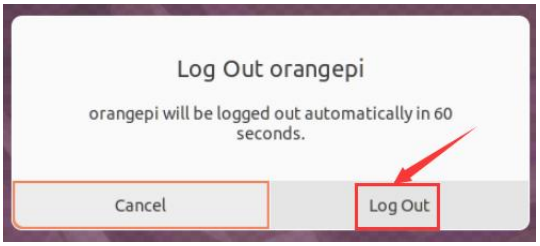


4. 6. Kodi hard solution to play video test method

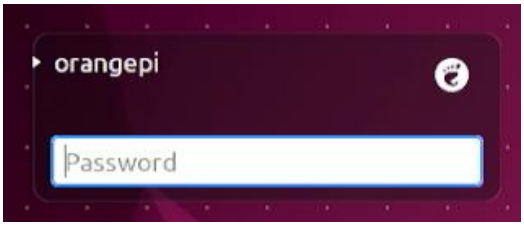
Note that there will be problems with the Kodi display directly on the Wayland desktop. Please open Kodi strictly according to the following method。

1) First log in the system

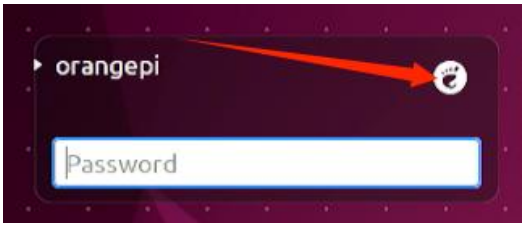




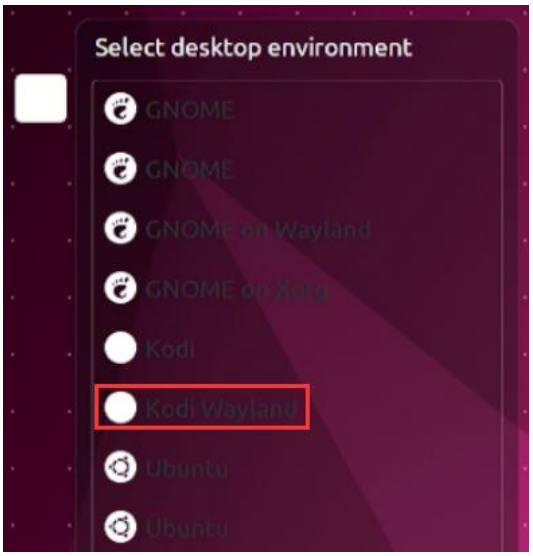
2) When the login system will enter the login interface below



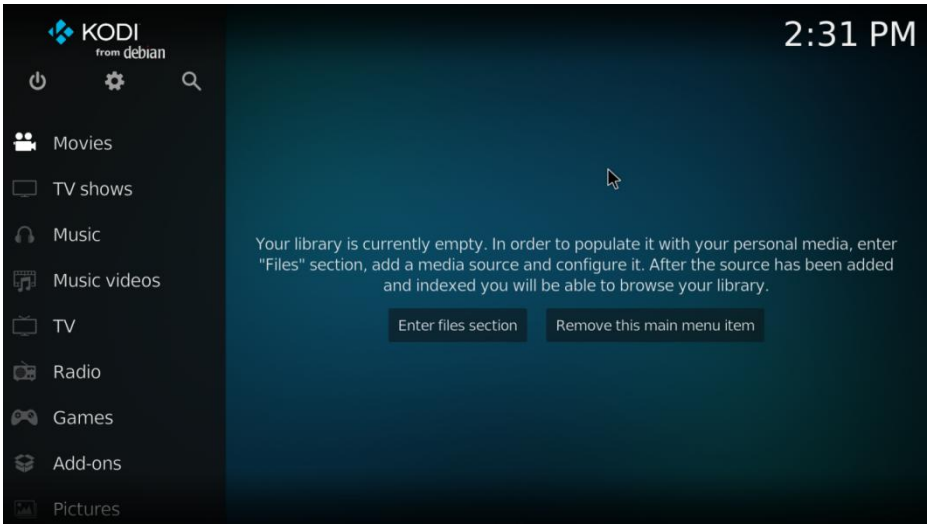
3) Then click the location shown in the figure below



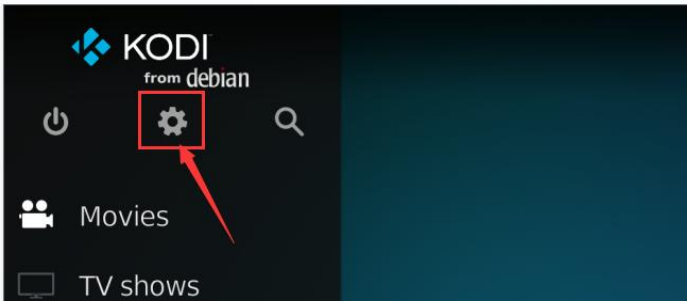
4) Then select **Kodi Wayland**, then enter the password login system



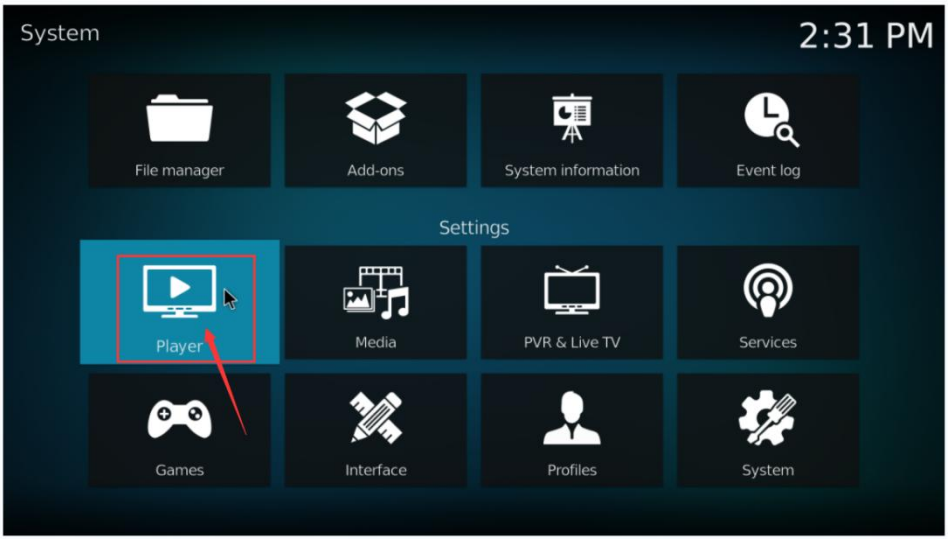
5) The interface after Kodi is opened is displayed as shown below



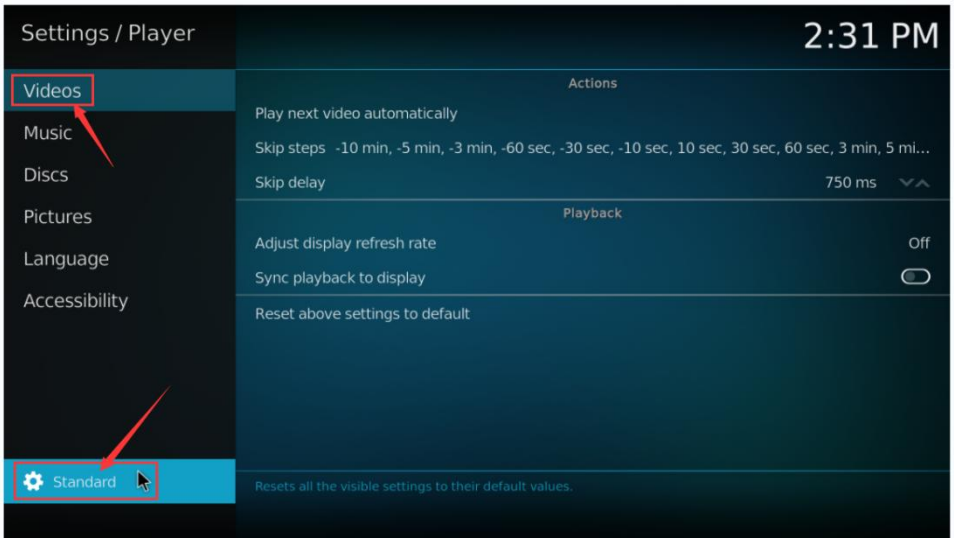
6) Then click Settings



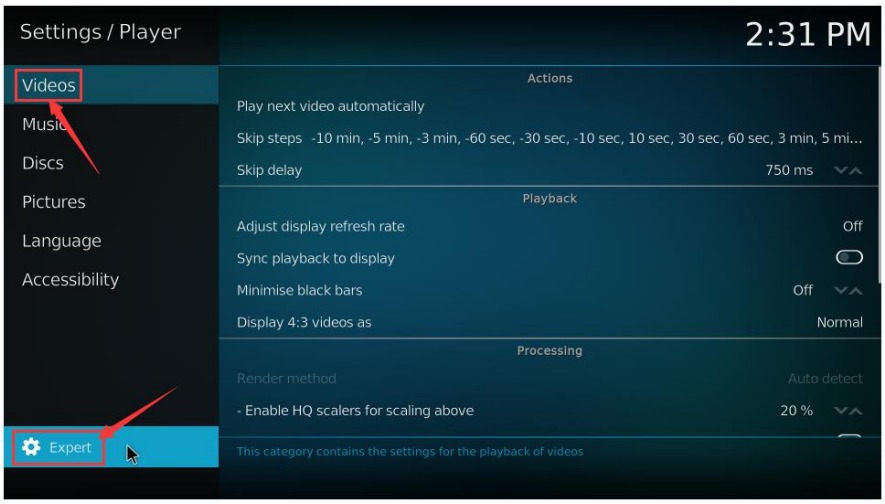
7) Then select **Player**



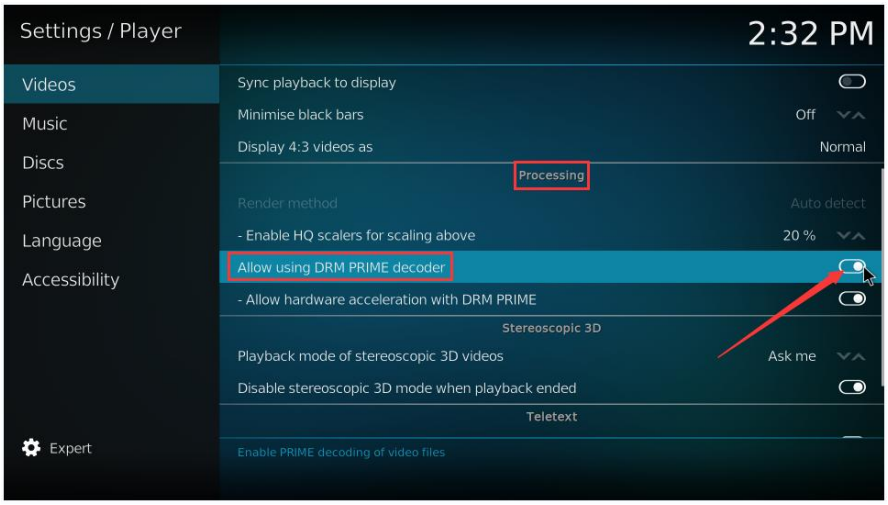
8) Then select **Videos**, and then click **Standard** in the lower left corner



9) After clicking twice, it will be switched to the **Expert** mode. The specific display is shown in the figure below

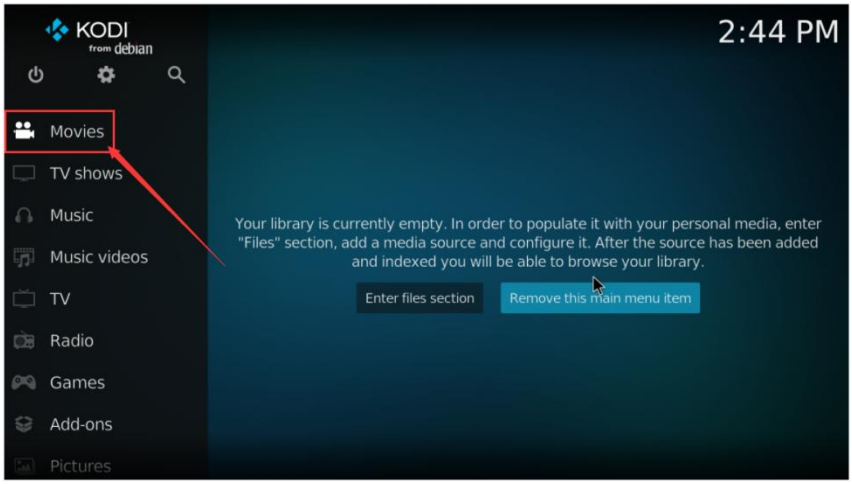


10) Then open the **Allow using DRM PRIME decoder** in the P**rocessing** settings

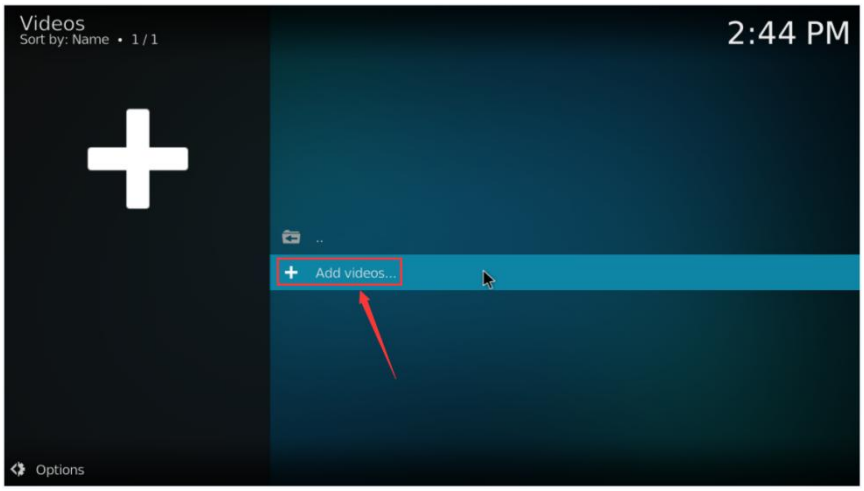


11) Then let's introduce a system's own test video test. You can also upload the video you want to play to the system, and then import and play

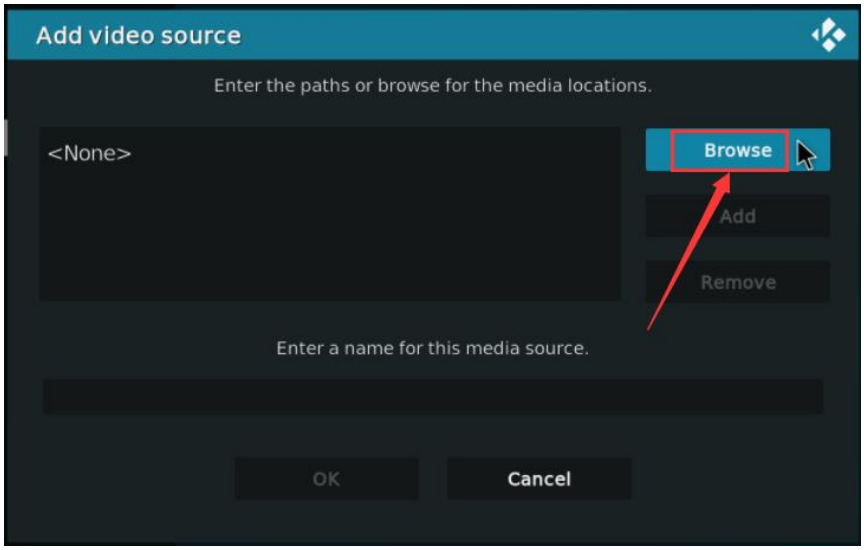
a. First enter the main interface, then select **Movies**



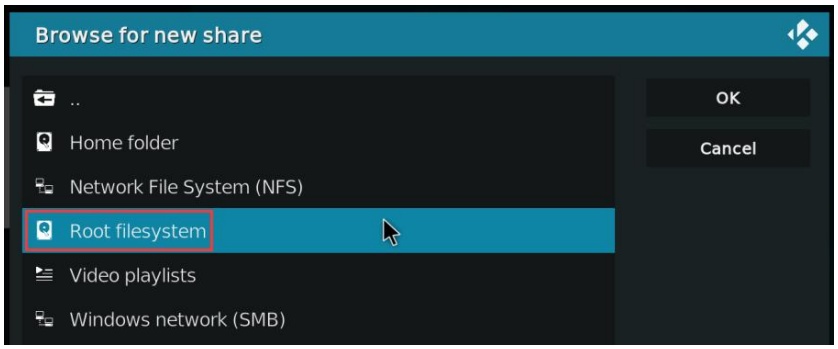
b. Then choose **Add videos...**



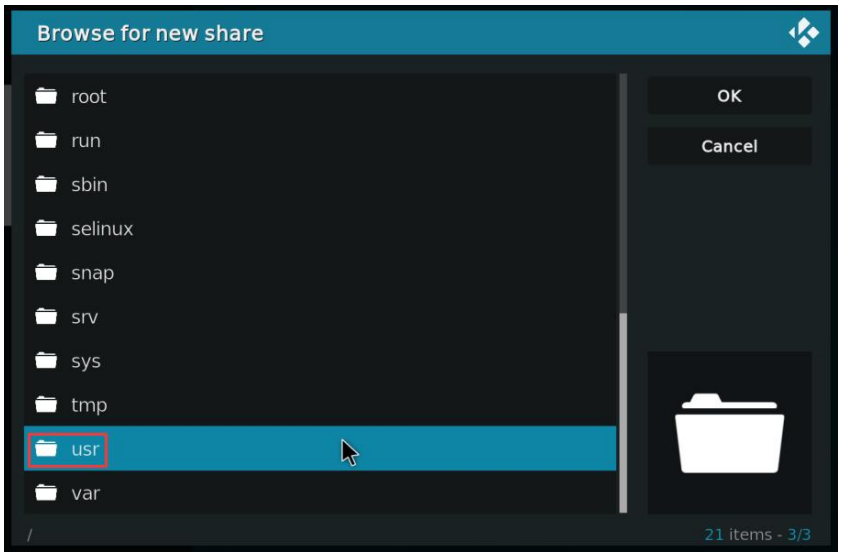
c. Then choose **Browse**



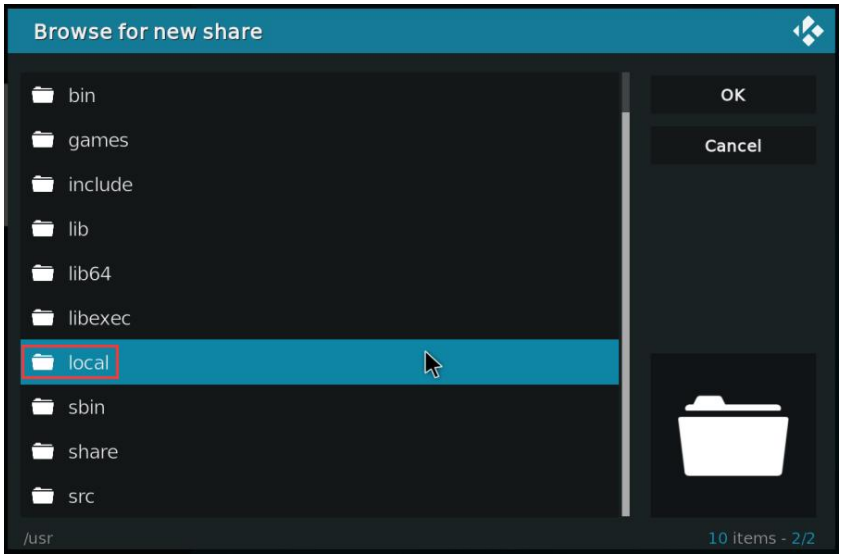
d. Then choose **Root filesystem**



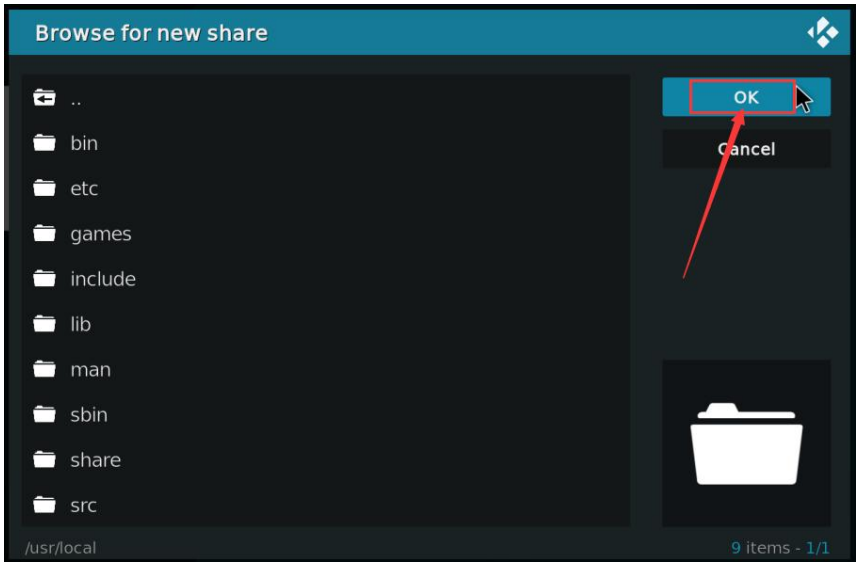
e. Then choose **usr**



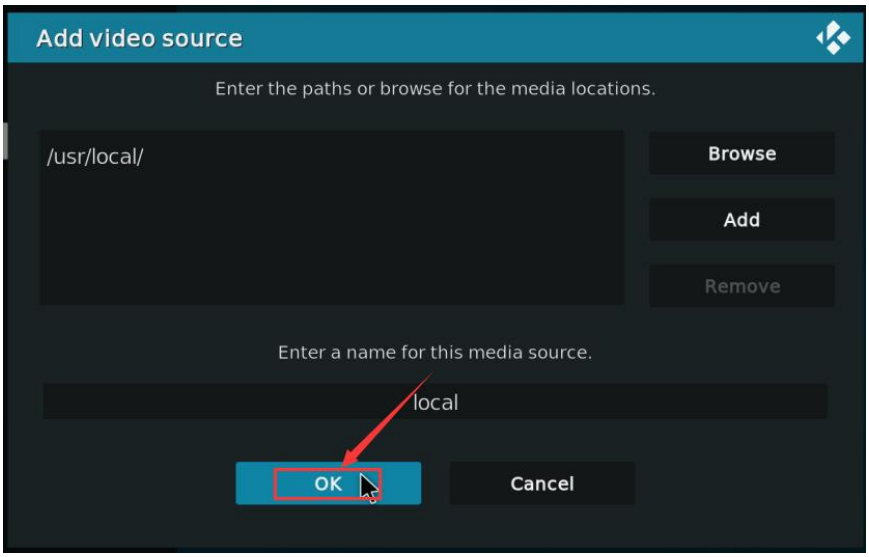
f. Then choose **local**



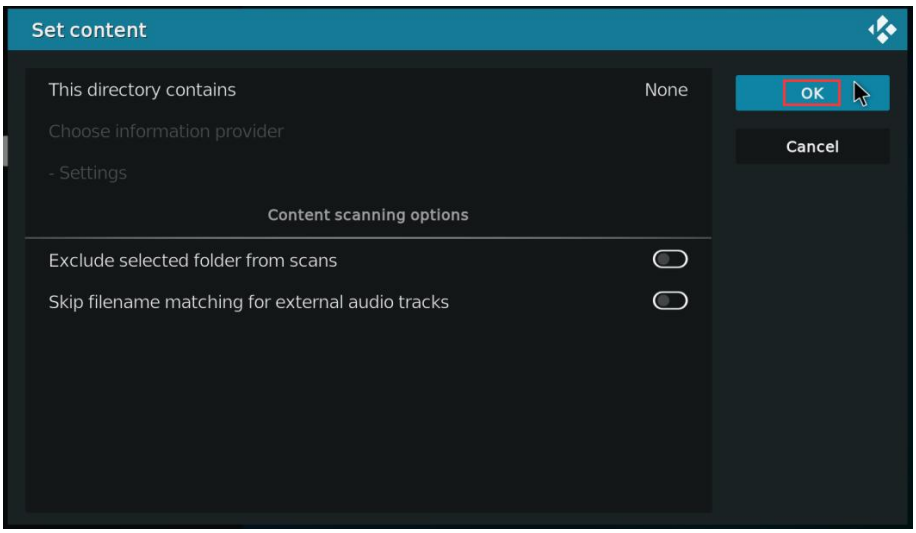
g. Then choose **OK**



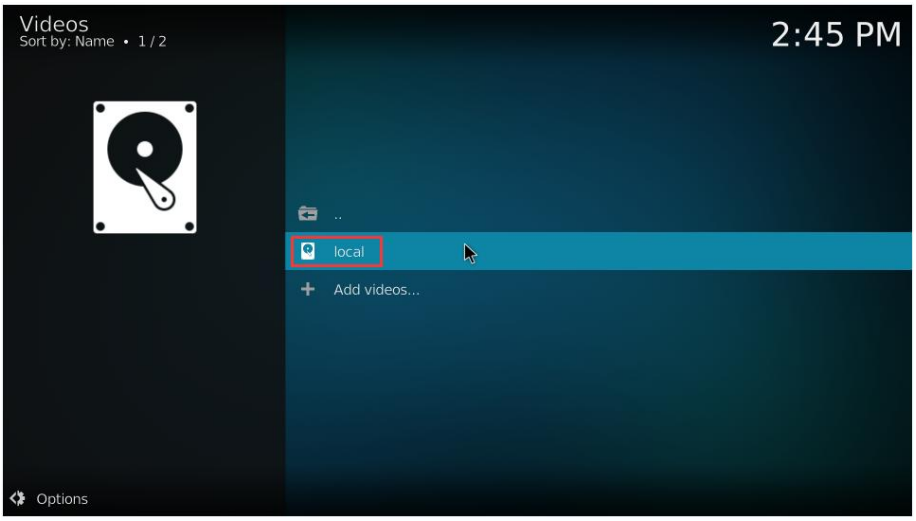
h. Then choose **OK**



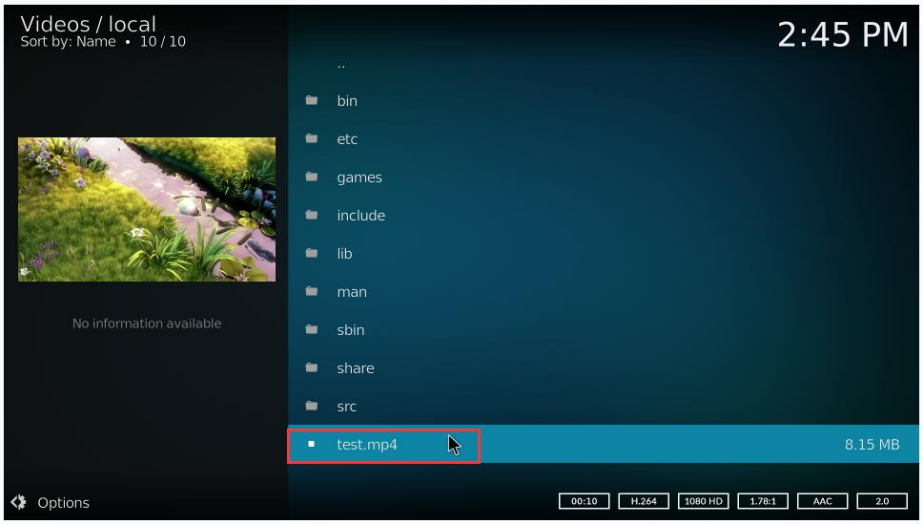
i. Then choose OK



j. Then enter the Local folder



k. Then you can play **test.mp4** test video



12) When playing the video, you can run the **vpu_debug.sh** script under the command line (via SSH or serial port). If there is a print output below, it means that there is a hardware to decode the video

```
orangepi@orangepi:~$ vpu_debug.sh
[ 1830.938378] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 2728 us
[ 1830.938461] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 2617 us
[ 1830.941179] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 2661 us
[ 1830.941777] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 2708 us
[ 1830.944727] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 3444 us
[ 1830.945211] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 3331 us
[ 1830.970563] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 2547 us
[ 1831.199650] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 2703 us
```

13) Play **test.mp4** video file CPU occupation rates of about **20%~ 30%**。

4. 7. Ubuntu22.04 Gnome to install ROS 2 Humble

1) You can install ROS2 with **install_ros.sh** script

```
orangepi@orangepi:~$ install_ros.sh ros2
```

2) install**_ros.sh** script will automatically run the **ros2 -h** command after ros2 is installed. If you can see the printing below

```
usage: ros2 [-h] Call `ros2 <command> -h` for more detailed usage. ...

ros2 is an extensible command-line tool for ROS 2.

optional arguments:
  -h, --help            show this help message and exit
```

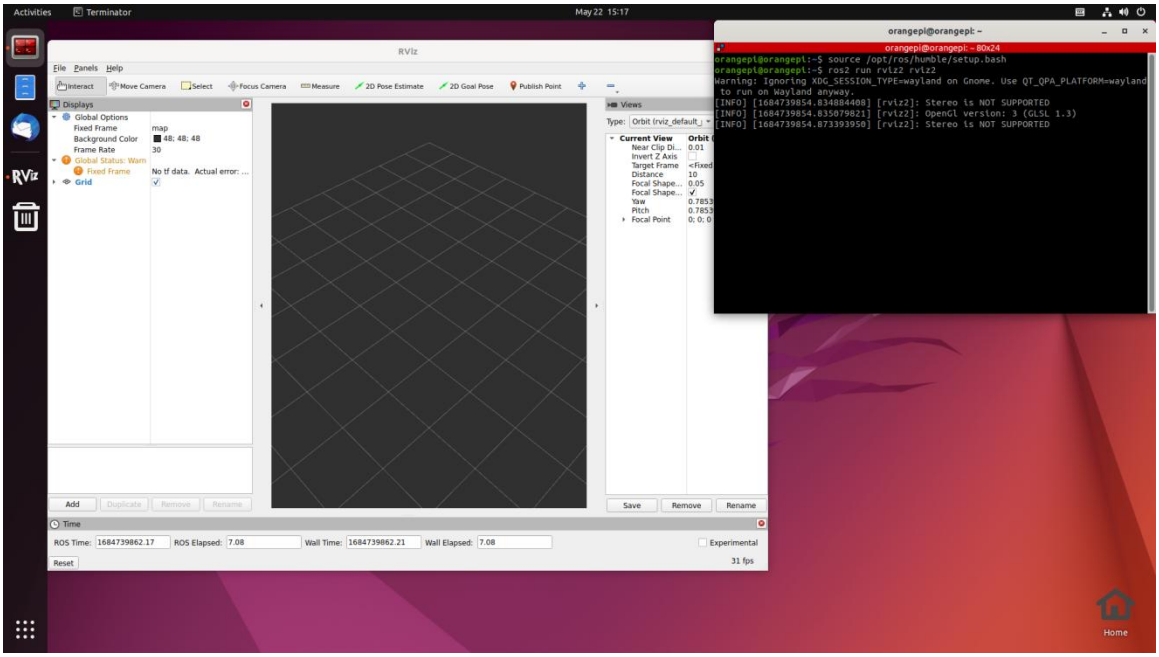
```
Commands:
  action         Various action related sub-commands
  bag            Various rosbag related sub-commands
  component      Various component related sub-commands
  daemon         Various daemon related sub-commands
  doctor         Check ROS setup and other potential issues
  interface      Show information about ROS interfaces
  launch         Run a launch file
  lifecycle      Various lifecycle related sub-commands
  multicast      Various multicast related sub-commands
  node           Various node related sub-commands
  param          Various param related sub-commands
  pkg            Various package related sub-commands
  run            Run a package specific executable
  security       Various security related sub-commands
  service        Various service related sub-commands
  topic          Various topic related sub-commands
  wtf            Use `wtf` as alias to `doctor`

  Call `ros2 <command> -h` for more detailed usage.
```

3) Then you can use the **test_ros.sh** script to test whether the ROS 2 is successfully installed. If you can see the printing below, it means that the ROS 2 can run normally

```
orangepi@orangepi5plus:~$ test_ros.sh
[INFO] [1671174101.200091527] [talker]: Publishing: 'Hello World: 1'
[INFO] [1671174101.235661048] [listener]: I heard: [Hello World: 1]
[INFO] [1671174102.199572327] [talker]: Publishing: 'Hello World: 2'
[INFO] [1671174102.204196299] [listener]: I heard: [Hello World: 2]
[INFO] [1671174103.199580322] [talker]: Publishing: 'Hello World: 3'
[INFO] [1671174103.204019965] [listener]: I heard: [Hello World: 3]
```

4) Run the following command to open rviz2

```
orangepi@orangepi:~$ source /opt/ros/humble/setup.bash
orangepi@orangepi:~$ ros2 run rviz2 rviz2
```

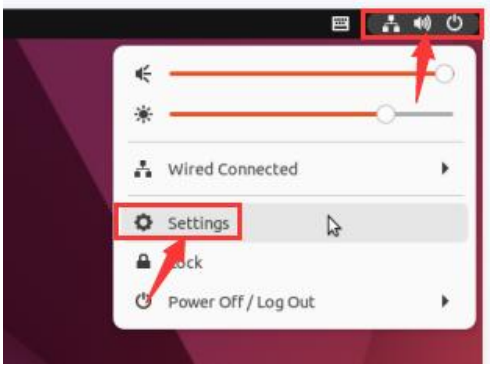


5) Reference document

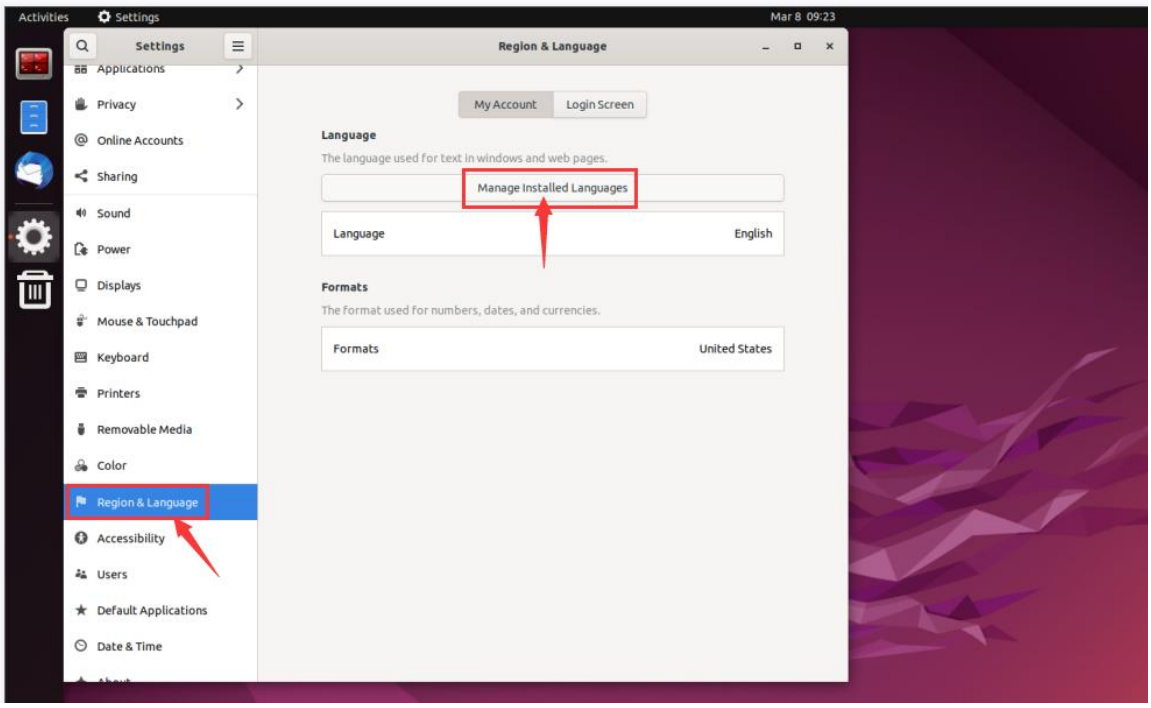
http://docs.ros.org/en/humble/index.html **http://docs.ros.org/en/humble/Installation/Ubuntu-Install-Debians.html**

4.8. Set the Chinese environment and the method of installing the Chinese input method

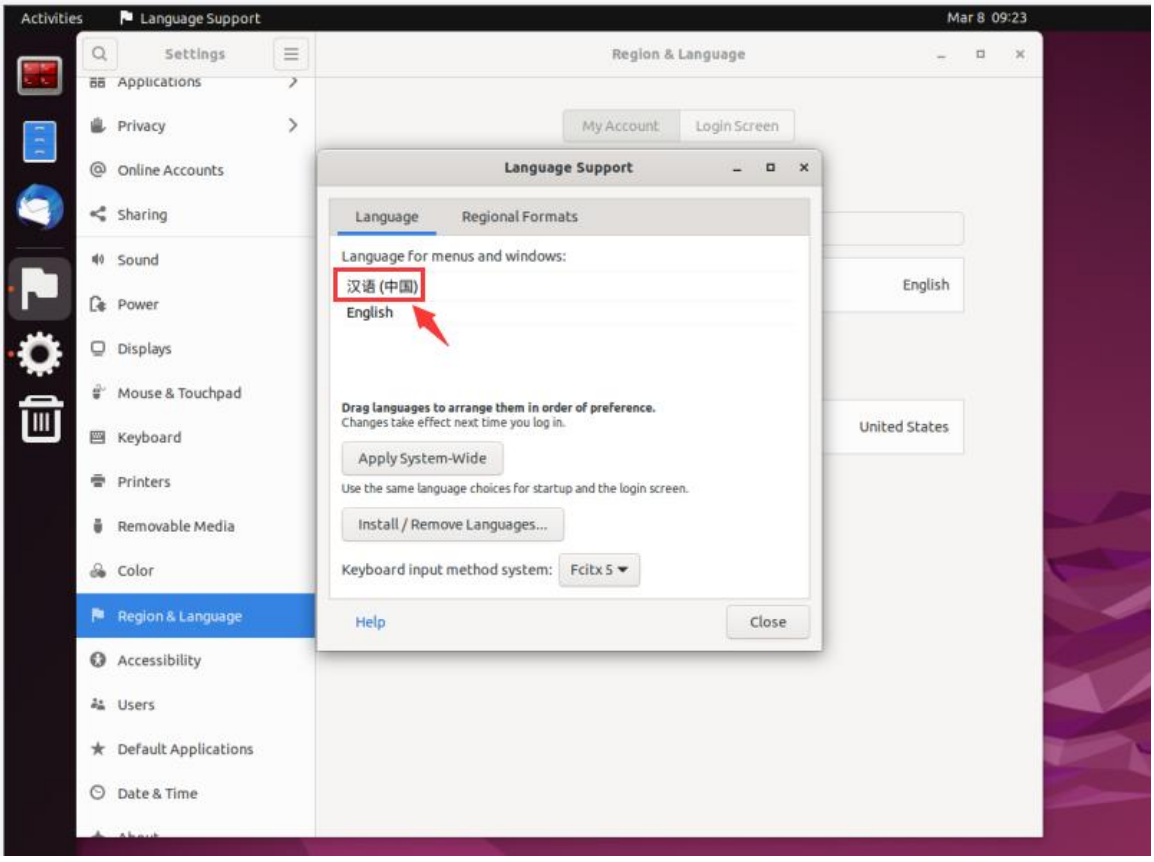
1) Open the settings first



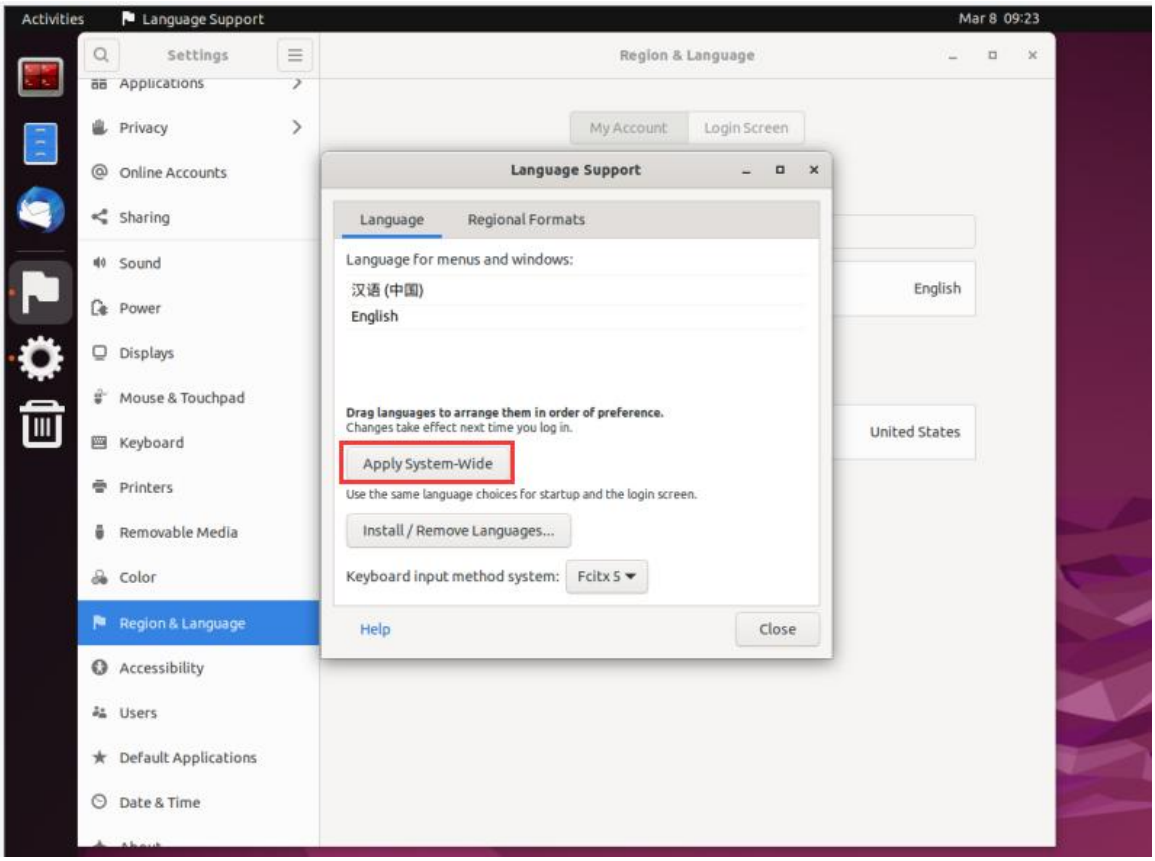
2) Then find the **Region & Language** option, and then click **Manage Installed Languages** options



3) Then use the left mouse button to select **Chinese (China)** and hold it down, and then drag it up to the beginning. The display after the dragging is shown in the figure below：



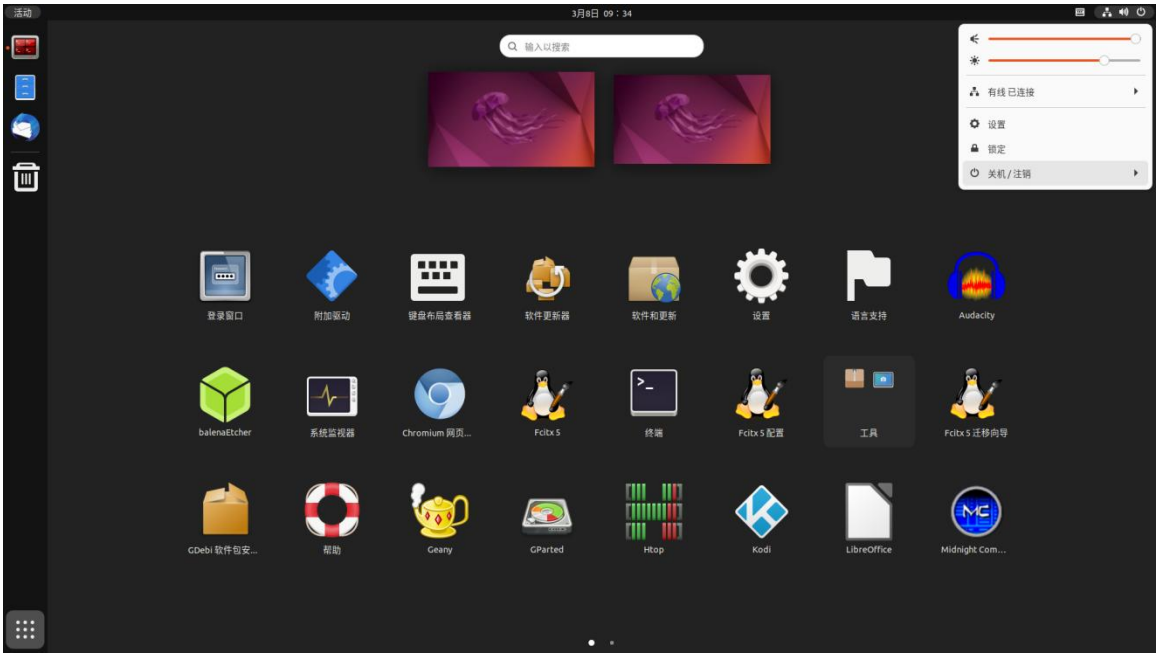
4) Then select the **Apply System-Wide** to apply the Chinese settings to the entire system



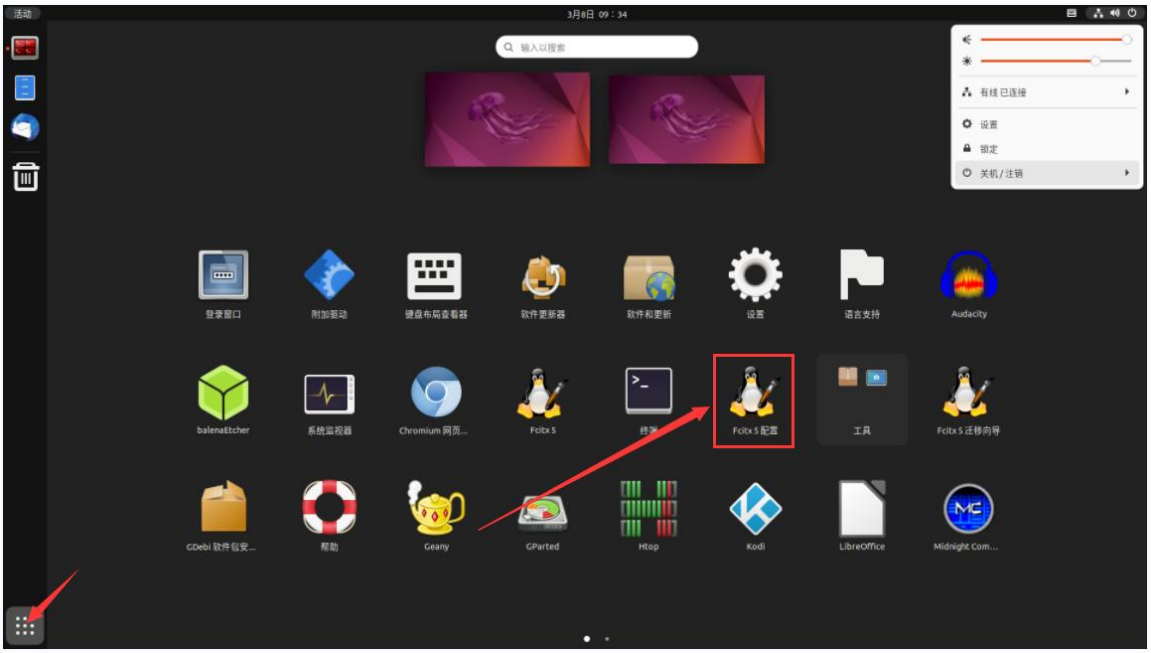
5) **Then restart the linux system to make the configuration effective**

6) After re -entering the system, please choose not to **ask me again** at the interface below, and then determine whether the standard folder should be updated to Chinese according to your preference

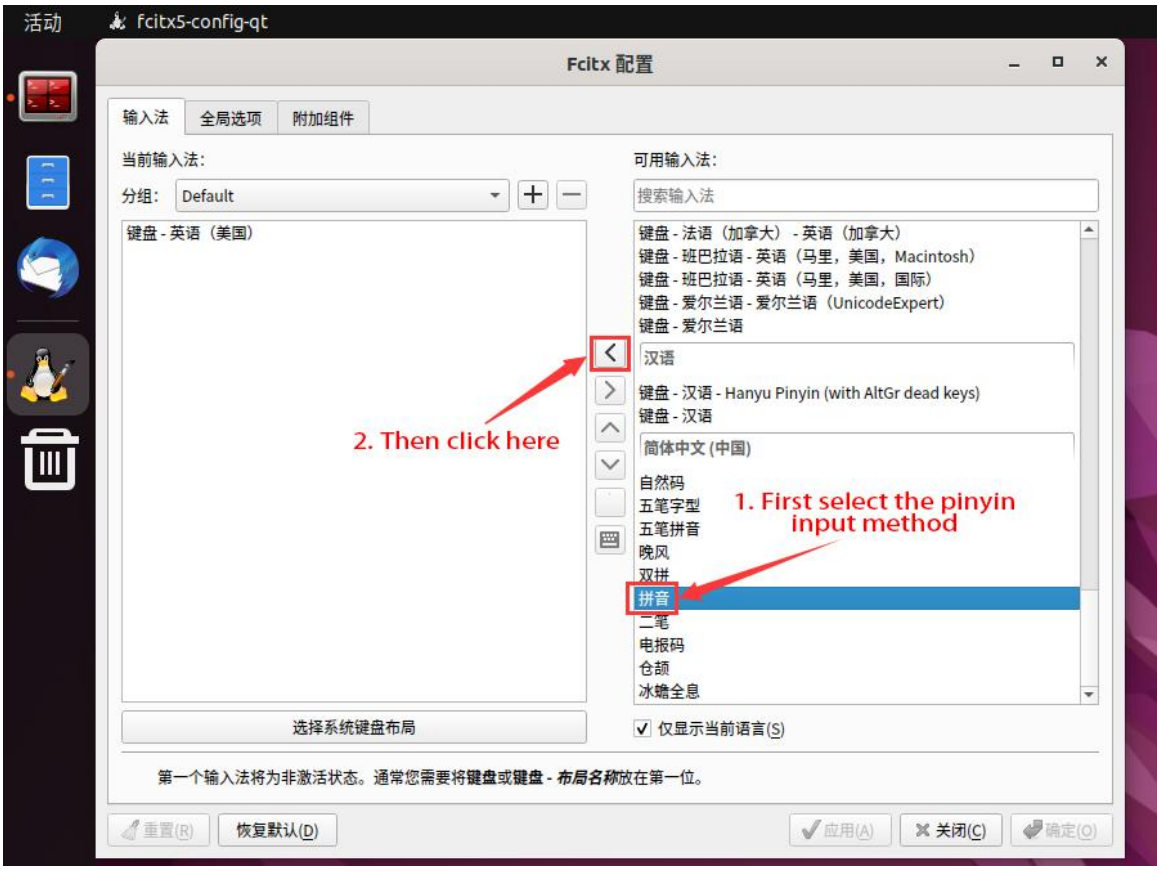
7) Then you can see that the desktop is displayed as Chinese



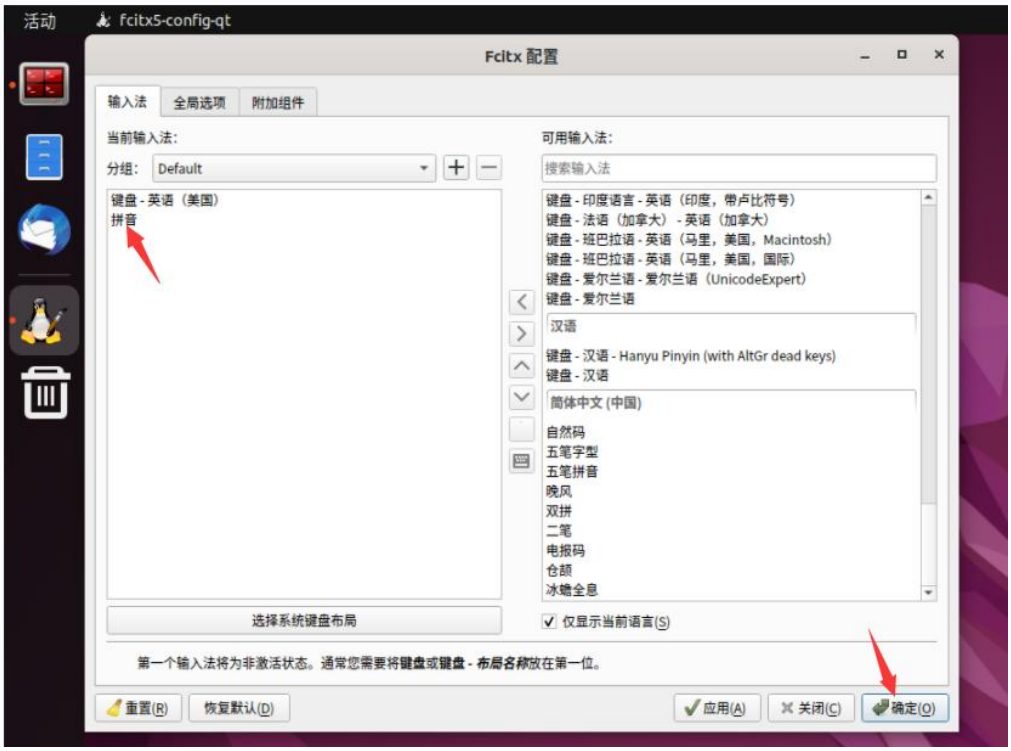
8) Then open the Fcitx5 configuration program



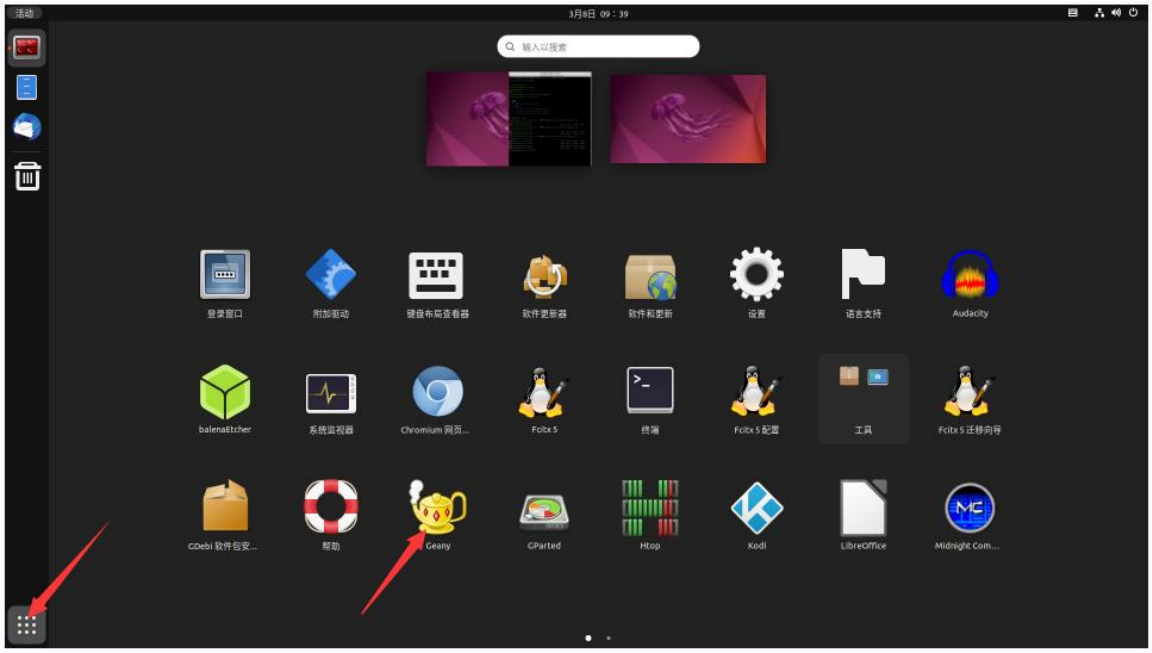
9) Then choose to use Pinyin input method



10) The interface after selecting is shown below, then click OK

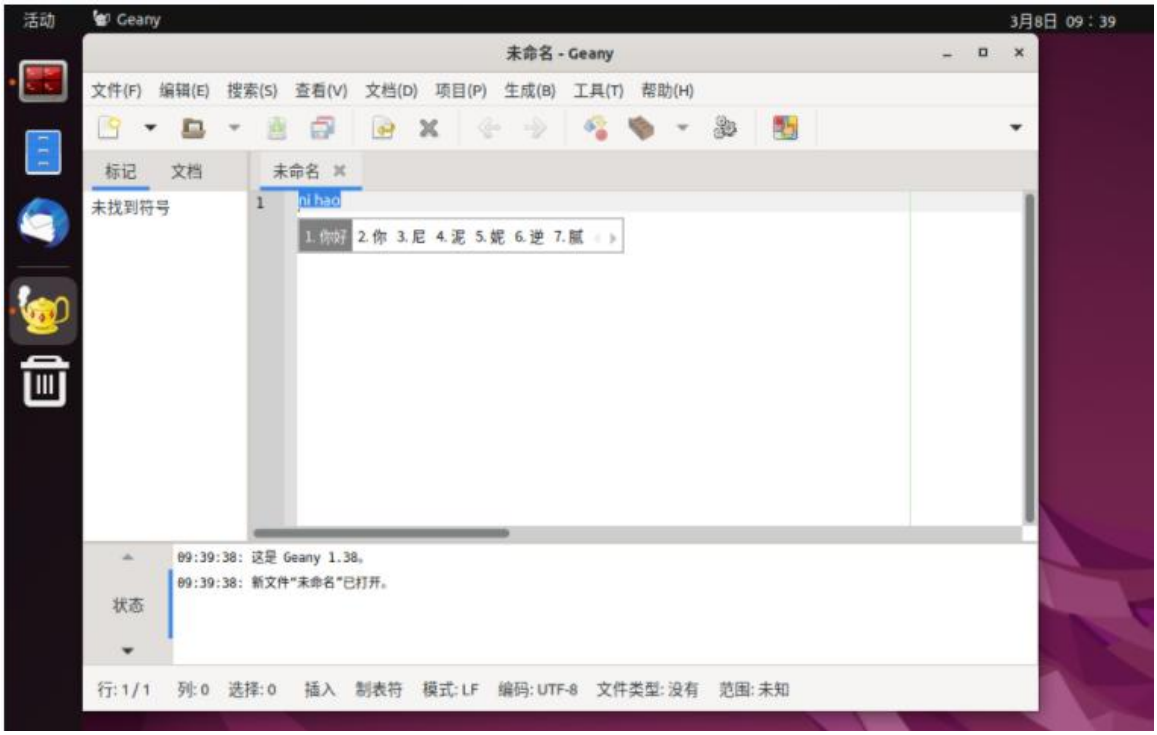


11) Then we can open the Chinese input method of **Geany** test, and the way to open is shown in the figure below



12) After opening **Geany**, the default is an English input method. We can switch into Chinese input method through the **Ctrl+Space** shortcut keys, and then we can enter

Chinese


活动
Geany
3月8日 09：39
未命名 - Geany
文件(F) 编辑(E) 搜索(S) 查看(V) 文档(D) 项目(P) 生成(B) 工具(T) 帮助(H)
标记 文档
未找到符号
未命名
1
ni hao
1. 你好 2. 你 3. 尼 4. 泥 5. 妮 6. 逆 7. 腻
09:39:38: 这是 Geany 1.38。
09:39:38: 新文件"未命名"已打开。
状态
行: 1 / 1 列: 0 选择: 0 插入 制表符 模式: LF 编码: UTF-8 文件类型: 没有 范围: 未知

5. Orange Pi OS Arch system use instructions

5. 1. Orange Pi OS Arch system adaptation situation

Function	OPi OS Arch Gnome	OPi OS Arch Xfce（To be released）
HDMI TX1 video	OK	OK
HDMI TX1 Audio	OK	OK
HDMI TX2 video	OK	OK
HDMI TX2 Audio	OK	OK
HDMI RX video	OK	OK
HDMI RX Audio	OK	OK
USB2.0X2	OK	OK
USB3.0X2	OK	OK
2.5G PCIe network port X2	OK	OK
2.5G PCIe network portlight	OK	OK
Debug serial port	OK	OK
RTC chip	OK	OK
FAN Fan interface	OK	OK
eMMC Extension ports	OK	OK
AP6275P-WIFI	OK	OK
AP6275P-BT	OK	OK
AX200-WIFI	OK	OK
AX200-BT	OK	OK
AX210-WIFI	OK	OK
AX210-BT	OK	OK
RTL8852BE-WIFI	OK	OK
RTL8852BE-BT	OK	OK
MaskROM button	OK	OK
Type-C to USB3.0	OK	OK

Type-C DP video	**OK**	**OK**
Type-C DP Audio	**OK**	**OK**
Switch button	**OK**	**OK**
Infrared function	**OK**	**OK**
Three -color LED light	**OK**	**OK**
Board MIC	**OK**	**OK**
Headphones play	**OK**	**OK**
Headset recording	**OK**	**OK**
SPK trumpet	**OK**	**OK**
40PIN GPIO	**OK**	**OK**
40PIN I2C	**OK**	**OK**
40PIN SPI	**OK**	**OK**
40PIN UART	**OK**	**OK**
40PIN CAN	**OK**	**OK**
40PIN PWM	**OK**	**OK**
TF card startup	**OK**	**OK**
SPI+NVME start up	**OK**	**OK**
OV13850 Camera	**OK**	**OK**
OV13855 Camera	**OK**	**OK**
GPU	**OK**	**OK**
VPU	**OK**	**OK**
NPU	**NO**	**NO**
REBOOT Command restart	**OK**	**OK**
Poweroff Command shutdown	**OK**	**OK**
MIPI LCD show	**OK**	**OK**
MIPI LCD touch	**OK**	**OK**
Watch Dog Test	**OK**	**OK**
Chromium Hard solution video	**NO**	**NO**
MPV Hard solution video	**OK**	**OK**

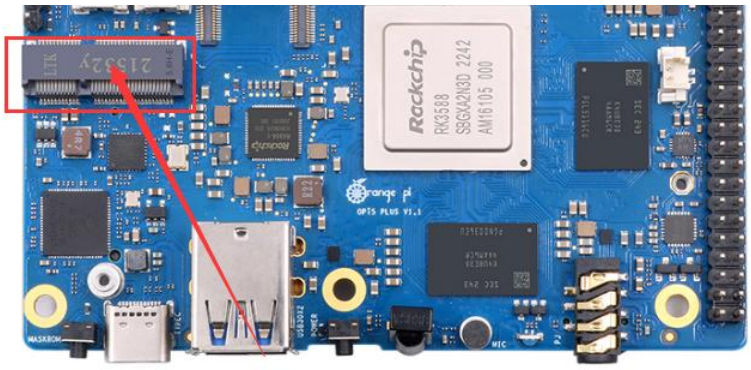
5. 2. How to use the M.2 E-Key PCIE WIFI6+Bluetooth module

1) First of all, you need to buy a PCIE WIFI6+Bluetooth module

SN	model	Physical picture	Supportive OS
1	AX200 （PCIE+USB Port）		Debian Ubuntu OpenWRT OPi OS Arch
2	AX210 （PCIE+USB Port）		Debian Ubuntu OpenWRT OPi OS Arch
3	RTL8852BE （PCIE+USB Port）		Debian Ubuntu Android12 OPi OS Arch OPi OS Droid

Pay attention to RTL8852BE, please do not buy the module shown in the figure below, there will be problems after testing.

2) Then insert the WiFi module into the M.2 E-Key interface of the development board and fix it



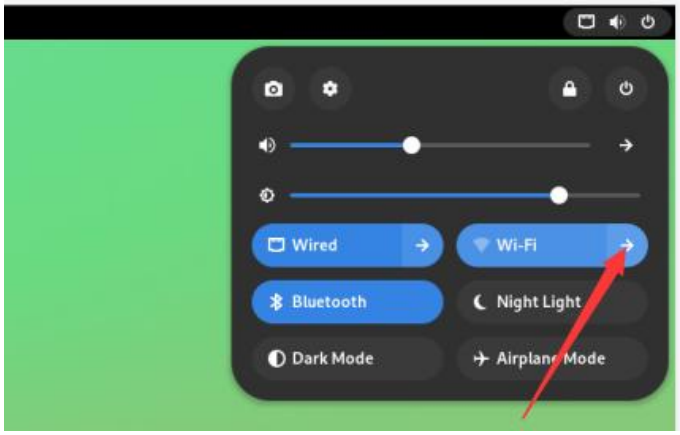
3) If everything is normal after the system starts, use the following command to see the WIFI device nodea

```
[orangepi@orangepi ~]$ ip a
.....
4: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 38:7a:0e:e3:80:05 brd ff:ff:ff:ff:ff:ff
    inet 192.168.1.237/24 brd 192.168.1.255 scope global dynamic noprefixroute wlan0
       valid_lft 42938sec preferred_lft 42938sec
    inet6 fe80::a098:5942:16e:e817/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

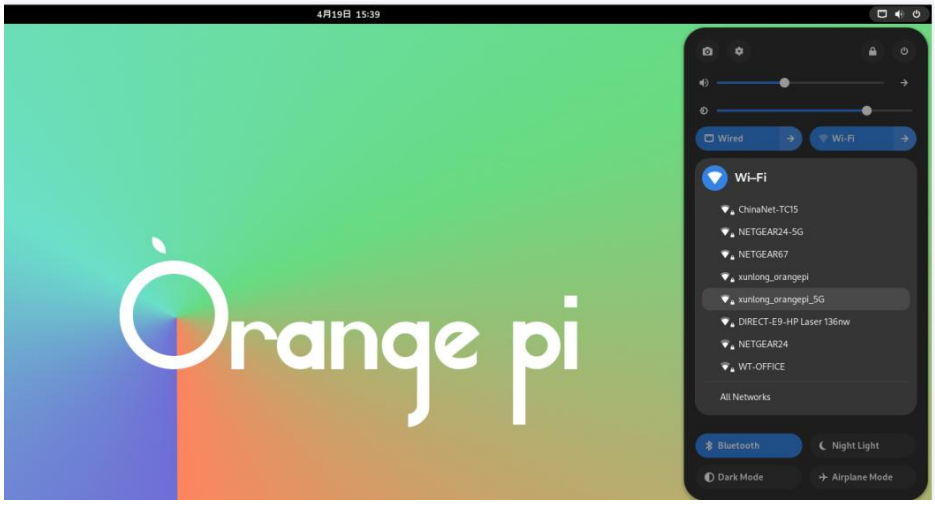
4) The steps connected to the wifi are shown below：

a. First click the area in the upper right corner of the desktop

b. Then choose Wi-Fi

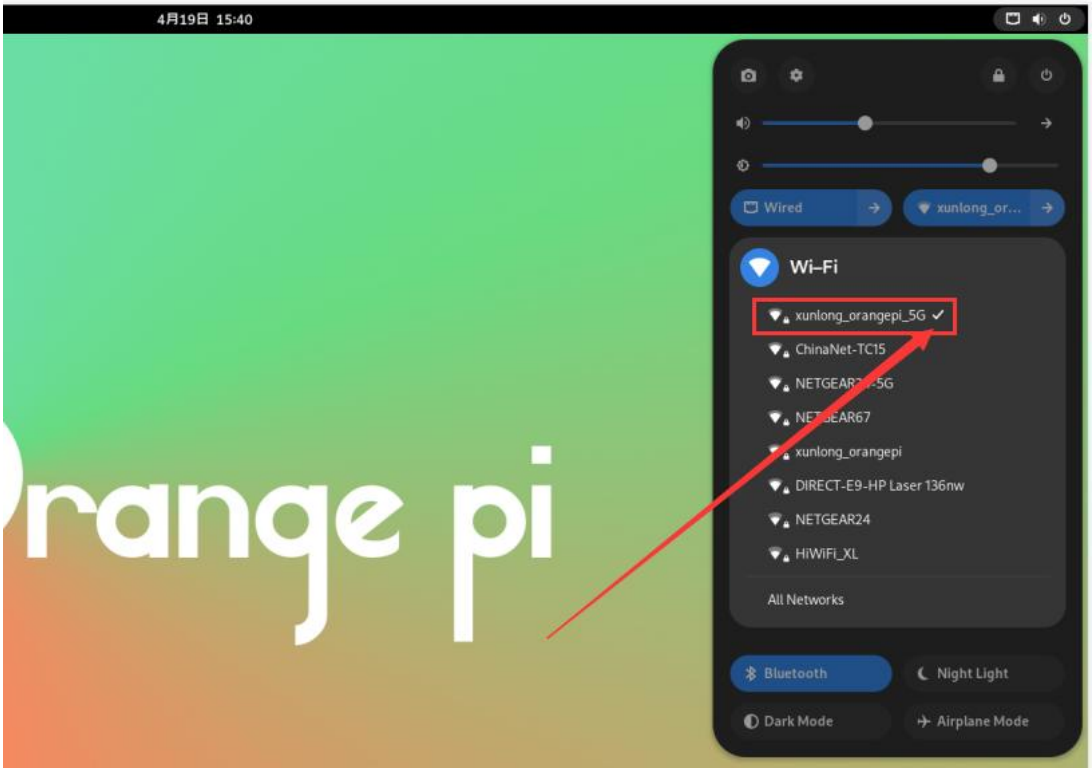


c. Then select the WIFI you want to connect



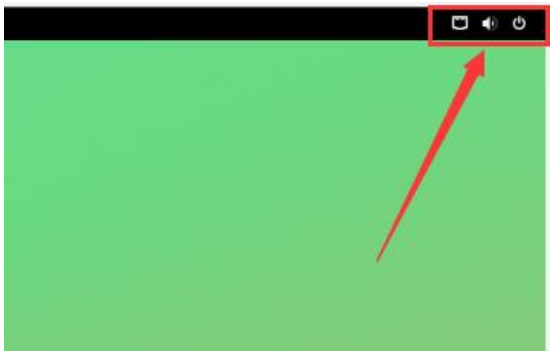
d. Then enter the password of the wifi, and click **Connect**

e. Then enter the following interface to see the wifi connection

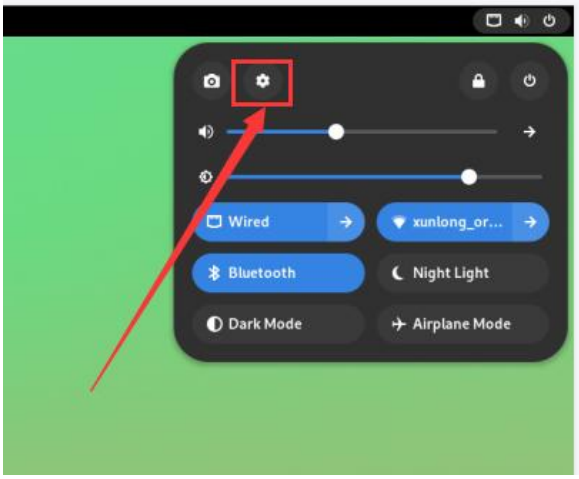


5) Example of Bluetooth use：

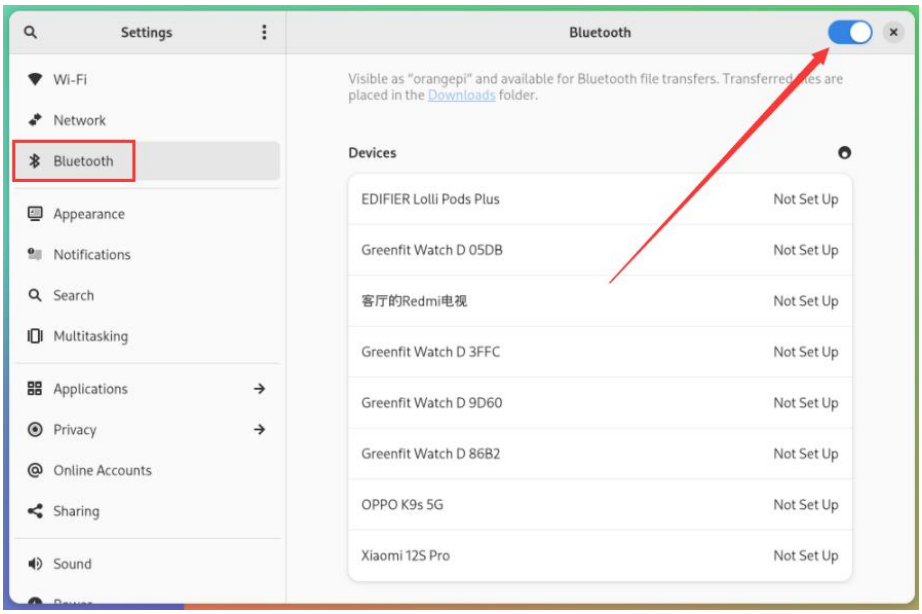
a. First click the area in the upper right corner of the desktop



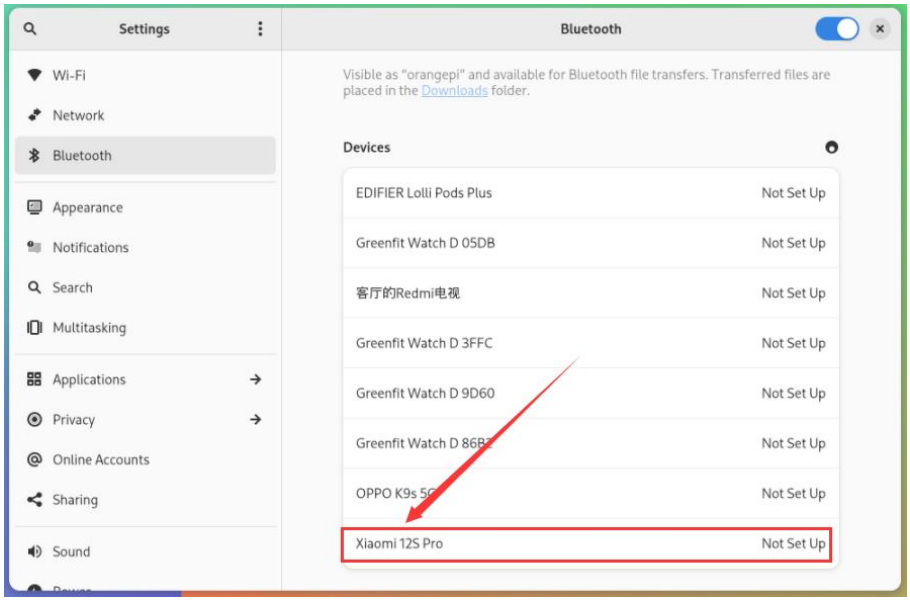
b. Then open the settings



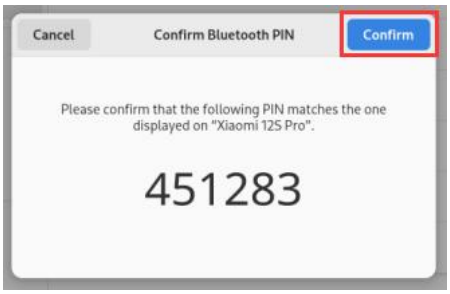
c. Then select Bluetooth in the settings, and make sure that the switch button in the upper right corner of the Bluetooth is opened



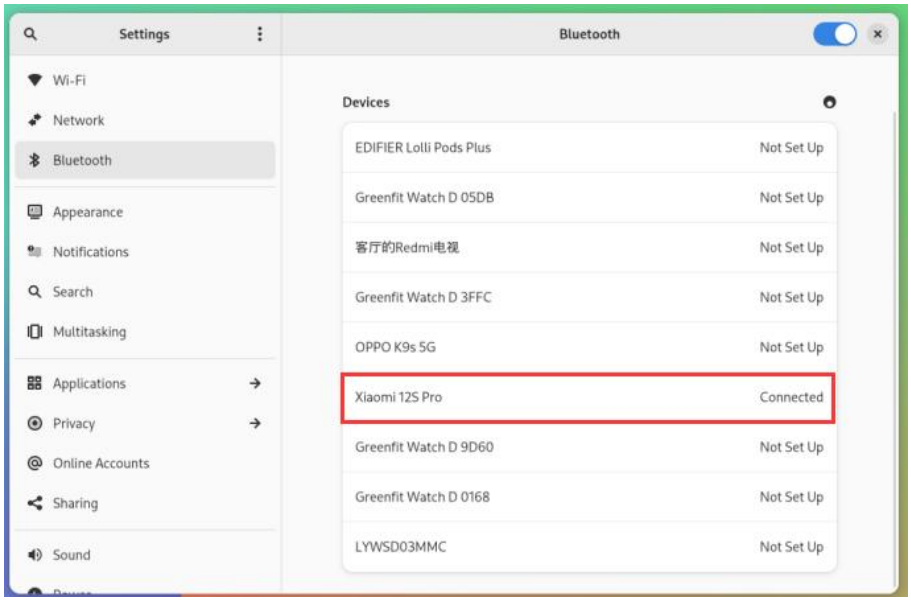
d. Then choose the Bluetooth device you want to configure the right, such as pairing with Android phones



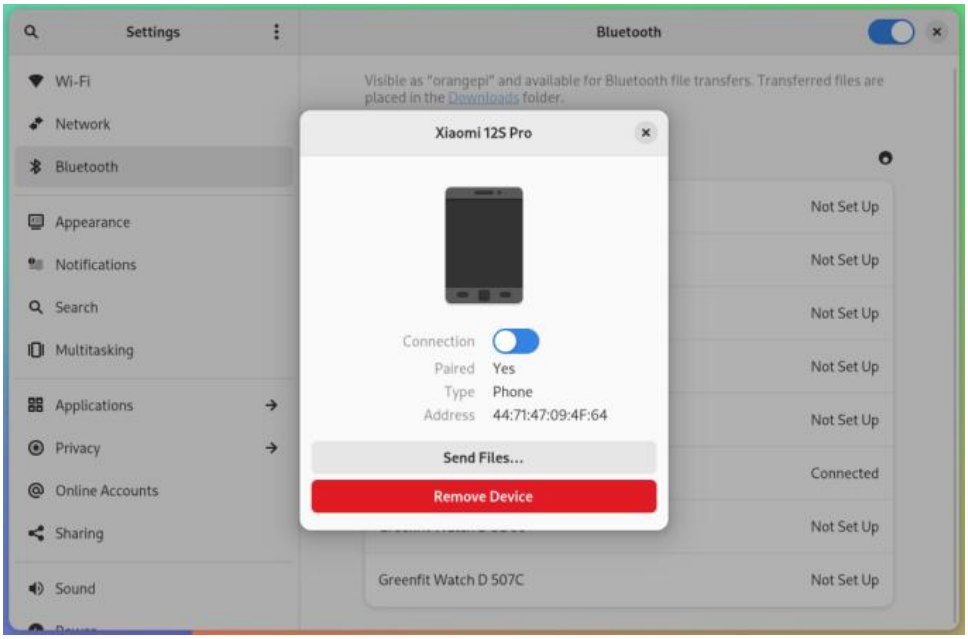
e. Then click **Confirm**, the mobile phone also needs to confirm the pairing



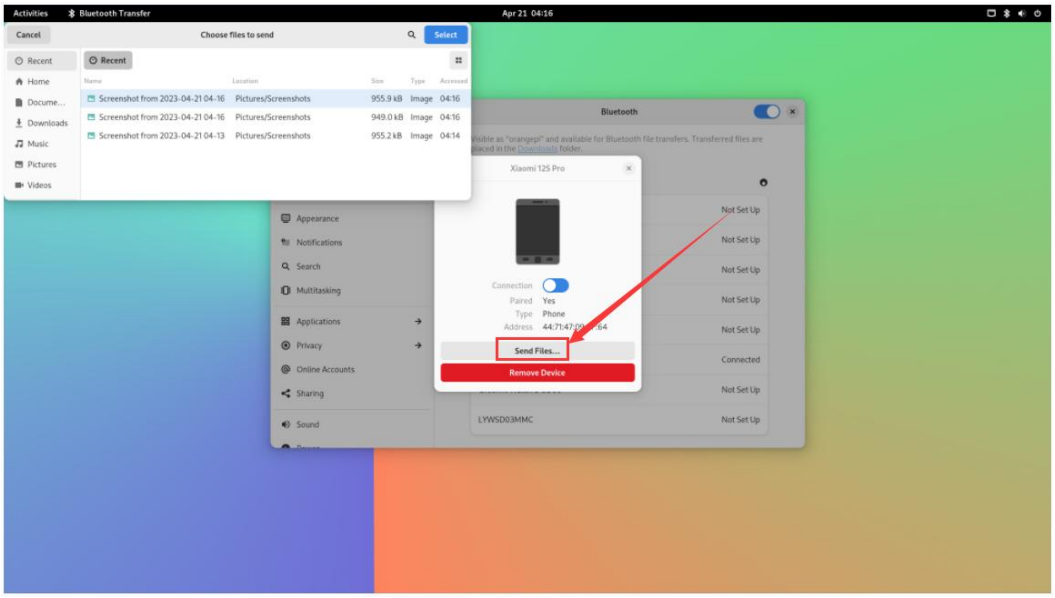
f. The display of the Bluetooth and Android phone is shown below：



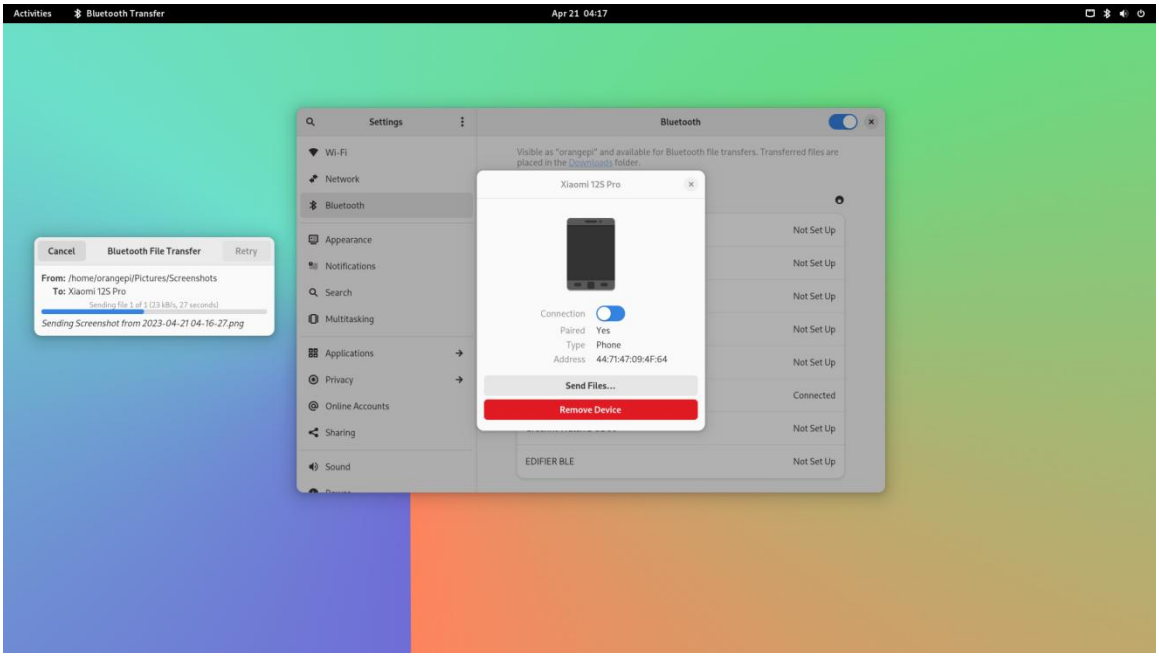
g. Then click the paired Bluetooth device to pop up the operating interface shown in the figure below



h. Click **Send Files...**you can send a file to the phone



i. The schematic diagram of the Bluetooth sent pictures to the phone is shown below：



5. 3. How to use 10.1 inch MIPI LCD screen

5. 3. 1. 10.1 -inch MIPI screen assembly method

1) First prepare the required accessories

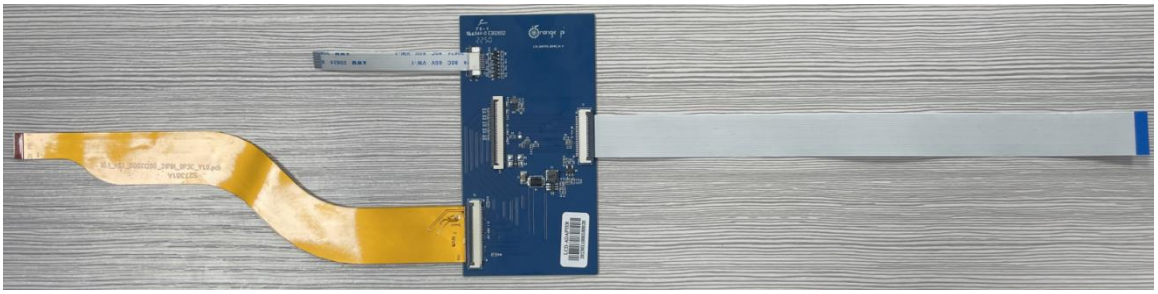
a. 10.1 -inch MIPI LCD display+touch screen (common to OPI5/OPI5B)

b. Screen divert+31pin to 40pin exhaust

c. 30pin mipi line

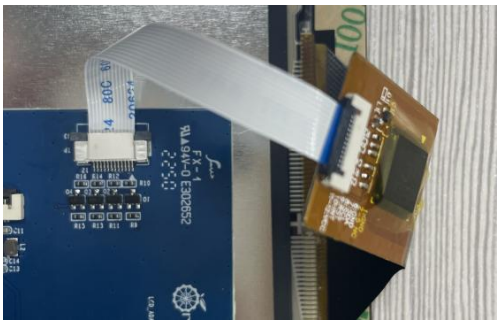
d. 12pin touch screen line

2) According to the figure below, the 12PIN touch screen row, 31PIN to 40Pin line, and 30Pin MIPI cables get on the screen dial board. Pay attention to **the blue insulation of the touch screen row line face to down**. If an error is connected, it will cause no display or unable to touch..

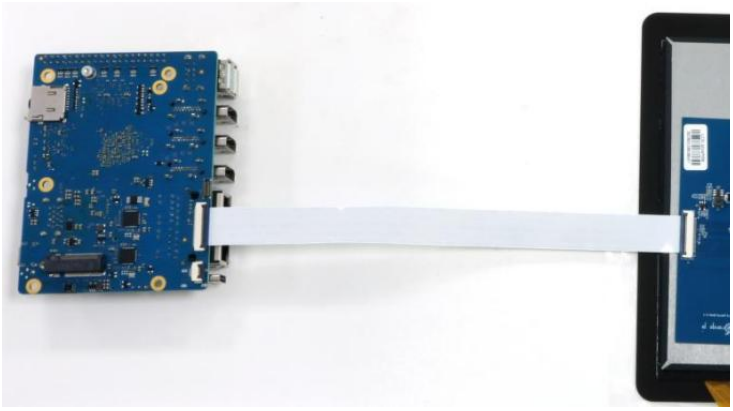


3) Place the connected rotor connected to the puzzle on the MIPI LCD screen according to the figure below, and connect the MIPI LCD screen and the rotary board through 31PIN to 40Pin row

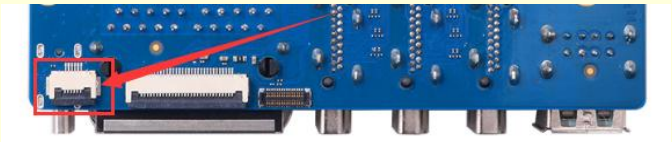
4) Then connect the touch screen and the rotor board through the 12PIN touch screen line, pay attention to the orientation of the insulating surface



5) Finally connect to the LCD interface of the development board through the 30PIN MIPI duct.

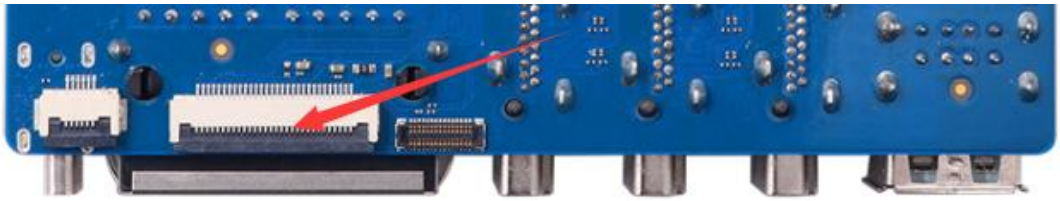


Note that the touch interface below is not used for the LCD MIPI screen. It is currently a spare interface and cannot be used.



5.3.2. How to open 10.1 -inch MIPI LCD screen configuration

1) The position of the interface of the MIPI LCD screen on the development board is shown in the figure below



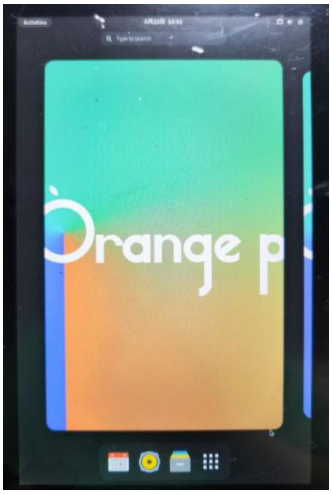
2) OPi OS Arch image default is not to open the mipi lcd screen configuration. If you need to use the mipi lcd screen, you need to open it manually. The method of opening the mipi lcd configuration is shown below：

a. First add the following configuration in**/boot/extlinux/extlinux.conf**

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS    /dtbs/rockchip/overlay/rk3588-opi5plus-lcd.dtbo      #The configuration that needs to be added
```

b. **Then restart the OPi OS Arch system**

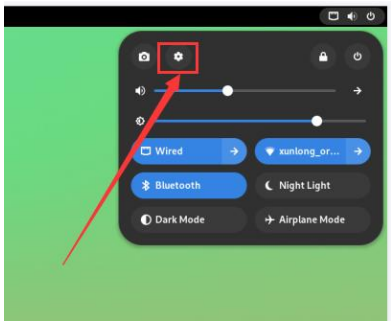
3) After restarting, you can see the display of the LCD screen as shown below (default vertical screen)：



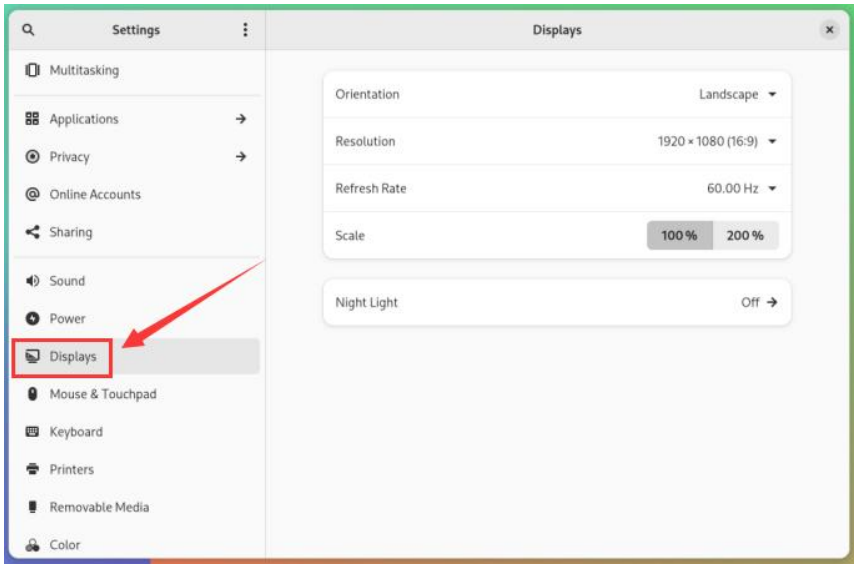
5. 3. 3. Method of rotating display and touch direction

1) First click the area in the upper right corner of the desktop

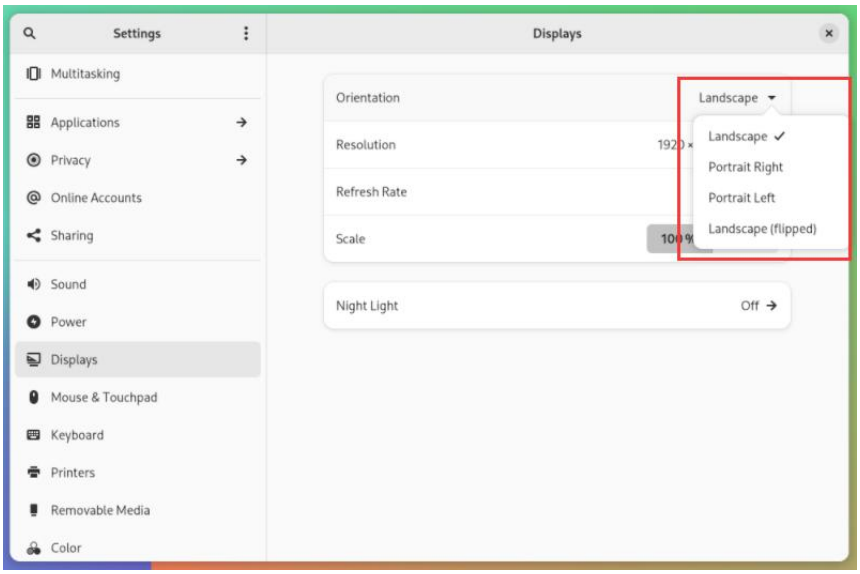
2) Then open the settings



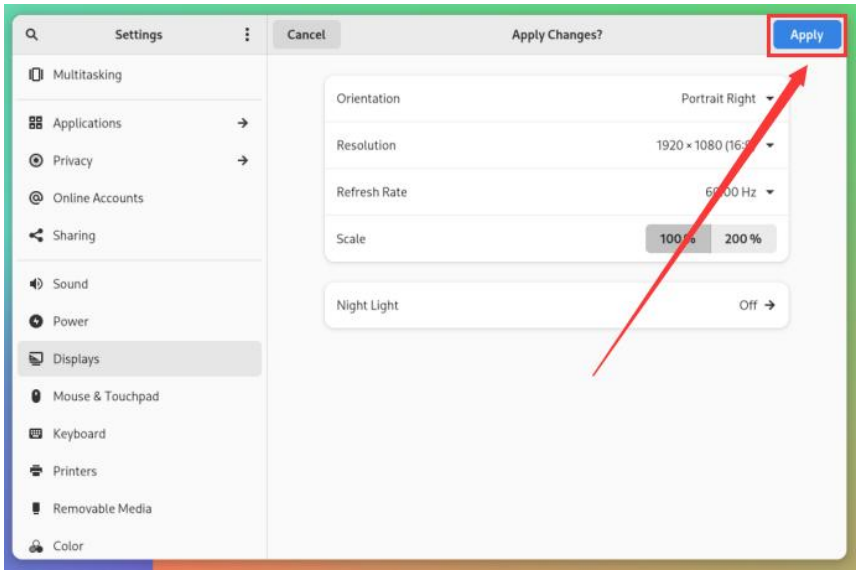
3) Then choose **Displays**



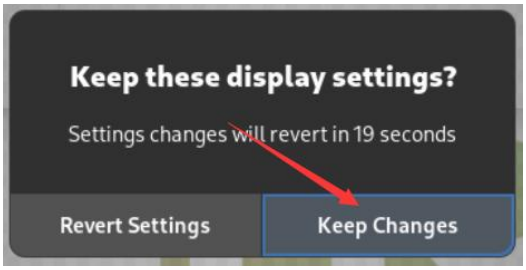
4) Then select the direction you want to rotate in the **Orientation** of **Displays**



5) Then choose **Apply**



6) Then you can see that the screen has been rotated. At this time, you need to choose **Keep Changes** to determine the rotation



7) The display of the LCD screen after 90 degrees is shown below：

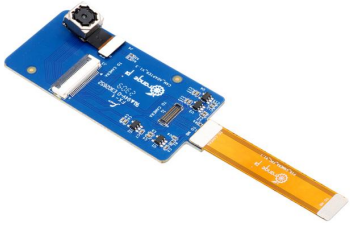
8) **The touch function of the OPi OS Arch system LCD screen will rotate with the rotation of the display direction without other settings.**

5. 4. OV13850 and OV13855 MIPI test methods for testing

At present, the development board supports two MIPI cameras, OV13850 and OV13855. The specific pictures are shown below：

a. OV13850 camera of 13 million MIPI interface

b. 13 million MIPI interface OV13855 camera



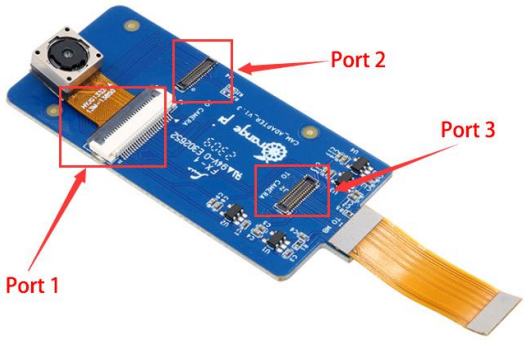
The rotary board used by OV13850 and OV13855 cameras is the same as the FPC cable, but the two cameras are different from the position on the rotary board. The FPC lines are shown in the figure below. Please note that the FPC line is directed. It is marked that the **TO MB** must be inserted into the camera interface of the development board. It is marked that the end of **TO CAMERA** needs to be inserted on the camera transfer board。

There are a total of 3 cameras on the camera to connect to the board, which can only be used at the same time, as shown in the figure below, of which：

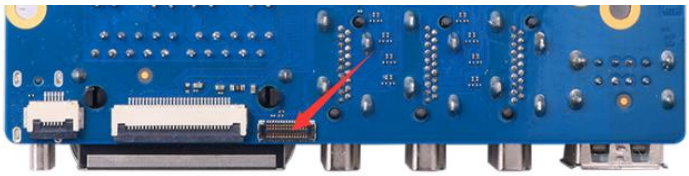
a. **No. 1 interface is connected to the OV13850 camera**

b. **No. 2 interface connected OV13855 camera**

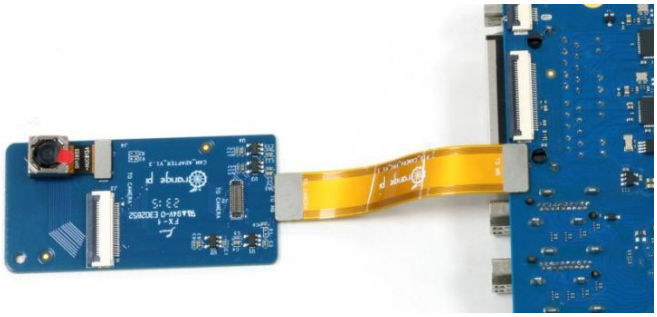
c. No. 3 interface is not used, just ignore it.



Orange Pi 5 Plus development board has a total of 1 camera interface, which is shown below：



The method of the camera inserted on the development board interface is shown below：



After connecting the camera to the development board, we can use the following method to test the next camera：

a. First add the following configuration in **/boot/extlinux/extlinux.conf**

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-opi5plus-ov13850.dtbo
```

The red font demonstrates the configuration of the camera interface **ov13850**. The

other configurations are shown in the table below, and the corresponding DTBO configuration can be added behind **FDTOVERLAYS**。

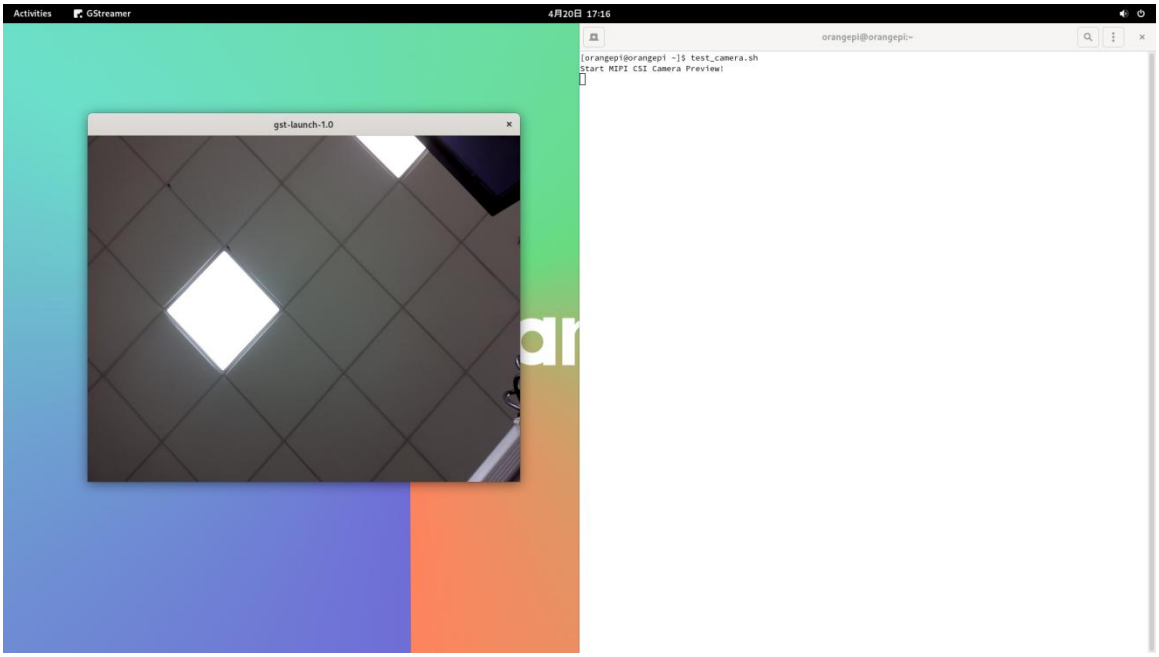
Camera	Dtbo configuration
connect ov13850	**/dtbs/rockchip/overlay/rk3588-opi5plus-ov13850.dtbo**
connect ov13855	**/dtbs/rockchip/overlay/rk3588-opi5plus-ov13855.dtbo**

b. **Then restart the OPi OS Arch system**

c. Then open a terminal in the desktop system and run the script below

```
orangepi@orangepi:~$ test_camera.sh
```

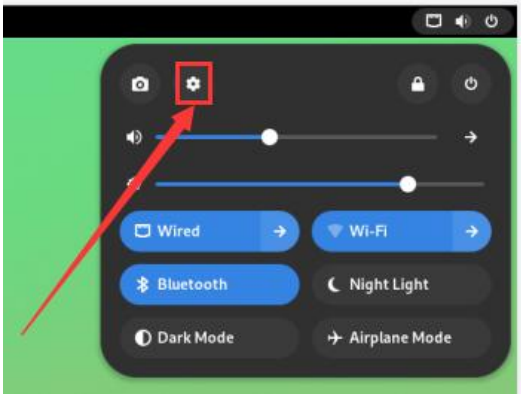
d. Then you can see the preview of the camera



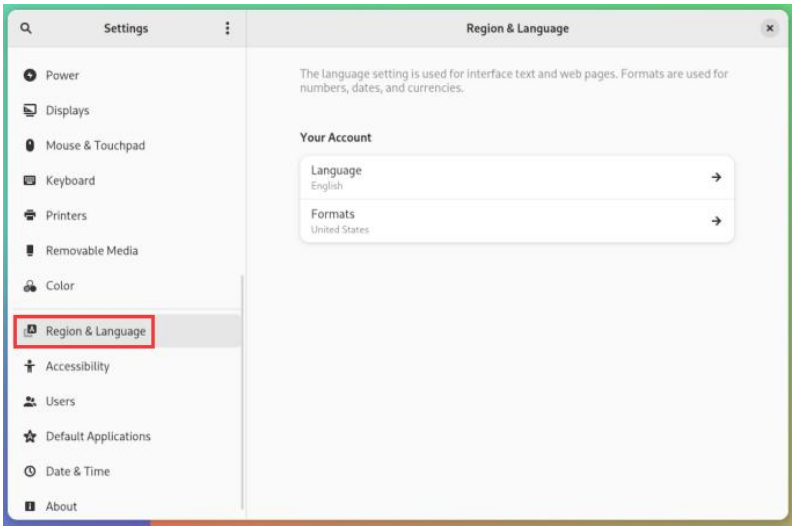
5. 5. Set the Chinese environment and the method of installing the Chinese input method

1) First click the area in the upper right corner of the desktop

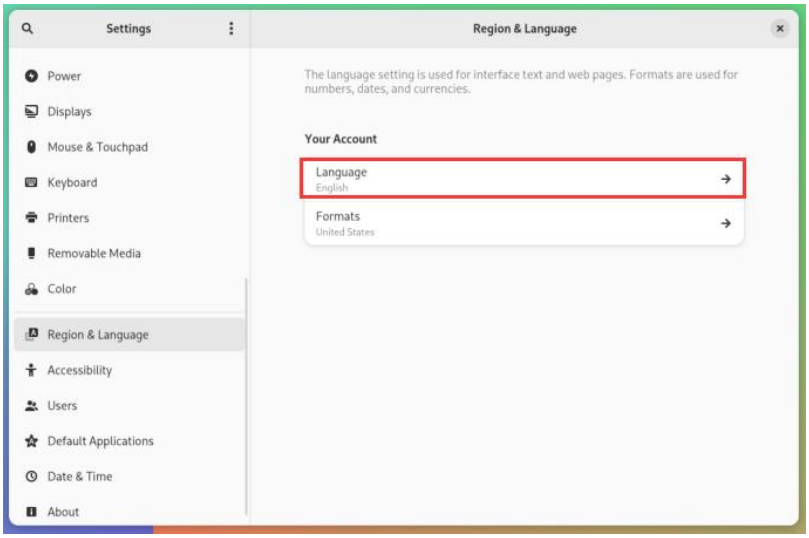
2) Then open the settings



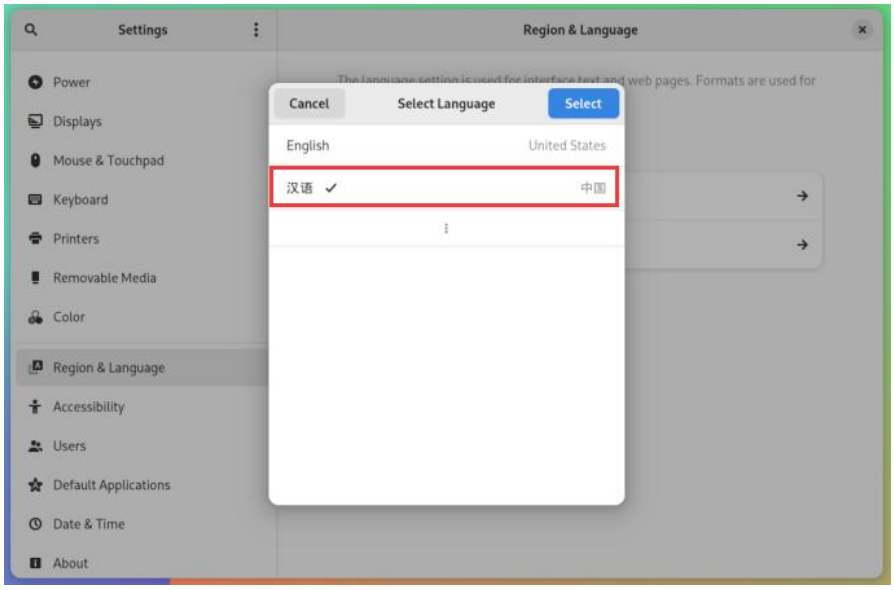
3) Then find the **Region & Language** option



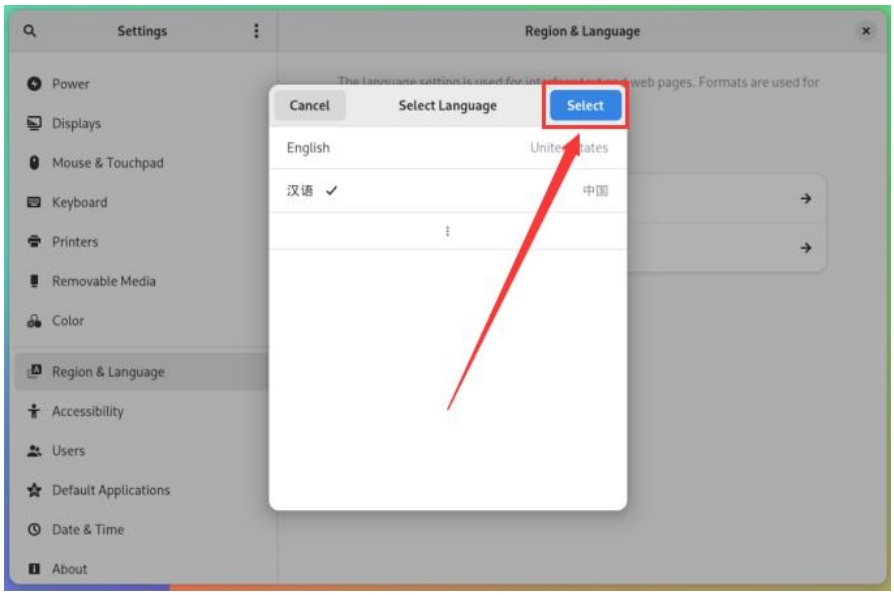
4) Then choose **Language**



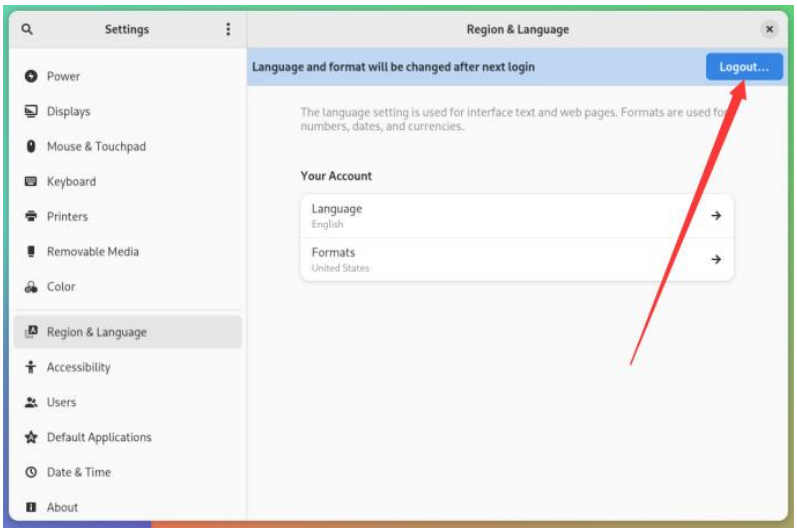
5) Then select Chinese



6) then click **Select**



7) Then click **Logout...** log in to the system, and then log in to the system

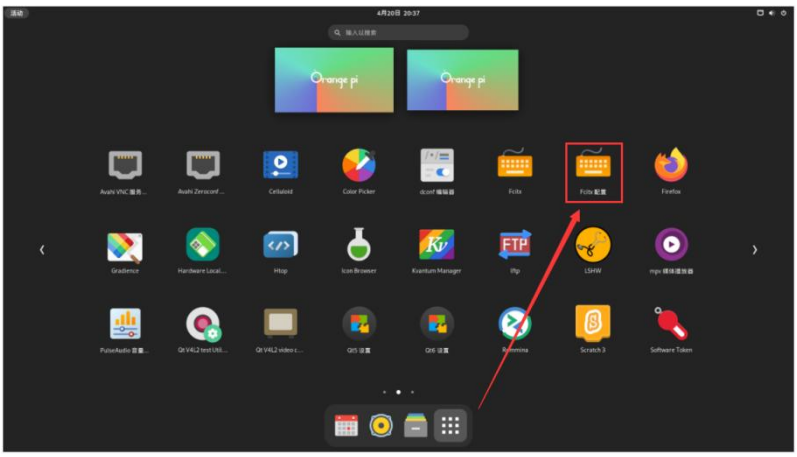


8) Then you can see that the desktop is displayed as Chinese

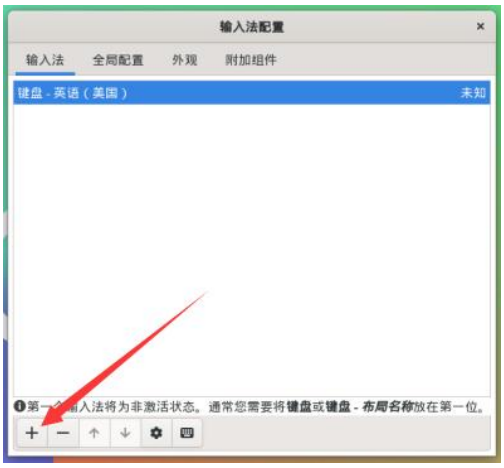
9) Then install **fcitx-im** and **fcitx-configtool**

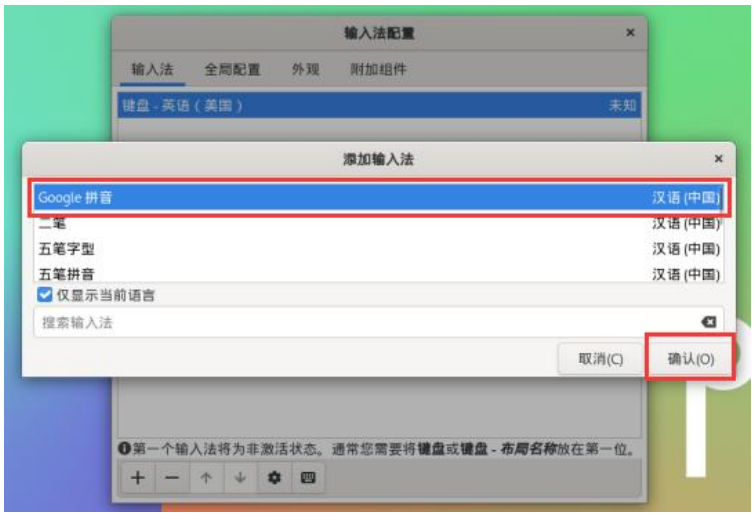
```
[orangepi@orangepi ~]$ sudo pacman -S fcitx-im fcitx-configtool
:: There are 3 members in the group fcitx-im：
:: Software warehouse Community
    1) fcitx    2) fcitx-qt5    3) fcitx-qt6

Enter a selection (default = all selected): 1
```

10) Then open the Fcitx configuration program



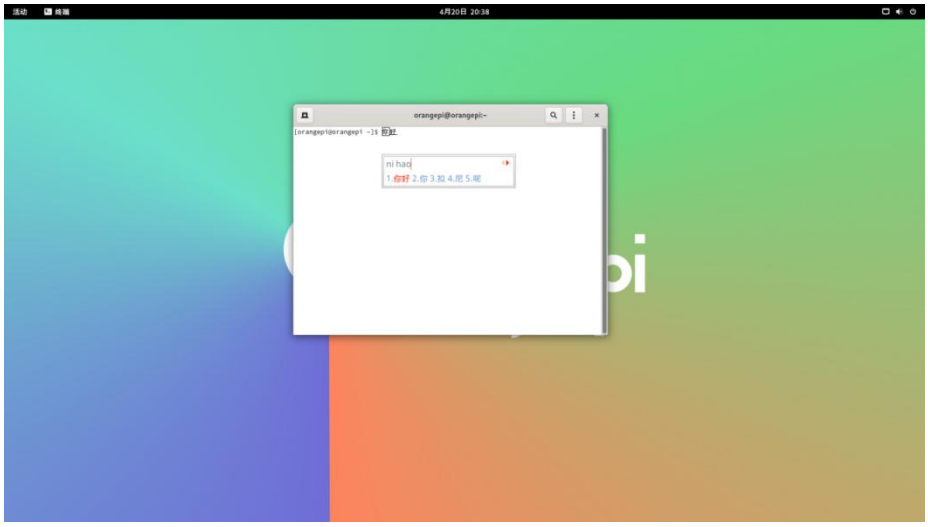
11) Then add **Google Pinyin** input method





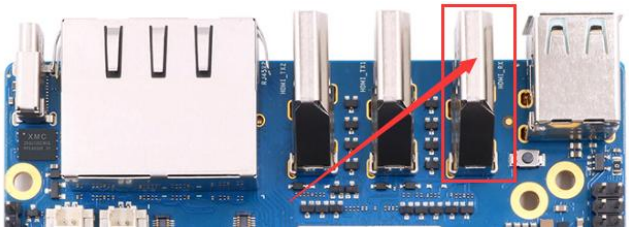
12) Then we can open a terminal test in the Chinese input method. After opening the terminal, if the English input method is still in English, we can switch to the Chinese

input method through the **Ctrl+Space** shortcut keys, and then you can enter Chinese



5. 6. HDMI IN test method

1) The position of the development board HDMI In interface is shown below：



2) First use the HDMI to HDMI line shown below to output the HDMI output of other devices to the HDMI In interface of the development board

3) The OPi OS Arch system HDMI in function is closed by default, and the opening method is shown below：

a. First add the following configuration in **/boot/extlinux/extlinux.conf**

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
```

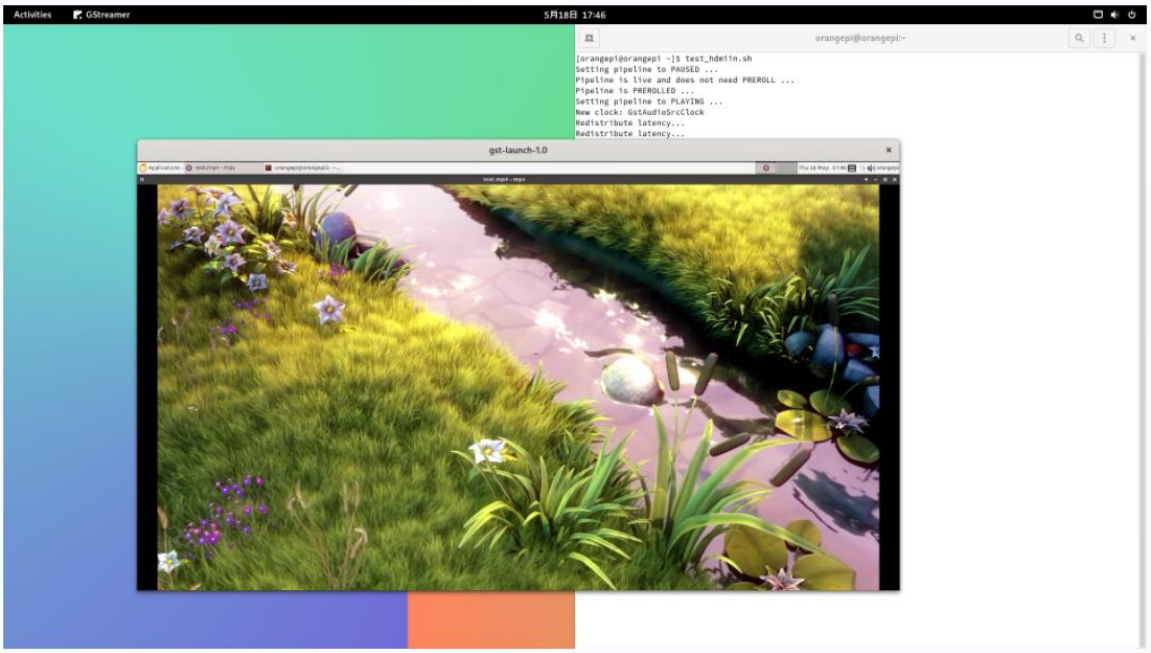
```
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-hdmirx.dtbo     #The configuration that needs to be added
```

b. **Then restart the OPi OS Arch system**

4) After restarting into the system, open a terminal on the desktop, and then run the **test_hdmiin.sh** script

```
[orangepi@orangepi ~]$ test_hdmiin.sh
```

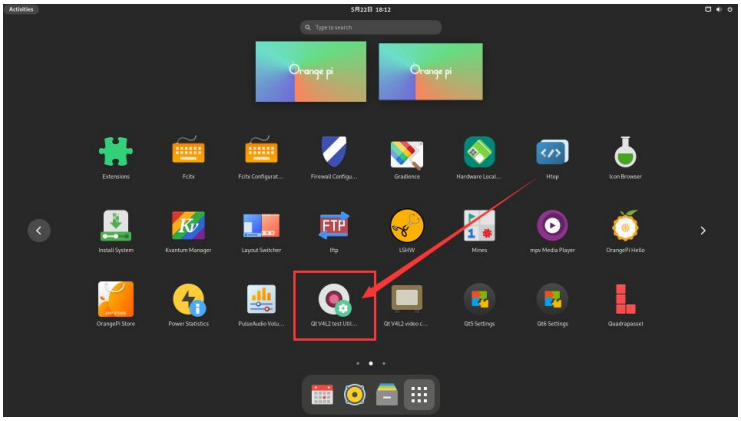
5) Then you can see the input screen of the HDMI in (the HDMI in in the figure below shows the screen of the OPI5 development board HDMI output, and it is playing a video at this time). **test_hdmiin.sh** script defaults to the audio entered by HDMI in to the HDMI_TX1, HDMI_TX2 and ES8388 (representing speakers or headphones) of the development board.



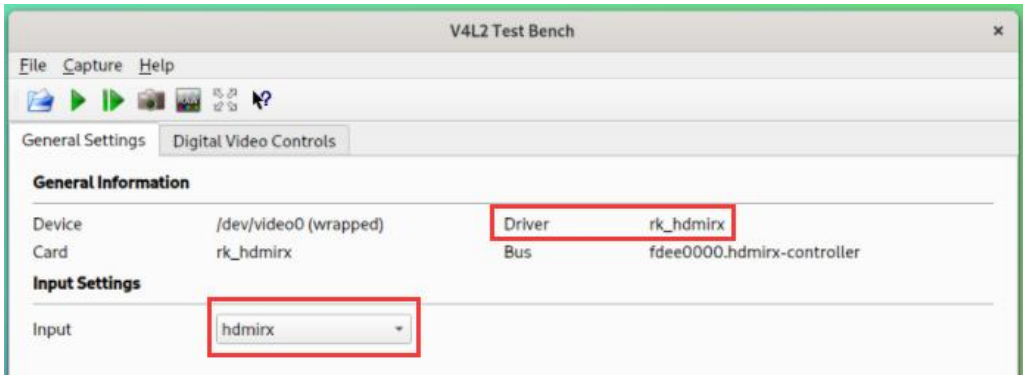
6) In addition to testing HDMI IN using **test_hdmiin.sh**, we can also use **Qt V4L2 test Utility** to test HDMI in video (**this method cannot test audio at present**). The detailed steps are shown below：

a. Enter the application list first

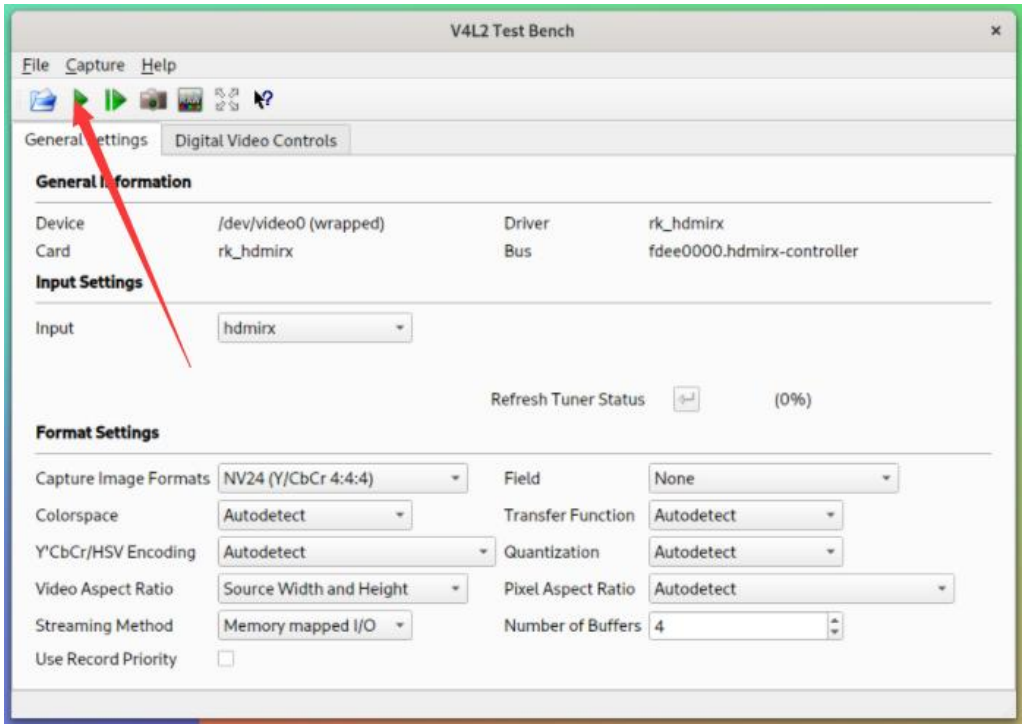
b. Then find **Qt V4L2 test Utility** and open it



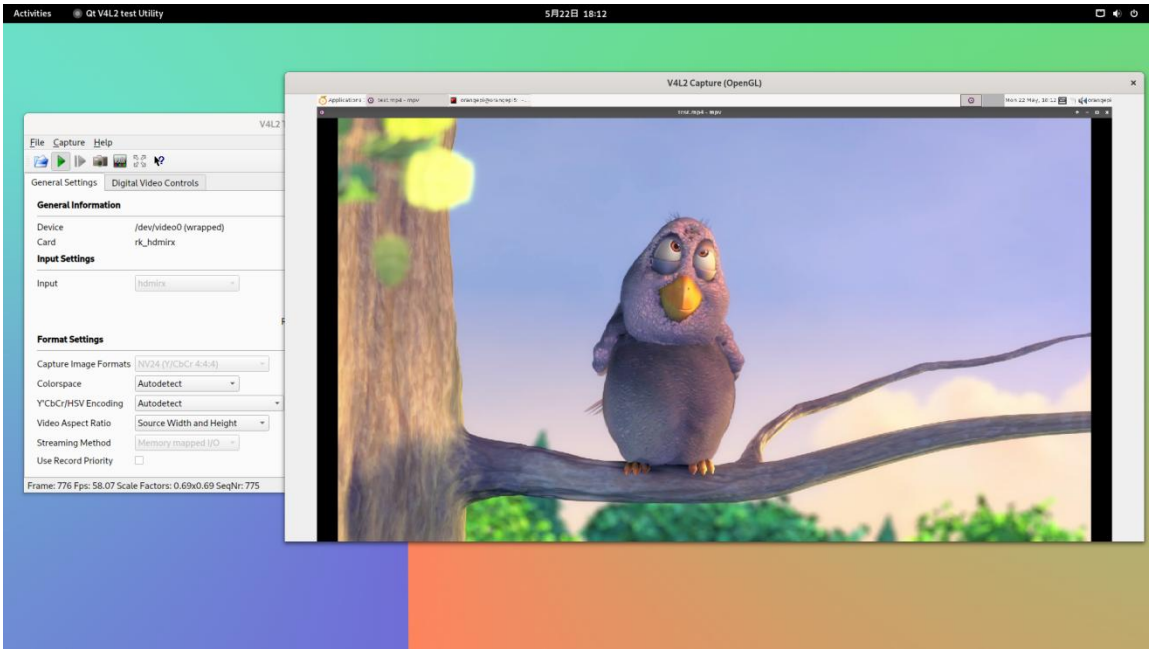
c. Then make sure **Qt V4L2 test Utility** recognizes the HDMI In device



d. Then click the location shown in the figure below to see the video entered by HDMI In



e. The video window entered by HDMI In is shown below：



5. 7. How to install wiringOP

Note that Wiringop has been pre -installed in the OPI OS Arch image released by Orange PI. Unless Wiringop's code is updated, it is not necessary to re -download

and compile and install it,just use it directly.

After entering the system, you can run the gpio readall command. If you can see the output below, it means that wiringOP is pre -installed and can be used normally

```
[orangepi@orangepi ~]$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |    PWM14 |     IN | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 | IN     | GPIO3_A1 | 6   | 97   |
 |   39 |   7 | GPIO1_A7 |     IN | 1 | 13 || 14 |   |        | GND      |     |      |
 |   40 |   8 | GPIO1_B0 |     IN | 1 | 15 || 16 | 1 | IN     | GPIO3_B5 | 9   | 109  |
 |      |     |     3.3V |        |   | 17 || 18 | 0 | IN     | GPIO3_B6 | 10  | 110  |
 |   42 |  11 | SPI0_TXD |     IN | 0 | 19 || 20 |   |        | GND      |     |      |
 |   41 |  12 | SPI0_RXD |     IN | 0 | 21 || 22 | 0 | IN     | GPIO1_A2 | 13  | 34   |
 |   43 |  14 | SPI0_CLK |     IN | 0 | 23 || 24 | 1 | IN     | SPI0_CS0 | 15  | 44   |
 |      |     |      GND |        |   | 25 || 26 | 1 | IN     | SPI0_CS1 | 16  | 45   |
 |   47 |  17 | GPIO1_B7 |     IN | 1 | 27 || 28 | 1 | IN     | GPIO1_B6 | 18  | 46   |
 |   63 |  19 | GPIO1_D7 |     IN | 1 | 29 || 30 |   |        | GND      |     |      |
 |   96 |  20 | GPIO3_A0 |     IN | 1 | 31 || 32 | 0 | IN     | GPIO1_A3 | 21  | 35   |
 |  114 |  22 | GPIO3_C2 |     IN | 0 | 33 || 34 |   |        | GND      |     |      |
 |   98 |  23 | GPIO3_A2 |     IN | 1 | 35 || 36 | 0 | IN     | GPIO3_A5 | 24  | 101  |
 |  113 |  25 | GPIO3_C1 |     IN | 0 | 37 || 38 | 0 | IN     | GPIO3_A4 | 26  | 100  |
 |      |     |      GND |        |   | 39 || 40 | 1 | IN     | GPIO3_A3 | 27  | 99   |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
[orangepi@orangepi ~]$
```

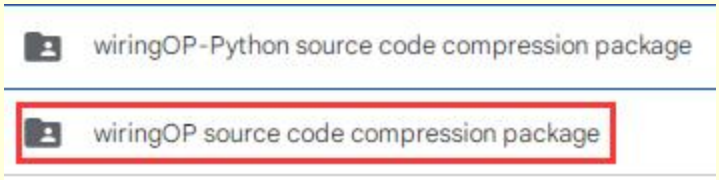
wiringOP is currently adapted to set the GPIO port input output, set the GPIO port output high and low level, and set the function of pulling and down resistance. It is impossible to use functions like hardware PWM.。

1) Download the code of wiringOP

```
[orangepi@orangepi ~]$ sudo pacman -Syy git
[orangepi@orangepi ~]$ git clone https://github.com/orangepi-xunlong/wiringOP.git -b next
```

Note that Orange Pi 5 Plus needs to download the code of the wiringOP next branch, please don't miss the parameter of -b next。

If you have a problem with the download code from github, you can download the source code compression package of wiringOp.tar.gz in the official tools of the Orange Pi 5 Plus data download page



2) Compile and install wiringOP

```
[orangepi@orangepi ~]$ sudo pacman -Syy make gcc
[orangepi@orangepi ~]$ cd wiringOP
[orangepi@orangepi wiringOP]$ sudo ./build clean
[orangepi@orangepi wiringOP]$ sudo ./build
```

3) Test the output of the GPIO Readall command as follows

```
[orangepi@orangepi ~]$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |    PWM14 |     IN | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 | IN     | GPIO3_A1 | 6   | 97   |
 |   39 |   7 | GPIO1_A7 |     IN | 1 | 13 || 14 |   |        | GND      |     |      |
 |   40 |   8 | GPIO1_B0 |     IN | 1 | 15 || 16 | 1 | IN     | GPIO3_B5 | 9   | 109  |
 |      |     |     3.3V |        |   | 17 || 18 | 0 | IN     | GPIO3_B6 | 10  | 110  |
 |   42 |  11 | SPI0_TXD |     IN | 0 | 19 || 20 |   |        | GND      |     |      |
 |   41 |  12 | SPI0_RXD |     IN | 0 | 21 || 22 | 0 | IN     | GPIO1_A2 | 13  | 34   |
 |   43 |  14 | SPI0_CLK |     IN | 0 | 23 || 24 | 1 | IN     | SPI0_CS0 | 15  | 44   |
 |      |     |      GND |        |   | 25 || 26 | 1 | IN     | SPI0_CS1 | 16  | 45   |
 |   47 |  17 | GPIO1_B7 |     IN | 1 | 27 || 28 | 1 | IN     | GPIO1_B6 | 18  | 46   |
 |   63 |  19 | GPIO1_D7 |     IN | 1 | 29 || 30 |   |        | GND      |     |      |
 |   96 |  20 | GPIO3_A0 |     IN | 1 | 31 || 32 | 0 | IN     | GPIO1_A3 | 21  | 35   |
 |  114 |  22 | GPIO3_C2 |     IN | 0 | 33 || 34 |   |        | GND      |     |      |
 |   98 |  23 | GPIO3_A2 |     IN | 1 | 35 || 36 | 0 | IN     | GPIO3_A5 | 24  | 101  |
 |  113 |  25 | GPIO3_C1 |     IN | 0 | 37 || 38 | 0 | IN     | GPIO3_A4 | 26  | 100  |
 |      |     |      GND |        |   | 39 || 40 | 1 | IN     | GPIO3_A3 | 27  | 99   |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
[orangepi@orangepi ~]$
```

5. 8. 40 PIN interface GPIO, I2C, UART, SPI, CAN and PWM test

Note that if you need to set FDT Overlays to open multiple configurations at the same time, please use a space to write in a line like the red font configuration below.

[orangepi@orangepi ~]$ **sudo vim /boot/extlinux/extlinux.conf**

LABEL Orange Pi

LINUX /Image

FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb

```
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-i2c1-m2.dtbo /dtbs/rockchip/overlay/rk3588-uart0-m2.dtbo
```

5.8.1. 40 PIN GPIO port test

1) A total of 28 GPIO ports can be used in the development board 40 PIN. Below is No. 7 pins -corresponding to GPIO1_D6 -corresponding WPI serial number 2 -as an example to demonstrate how to set the high and low level of the GPIO port

```
[orangepi@orangepi ~]$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |   PWM14  |     IN | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 | IN     | GPIO3_A1 | 6   | 97   |
```

2) First set the GPIO port as the output mode. The third parameter needs to enter the serial number of the wpi corresponding to the pins

```
[orangepi@orangepi ~]$ gpio mode 2 out
```

3) Then set the GPIO port output low level. After setting, you can use the value of the voltage of the pins with a multimeter. If it is 0V, it means that the low -power flat is set

```
[orangepi@orangepi ~]$ gpio write 2 0
```

4) Then set the GPIO port output high level. After setting, you can use the value of the voltage of the pins with a multimeter. If it is 3.3V, it means that the high -power flat is set to be successful

```
[orangepi@orangepi ~]$ gpio write 2 1
```

1) The setting method of other pins is similar. Just modify the serial number of the wpi serial number as the corresponding serial number.

5.8.2. 40 PIN GPIO Port -to -Plattering resistance setting method

1) Below the No. 7 pin — corresponding to GPIO1_D6 -corresponding WPI serial number 2 -to demonstrate how to set up and down pull -down resistance of the GPIO port

```
[orangepi@orangepi ~]$ gpio readall
 +------+-----+----------+--------+---+ PI5 PLUS +---+--------+----------+-----+------+
 | GPIO | wPi |   Name   |  Mode  | V | Physical | V |  Mode  | Name     | wPi | GPIO |
 +------+-----+----------+--------+---+----++----+---+--------+----------+-----+------+
 |      |     |     3.3V |        |   |  1 || 2  |   |        | 5V       |     |      |
 |   16 |   0 |    SDA.2 |     IN | 0 |  3 || 4  |   |        | 5V       |     |      |
 |   15 |   1 |    SCL.2 |     IN | 0 |  5 || 6  |   |        | GND      |     |      |
 |   62 |   2 |    PWM14 |     IN | 1 |  7 || 8  | 0 | IN     | GPIO1_A1 | 3   | 33   |
 |      |     |      GND |        |   |  9 || 10 | 0 | IN     | GPIO1_A0 | 4   | 32   |
 |   36 |   5 | GPIO1_A4 |     IN | 0 | 11 || 12 | 1 | IN     | GPIO3_A1 | 6   | 97   |
```

2) First of all, you need to set the GPIO port as the input mode. The third parameter needs to enter the serial number of the wpi corresponding to the pins

```
[orangepi@orangepi ~]$ gpio mode 2 in
```

3) After the setting is set to input mode, execute the following command to set the GPIO port as the pull -down mode

```
[orangepi@orangepi ~]$ gpio mode 2 up
```

4) Then enter the following command to read the level of the GPIO port. If the level is 1, it means that the drawing mode is successful

```
[orangepi@orangepi ~]$ gpio read 2
1
```

5) Then execute the following command to set the GPIO port as the drop-down mode

```
[orangepi@orangepi ~]$ gpio mode 2 down
```

6) Then enter the command below to read the level of the GPIO port. If the level is 0, it means that the drop -down mode is set successfully

```
[orangepi@orangepi ~]$ gpio read 2
0
```

5. 8. 3. 40 PIN SPI test

1) As can be seen from the figure below, the SPI available for Orange Pi 5 Plus is SPI0 and SPI4

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins corresponding to SPI0 and SPI4 are shown in the table below. SPI4_M1 and SPI4_M2 can only be used at the same time, and they cannot be used at the same time. They are the same SPI4, but they are just getting different pins. Please don't think that they are two different SPI bus。

	SPI0_M2 to 40pin	SPI4_M1 to 40pin	SPI4_M2 to 40pin
MOSI	**No. 19 pins**	**No. 12 pins**	**No. 8 pins**
MISO	**No. 21 pins**	**No. 31 pins**	**No. 10 pins**
CLK	**No. 23 pins**	**No. 35 pins**	**No. 22 pins**
CS0	**No. 24 pins**	**No. 40 pins**	**No. 31 pins**
CS1	**No. 26 pins**	**No. 38 pins**	**None**

3) In the Linux system, the SPI in 40 PIN is closed by default, and it needs to be opened manually to use. The detailed steps are shown below：

a. First add the following configuration to the **/boot/extlinux/extlinux.conf**

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-spi0-m2-cs0-cs1-spidev.dtbo
```

The red font demonstrated the configuration of opening the **SPI0-M2 and using the CS0 and CS1 pin**. The other configurations are shown in the table below, and the corresponding dtbo configuration can be added to **FDTOVERLAYS**

SPI bus	dtbo configuration
SPI0_M2-cs0	**/dtbs/rockchip/overlay/rk3588-spi0-m2-cs0-spidev.dtbo**
SPI0_M2-cs1	**/dtbs/rockchip/overlay/rk3588-spi0-m2-cs1-spidev.dtbo**
SPI0_M2-cs0-cs1	**/dtbs/rockchip/overlay/rk3588-spi0-m2-cs0-cs1-spidev.dtbo**
SPI4_M1-cs0	**/dtbs/rockchip/overlay/rk3588-spi4-m1-cs0-spidev.dtbo**

SPI4_M1-cs1	**/dtbs/rockchip/overlay/rk3588-spi4-m1-cs1-spidev.dtbo**
SPI4_M1-cs0-cs1	**/dtbs/rockchip/overlay/rk3588-spi4-m1-cs0-cs1-spidev.dtbo**
SPI4_M2-cs0	**/dtbs/rockchip/overlay/rk3588-spi4-m2-cs0-spidev.dtbo**

b. Then **restart the OPi OS Arch system**

4) After the restart, enter the system first to check whether there is a **spidevx.x** device node in the Linux system. If it exists, it means that the SPI has been set and can be used directly

```
[orangepi@orangepi ~]$ ls /dev/spidev*
/dev/spidev0.0  /dev/spidev0.1  /dev/spidev4.0  /dev/spidev4.1
```

The above is the result displayed after opening the spi0-m2-cs0-cs1-spidev and spi4-m1-cs0-cs1-spidev

5) Then do not connect the SPI0 or SPI4 MOSI and MISO pins, and run the output result of the spidev_teest as shown below. You can see that the data of TX and RX are inconsistent

```
[orangepi@orangepi ~]$ sudo spidev_test -v -D /dev/spidev4.0
Or
[orangepi@orangepi ~]$ sudo spidev_test -v -D /dev/spidev0.0
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 KHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF F0 0D    | ......@....▒.................▒.
RX | FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF    | ................................
```

6) Then the output of spidev_test, which is then connected to SPI0 or SPI4 MOSI and MISO, is as follows. You can see that the sending and receiving data can be seen, indicating that the SPI loop test is normal

```
[orangepi@orangepi ~]$ sudo spidev_test -v -D /dev/spidev4.0
Or
[orangepi@orangepi ~]$ sudo spidev_test -v -D /dev/spidev0.0
```

```
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 KHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF F0 0D    | ......@....▒.................▒.
RX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF F0 0D    | ......@....▒.................▒.
```

5. 8. 4. 40 pin I2C test

1) From the table below, the I2C available for Orange Pi 5 Plus is I2C2, I2C4, I2C5, and I2C8. There are four groups of I2C bus

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins corresponding to the 4 group I2C bus are shown below. I2C2_M0 and I2C2_M4 can only be used at the same time, and they cannot be used at the same time. They are the same I2C2, but they only receive different pins. Please don't think that they are two different I2C2 bus

I2C bus	SDA to 40pin	SCL to 40pin
I2C2_M0	No. 3 pin	No. 5 pin
I2C2_M4	No. 10 pin	No. 8 pin
I2C4_M3	No. 22 pin	No. 32 pin
I2C5_M3	No. 27 pin	No. 28 pin
I2C8_M2	No. 29 pin	No. 7 pin

3) In the Linux system, the I2C bus in 40 PIN is closed by default, and it needs to be opened manually to use. The detailed steps are shown below：

a. First add the following configuration in **/boot/extlinux/extlinux.conf**.

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
```

```
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-i2c2-m0.dtbo
```

The red font on the above demonstrates the configuration of the **i2c2-m0**. The other configurations are shown in the table below, and the corresponding dtbo configuration can be added behind **FDTOVERLAYS**

I2C bus	dtbo configuration
I2C2_M0	/dtbs/rockchip/overlay/rk3588-i2c2-m0.dtbo
I2C2_M4	/dtbs/rockchip/overlay/rk3588-i2c2-m4.dtbo
I2C4_M3	/dtbs/rockchip/overlay/rk3588-i2c4-m3.dtbo
I2C5_M3	/dtbs/rockchip/overlay/rk3588-i2c5-m3.dtbo
I2C8_M2	/dtbs/rockchip/overlay/rk3588-i2c8-m2.dtbo

b. Then restart the **OPi OS Arch** system

4) After starting the linux system, first confirm that there is a device node that needs to be used under the**/dev**

```
orangepi@orangepi:~$ ls /dev/i2c-*
```

5) Then connect a I2C device on the I2C pin corresponding to the 40 PIN interface

6) Then use the **i2cdetect -y** command to detect the address of the connected i2c device, which means that the i2c can be used normally

```
[orangepi@orangepi ~]$ sudo pacman -S i2c-tools          #First of all, I2C tools
[orangepi@orangepi ~]$ sudo i2cdetect -y 2               #i2c2 test command
[orangepi@orangepi ~]$ sudo i2cdetect -y 4               #i2c4 test command
[orangepi@orangepi ~]$ sudo i2cdetect -y 5               #i2c5 test command
[orangepi@orangepi ~]$ sudo i2cdetect -y 8               #i2c8 test command
```

5.8.5. 40 Pin's UART test

1) As can be seen from the table below, the UART available for Orange Pi 5 Plus is UART1, UART3, UART4, UART6, UART7, and UART8. There are 6 sets of UART bus

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) In the Linux system, the UART in 40 pin is closed by default, and it needs to be opened manually to use. The detailed steps are shown below：

a. First add the following configuration to the**/boot/extlinux/extlinux.conf**

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-uart1-m1.dtbo
```

The red font demonstrates the configuration of the **uart1-m1**. The other configurations are shown in the table below, and the corresponding dtbo configuration can be added behind **FDTOVERLAYS**

UART bus	dtbo configuration
UART1_M1	/dtbs/rockchip/overlay/rk3588-uart1-m1.dtbo
UART3_M1	/dtbs/rockchip/overlay/rk3588-uart3-m1.dtbo
UART4_M2	/dtbs/rockchip/overlay/rk3588-uart4-m2.dtbo
UART6_M1	/dtbs/rockchip/overlay/rk3588-uart6-m1.dtbo
UART7_M2	/dtbs/rockchip/overlay/rk3588-uart7-m2.dtbo
UART8_M1	/dtbs/rockchip/overlay/rk3588-uart8-m1.dtbo

b. Then **restart the OPI OS Arch system**

3) After entering the Linux system, first confirm whether there is a device node corresponding to UART under the**/dev**

```
[orangepi@orangepi ~]$ ls /dev/ttyS*
```

4) Then start testing the UART interface, and first use the RX and TX pins of the UART interface to be tested by DuPont

UART bus	RX to 40pin	TX to 40pin
UART1_M1	No. 27 pin	No. 28 pin
UART3_M1	No. 18 pin	No. 16 pin
UART4_M2	No. 19 pin	No. 23 pin
UART6_M1	No. 10 pin	No. 8 pin
UART7_M2	No. 24 pin	No. 26 pin
UART8_M1	No. 40 pin	No. 35 pin

5) Use the **gpio serial** command to test the loop function of the serial port as shown below. If you can see the printed below, it means that the serial port communication is normal (TTYSX needs to be replaced with a node name corresponding to UART, please do not copy it)

```
[orangepi@orangepi ~]$ sudo gpio serial /dev/ttySX
[sudo] password for orangepi:    #Enter the password here

Out:    0:    ->    0
Out:    1:    ->    1
Out:    2:    ->    2
Out:    3:    ->    3
Out:    4:    ->    4
Out:    5:    ->    5^C
```

5.8.6. PWM test method

1) From the table below, the PWMs available for Orange Pi 5 Plus include PWM0, PWM1, PWM11, PWM12, PWM13, and PWM14 a total of six PWM

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) The corresponding pins of PWM in 40pin are shown below. PWM0_M0 and PWM0_M2, PWM1_M0 and PWM1_M2, PWM14_M0 and PWM14_M2 can only be used at the same time. They cannot be used at the same time. They are the same PWM,

but they only get different pins. Please think that they are two different PWM bus

PWM bus	Corresponding 40pin
PWM0_M0	No. 5 pin
PWM0_M2	No. 22 pin
PWM1_M0	No. 3 pin
PWM1_M2	No. 32 pin
PWM11_M0	No. 12 pin
PWM12_M0	No. 14 pin
PWM13_M0	No. 16 pin
PWM14_M0	No. 33 pin
PWM14_M2	No. 7 pin

3) In the Linux system, the PWM in 40 PIN is closed by default, and it needs to be opened manually to use. The detailed steps are shown below：

a. First add the following configuration to the**/boot/extlinux/extlinux.conf**

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-pwm0-m0.dtbo
```

The red font demonstrates the configuration of the **pwm0-m0**. The other configurations are shown in the table below, and the corresponding dtbo configuration can be added behind **FDTOVERLAYS**

PWM bus	Dtbo configuration
PWM0_M0	/dtbs/rockchip/overlay/rk3588-pwm0-m0.dtbo
PWM0_M2	/dtbs/rockchip/overlay/rk3588-pwm0-m2.dtbo
PWM1_M0	/dtbs/rockchip/overlay/rk3588-pwm1-m0.dtbo
PWM1_M2	/dtbs/rockchip/overlay/rk3588-pwm1-m2.dtbo
PWM11_M0	/dtbs/rockchip/overlay/rk3588-pwm11-m0.dtbo
PWM12_M0	/dtbs/rockchip/overlay/rk3588-pwm12-m0.dtbo
PWM13_M0	/dtbs/rockchip/overlay/rk3588-pwm13-m0.dtbo
PWM14_M0	/dtbs/rockchip/overlay/rk3588-pwm14-m0.dtbo
PWM14_M2	/dtbs/rockchip/overlay/rk3588-pwm14-m2.dtbo

b. Then **restart the OPi OS Arch system**

4) After opening a pwm,In the**/sys/class/pwm**/, there will be an additional pwmchipX (x is a specific number). For example, after opening PWM14,viewing**/sys/class/pwm/**down Pwmchipx will change from two to three.

```
[orangepi@orangepi ~]$ ls /sys/class/pwm/
pwmchip0  pwmchip1  pwmchip2
```

5) Which pwmchip corresponds to pwm14 above? Let's first check out the output of **ls /sys/class/pwm/ -l** command, as shown below：

```
[orangepi@orangepi ~]$ ls /sys/class/pwm/ -lh
total 0
lrwxrwxrwx 1 root root 0  5月22日 19:50 pwmchip0 -> ../../devices/platform/fd8b0020.pwm/pwm/pwmchip0
lrwxrwxrwx 1 root root 0  5月22日 19:50 pwmchip1 -> ../../devices/platform/fd8b0030.pwm/pwm/pwmchip1
lrwxrwxrwx 1 root root 0  5月22日 19:50 pwmchip2 -> ../../devices/platform/febf0020.pwm/pwm/pwmchip2
[orangepi@orangepi ~]$
```

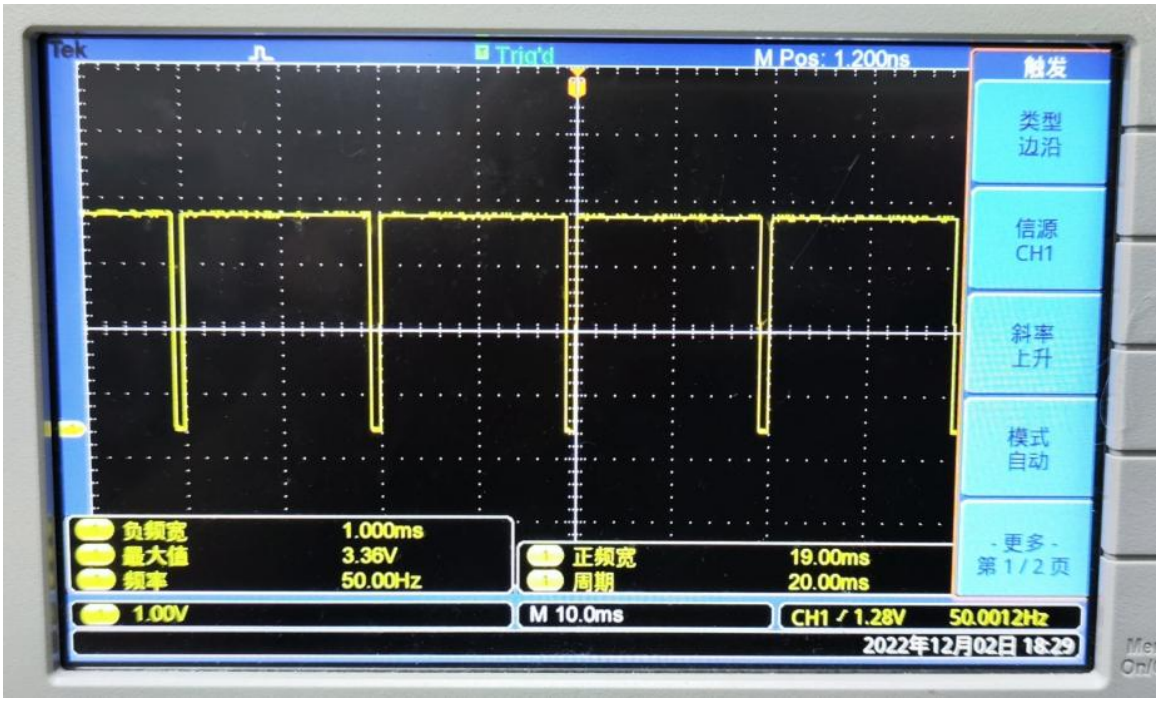
6) Then from the table below, the base address of the PWM14 register is FEBF0020, and then look at the output of the **ls /sys/class/pwm/ -l** command. You can see that the link in PWMCHIP2 is connected to Febf0020.PWM, so the PWM14 corresponds to PWMCHIP2

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号
			3.3V		1
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7
			GND		9
			GPIO1_A4	36	11
			GPIO1_A7	39	13
			GPIO1_B0	40	15
			3.3V		17
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19
		SPI0_MISO_M2	GPIO1_B1	41	21
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23
			GND		25
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31
		PWM14_M0（febf0020）	GPIO3_C2	114	33
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35
			GPIO3_C1	113	37
			GND		39

7) Then use the following command to allow the PWM14 to output a 50Hz square wave (please switch to the root user first, and then execute the following command)

```
[root@orangepi ~]# echo 0 > /sys/class/pwm/pwmchip2/export
```

```
[root@orangepi ~]# echo 20000000 > /sys/class/pwm/pwmchip2/pwm0/period
[root@orangepi ~]# echo 1000000 > /sys/class/pwm/pwmchip2/pwm0/duty_cycle
[root@orangepi ~]# echo 1 > /sys/class/pwm/pwmchip2/pwm0/enable
```



8) The other pwm testing methods in the pwm14 demonstration above are similar。

5.8.7. CAN's test method

5.8.7.1. How to open a can

1) As can be seen from the table below, the Canal bus available for Orange Pi 5 Plus is CAN0 and CAN1

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

2) In the Linux system, the Can in 40 PIN is closed by default and needs to be opened manually to use. The detailed steps are shown below：

a. First add the following configuration to the **/boot/extlinux/extlinux.conf**

```
[orangepi@orangepi ~]$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588-orangepi-5-plus.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-can0-m0.dtbo
```

The red font demonstrates the configuration of the **can0-m0**. The other configurations are shown in the table below, and the corresponding dtbo configuration can be added to **FDTOVERLAYS**

CAN bus	Dtbo configuration
can0-m0	**/dtbs/rockchip/overlay/rk3588-can0-m0.dtbo**
can1-m0	**/dtbs/rockchip/overlay/rk3588-can1-m0.dtbo**

b. Then **restart the OPI OS Arch system**

3) After entering the Linux system, using the **sudo ifconfig -a** command If you can see the CAN device node, it means that the CAN has been opened correctly

```
[orangepi@orangepi ~]$ sudo pacman -Syy net-tools
[orangepi@orangepi ~]$ sudo ifconfig -a
can0: flags=128<NOARP>  mtu 16
        unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00  txqueuelen 10  (UNSPEC)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 94

can1: flags=128<NOARP>  mtu 16
        unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00  txqueuelen 10  (UNSPEC)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 95
```

4) The pins corresponding to the Can0 and Can1 are

	CAN0	CAN1
TX Pin	**Corresponding to No. 5 pin in 40pin**	**Corresponding to No. 18 pin in 40pin**
RX Pin	**Corresponding to No. 3 pin in 40pin**	**Corresponding to No. 16 pin in 40pin**

5) Use Canalyst-II analyzer to test CAN receiving messages, please refer to the content of the one-section of **the Canalyst-II analyzer to test receive and send message**

6. Linux SDK——orangepi-build instructions

6.1. Compilation system requirements

We can cross-compile the Linux image of the development board on the x64 computer, or compile the Linux image of the development board on the Ubuntu22.04 system of the development board, please choose one according to your preference.

If you use orangepi-build to compile the Linux image in the Ubuntu22.04 system of the development board, please do a good job of cooling (especially when the SSD starts). If the heat dissipation is not done well, it is prone to the error of file system runaway.

6.1.1. Compile with the Ubuntu22.04 system of the development board

1) The Linux SDK, namely **orangepi-build**, supports running on the **Ubuntu 22.04** of the development board (other systems have not been tested), so before downloading orangepi-build, please first ensure that the Ubuntu version installed on the development board is Ubuntu 22.04. The command to check the Ubuntu version installed on the development board is as follows. If the Release field does not display **22.04**, it means that the current Ubuntu version does not meet the requirements. Please replace the system before performing the following operations.

```
orangepi@orangepi:~$ lsb_release -a
No LSB modules are available.
Distributor ID:    Ubuntu
Description:       Ubuntu 22.04.1 LTS
Release:           22.04
Codename:          jammy
```

2) Since the source codes such as the kernel and U-boot are stored on GitHub, it is very important to ensure that the development board can download codes from GitHub normally when compiling the image.

6.1.2. Compile with x64 Ubuntu22.04 computer

1) The Linux SDK, **orangepi-build**, supports running on computers with **Ubuntu 22.04**

installed, so before downloading orangepi-build, please make sure that the Ubuntu version installed on your computer is Ubuntu 22.04. The command to check the Ubuntu version installed on the computer is as follows. If the Release field does not display **22.04**, it means that the current Ubuntu version does not meet the requirements. Please replace the system before performing the following operations.

```
test@test:~$ lsb_release -a
No LSB modules are available.
Distributor ID:	Ubuntu
Description:	Ubuntu 22.04 LTS
Release:	22.04
Codename:	jammy
```

2) If the computer is installed with Windows system and there is no computer with Ubuntu 22.04 installed, you can consider using **VirtualBox** or **VMware** to install an Ubuntu 22.04 virtual machine in the Windows system. But please be careful not to compile orangepi-build on the WSL virtual machine, because orangepi-build has not been tested in the WSL virtual machine, so it cannot be guaranteed that orangepi-build can be used normally in WSL.

3) The download address of the installation image of Ubuntu 22.04 **amd64** version is：

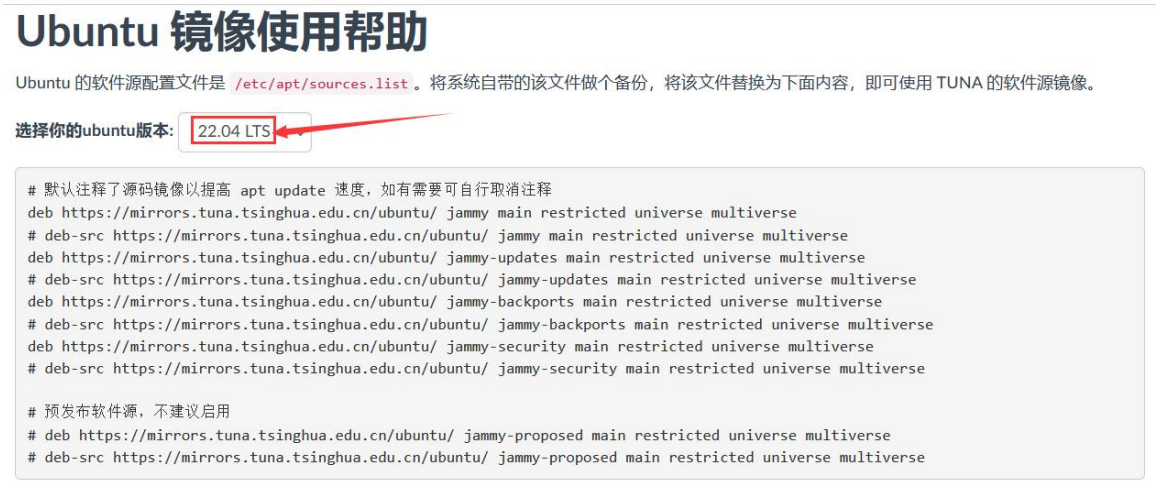
https://mirrors.tuna.tsinghua.edu.cn/ubuntu-releases/22.04/ubuntu-22.04.3-desktop-amd64.iso
or
https://repo.huaweicloud.com/ubuntu-releases/22.04/ubuntu-22.04.3-desktop-amd64.iso

4) After installing Ubuntu 22.04 on the computer or virtual machine, please set the software source of Ubuntu 22.04 to Tsinghua source, otherwise it is easy to make mistakes due to network reasons when installing the software later

a. For the method of replacing Tsinghua source, please refer to the instructions on this web page

https://mirrors.tuna.tsinghua.edu.cn/help/ubuntu/

b. Note that the Ubuntu version needs to be switched to 22.04



c. The content of the **/etc/apt/sources.list** file that needs to be replaced is

```
test@test:~$ sudo mv /etc/apt/sources.list /etc/apt/sources.list.bak
test@test:~$ sudo vim /etc/apt/sources.list
# By default, the source image is commented to improve the speed of apt update, you can uncomment it yourself if necessary
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy main restricted universe multiverse
# deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy main restricted universe multiverse
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-updates main restricted universe multiverse
# deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-updates main restricted universe multiverse
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-backports main restricted universe multiverse
# deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-backports main restricted universe multiverse
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse
# deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse

# Pre-release software source, not recommended to enable
# deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-proposed main restricted universe multiverse
# deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-proposed main restricted universe multiverse
```

d. After the replacement, you need to update the package information and make sure there is no error

```
test@test:~$ sudo apt update
```

e. In addition, since the source codes such as the kernel and U-boot are stored on GitHub, it is very important to ensure that the computer can download codes from GitHub normally when compiling the image.

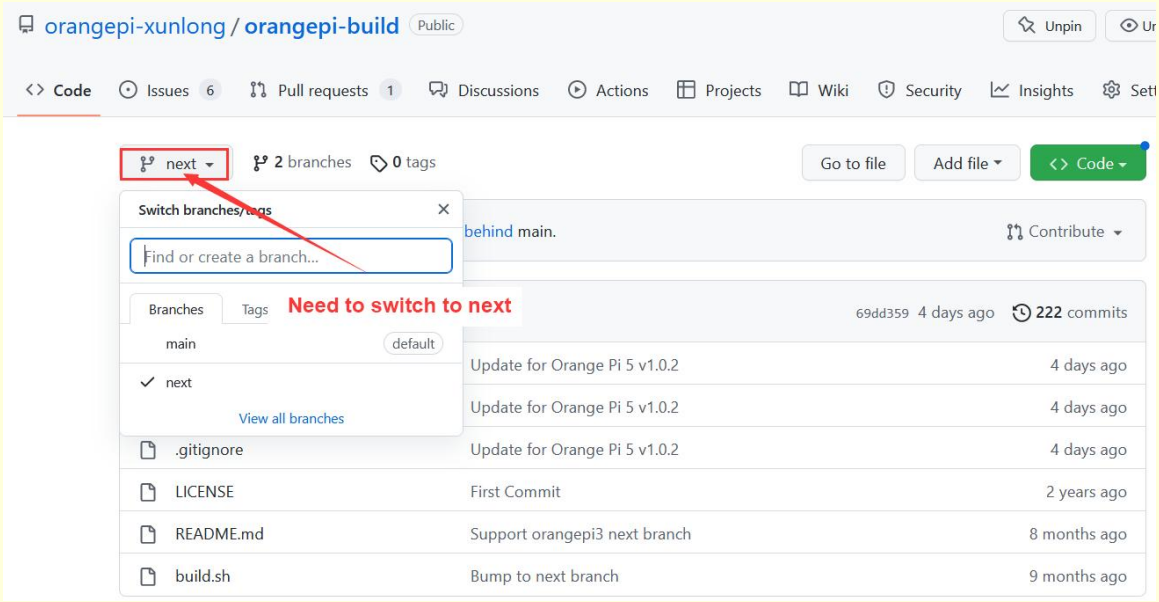
6. 2. Get the source code of linux sdk

6. 2. 1. Download orangepi-build from github

1) The linux sdk actually refers to the code of orangepi-build. orangepi-build is modified based on the armbian build system. Using orangepi-build, multiple versions of linux images can be compiled. First download the code of orangepi-build, the command is as follows：

```
test@test:~$ sudo apt-get update
test@test:~$ sudo apt-get install -y git
test@test:~$ git clone https://github.com/orangepi-xunlong/orangepi-build.git -b next
```

Note that the Orange Pi 5 Plus development board needs to download the source code of the next branch of orangepi-build. The above git clone command needs to specify the branch of the orangepi-build source code as next.



Downloading the orangepi-build code through the git clone command does not require entering the user name and password of the github account (the same is true for downloading other codes in this manual), if the Ubuntu PC prompts the user to enter the github account after entering the git clone command The name and password are usually entered incorrectly in the address of the orangepi-build

warehouse behind the git clone. Please check the spelling of the command carefully, instead of thinking that we forgot to provide the username and password of the github account.

2) The u-boot and linux kernel versions currently used by the development board are as follows

branch	u-boot version	linux kernel version
legacy	u-boot 2017.09	linux5.10
current	u-boot 2017.09	linux6.1

The branch mentioned here is not the same thing as the branch of the orangepi-build source code, please do not confuse it. This branch is mainly used to distinguish different kernel source code versions.

We currently define the linux5.10 bsp kernel provided by RK as the legacy branch, and the linux6.1 bsp kernel as the current branch.

3) orangepi-build will contain the following files and folders after downloading

a. **build.sh**: Compile the startup script
b. **external**: Contains the configuration files needed to compile the image, specific scripts, and the source code of some programs, etc.
c. **LICENSE**: GPL 2 license file
d. README.md: orangepi-build documentation
e. **scripts**: General script for compiling linux images

```
test@test:~/orangepi-build$ ls
build.sh  external  LICENSE  README.md  scripts
```

If you downloaded the code of orangepi-build from github, after downloading, you may find that orangepi-build does not contain the source code of u-boot and linux kernel, nor does u-boot and linux kernel need to use cross-compilation tools Chain, this is normal, because these things are stored in other separate github warehouses or some servers (the addresses will be detailed below). orangepi-build will specify the address of u-boot, linux kernel and cross-compilation toolchain in the script and configuration file. When running orangepi-build, when it finds that there are no such things locally, it will automatically go to the corresponding place to download them.

6. 2. 2. Download the cross-compilation toolchain

The cross-compilation toolchain will only be downloaded when the orangepi-build compilation image is used on an x64 computer. Compiling the linux image of the development board in the Ubuntu22.04 of the development board will not download the cross-compilation toolchain. At this time, orangepi-build/toolchains will be an empty folder.

1) When orangepi-build runs for the first time, it will automatically download the cross-compilation toolchain and put it in the toolchains folder. Every time after running the build.sh script of orangepi-build, it will check whether the cross-compilation toolchain in toolchains exists , if it does not exist, the download will be restarted, if it exists, it will be used directly, and the download will not be repeated.

```
[ o.k. ] Checking for external GCC compilers
[ ... ] downloading using http(s) network [ gcc-linaro-aarch64-none-elf-4.8-2013.11_linux.tar.xz ]
#8d7029 16MiB/24MiB(65%) CN:1 DL:7.9MiB ETA:1s]
[ o.k. ] Verified [ PGP ]
[ ... ] decompressing
[ ... ] gcc-linaro-aarch64-none-elf-4.8-2013.11_linux.tar.xz: 24.9MiB [14.4MiB/s] [==========>] 100%
[ ... ] downloading using http(s) network [ gcc-linaro-arm-none-eabi-4.8-2014.04_linux.tar.xz ]
#e30eec 17MiB/33MiB(50%) CN:1 DL:10MiB ETA:1s]
[ o.k. ] Verified [ PGP ]
[ ... ] decompressing
[ ... ] gcc-linaro-arm-none-eabi-4.8-2014.04_linux.tar.xz: 33.9MiB [9.66MiB/s] [==========>] 100%
[ ... ] downloading using http(s) network [ gcc-linaro-arm-linux-gnueabihf-4.8-2014.04_linux.tar.xz ]
#041c24 48MiB/48MiB(99%) CN:1 DL:2.7MiB]
[ o.k. ] Verified [ PGP ]
[ ... ] decompressing
[ ... ] gcc-linaro-arm-linux-gnueabihf-4.8-2014.04_linux.tar.xz: 48.8MiB [13.0MiB/s] [==========>] 100%
[ ... ] downloading using http(s) network [ gcc-linaro-4.9.4-2017.01-x86_64_arm-linux-gnueabi.tar.xz ]
#3dee3e 72MiB/76MiB(93%) CN:1 DL:3.7MiB ETA:1s]
[ o.k. ] Verified [ MD5 ]
[ ... ] decompressing
[ ... ] gcc-linaro-4.9.4-2017.01-x86_64_arm-linux-gnueabi.tar.xz: 77.0MiB [14.2MiB/s] [==========>] 100%
[ ... ] downloading using http(s) network [ gcc-linaro-7.4.1-2019.02-x86_64_arm-linux-gnueabi.tar.xz ]
#42e728 104MiB/104MiB(99%) CN:1 DL:2.8MiB]
[ o.k. ] Verified [ MD5 ]
[ ... ] decompressing
[ ... ] gcc-linaro-7.4.1-2019.02-x86_64_arm-linux-gnueabi.tar.xz:  104MiB [13.9MiB/s] [==========>] 100%
[ ... ] downloading using http(s) network [ gcc-linaro-7.4.1-2019.02-x86_64_aarch64-linux-gnu.tar.xz ]
#2c065e 108MiB/111MiB(97%) CN:1 DL:3.9MiB]
[ o.k. ] Verified [ MD5 ]
[ ... ] decompressing
[ ... ] gcc-linaro-7.4.1-2019.02-x86_64_aarch64-linux-gnu.tar.xz:  111MiB [13.4MiB/s] [==========>] 100%
[ ... ] downloading using http(s) network [ gcc-arm-9.2-2019.12-x86_64-arm-none-linux-gnueabihf.tar.xz ]
#d232ee 250MiB/251MiB(99%) CN:1 DL:2.0MiB]
[ o.k. ] Verified [ MD5 ]
[ ... ] decompressing
[ ... ] gcc-arm-9.2-2019.12-x86_64-arm-none-linux-gnueabihf.tar.xz:  251MiB [13.7MiB/s] [==========>] 100%
[ ... ] downloading using http(s) network [ gcc-arm-9.2-2019.12-x86_64-aarch64-none-linux-gnu.tar.xz ]
#88b441 268MiB/269MiB(99%) CN:1 DL:0.9MiB]
[ o.k. ] Verified [ MD5 ]
[ ... ] decompressing
```

2) The image URL of the cross-compilation toolchain in China is the open source software image site of Tsinghua University

https://mirrors.tuna.tsinghua.edu.cn/armbian-releases/_toolchain/

3) After **toolchains** is downloaded, it will contain multiple versions of cross-compilation toolchains, and the development board will only use two of them

```
test@test:~/orangepi-build$ ls toolchains/
gcc-arm-11.2-2022.02-x86_64-aarch64-none-linux-gnu
gcc-arm-11.2-2022.02-x86_64-arm-none-linux-gnueabihf
gcc-arm-9.2-2019.12-x86_64-aarch64-none-linux-gnu
```

gcc-arm-9.2-2019.12-x86_64-arm-none-linux-gnueabihf gcc-linaro-4.9.4-2017.01-x86_64_arm-linux-gnueabi gcc-linaro-5.5.0-2017.10-x86_64_arm-linux-gnueabihf gcc-linaro-7.4.1-2019.02-x86_64_aarch64-linux-gnu gcc-linaro-7.4.1-2019.02-x86_64_arm-linux-gnueabi gcc-linaro-aarch64-none-elf-4.8-2013.11_linux gcc-linaro-arm-linux-gnueabihf-4.8-2014.04_linux gcc-linaro-arm-none-eabi-4.8-2014.04_linux

4) The cross-compilation toolchain used to compile the linux kernel source code is

a. linux5.10 and linux6.1

gcc-arm-11.2-2022.02-x86_64-aarch64-none-linux-gnu

5) The cross-compilation tool chain used to compile the u-boot source code is

a. v2017.09

gcc-linaro-7.4.1-2019.02-x86_64_aarch64-linux-gnu

6.2.3. orangepi-build complete directory structure description

1) The orangepi-build repository does not contain the source code of the linux kernel, u-boot, and cross-compilation toolchain after downloading. The source code of the linux kernel and u-boot is stored in an independent git repository

a. The git repository where the Linux5.10 kernel source code is stored is as follows:

https://github.com/orangepi-xunlong/linux-orangepi/tree/orange-pi-5.10-rk35xx

b. The git warehouse where the Linux6.1 kernel source code is stored is as follows:

https://github.com/orangepi-xunlong/linux-orangepi/tree/orange-pi-6.1-rk35xx

c. The git warehouse where the u-boot source code is stored is as follows：

https://github.com/orangepi-xunlong/u-boot-orangepi/tree/v2017.09-rk3588

2) When orangepi-build runs for the first time, it will download the cross-compilation toolchain, u-boot and linux kernel source code. After successfully compiling a linux image, the files and folders that can be seen in orangepi-build are:

a. **build.sh**: compile startup script

b. **external**: Contains the configuration files needed to compile the image, scripts with specific functions, and the source code of some programs. The rootfs compressed package cached during the image compilation process is also stored in

external

c. **kernel**: Stores the source code of the Linux kernel. The folder named **orange-pi-5.10-rk35xx** stores the kernel source code of the legacy branch of the RK3588/RK3588S series development board. The folder named **orange-pi-6.1-rk35xx** stores the RK3588 /Kernel source code of the current branch of the RK3588S series development board. Please do not modify the name of the folder of the kernel source code manually. If modified, the kernel source code will be re-downloaded when the compilation system is running.

d. **LICENSE**: GPL 2 license file

e. **README.md**: orangepi-build documentation

f. **output**: Store compiled deb packages such as u-boot and linux, compilation logs, and compiled images and other files

g. **scripts**: general scripts for compiling linux images

h. **toolchains**: store cross-compilation toolchain

i. **u-boot**: Store the u-boot source code. The folder named **v2017.09-rk3588** stores the u-boot source code of the legacy and current branches of the RK3588/RK3588S series development board. Please do not modify the name of the u-boot source code folder manually. , if modified, the u-boot source code will be re-downloaded when the compilation system is running.

j. **userpatches**: Store configuration files needed to compile scripts

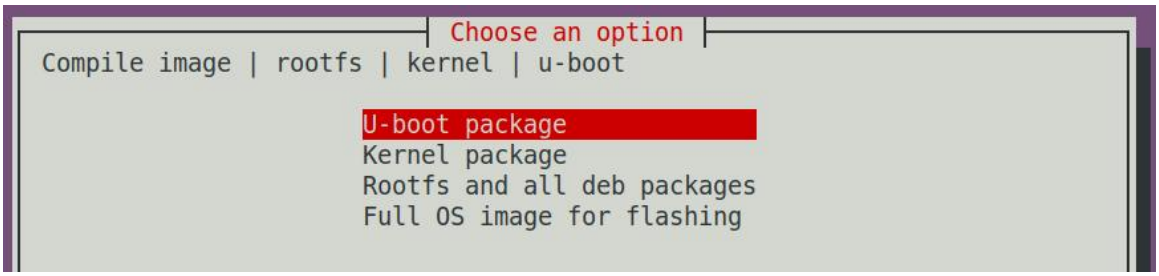
```
test@test:~/orangepi-build$ ls
build.sh  external  kernel  LICENSE  output  README.md  scripts  toolchains  u-boot  userpatches
```

6.3. Compile u-boot

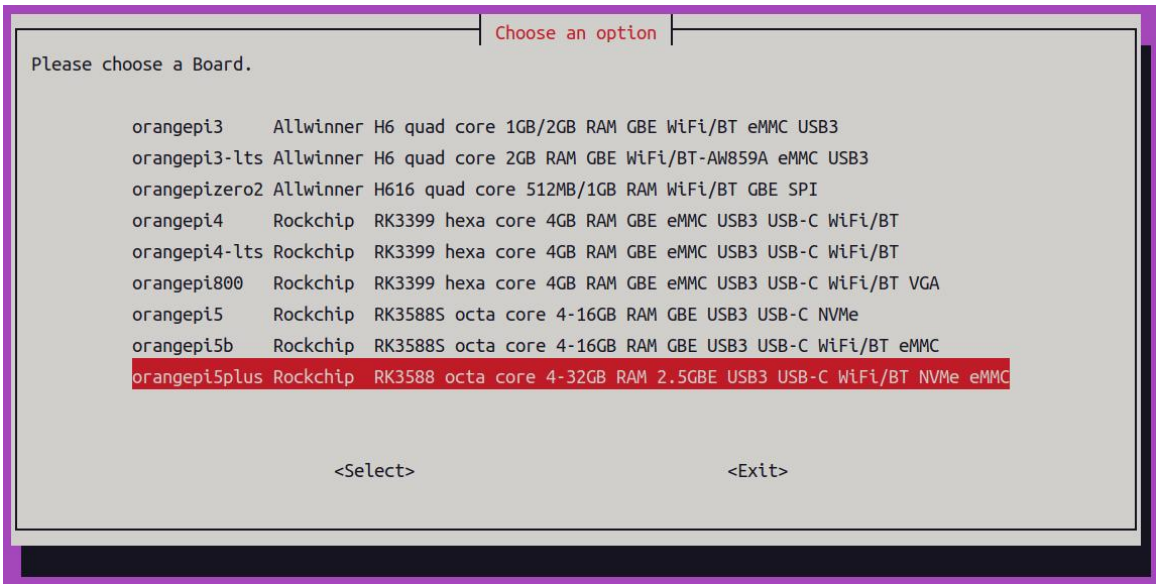
1) Run the build.sh script, remember to add sudo permission

```
test@test:~/orangepi-build$ sudo ./build.sh
```

2) Select **U-boot package**, then press Enter



3) Then select the model of the development board



4) Then it will start to compile u-boot, and some information prompted during compilation is explained as follows

a. u-boot source code version

[o.k.] Compiling u-boot [**v2017.09**]

b. The version of the cross-compilation toolchain

[o.k.] Compiler version [**aarch64-linux-gnu-gcc 7.4.1**]

c. Path to the generated u-boot deb package

[o.k.] Target directory [**orangepi-build/output/debs/u-boot**]

d. The package name of the generated u-boot deb package

[o.k.] File name [**linux-u-boot-legacy-orangepi5plus_1.0.0_arm64.deb**]

e. Compilation time

[o.k.] Runtime [**1 min**]

f. Repeat the command to compile u-boot, use the following command to start

compiling u-boot directly without selecting through the graphical interface

```
[ o.k. ] Repeat Build Options [ sudo ./build.sh BOARD=orangepi5plus
BRANCH=legacy BUILD_OPT=u-boot KERNEL_CONFIGURE=no ]
```

5) View the u-boot deb package generated by compilation

```
test@test:~/orangepi-build$ ls output/debs/u-boot/
linux-u-boot-legacy-orangepi5plus_1.0.0_arm64.deb
```

6) The files contained in the generated u-boot deb package are as follows

a. Use the following command to decompress the deb package

```
test@test:~/orangepi-build$ cd output/debs/u-boot
test@test:~/orangepi_build/output/debs/u-boot$ $ sudo dpkg -x \
linux-u-boot-legacy-orangepi5plus_1.0.0_arm64.deb .      (Note that there is a "." at
the end of the command)
test@test:~/orangepi_build/output/debs/u-boot$ ls
linux-u-boot-legacy-orangepi5plus_1.0.0_arm64.deb    usr
```

b. The decompressed file is as follows

```
test@test:~/orangepi-build/output/debs/u-boot$ tree usr
usr
└── lib
    ├── linux-u-boot-legacy-orangepi5plus_1.0.0_arm64
    │   ├── idbloader.img
    │   ├── rkspi_loader.img
    │   └── u-boot.itb
    └── u-boot
        ├── LICENSE
        ├── orangepi_5_plus_defconfig
        └── platform_install.sh

3 directories, 6 files
```

7) When the orangepi-bulid compilation system compiles the u-boot source code, it will first synchronize the u-boot source code with the u-boot source code of the github server, so if you want to modify the u-boot source code, you first need to turn off the download and update function of the source code **(need This function can only be turned off after**

u-boot has been fully compiled, otherwise it will prompt that the source code of u-boot cannot be found. If the source code compressed package is downloaded from Google Drive, there is no such problem because the source code of u-boot cached), otherwise the changes made will be restored, the method is as follows：

Set the IGNORE_UPDATES variable in userpatches/config-default.conf to "yes"

```
test@test:~/orangepi-build$ vim userpatches/config-default.conf
IGNORE_UPDATES="yes"
```

8) When debugging u-boot code, you can use the following method to update u-boot in the linux image for testing

a. Upload the compiled u-boot deb package to the linux system of the development board

```
test@test:~/orangepi-build$ cd output/debs/u-boot
test@test:~/orangepi_build/output/debs/u-boot$ scp \
linux-u-boot-legacy-orangepi5plus_1.0.0_arm64.deb root@192.168.1.xxx:/root
```

b. Then log in to the development board and uninstall the deb package of u-boot installed

```
root@orangepi:~# apt purge -y linux-u-boot-orangepi5plus-legacy
```

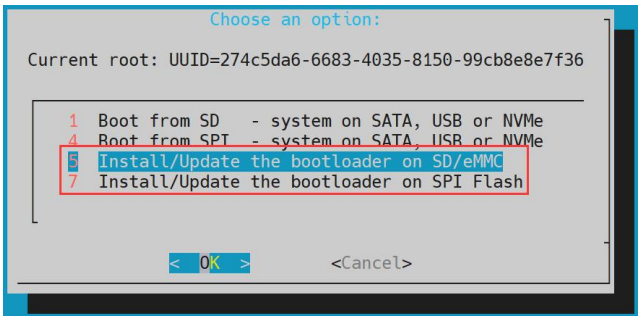
c. Install the new u-boot deb package just uploaded

```
root@orangepi:~# dpkg -i linux-u-boot-legacy-orangepi5plus_1.0.0_arm64.deb
```

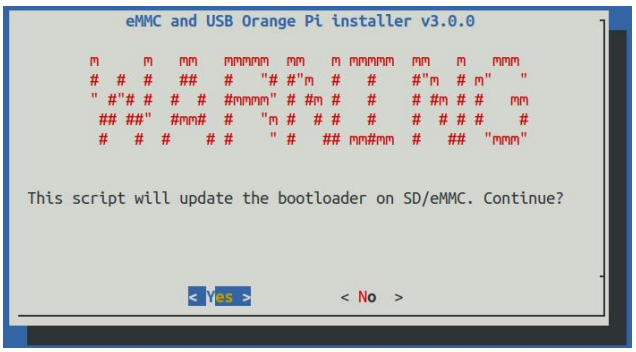
d. Then run the nand-sata-install script

```
root@orangepi:~# nand-sata-install
```

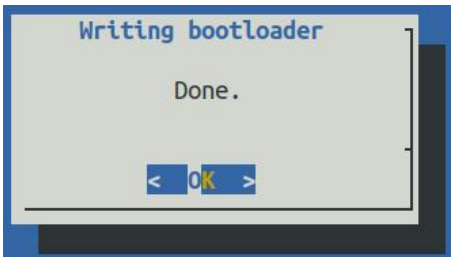
e. Then select **5 Install/Update the bootloader on SD/eMM** to update the u-boot in the TF card or **7 Install/Update the bootloader on SPI Flash** to update the u-boot in the SPI Flash



f. After pressing the Enter key, a Warning will pop up first



g. Press the Enter key again to start updating u-boot, and the following information will be displayed after the update is completed



h. Then you can restart the development board to test whether the modification of u-boot takes effect

9) Other useful information

a. u-boot 2017.09 source code, the defconfig configuration file used by the development board is

orangepi-build/u-boot/v2017.09-rk3588/configs/orangepi_5_plus_defconfig

b. u-boot 2017.09 source code, the dts file used by the development board is

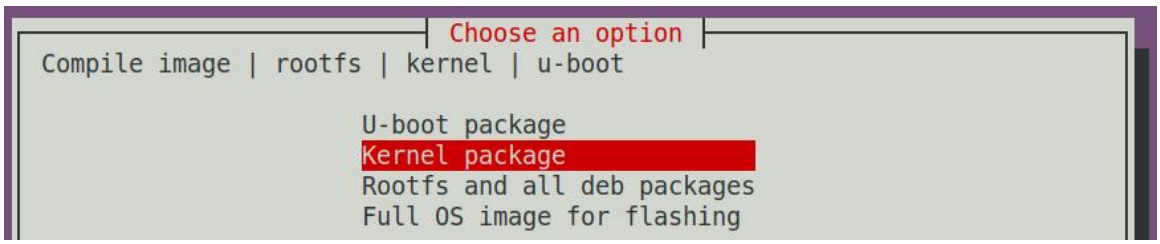
orangepi-build/u-boot/v2017.09-rk3588/arch/arm/dts/rk3588-orangepi-5-plus.dts

6. 4. Compile the linux kernel

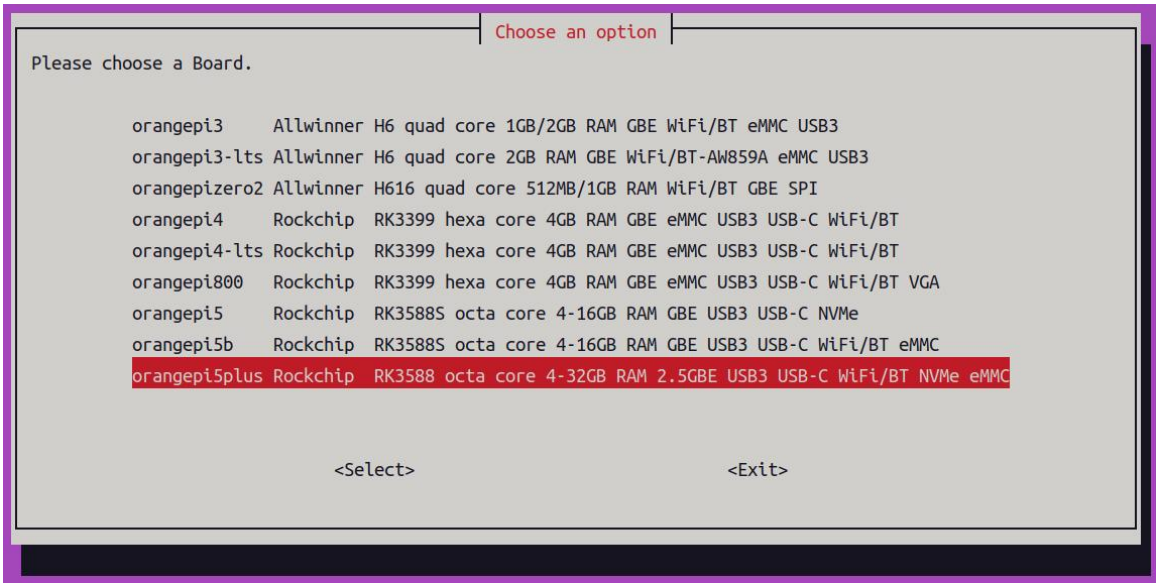
1) Run the build.sh script, remember to add sudo permission

```
test@test:~/orangepi-build$ sudo ./build.sh
```

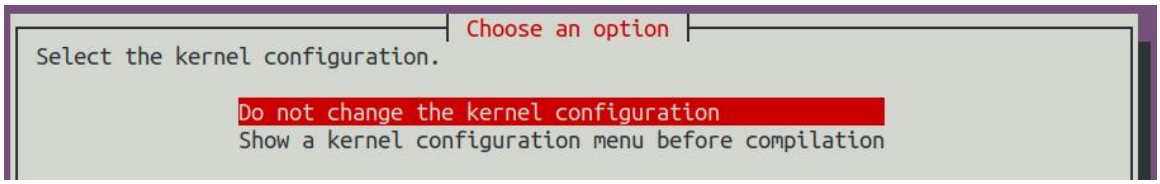
2) Select **Kernel package**, then press Enter



3) Then select the model of the development board



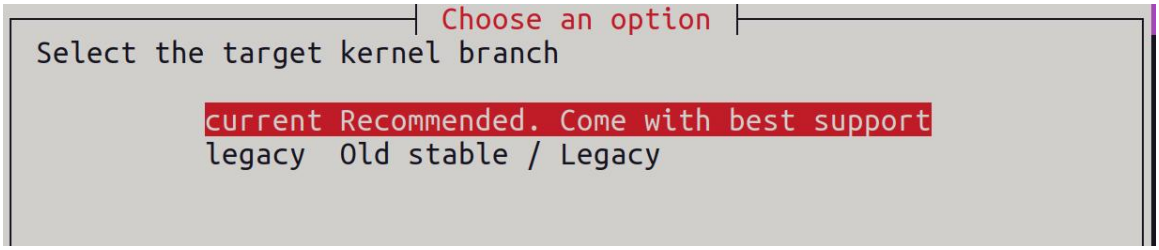
4) Then it will prompt whether to display the kernel configuration interface. If you do not need to modify the kernel configuration, select the first one. If you need to modify the kernel configuration, select the second one.



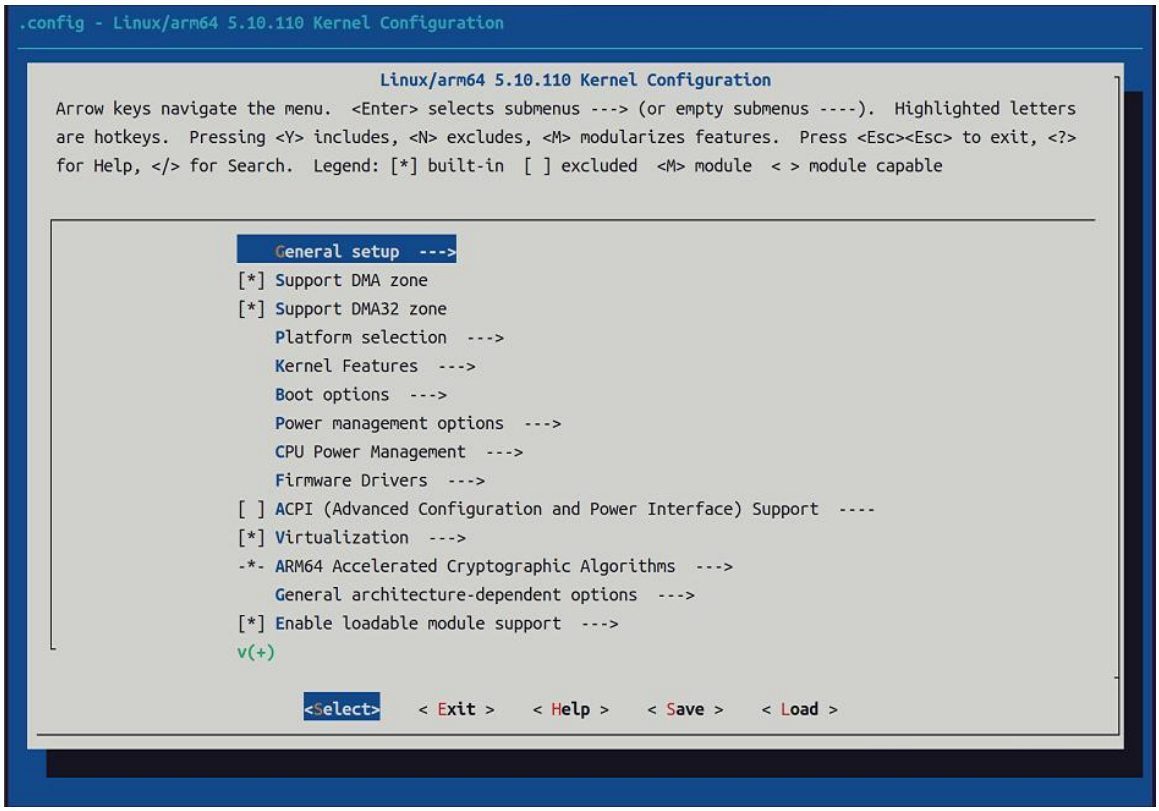
5) Then select the branch type of the kernel source code

a. The a.legacy branch will compile the linux5.10 kernel source code

b. The b.current branch will compile the linux6.1 kernel source code



6) If you choose to display the kernel configuration menu (the second option) in step 4), the kernel configuration interface opened by **make menuconfig** will pop up. At this time, you can directly modify the kernel configuration, save and exit after modification. Yes, after exiting, the kernel source code will be compiled



a. If you do not need to modify the configuration options of the kernel, when running the build.sh script, pass in **KERNEL_CONFIGURE=no** to temporarily block the pop-up kernel configuration interface

```
test@test:~/orangepi-build$ sudo ./build.sh KERNEL_CONFIGURE=no
```

b. You can also set **KERNEL_CONFIGURE=no** in the **orangepi-build/userpatches/config-default.conf** configuration file, which can permanently disable this function

c. If the following error is displayed when compiling the kernel, it is because the terminal interface of the Ubuntu PC is too small to display the **make menuconfig**

interface. Please maximize the terminal of the Ubuntu PC and run the build.sh script again

```
  HOSTCC  scripts/kconfig/mconf.o
  HOSTCC  scripts/kconfig/lxdialog/checklist.o
  HOSTCC  scripts/kconfig/lxdialog/util.o
  HOSTCC  scripts/kconfig/lxdialog/inputbox.o
  HOSTCC  scripts/kconfig/lxdialog/textbox.o
  HOSTCC  scripts/kconfig/lxdialog/yesno.o
  HOSTCC  scripts/kconfig/lxdialog/menubox.o
  HOSTLD  scripts/kconfig/mconf
scripts/kconfig/mconf  Kconfig
Your display is too small to run Menuconfig!
It must be at least 19 lines by 80 columns.
scripts/kconfig/Makefile:28: recipe for target 'menuconfig' failed
make[1]: *** [menuconfig] Error 1
Makefile:560: recipe for target 'menuconfig' failed
make: *** [menuconfig] Error 2
[ error ] ERROR in function compile_kernel [ compilation.sh:376 ]
[ error ] Error kernel menuconfig failed
[ o.k. ] Process terminated
```

7) Part of the information prompted when compiling the kernel source code is as follows

a. The version of the linux kernel source code

[o.k.] Compiling current kernel [**5.10.160**]

b. The version of the cross-compilation toolchain used

[o.k.] Compiler version [**aarch64-none-linux-gnu-gcc 11.2.1**]

c. The configuration file used by the kernel by default and the path where it is stored

[o.k.] Using kernel config file [**config/kernel/linux-rockchip-rk3588-legacy.config**]

d. The path of the deb package related to the kernel generated by compiling

[o.k.] Target directory [**orangepi-build/output/debs/**]

e. The package name of the compiled kernel image deb package

[o.k.] File name [**linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb**]

f. The time used for compilation

[o.k.] Runtime [**5 min**]

g. Finally, the compilation command to repeatedly compile the kernel selected last time will be displayed. Use the following command to start compiling the kernel source code directly without selecting through the graphical interface

[o.k.] Repeat Build Options [**sudo ./build.sh BOARD=orangepi5plus BRANCH=legacy BUILD_OPT=kernel KERNEL_CONFIGURE=no**]

8) View the deb package related to the kernel generated by compilation

a. **linux-dtb-legacy-rockchip-rk3588_1.0.0_arm64.deb** Contains dtb files used by the kernel

b. **linux-headers-legacy-rockchip-rk3588_1.0.0_arm64.deb** Include kernel headers

c. **linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb** Contains kernel images and kernel modules

```
test@test:~/orangepi-build$ ls output/debs/linux-*
output/debs/linux-dtb-legacy-rockchip-rk3588_1.0.0_arm64.deb
output/debs/linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb
output/debs/linux-headers-legacy-rockchip-rk3588_1.0.0_arm64.deb
```

9) The files contained in the generated linux-image deb package are as follows

a. Use the following command to decompress the deb package

```
test@test:~/orangepi-build$ cd output/debs
test@test:~/orangepi_build/output/debs$ mkdir test
test@test:~/orangepi_build/output/debs$ cp \
linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb test/
test@test:~/orangepi_build/output/debs$ cd test
test@test:~/orangepi_build/output/debs/test$ dpkg -x \
linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb .
test@test:~/orangepi_build/output/debs/test$ ls
boot  etc  lib  linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb  usr
```

b. The decompressed file is as follows

```
test@test:~/orangepi-build/output/debs/test$ tree -L 2
.
├── boot
│   ├── config-5.10.160-rockchip-rk3588
│   ├── System.map-5.10.160-rockchip-rk3588
│   └── vmlinuz-5.10.160-rockchip-rk3588
├── etc
│   └── kernel
├── lib
│   └── modules
├── linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb
└── usr
    ├── lib
    └── share
```

10) The orangepi-bulid compilation system will first synchronize the linux kernel source code with the linux kernel source code of the github server when compiling the linux kernel source code, so if you want to modify the linux kernel source code, you first need to turn off the update function of the source code **(you need to compile it once This function can only be turned off after the linux kernel source code, otherwise it will prompt that the source code of the linux kernel cannot be found. If the source code compressed package downloaded from Google Drive, there is no such problem, because the source code of linux has been cached)**, otherwise the The changes made will be reverted as follows:

Set the IGNORE_UPDATES variable in **userpatches/config-default.conf** to "yes"

```
test@test:~/orangepi-build$ vim userpatches/config-default.conf
IGNORE_UPDATES="yes"
```

11) If the kernel has been modified, the following method can be used to update the kernel and kernel modules of the development board linux system

a. Upload the deb package of the compiled linux kernel to the linux system of the development board

```
test@test:~/orangepi-build$ cd output/debs
test@test:~/orangepi-build/output/debs$ scp \
linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb root@192.168.1.xxx:/root
```

b. Then log in to the development board and uninstall the deb package of the installed linux kernel

```
root@orangepi:~# apt purge -y linux-image-legacy-rockchip-rk3588
```

c. Install the deb package of the new linux kernel just uploaded

```
root@orangepi:~# dpkg -i linux-image-legacy-rockchip-rk3588_1.0.0_arm64.deb
```

d. Then restart the development board, and then check whether the kernel-related modifications have taken effect

```
root@orangepi:~# reboot
```

10) Other useful information

a. The storage location of the kernel configuration file is as follows. Please do not go to the kernel source code to find the kernel configuration file used by the development board.

a) Linux5.10

```
orangepi-build/external/config/kernel/linux-rockchip-rk3588-legacy.config
```

b) Linux6.1

orangepi-build/external/config/kernel/linux-rockchip-rk3588-current.config

b. The location of the dts file used by the development board is

a) Linux5.10

orangepi-build/kernel/orange-pi-5.10-rk35xx/arch/arm64/boot/dts/rockchip/rk3588-orangepi-5-plus.dts

b) Linux6.1

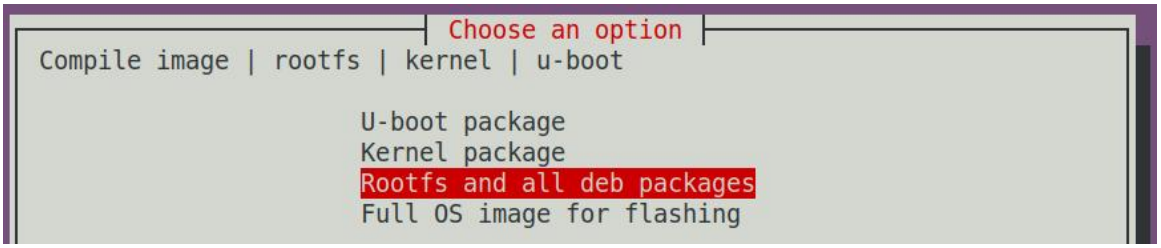
orangepi-build/kernel/orange-pi-6.1-rk35xx/arch/arm64/boot/dts/rockchip/rk3588-orangepi-5-plus.dts

6. 5. Compile rootfs

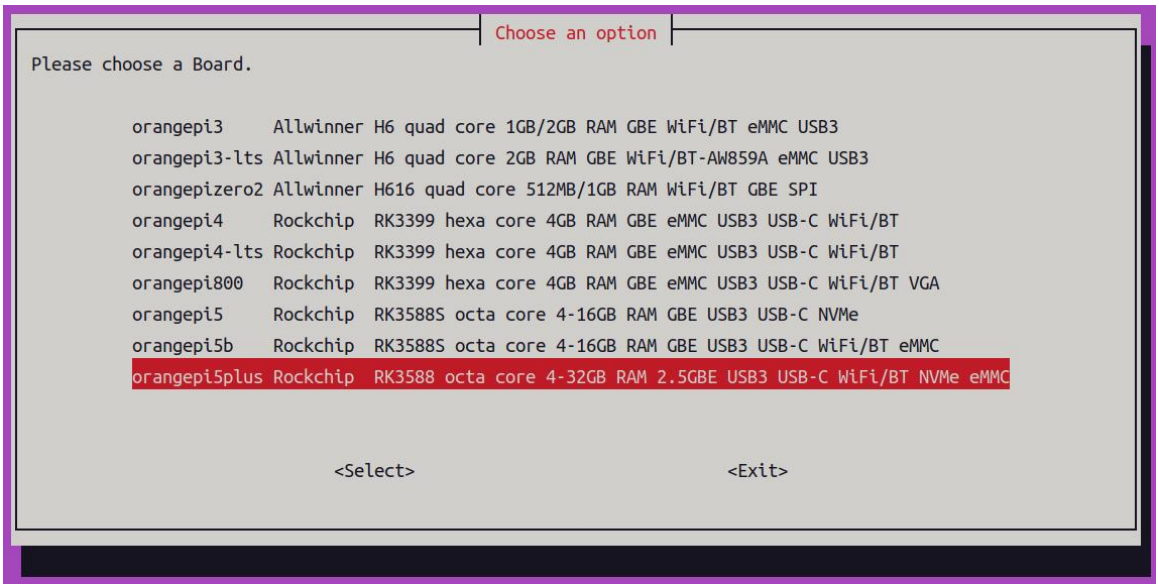
1) Run the build.sh script, remember to add sudo permission

```
test@test:~/orangepi-build$ sudo ./build.sh
```

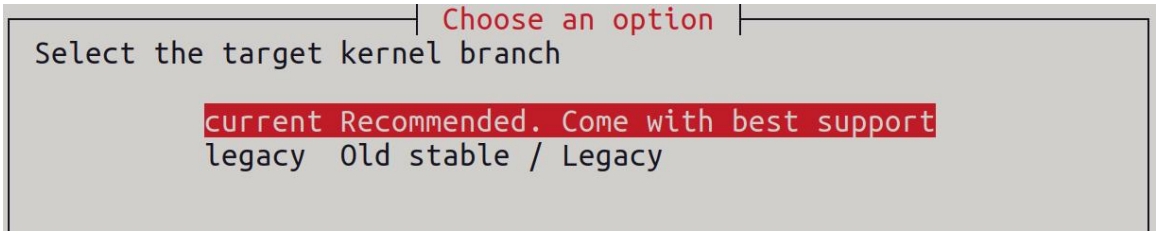
2) Select **Rootfs and all deb packages**, then press Enter



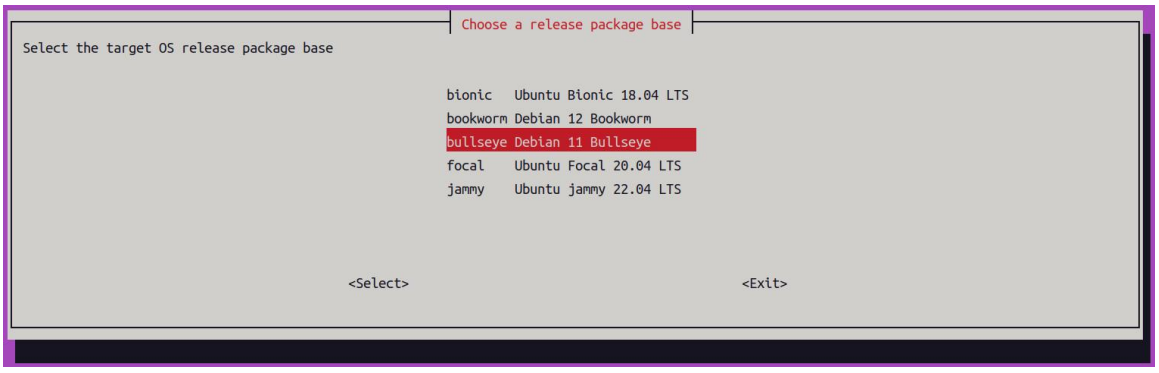
3) Then select the model of the development board



4) Then select the branch type of the kernel source code. Currently, the rootfs maintained by the kernel source code uses the same set.



5) Then select the type of rootfs (mainly maintain **bullseye/bookworm/focal/jammy** at present)

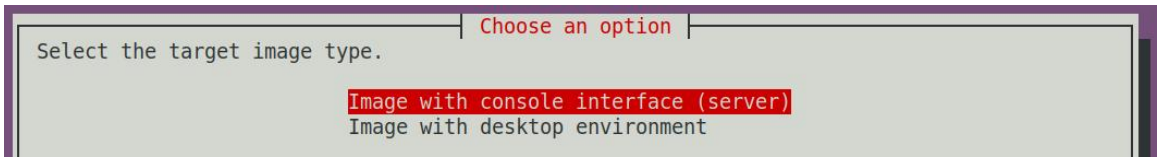


6) Then select the type of image

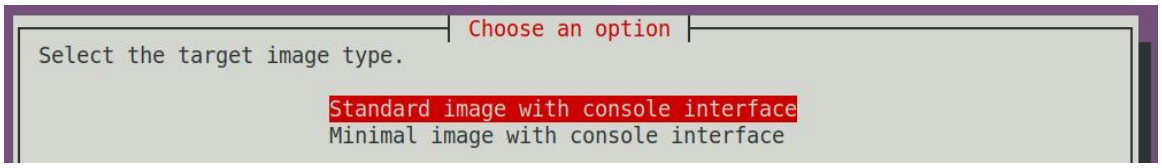
a. **Image with console interface (server)** Indicates the image of the server version, which is relatively small

b. **Image with desktop environment** Indicates a mirror image with a desktop,

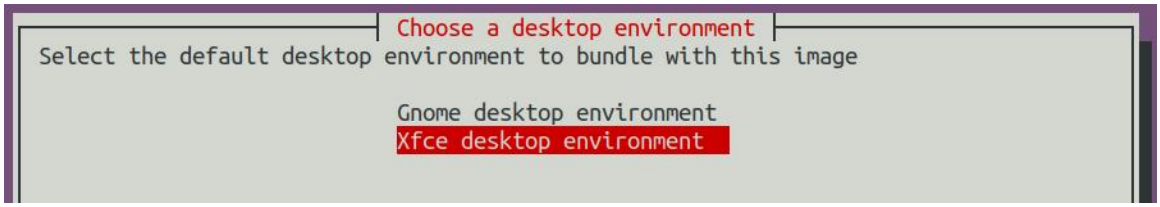
which is relatively large

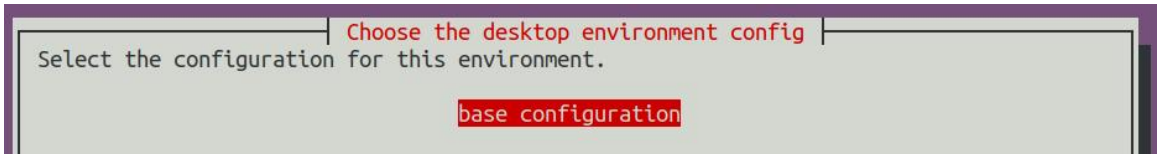


7) If you are compiling the image of the server version, you can also choose to compile the Standard version or the Minimal version. The pre-installed software of the Minimal version will be much less than that of the Standard version **(please do not choose the Minimal version if there is no special requirement, because many things are not pre-installed by default. Some functions may not be available)**

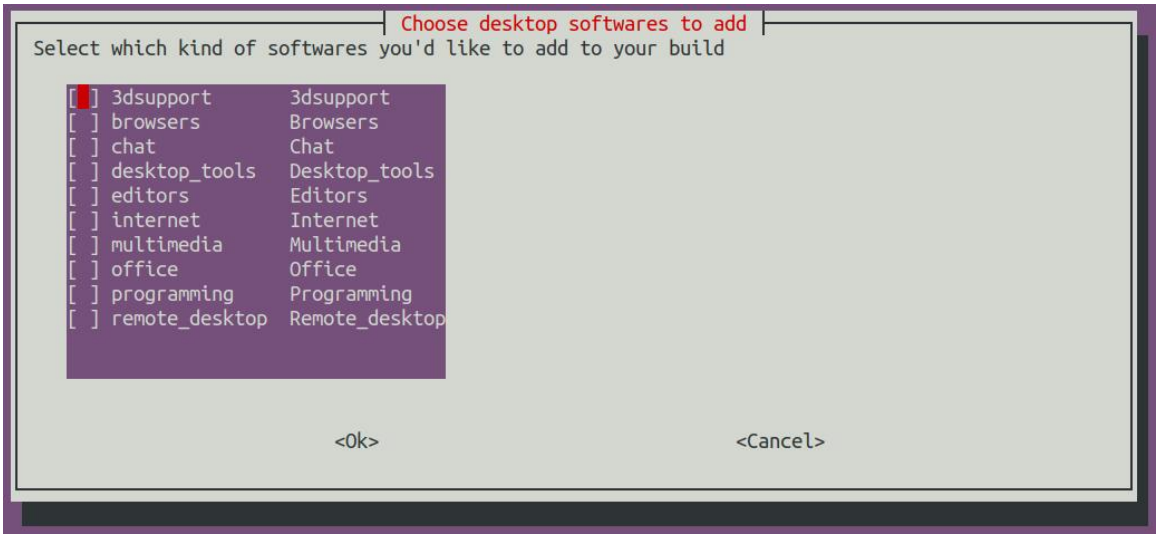


8) If you are compiling the image of the desktop version, you also need to select the type of desktop environment. Currently, Ubuntu Jammy mainly maintains XFCE and Gnome desktops, Ubuntu Focal only maintains XFCE desktops, Debian Bullseye mainly maintains XFCE and KDE desktops, and Debian Bookwork mainly maintains XFCE desktops.





You can then select additional packages that need to be installed. Please press the Enter key to skip directly here.



9) Then it will start to compile rootfs, and some of the information prompted during compilation are as follows

a. The type of rootfs

[o.k.] local not found [Creating new rootfs cache for **jammy**]

b. The storage path of the compiled rootfs compressed package

[o.k.] Target directory [**external/cache/rootfs**]

c. The name of the rootfs compressed package generated by compilation

[o.k.] File name [**jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4**]

d. The time used for compilation

[o.k.] Runtime [**13 min**]

10) View the rootfs compressed package generated by compilation

a. **jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4** is the rootfs compressed package, the meaning of each field of the name is

a) **jammy** indicates the type of linux distribution of rootfs

b) **xfce** means rootfs is the type of desktop version, if it is **cli**, it means the type of server version

c) **arm64** represents the architecture type of rootfs

d) **f930ff6ebbac1a72108a2e100762b18f** is the MD5 hash value generated by the package names of all software packages installed by rootfs. As long as the list of software packages installed by rootfs is not modified, this value will not change. The compilation script will use this MD5 hash value to

generate Determine whether rootfs needs to be recompiled

b. **jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4.list** lists the package names of all packages installed by rootfs

```
test@test:~/orangepi-build$ ls external/cache/rootfs/
jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4
jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4.current
jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4.list
```

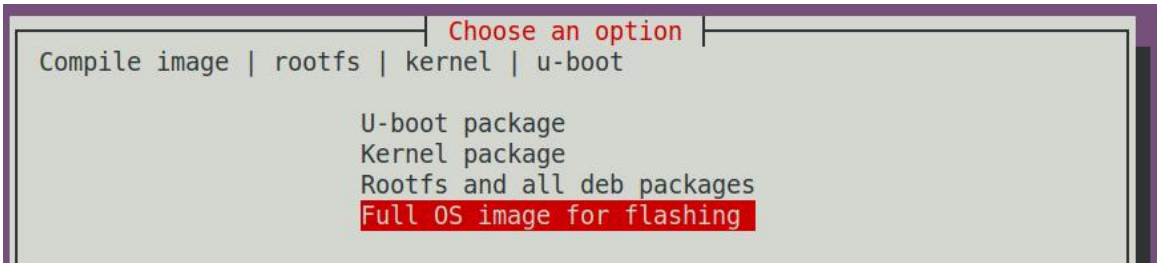
11) If the required rootfs already exists under **external/cache/rootfs**, then compiling rootfs again will directly skip the compilation process and will not restart the compilation. When compiling the image, it will also go to **external/cache/rootfs** to find out whether it has If there is rootfs available in the cache, use it directly, which can save a lot of download and compilation time.

6. 6. Compile linux image

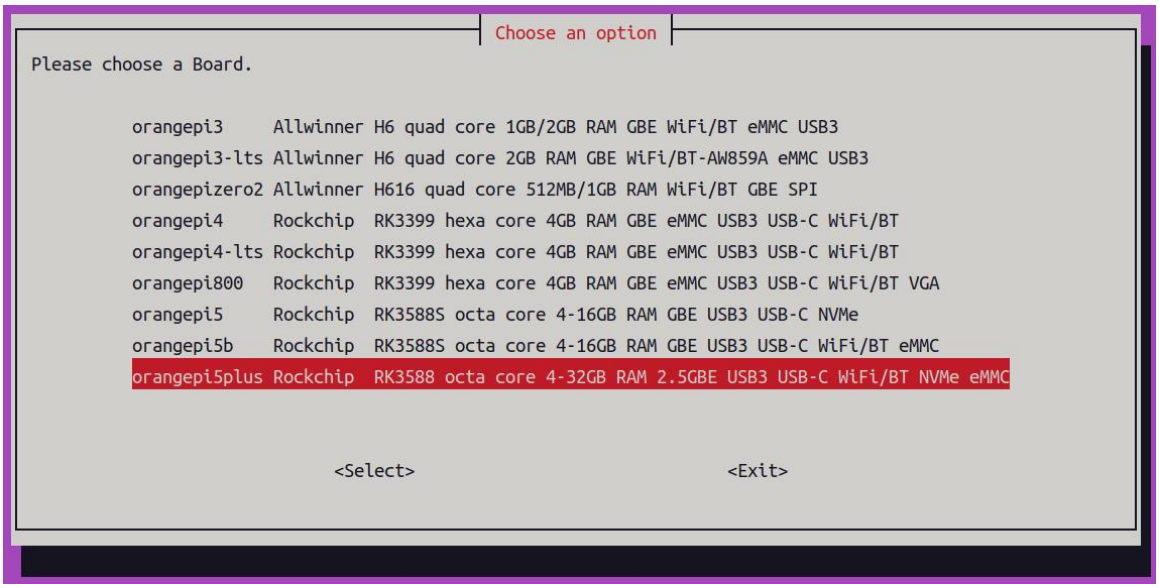
1) Run the build.sh script, remember to add sudo permission

```
test@test:~/orangepi-build$ sudo ./build.sh
```

2) Select **Full OS image for flashing**, then press Enter



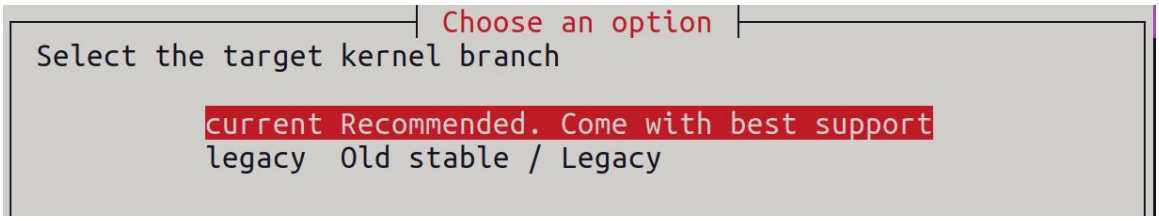
3) Then select the model of the development board



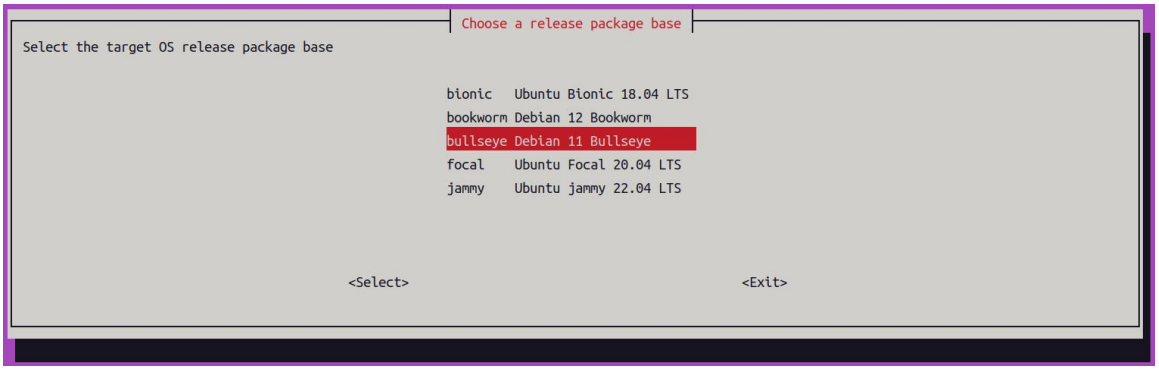
4) Then select the branch type of the kernel source code

a. The a.legacy branch will compile the linux5.10 kernel source code

b. The b.current branch will compile the linux6.1 kernel source code



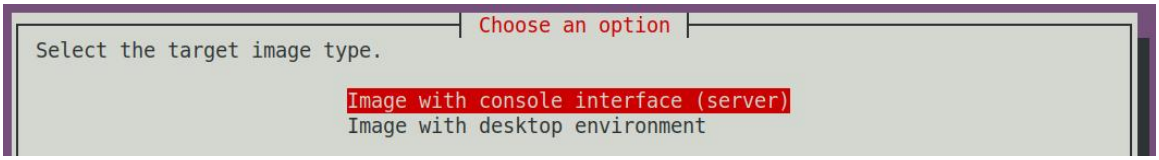
5) Then select the type of rootfs (mainly maintain **bullseye/bookworm/focal/jammy** at present)



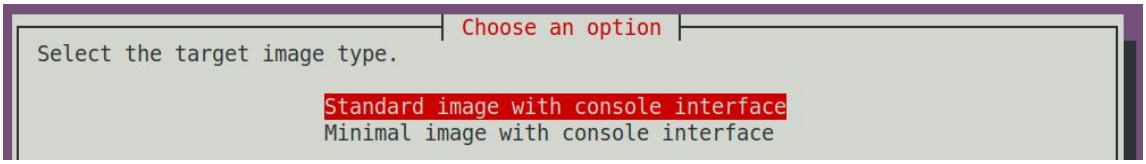
6) Then select the type of image

a. **Image with console interface (server)** Indicates the image of the server version, which is relatively small

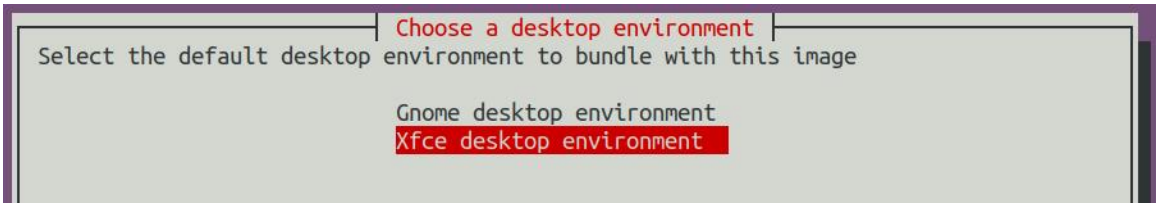
b. **Image with desktop environment** Indicates a image with a desktop, which is relatively large

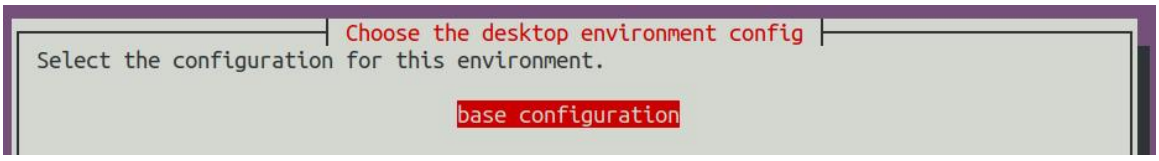


7) If you are compiling the image of the server version, you can also choose to compile the Standard version or the Minimal version. The pre-installed software of the Minimal version will be much less than that of the Standard version **(please do not choose the Minimal version if there is no special requirement, because many things are not pre-installed by default. Some functions may not be available)**

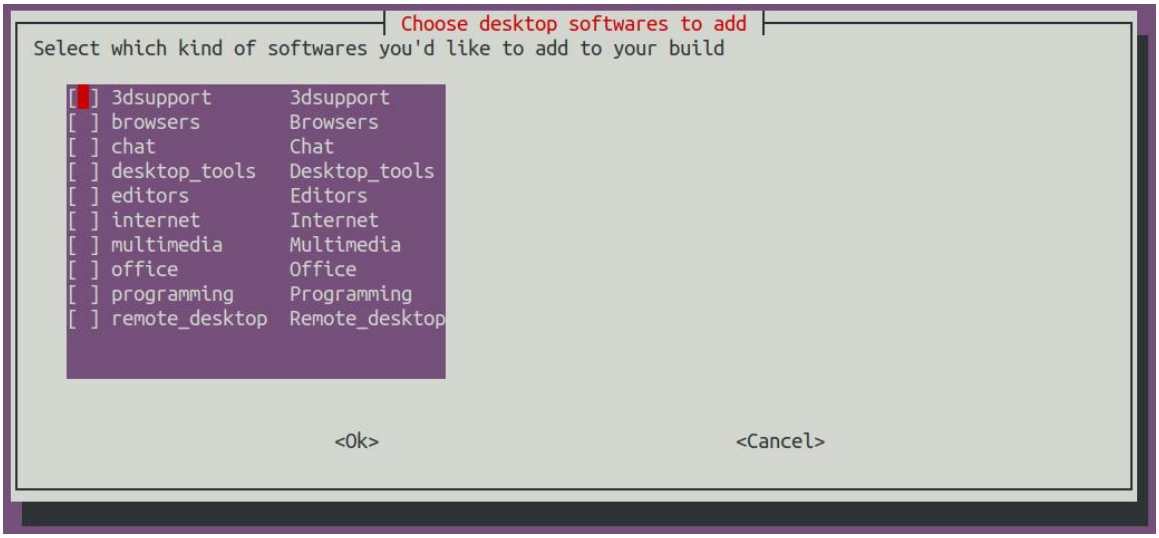


8) If you are compiling the image of the desktop version, you need to select the type of desktop environment. Currently, Ubuntu Jammy mainly maintains XFCE and Gnome desktops, Ubuntu Focal only maintains XFCE desktops, Debian Bullseye mainly maintains XFCE and KDE desktops, and Debian Bookwork mainly maintains XFCE desktop





You can then select additional packages that need to be installed. Please press the Enter key to skip directly here.



9) Then it will start to compile the linux image. The general process of compilation is as follows

a. Initialize the compilation environment of Ubuntu PC and install the software packages required for the compilation process

b. Download the source code of u-boot and linux kernel (if cached, only update the code)

c. Compile u-boot source code and generate u-boot deb package

d. Compile the linux source code and generate linux-related deb packages

e. Make the deb package of linux firmware

f. Make the deb package of the orangepi-config tool

g. Create a deb package supported by the board

h. If you are compiling the desktop image, you will also create desktop-related deb packages

i. Check whether the rootfs has been cached, if not, recreate the rootfs, if it has been cached, directly decompress and use

j. Install the previously generated deb package into rootfs

k. Make some specific settings for different development boards and different types of images, such as pre-installing additional software packages, modifying system configuration, etc.

l. Then make an image file and format the partition, the default type is ext4

m. Then copy the configured rootfs to the mirrored partition

n. Then update initramfs

o. Finally, write the bin file of u-boot into the image through the dd command

10) After compiling the image, the following information will be prompted

a. The storage path of the compiled image

```
[ o.k. ] Done building
[ output/images/orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160/orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.img ]
```

b. Compilation time

```
[ o.k. ] Runtime [ 19 min ]
```

c. Repeat the command to compile the image, and use the following command to start compiling the image directly without selecting through the graphical interface

```
[ o.k. ] Repeat Build Options [ sudo ./build.sh  BOARD=orangepi5plus BRANCH=legacy BUILD_OPT=image RELEASE=bullseye BUILD_MINIMAL=no BUILD_DESKTOP=no KERNEL_CONFIGURE=yes ]
```

7. Linux Development Manual

7.1. The method of compiling the kernel source code separately in the linux system of the development board

1) First download the Linux kernel source code of the development board

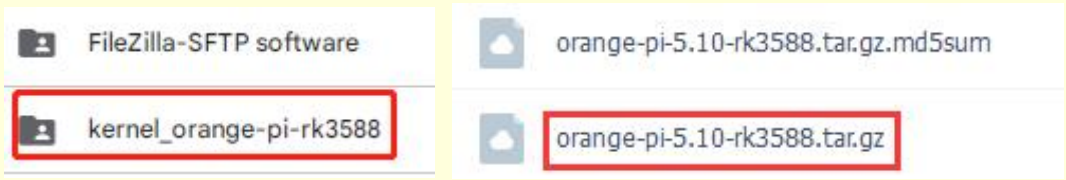
a. If you are using a Linux 5.10 kernel system, you need to download the orange-pi-5.10-rk35xx branch.

```
orangepi@orangepi:~$ git clone --depth=1 -b orange-pi-5.10-rk35xx https://github.com/orangepi-xunlong/linux-orangepi
```

b. If you are using a Linux 6.1 kernel system, you need to download the orange-pi-6.1-rk35xx branch.

```
orangepi@orangepi:~$ git clone --depth=1 -b orange-pi-6.1-rk35xx https://github.com/orangepi-xunlong/linux-orangepi
```

If you have problems downloading the code from github, you can go to the official tool of the development board to download the compressed kernel source code package, then upload it to the linux system of the development board, and then decompress it.



The command to decompress the compressed kernel source code package is:

a. Linux5.10 kernel

orangepi@orangepi:~$ **tar zxf orange-pi-5.10-rk35xx.tar.gz**
orangepi@orangepi:~$ **mv orange-pi-5.10-rk35xx linux-orangepi**

b. Linux6.1 kernel

orangepi@orangepi:~$ **tar zxf orange-pi-6.1-rk35xx.tar.gz**
orangepi@orangepi:~$ **mv orange-pi-6.1-rk35xx linux-orangepi**

After decompression, please execute the following command to synchronize the source code with github to ensure that the source code is in the latest state:
orangepi@orangepi:~$ **cd linux-orangepi**
orangepi@orangepi:~/linux-orangepi$ **git pull**

2) Then configure the default kernel configuration

```
orangepi@orangepi:~$ cd linux-orangepi
orangepi@orangepi:~/linux-orangepi$ make rockchip_linux_defconfig
```

The path of rockchip_linux_defconfig in the kernel source code is arch/arm64/configs/

3) Then compile the kernel source code

```
orangepi@orangepi:~/linux-orangepi$ make -j10
```

4) Then install the kernel module

```
orangepi@orangepi:~/linux-orangepi$ sudo make modules_install
```

The installation path of the kernel module is：/lib/modules

After executing the sudo make modules_install command, you can see that there will be an additional kernel module folder under /lib/modules/:

```
orangepi@orangepi5plus:~$ ls /lib/modules
# If it is a system with Linux 5.10 kernel, the output is as follows
5.10.160+    5.10.160-rockchip-rk3588
# If it is a system with Linux 6.1 kernel, the output is as follows
6.1.43+    6.1.43-rockchip-rk3588
```

5) Then install the kernel image and uInitrd

```
orangepi@orangepi:~/linux-orangepi$ sudo make install
```

The installation path of the kernel image and uInitrd is：/boot/

After executing the sudo make install command, you can see that there will be one more kernel file under /boot/：

```
orangepi@orangepi5plus:~/linux-orangepi$ ls /boot/vmlinuz*
# If it is a system with Linux 5.10 kernel, the output is as follows
/boot/vmlinuz-5.10.160+    /boot/vmlinuz-5.10.160-rockchip-rk3588
# If it is a system with Linux 6.1 kernel, the output is as follows
/boot/vmlinuz-6.1.43+    /boot/vmlinuz-6.1.43-rockchip-rk3588
```

The file /boot/Image is actually loaded when the system starts, and Image is a copy of the vmlinuz file

6) Then install the dtb file into **/boot/dtb**

```
orangepi@orangepi:~/linux-orangepi$ sudo make dtbs_install INSTALL_DTBS_PATH=/boot/dtb/
```

7) Then restart the Linux system and the newly compiled kernel will be loaded

```
orangepi@orangepi:~$ uname -r
```

```
# If it is a Linux5.10 system, the output is as follows
5.10.160+
# If it is a Linux 6.1 system, the output is as follows
6.1.43+
```

8. OpenWRT system instructions

8. 1. OpenWRT version

OpenWRT version	kernel version
v22.03.4	Linux5.10.110

8. 2. OpenWRT Adaptation

Function	OpenWRT
USB2.0x2	OK
USB3.0x2	OK
USB Type-C 3.0	OK
3pin debugging serial port	OK
TF card start	OK
SPIFlash+NVMe SSD Boot	OK
SPIFlash boots the complete system	OK
2.5G PCIe network port X2	OK
Network port status light	OK
led light	OK
FAN fan interface	OK
AX200-WIFI	OK

AX200-WIFI	OK
eMMC extension interface	OK

8. 3. The first start to expand rootfs

1) When the OpenWRT system is started for the first time, the **resize-rootfs.sh** script will be executed to expand the rootfs, and it will automatically restart after the expansion is completed

2) After logging in to the system, you can use the **df -h** command to view the size of rootfs. If it is consistent with the actual capacity of the storage device (TF card, eMMC or NVME SSD), it means that the automatic expansion is running correctly

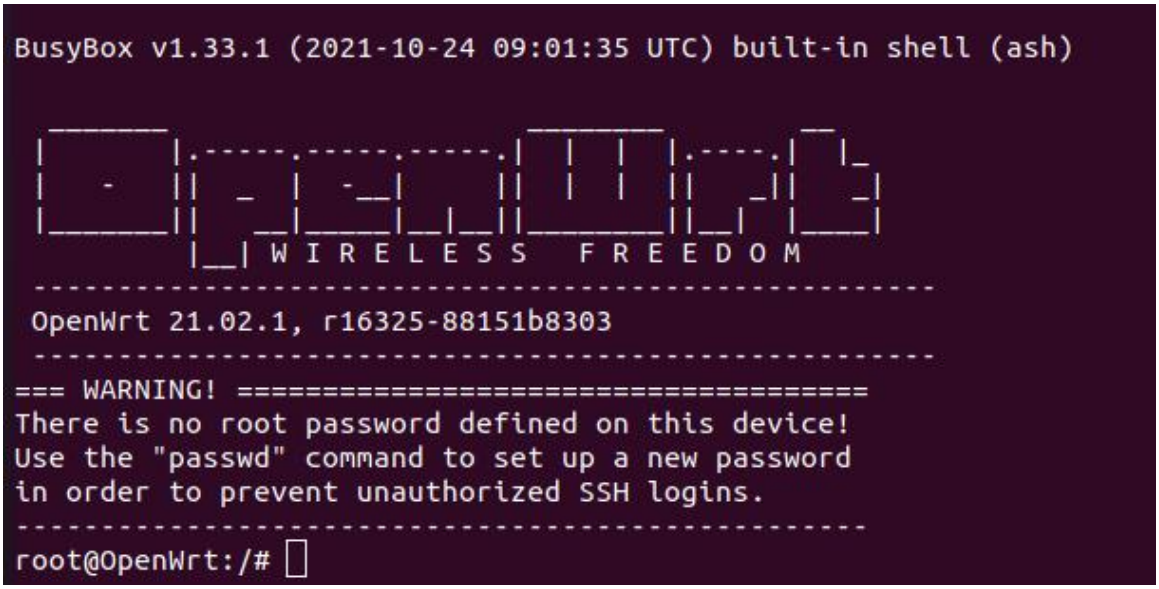
```
root@OpenWrt:~# df -h
Filesystem                Size      Used Available Use% Mounted on
/dev/root                14.8G     14.7G     91.6M  99% /
tmpfs                   495.5M      6.1M    489.4M   1% /tmp
tmpfs                   512.0K         0    512.0K   0% /dev
/dev/root                14.8G     14.7G     91.6M  99% /opt/docker
```

8. 4. How to log in to the system

8. 4. 1. Login via serial port

1) First, to use the debugging serial port, please refer to the chapter on how to use the debugging serial port

2) The OpenWrt system will automatically log in as the **root** user by default, and the display interface is as follows



8. 4. 2. Log in to the system via SSH

Please note that in the OpenWrt system of Orange Pi 5 Plus, the network port near the typeC power interface is configured as a WAN port by default, and the network port near the HDMI port is configured as a LAN port by default.

1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

3) If the computer is installed with an Ubuntu system, you can execute the following command to log in to the system through SSH. By default, you can log in directly without a password

```
test@ubuntu:~$ ssh root@192.168.2.1
```

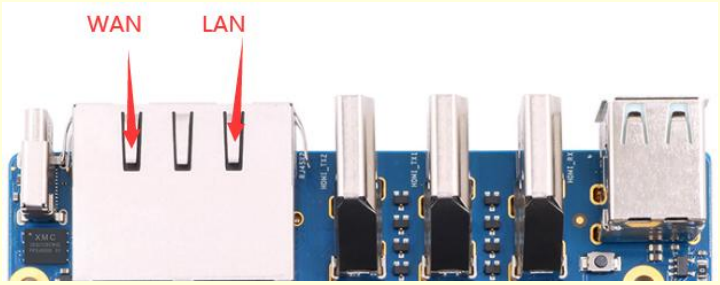
4) After successfully logging in to the system, the display is as shown in the figure below

```
orangepi:~$ ssh root@192.168.2.1


BusyBox v1.35.0 (2023-04-09 12:27:46 UTC) built-in shell (ash)

  _______                     ________        __
 |       |.-----.-----.-----.|  |  |  |.----.|  |_
 |   -   ||  _  |  -__|     ||  |  |  ||   _||   _|
 |_______||   __|_____|__|__||________||__|  |____|
          |__| W I R E L E S S   F R E E D O M
 -----------------------------------------------------
 OpenWrt 22.03.4, r20123-38ccc47687
 -----------------------------------------------------
=== WARNING! =====================================
There is no root password defined on this device!
Use the "passwd" command to set up a new password
in order to prevent unauthorized SSH logins.
--------------------------------------------------
root@OpenWrt:~#
```

5) If the computer is installed with Windows system, you can log in by referring to the method introduced in the section of SSH remote login to the development board under Windows.

8. 4. 3. Log in to the LuCI management interface

Please note that the OpenWRT system configures the network port near the Type-C power port as a WAN port by default, and the network port near the HDMI port as a LAN port by default.

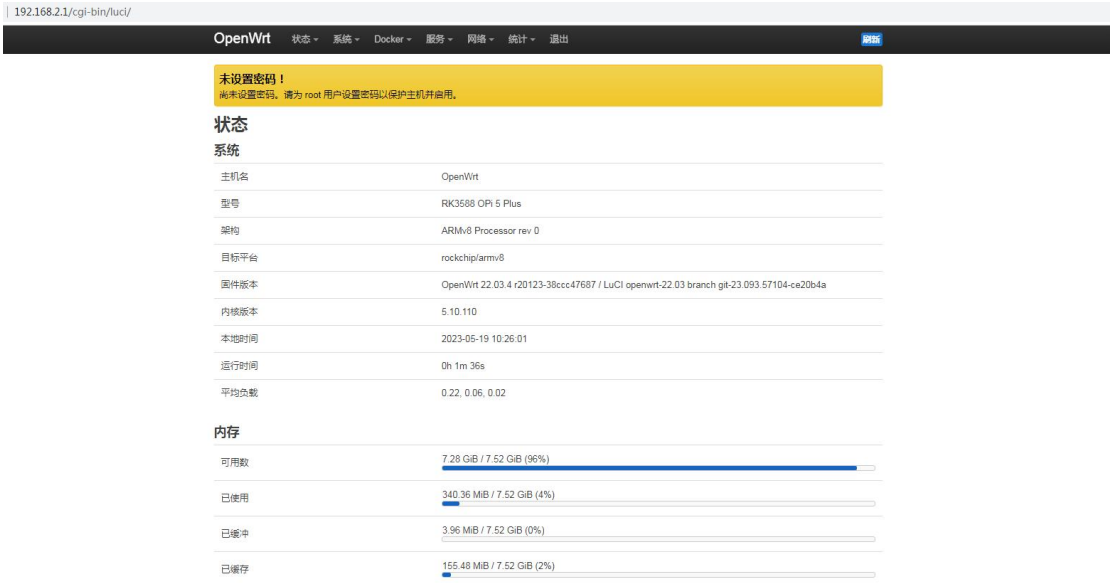


1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

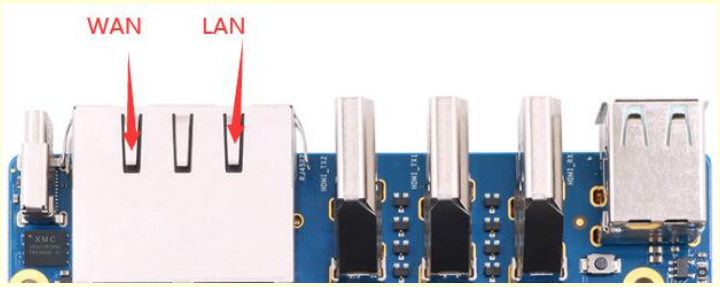
3) Enter the IP address **192.168.2.1** in the browser on the computer to log in to the LuCI interface

4) **The OpenWrt system does not set a password by default**, so just click the **login** button. After successful login, the interface is displayed as shown in the figure below



8. 4. 4. Log in to the terminal through the LuCI management interface

Please note that the OpenWRT system configures the network port near the Type-C power port as a WAN port by default, and the network port near the HDMI port as a LAN port by default.



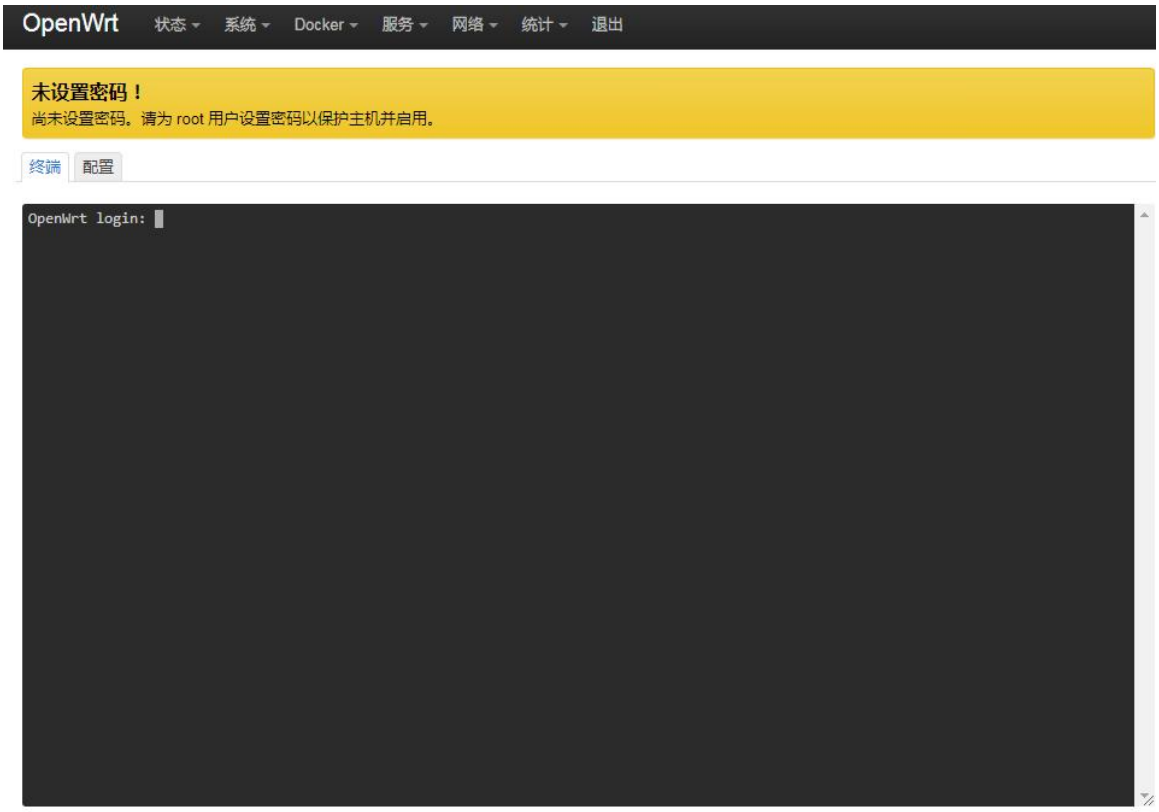
1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

3) Enter the IP address **192.168.2.1** in the browser on the computer to log in to the LuCI interface

4) Select "**Terminal**" in the "**Service**" column of the navigation bar and click to enter

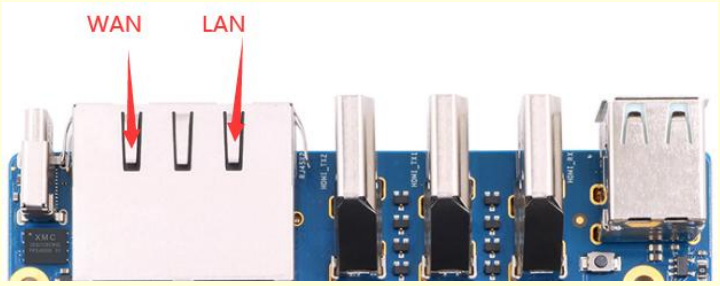
5) At this time, the terminal interface is as shown in the figure below



6) Enter the user name root to log in

8. 4. 5. Use IP address + port number to log in to the terminal

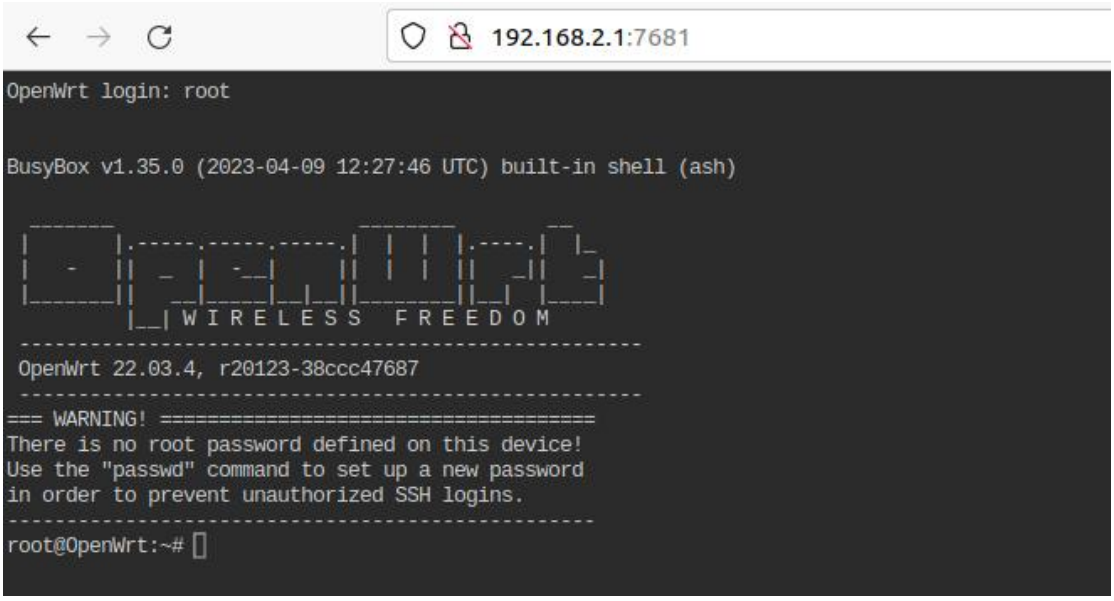
Please note that the OpenWRT system configures the network port near the Type-C power port as a WAN port by default, and the network port near the HDMI port as a LAN port by default.



1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

3) Then enter **192.168.2.1:7681** in the browser to log in to the OpenWRT terminal



8.5. How to modify the IP address of the LAN port through the command line

1) In the OpenWrt system, a command line tool uci is provided, which can easily modify, add, delete and read the content in the configuration file. For details, please refer to the official document

2) First use the following command to obtain the network configuration, the corresponding configuration file is **/etc/config/network**, you can see that the value of **network.lan.ipaddr** is **192.168.2.1**

```
root@OpenWrt:~# uci show network
...
network.lan=interface
network.lan.device='br-lan'
network.lan.proto='static'
network.lan.ipaddr='192.168.2.1'
network.lan.netmask='255.255.255.0'
network.lan.ip6assign='60'
....
```

3) Then enter the following command to modify the item **network.lan.ipaddr**

```
root@OpenWrt:~# uci set network.lan.ipaddr='192.168.100.1'
```

4) Then enter the following command to complete the submission, that is, write to the configuration file

```
root@OpenWrt:~# uci commit
```

If the IP address in red font is consistent with the one to be set, it means that the modification is successful

```
root@OpenWrt:~# cat /etc/config/network
...
config interface 'lan'
        option device 'br-lan'
        option proto 'static'
        option netmask '255.255.255.0'
```

```
        option ip6assign '60'
        option ipaddr '192.168.100.1'
...
```

5) Restart the network through ubus, please refer to the official document for the usage instructions of ubus

```
root@OpenWrt:~# ubus call network restart
```

6) At this point, enter the command and you can see that the IP of the LAN port is **192.168.100.1**

```
root@OpenWrt:~# ifconfig br-lan
br-lan    Link encap:Ethernet  HWaddr FE:55:13:A3:EF:E7
          inet addr:192.168.100.1  Bcast:192.168.100.255  Mask:255.255.255.0
          inet6 addr: fd60:c4cd:1033::1/60 Scope:Global
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:370 (370.0 B)
```

8. 6. How to modify the root password

8. 6. 1. Modify via command line

1) First enter passwd root on the command line of the system, and the following prompt message will appear. At this time, you can enter the password you want to set, and press the Enter key to confirm

```
root@OpenWrt:/# passwd root
Enter new UNIX password:
```

2) Then you will be prompted to re-enter the password. At this time, enter the password again to confirm and press Enter

```
Retype password:
```

3) The display of successful modification is as follows

```
passwd: password for root changed by root
```

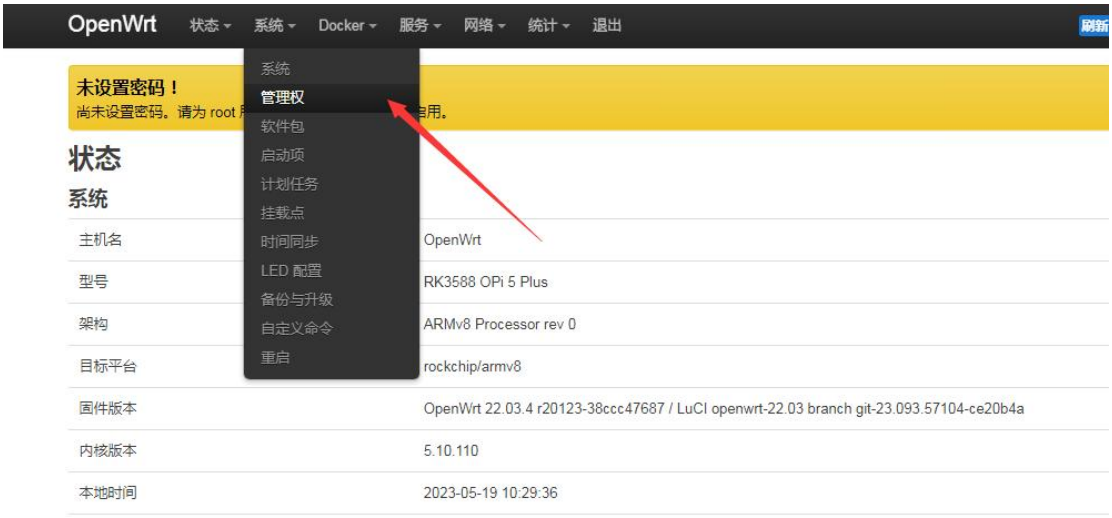
8. 6. 2. Modify through the LuCI management interface

1) First refer to the login LuCI management interface to enter the OpenWRT management interface

2) Then follow the steps below to change the password

a. Find the "**System**" option in the navigation bar and click

b. In the column options below the system, select "**Management Rights**" and click



c. Select the "**Router Password**" option on the Tab page

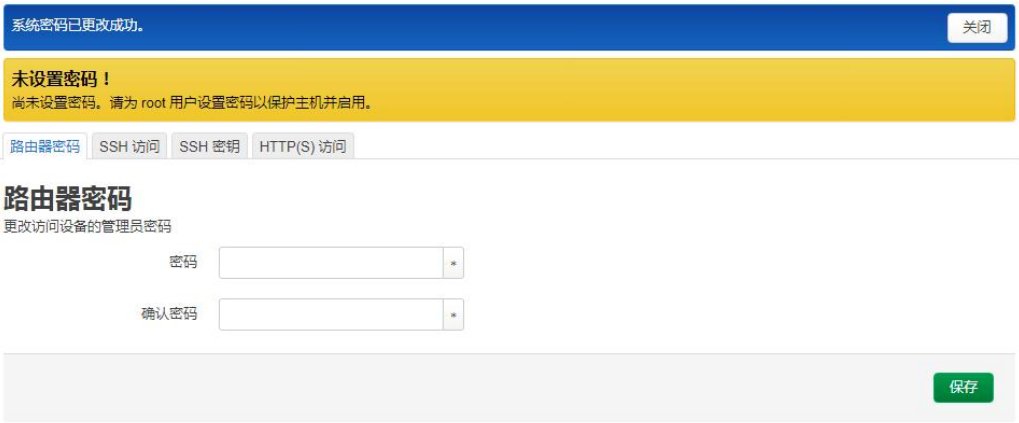
3) Modify and save the router password

a. Enter the password you set in the "**Password**" and "**Confirm Password**" dialog boxes (if you are not sure whether the password is entered correctly, you can click the "*" icon behind the dialog box to display the input characters)

b. Click "**Save**" to save the newly modified password

Note: In the "Password" and "Confirm Password" dialog boxes, the passwords entered twice must be consistent.

4) After the password is changed successfully, a pop-up box will pop up saying "**The system password has been changed successfully**". At this time, a password is required to log in to OpenWRT



8. 7. USB interface test

8. 7. 1. Mount the USB storage device under the command line

1) First insert the U disk into the USB interface of the Orange Pi development board

2) Execute the following command, if you can see the output of sdX, it means that the U disk is recognized successfully

```
root@OpenWrt:~# cat /proc/partitions | grep "sd*"
```

```
major minor  #blocks  name
   8        0     15126528 sda
```

3) Use the mount command to mount the U disk to /mnt, and then you can view the files in the U disk

```
root@OpenWrt:~# mount /dev/sda /mnt/
root@OpenWrt:~# ls /mnt/
test.txt
```

4) After mounting, you can view the capacity usage and mount point of the U disk through the df -h command

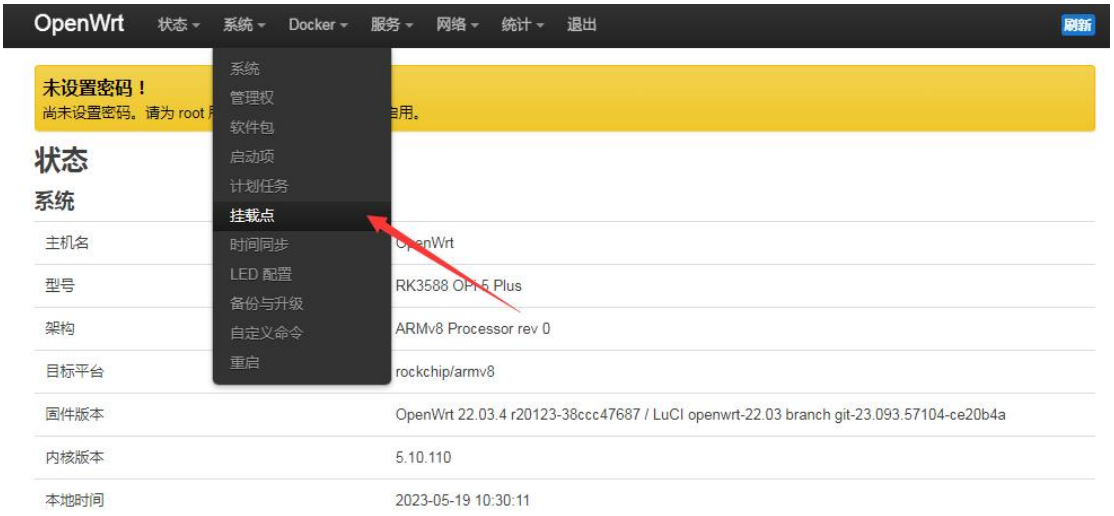
```
root@OpenWrt:~# df -h | grep "sd"
/dev/sda                14.4G       187.2M        14.2G   1% /mnt
```

8.7.2. Mount the USB storage device on the LuCI management interface

1) First connect the U disk (or other storage device) to the development board via USB2.0

2) Then follow the login LuCI management interface to enter the LuCI management interface

3) Then in the LuCI management interface, click "System -> Mount Point" to enter the configuration interface of the mount point



4) Then follow the steps below to add a mount point

a. Find "**Mount Point**" at the bottom of the mount point **global setting interface**

b. Under the mount point, select the "Add" button and click Enter

c. Then the following pop-up interface will pop up

d. Then you can start to mount the storage device

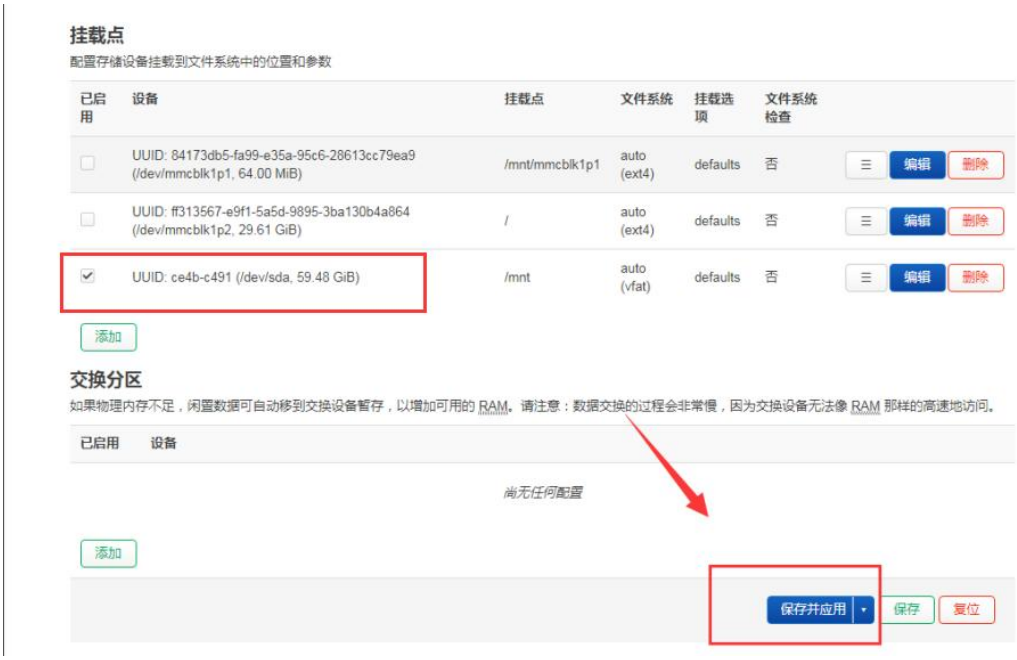
a) Check "**Enabled**"

b) Select the actual connected device /dev/sda in the UUID column of general settings (choose according to your own device)

c) Select "**Custom**" in the mount point column, and fill in the target directory to be mounted. Here, take the **/mnt** directory as an example, and press **Enter** to confirm

d) Then click the "**Save**" button in the lower right corner

5) Then you will return to the mount point global settings page, click "**Save and Apply**" in the lower left corner of the page to make the mount point take effect



6) After saving, you can see the "**mounted file system**", the storage device has been mounted successfully

8. 8. How to use E-Key PCIe wireless network card

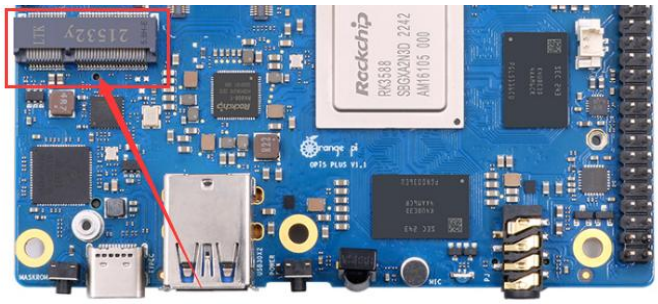
1) The PCIe wireless network card models currently compatible with the OpenWRT image are as follows：

SN	model	Physical picture	Supported OS
1	AX200 （PCIE+USB port)		Debian Ubuntu OpenWRT OPi OS Arch
2	AX210 （PCIE+USB port)		Debian Ubuntu OpenWRT OPi OS Arch
3	RTL8852BE （PCIE+USB port)		Debian Ubuntu Not Supported OpenWRT Android12 OPi OS Arch OPi OS Droid

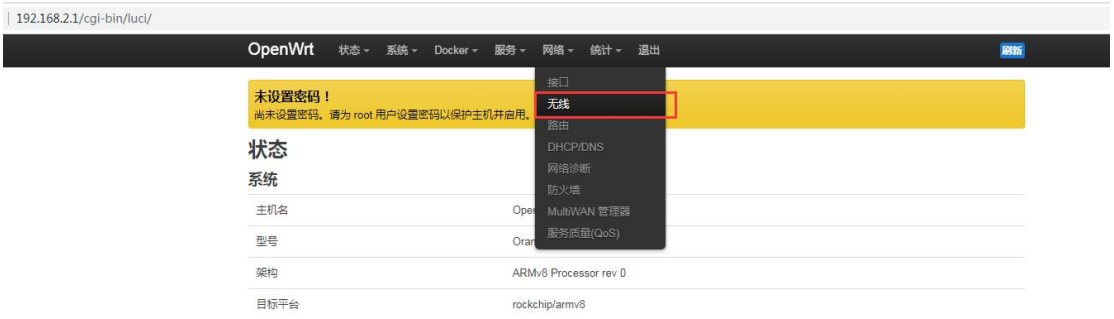
8. 8. 1. How to create WIFI hotspot

Note that AX200 and AX210 currently only support hotspots in the 2.4G frequency band. In the 5G frequency band mode, there will be an error that the modified configuration of the wireless network card cannot be applied.

1）First insert the PCIe wireless network card into the M.2 E-KEY port of the development board, and then connect the Type-C power supply to power up the development board.



2）After the system startup is complete, click **Network -> Wireless** to enter the wireless WiFi configuration interface.



3）The default wireless configuration of the OpenWRT system is **Master** mode. Here, for the convenience of the next operation, we will remove the default wireless connection.

4）Then click **Save** in the lower right corner of the page to make the configuration take effect.

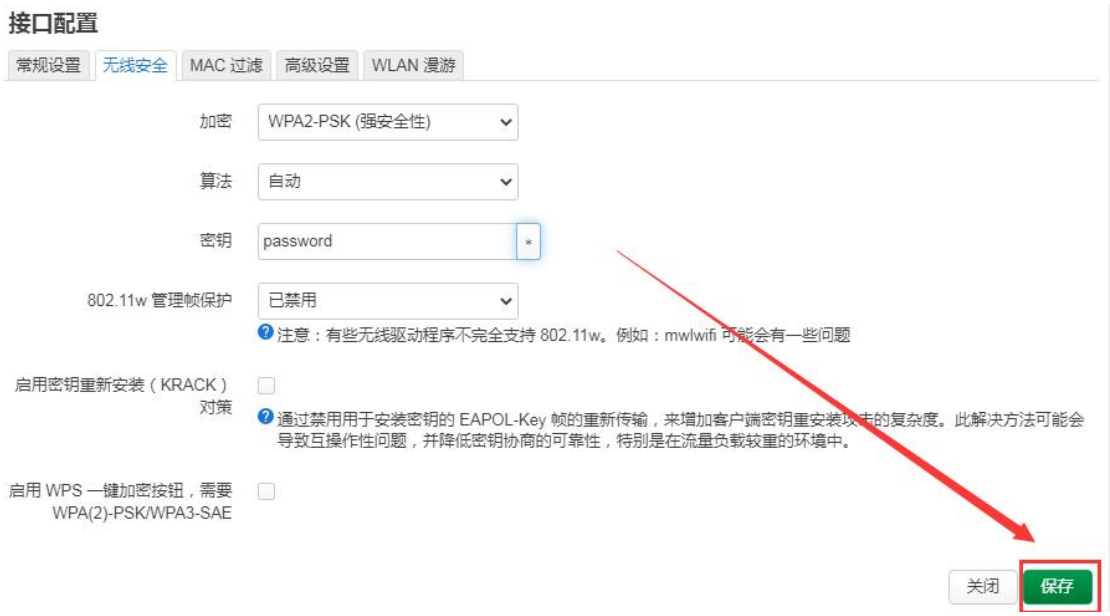
5）Then click the **Add** button on the right.

6）In the pop-up tab page **Device Configuration**, we set the parameters as shown in the figure below.

7）Then in **Interface Configuration -> General Settings**, set the mode to **Access Point AP**, set the **ESSID** (wireless network name) to **OpenWrt**, and specify the network as **lan**

8）Then in **Interface Configuration -> Wireless Security**, select **WPA2-PSK** as the encryption algorithm; set the key (wireless password) to **password**

9）After the above settings are completed, click **Save** in the lower right corner of the page, and then exit the tab page



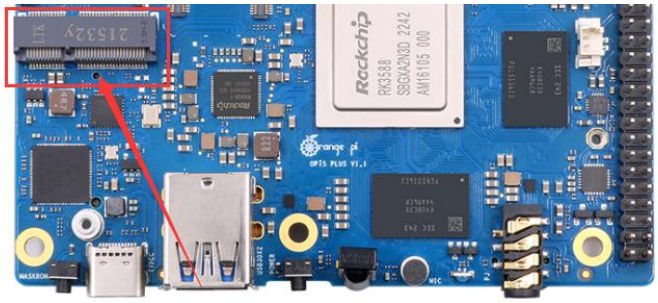
10）Then click **Save and Apply** in the lower right corner of the page and wait for the configuration to be applied.

11）The display interface of successfully creating a hotspot is shown in the figure below

12）Then use the mobile phone or computer to search for the WiFi corresponding to the SSID to connect. After the connection is successful, as shown in the figure below

8. 8. 2. How to connect to WIFI hotspot

1）Insert the PCIe wireless network card into the M.2 E-KEY port of the development board, and then connect the Type-C power supply to power the development board.



2）After the system startup is complete, click **Network -> Wireless** to enter the configuration wireless WiFi interface.

3）The default wireless configuration of the OpenWRT system is **Master** mode. Here, for the convenience of the next operation, we will remove the default wireless connection.

4）Then click **Save** in the lower right corner of the page to make the configuration take effect.

5）Then click the **Scan** button to scan the surrounding WiFi hotspots.

6）Then the following window will pop up to display the available WiFi hotspots. At this time, click the **Join Network** button on the right side of the WiFi hotspot you want to connect to the WiFi hotspot.

7）Then an interface for connecting to a WiFi hotspot will pop up. We enter the password of the hotspot as shown in the figure below, and then click the **Submit** button.

8）Then the following interface will pop up, click the **Save** button in the lower right corner.

9）Finally, you will return to the main interface of wireless configuration, click **Save and Apply** and wait for the configuration to be applied.

10）After successfully connecting to the WiFi hotspot, the interface is displayed as shown in the figure below.

8. 9. Installing packages via the command line

8. 9. 1. Install via opkg in the terminal

1) Update the list of available packages

```
root@OpenWrt:/# opkg update
```

2) Get the software list

```
root@OpenWrt:/# opkg list
```

3) Install the specified package

```
root@OpenWrt:/# opkg install <package name>
```

4) Check the installed software

```
root@OpenWrt:/# opkg list-installed
```

5) Uninstall the software

```
root@OpenWrt:/# opkg remove <package name>
```

8. 10. OpenWRT management interface installation software package

If you need to add new software packages, you can install them through the

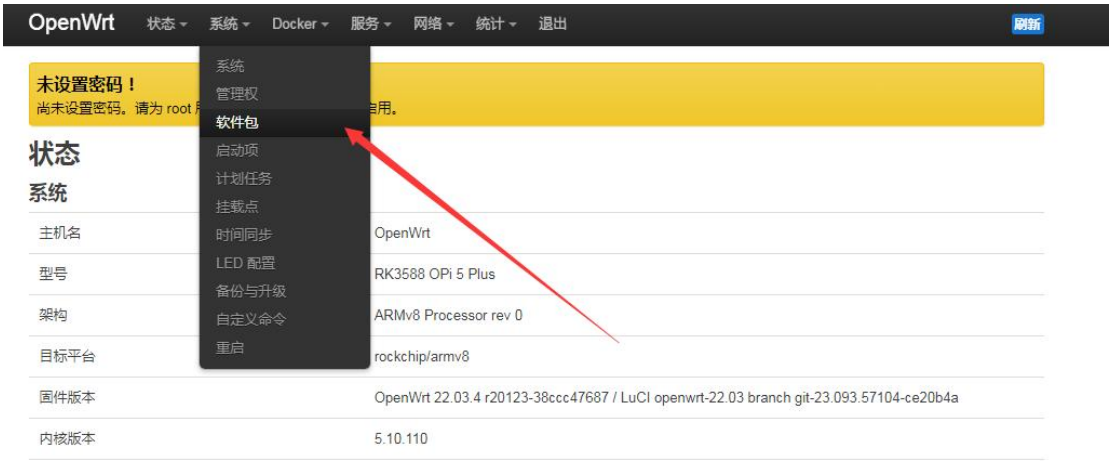
OpenWRT management interface.

8. 10. 1. View the list of available software packages in the system

1) First enter the package management page

a. Find the "**System**" option in the navigation bar and click to enter

b. In the vertical column options below the system, select "**software package**" and click to enter



2) Then the main page of the software package will appear, as shown in the figure below, to obtain the list of available software

a. In the "**Operation**" option of the software package, click "**Update List**" to get the list of available software packages

b. On the Tab page, click "**Available**" to view the currently available software packages

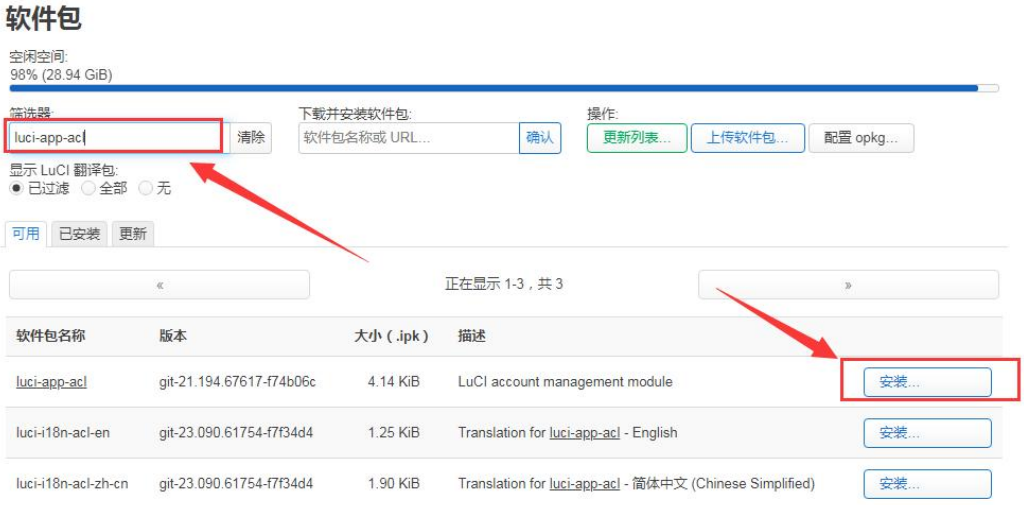
c. View the number of currently available packages

8. 10. 2. Example of installing software packages

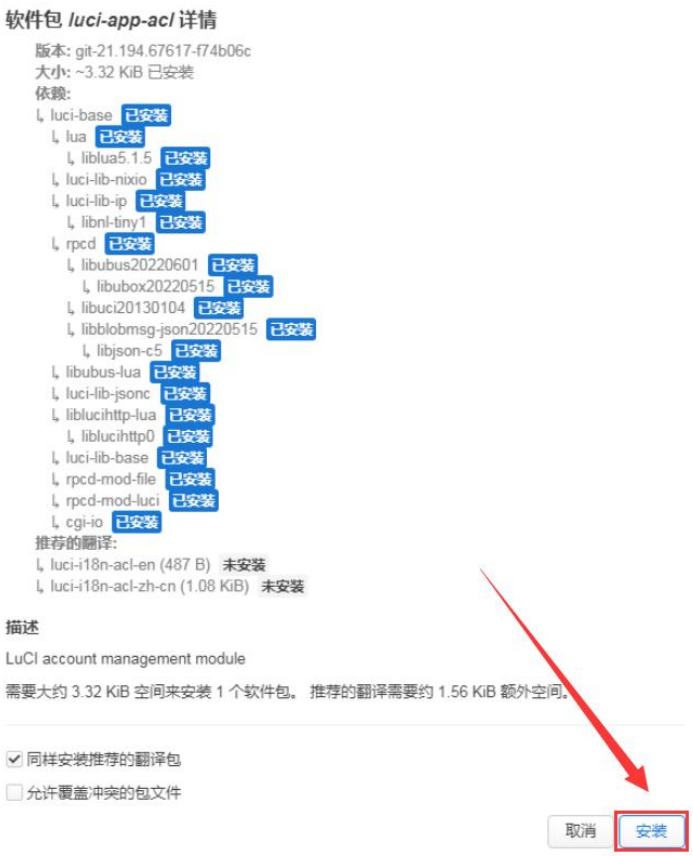
1) Take the installation package “**luci-app-acl**” as an example

   a. In the OpenWRT software package management interface, click the filter dialog box and enter “**luci-app-acl**”

   b. In the list of software packages, you can see the version, package size and description information of the “**luci-app-acl**” software package, and then click the **"Install"** button



   c. Then the following pop-up window will appear, click **"Install"**



d. Then wait for the installation to complete

e. The display after the installation is complete is as follows

2) Check whether the software package is installed successfully

a. In the OpenWRT software package management interface, click the filter dialog box and enter “**luci-app-acl**”

b. Select and click **"Available"** on the Tab page

c. The “**luci-app-acl**” package will be displayed in the package list, and the update status will be **"installed"**

8. 10. 3. Remove package example

1) Take the removal of the package “**luci-app-acl**” as an example

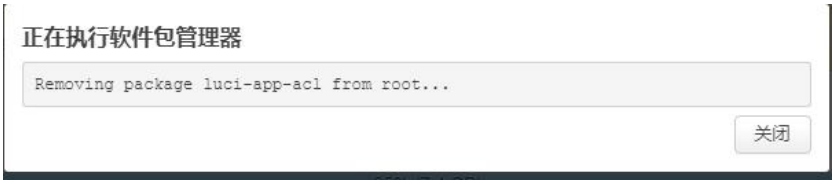
a. In the OpenWRT software package management interface, click the filter dialog box and enter “**luci-app-acl**”

b. Select **"Installed"** on the Tab page to display the list of installed software packages

c. Click **"Remove"** on the right to remove the corresponding software package

d. Then the following pop-up window will be displayed, click **"Remove"**

e. After the removal is successful, the display interface is as follows



2) Check whether the software package is removed successfully

a. In the OpenWRT software package management interface, click the filter dialog box and enter **"luci-app-acl"**

b. Select and click **"Installed"** on the Tab page

c. The **"luci-app-acl"** package will not be displayed in the package list, and the **"luci-app-acl"** package has been removed successfully

8. 11. Using Samba Network Shares

There are mainly two software options for OpenWRT LAN file sharing, Samba and NFS. The compatibility of the Samba system is better, while the performance of NFS is superior. For users who need to use Windows devices, it is recommended to choose Samba.

1) Enter the management page of the Samba network share
   a. Find the **"Service"** option in the navigation bar and click to enter
   b. In the vertical column options below the service, select **"network sharing"** and click to enter

2) Select the interface that the Samba service needs to monitor
   a. Select **"General Settings"** in the navigation bar of network sharing and click to enter
   b. The interface is specified according to actual needs. If you want to access through the "wan port", set it to **"wan"**

3) Set the shared directory of the network share

a. In the **"Shared Directory"** of the **"General Settings"** of the network share, click **"Add"** the shared directory address

b. Enter the name of the shared folder as **"mmt"** under the name

c. Under the path of the shared directory, choose to set the shared directory location **"/mnt"**

d. Check **"Browseable"** and "Run anonymous user"

e. Click **"Save and Apply"** to save the configuration

4) window10 starts network discovery and sharing

Note: To access Samba under the Windows 10 system, you need to confirm whether Windows 10 has enabled network discovery and sharing for sharing. If it is not enabled, perform the following settings first.

a. Enable Samba v1/v2 access

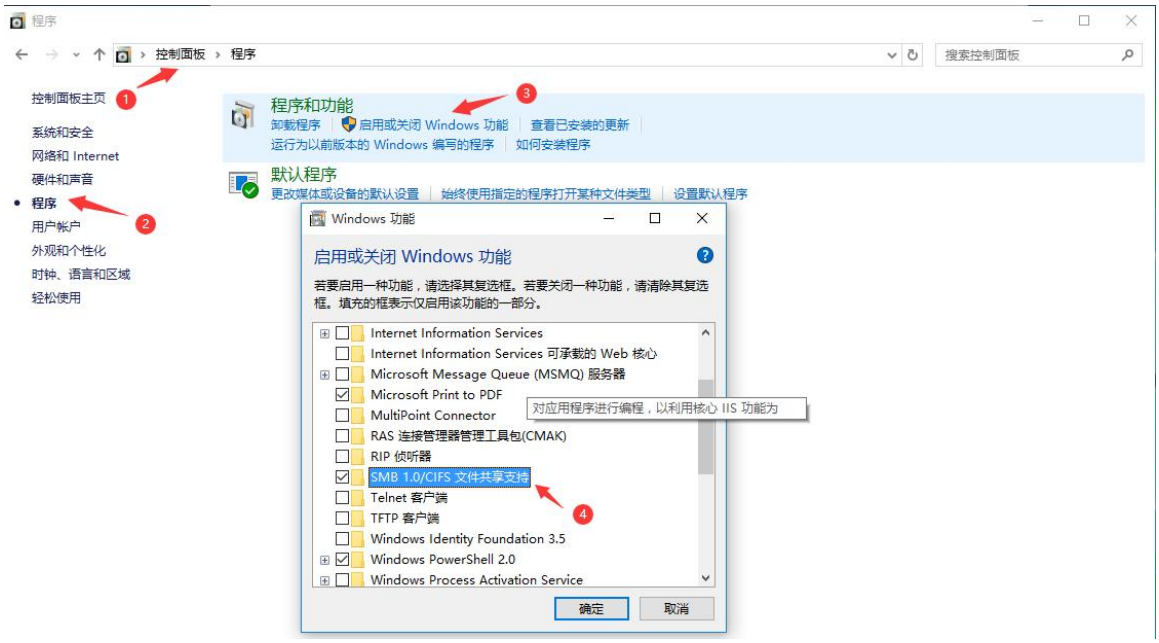
a) Enter the "Control Panel" of Windows 10

b) Click "Programs" on the left navigation bar of the control panel

c) Select "Turn Windows features on or off" in Programs and Features

d) Check "SMB 1.0/CIFS file sharing support" in the pop-up box of enabling or disabling Windows functions

e) Click "OK" to configure the application



b. Turn on the network discovery of Windows 10

a) Enter the "Control Panel" of Windows 10

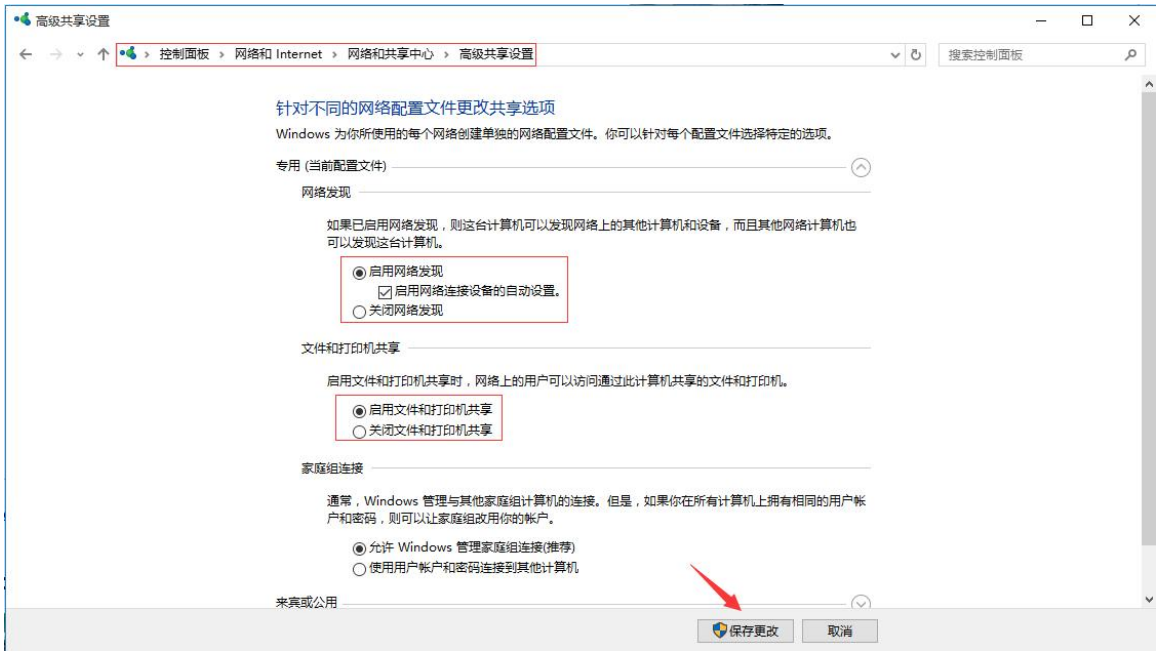
b) Select "Network and Internet" in the Control Panel

c) Then open "Network and Sharing Center"

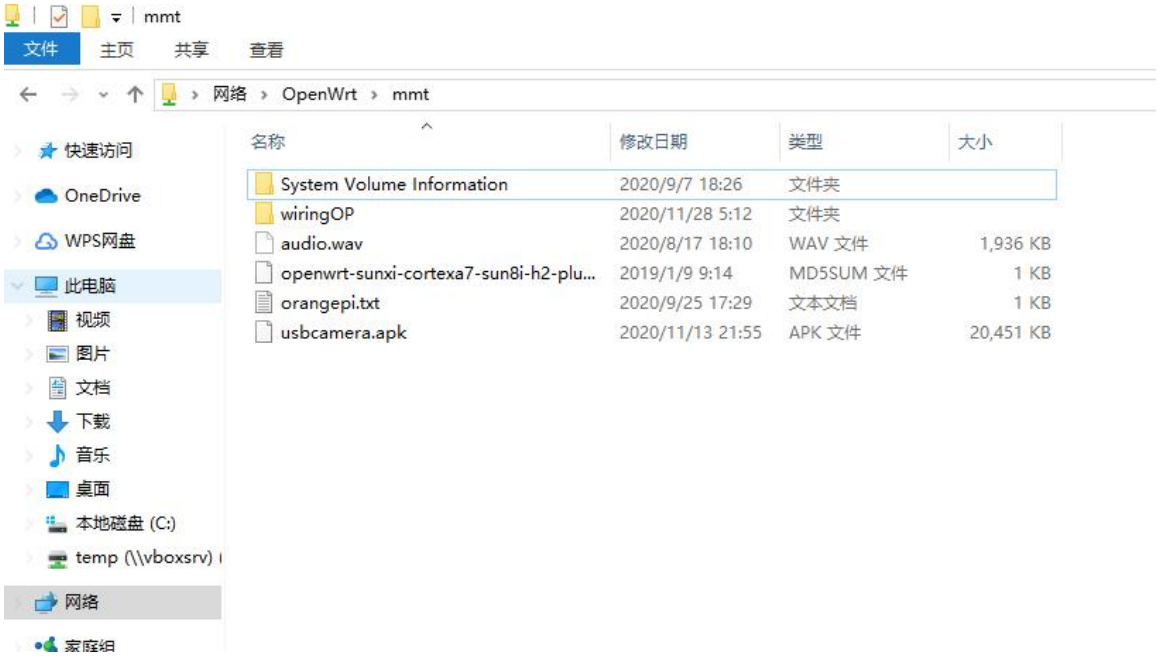
d) Click | "Advanced Sharing Settings"

e) Turn on **"Enable Network Discovery"** and **"Enable File and Printer Sharing"**

f) Click "Save Changes" to save the Windows 10 network discovery configuration



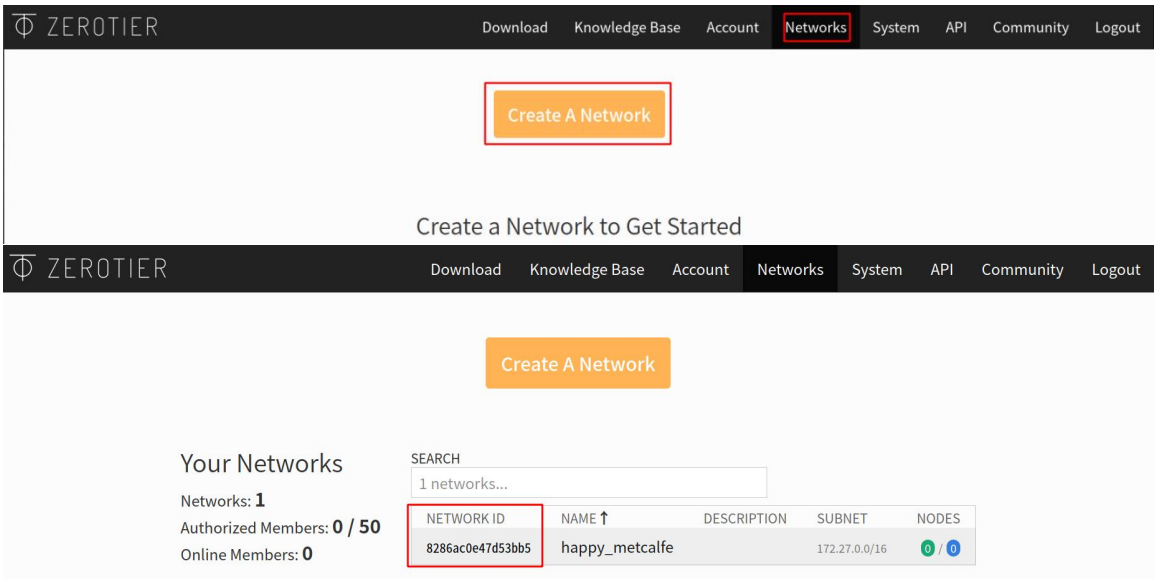
5) After the setting is completed, enter \\OpenWrt in the address bar of the resource manager to access the shared directory, the user name is root, and the password is the password set by the development board host



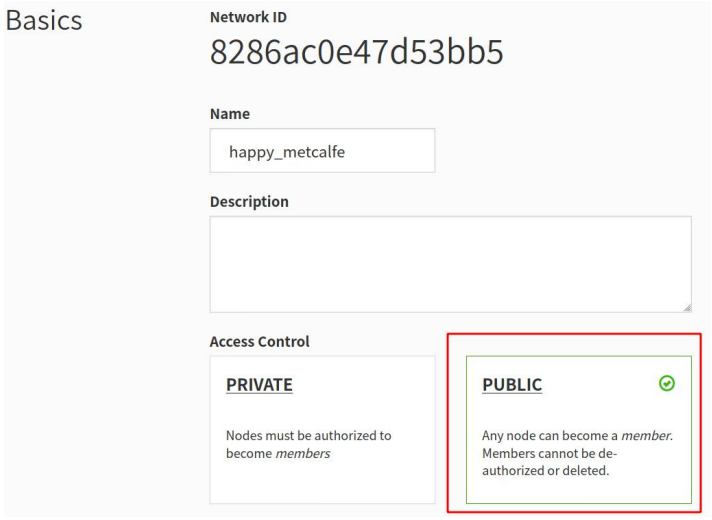
8. 12. Zerotier Instructions

The OpenWRT system has pre-installed the zerotier client. After creating a virtual LAN on the zerotier official website, the client can directly join it through the Network ID. The specific operation is as shown below.

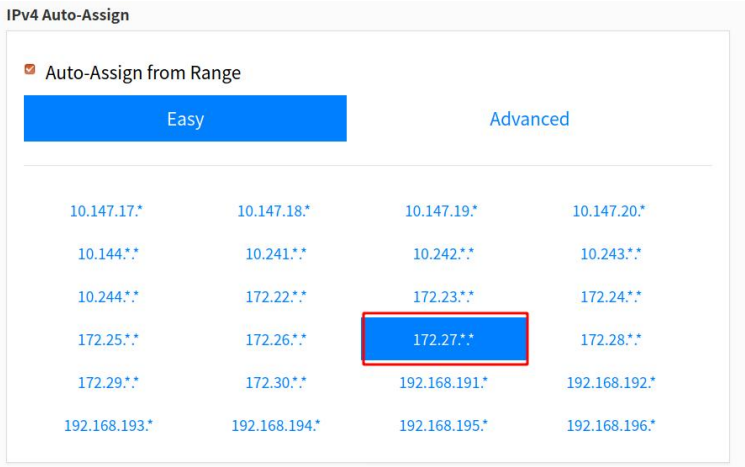
1) Log in to zerotier official website https://my.zerotier.com/network, register and log in and click Network->Create A Network to create a virtual local area network



2) Click to enter the network console page, you can set the privacy option to public, so that the added network nodes do not need to be verified



3) The following automatically assigns the address Here you can choose the network segment yourself, here is 172.27.*.*



4) Enter the following command in the OpenWRT terminal to join the virtual LAN created above, **where 8286ac0e47d53bb5 is the Network ID of the virtual LAN created above**

```
root@OpenWrt:/# zerotier-one -d                          #Start the zerotier client
root@OpenWrt:/# zerotier-cli join 8286ac0e47d53bb5    #join the network
```

5) Enter ifconfig in the terminal and you can see that there is already a new **ztks54inm2** device with an IP address of **172.27.214.213**

```
root@OpenWrt:/# ifconfig
ztks54inm2 Link encap:Ethernet  HWaddr F6:4E:DE:BF:D8:52
          inet addr:172.27.214.213  Bcast:172.27.255.255  Mask:255.255.0.0
          inet6 addr: fe80::e82f:d0ff:fe5a:867e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:2800  Metric:1
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0
          TX packets:48 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1720 (1.6 KiB)  TX byte81 (8.2 KiB)
```

6) Install the zerotier client on another device (Ubuntu18.04 is used as an example here), execute the following command to install, and restart the computer after the installation is complete

```
test@ubuntu:~$ curl -s https://install.zerotier.com | sudo bash
```

7) After restarting, join the virtual LAN according to the Network ID, and you can also see that the ip address assigned by zerotier has been obtained. At this time, the Ubuntu PC and OrangePi R1 Plus LTS are in the same LAN, and the two can communicate freely

```
test@ubuntu:~$ sudo zerotier-cli join 8286ac0e47d53bb5
test@ubuntu:~$ ifconfig
ztks54inm2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 2800
        inet 172.27.47.214  netmask 255.255.0.0  broadcast 172.27.255.255
        inet6 fe80::5ce1:85ff:fe2b:6918  prefixlen 64  scopeid 0x20<link>
        ether f6:fd:87:68:12:cf  txqueuelen 1000  (ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 46  bytes 10006 (10.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

8) Test whether the two terminals can communicate

```
root@OpenWrt:/# ping 172.27.47.214 -I ztks54inm2
PING 172.27.47.214 (172.27.47.214): 56 data bytes
64 bytes from 172.27.47.214: seq=0 ttl=64 time=1.209 ms
64 bytes from 172.27.47.214: seq=1 ttl=64 time=1.136 ms
64 bytes from 172.27.47.214: seq=2 ttl=64 time=1.203 ms
64 bytes from 172.27.47.214: seq=3 ttl=64 time=1.235 ms
^C
--- 172.27.47.214 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 1.136/1.195/1.235 ms
```

9) other common commands of zerotier

```
root@OpenWrt:/# zerotier-one -d                    #Start the zerotier client
root@OpenWrt:/# zerotier-cli status                #Get address and service status
root@OpenWrt:/# zerotier-cli join # Network ID     #join the network
root@OpenWrt:/# zerotier-cli leave # Network ID    #leave the network
root@OpenWrt:/# zerotier-cli listnetworks          #list networks
OPENWRT_DEVICE_REVISION="v0"
OPENWRT_RELEASE="OpenWrt 22.03.4 r20123-38ccc47687"
```

9. Compilation method of OpenWRT source code

9.1. Download OpenWRT source code

1) First execute the following command to download the openwrt-22.03 branch code

```
test@test:~$ sudo apt update
test@test:~$ sudo apt install -y git
test@test:~$ git clone https://github.com/orangepi-xunlong/openwrt.git -b openwrt-22.03
```

2) After the OpenWRT code is downloaded, the following files and folders will be included

```
test@test:~/openwrt$ ls
BSDmakefile  Config.in  include  Makefile  README.md  scripts  toolchain
Config  feeds.conf.default  LICENSE  package  rules.mk  target  tools
```

9.2. Compile OpenWRT source code

1) First install the following dependent packages (currently only tested on Ubuntu 20.04 to compile the following dependent packages, if you compile on other versions of the system, please install the dependent packages by yourself according to the error message)

a. Method 1: The command to install dependent packages using a script is as follows:

```
test@test:~/openwrt$ sudo ./install_dep.sh
```

b. Method 2: Install the dependency package directly using the following command

```
test@test:~/openwrt$ sudo apt update
test@test:~/openwrt$ sudo apt install -y ack antlr3 asciidoc autoconf    \
automake autopoint binutils bison build-essential    \
bzip2 ccache cmake cpio curl device-tree-compiler fastjar \
flex gawk gettext gcc-multilib g++-multilib git gperf haveged \
help2man intltool libc6-dev-i386 libelf-dev libglib2.0-dev \
libgmp3-dev libltdl-dev libmpc-dev libmpfr-dev \
libncurses5-dev \libncursesw5-dev libreadline-dev libssl-dev \
libtool lrzsz mkisofs msmtp nano ninja-build p7zip p7zip-full \
```

```
patch pkgconf python2.7 python3 python3-pyelftools \
libpython3-dev qemu-utils rsync scons squashfs-tools \
subversion swig texinfo uglifyjs upx-ucl unzip \
vim wget xmlto xxd zlib1g-dev
```

2) Then execute **./scripts/feeds update -a** and **./scripts/feeds install -a** to download dependent packages

```
test@test:~/openwrt$ ./scripts/feeds update -a
test@test:~/openwrt$ ./scripts/feeds install -a
```

3) Then choose to use the configuration file of OrangePi 5 Plus

a. Compile the image that supports TF card, eMMC, and NVMe startup, and select the following configuration

```
test@test:~/openwrt$ cp configs/orangepi-5-plus-rk3588_defconfig .config
```

b. Compile the image that supports SPIFlash startup, and select the following configuration

```
test@test:~/openwrt$ cp configs/orangepi-5-plus-rk3588-spi_defconfig .config
```

4) Then execute the following command to make the configuration take effect

```
test@test:~/openwrt$ make defconfig
```

5) Execute the following command to start compiling the openwrt source code

```
test@test:~/openwrt$ make V=s
```

6) After the compilation is complete, the path where the image is generated is:

```
test@test:~/openwrt$ tree -L 1 bin/targets/rockchip/armv8/
bin/targets/rockchip/armv8/
├── config.buildinfo
├── feeds.buildinfo
├── openwrt-rockchip-armv8-xunlong_orangepi-5-plus-ext4-sysupgrade.img.gz
├── openwrt-rockchip-armv8-xunlong_orangepi-5-plus.manifest
├── openwrt-rockchip-armv8-xunlong_orangepi-5-plus-squashfs-sysupgrade.img.gz
├── packages
├── profiles.json
├── sha256sums
└── version.buildinfo
```

1 directory, 9 files

10. Instructions for using the Android 12 system

10. 1. Supported Android versions

Android version	kernel version
Android 12	Linux5.10
Android 12 Box	Linux5.10

10. 2. Android function adaptation

Function	Android 12	Android12 Box
HDMI TX1 Display - 1080p	OK	OK
HDMI TX1 Display - 4K 120HZ	OK	OK
HDMI TX1 Display - 8K 60HZ	OK	OK
HDMI TX1 Audio	OK	OK
HDMI TX2 Display - 1080p	OK	OK
HDMI TX2 Display - 4K 120HZ	OK	OK
HDMI TX2 Display - 8K 60HZ	OK	OK
HDMI TX2 Audio	OK	OK
HDMI RX display	OK	OK
HDMI RX Audio	OK	OK
USB2.0X2	OK	OK
2.5G PCIe network port X2	OK	OK
2.5G PCIe network port light	OK	OK
Debug serial port	OK	OK
RTC	OK	OK
FAN interface	OK	OK
eMMC extension interface	OK	OK
AP6275P-WIFI	OK	OK

AP6275P-BT	OK	OK
AX200-WIFI	NO	NO
AX200-BT	NO	NO
AX210-WIFI	NO	NO
AX210-BT	NO	NO
RTL8852BE-WIFI	OK	OK
RTL8852BE-BT	OK	OK
Recovery button	OK	OK
Type-C interface USB3.0 function	OK	OK
Type-C interface ADB function	OK	OK
Type-C interface DP display function	OK	OK
Type-C interface DP audio playback	OK	OK
USB3.0 Hub	OK	OK
switch button	OK	OK
infrared function	OK	OK
led light	OK	OK
Onboard MIC	OK	OK
headphone playback	OK	OK
headphone recording	OK	OK
SPK Horn	OK	OK
40PIN GPIO	OK	OK
40PIN I2C	OK	OK
40PIN SPI	OK	OK
40PIN UART	OK	OK
40PIN PWM	OK	OK
TF card start	OK	OK
SPI Flash+NVME solid state boot	OK	OK
OV13850 camera	OK	OK
OV13855 camera	OK	OK
GPU	OK	OK
VPU	OK	OK
NPU	OK	OK
MIPI LCD display	OK	NO
MIPI LCD Touch	OK	NO
MIPI LCD backlight	OK	NO

HDMI CEC function	NO	OK

10. 3. How to use the USB wireless network card

1) Currently, the USB wireless network card models compatible with the Android image are as follows：

Chip model	Function	VID&PID	Adaptation
RTL8723BU	2.4G WIFI+BT4.0	0bda:b720	Support WIFI and Bluetooth function, does not support hotspot
RTL8811CU	2.4G +5G WIFI	0bda:c811	Support WIFI function and open hotspot

2) The pictures of the above two USB wireless network cards are as follows：

a. The picture of the RTL8723BU USB wireless network card module is as follows：

b. The picture of the RTL8811CU USB wireless network card module is as follows：

3) The test methods of the above two types of USB wireless network cards are the same. First, the USB network card needs to be inserted into the USB interface of the development board.

4) Then, for the connection and test method of WIFI, please refer to the section of WIFI connection test method

5) For the Bluetooth test, please refer to the content of the Bluetooth test method

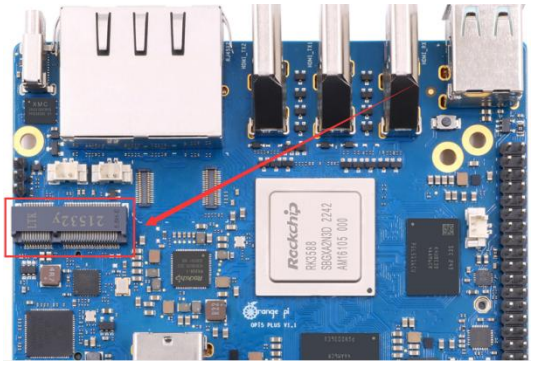
10. 4. M.2 How to use E-Key PCIe WIFI6+Bluetooth module

1) The PCIe wireless network card models currently compatible with Android 12 are as follows：

SN	model	Physical picture
1	RTL8852BE (PCIE+USB interface)	

Pay attention to RTL8852BE, please do not buy the module shown in the figure below, there will be problems after testing.

2) First insert the PCIe wireless network card into the M.2 E-KEY interface of the development board and fix it



3) Then connect the power supply of the Type-C interface to the development board, and power on

4) After the system starts, please refer to the section of WIFI connection test method for WIFI connection and test method

5) For the Bluetooth test, please refer to the content of the Bluetooth test method

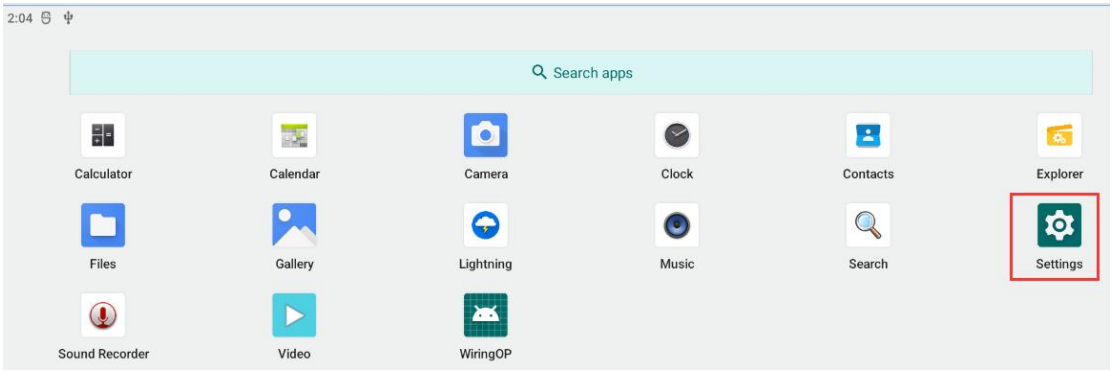
10. 5. WIFI connection test method

First of all, please note that there is no WIFI module on the Orange Pi 5 Plus development board, and an external PCIe network card or USB network card is required to use the WIFI function.

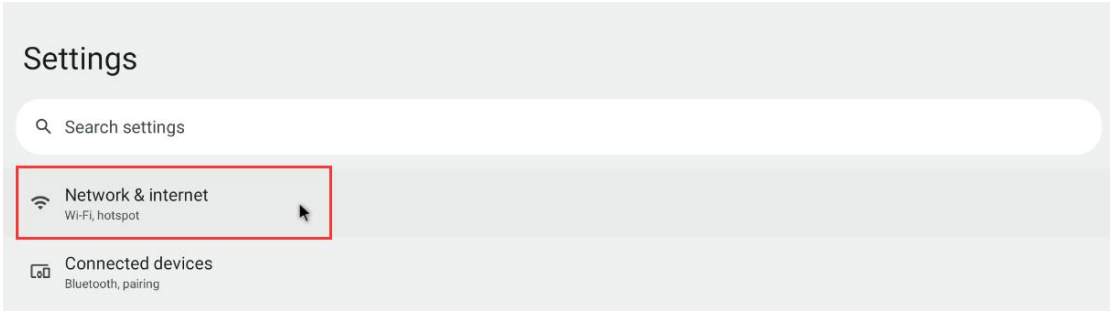
For instructions on using the external PCIe network card, please refer to the section on how to use the M.2 E-Key PCIe WIFI6+Bluetooth module.

For instructions on using the external USB network card, please refer to the section on how to use the USB wireless network card.

1) First click to enter the **Setting**

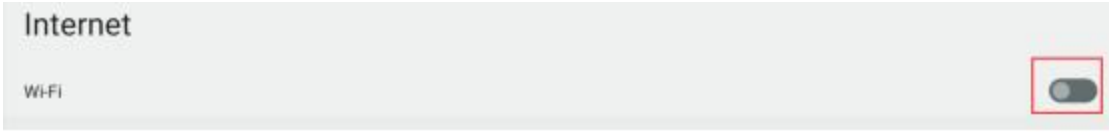


2) Then select **Network & internet**

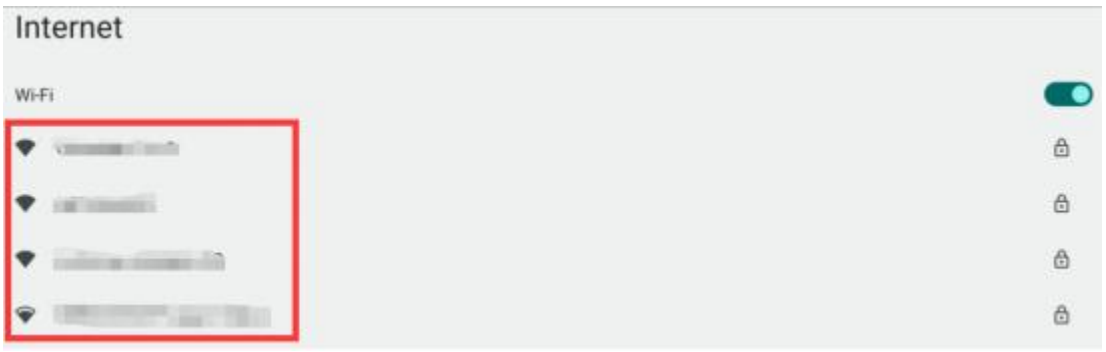


3) Then select **Internet**

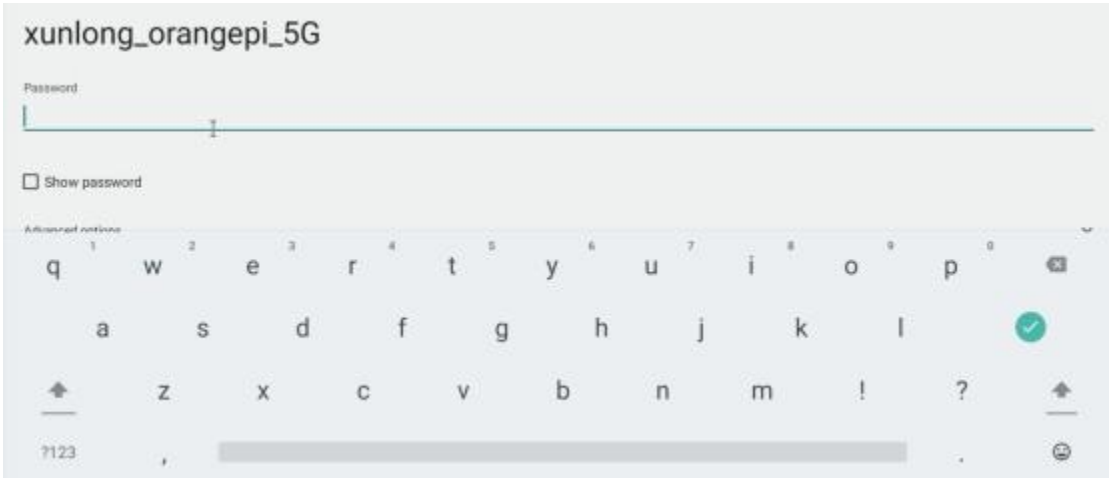
4) Then turn on the **Wi-Fi** switch



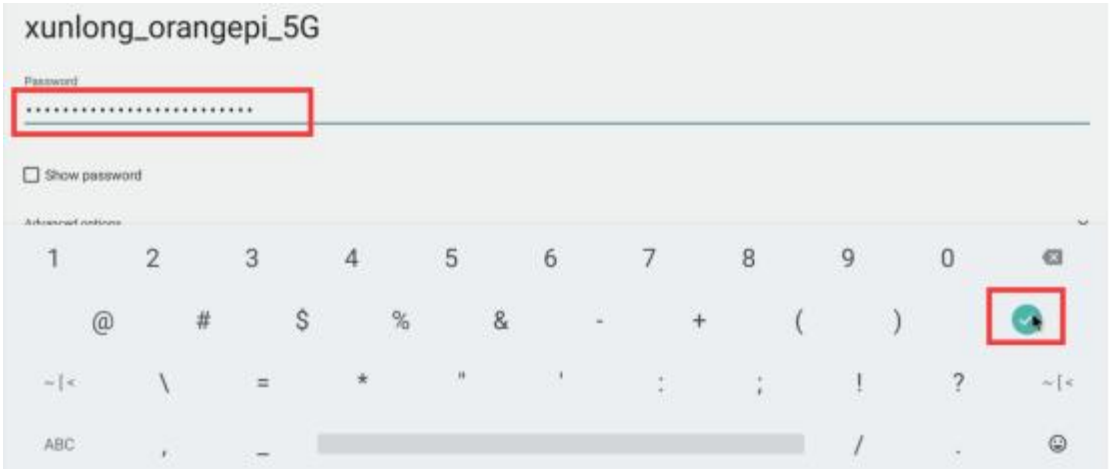
5) After turning on **Wi-Fi**, if everything is normal, you can scan to nearby Wi-Fi hotspots



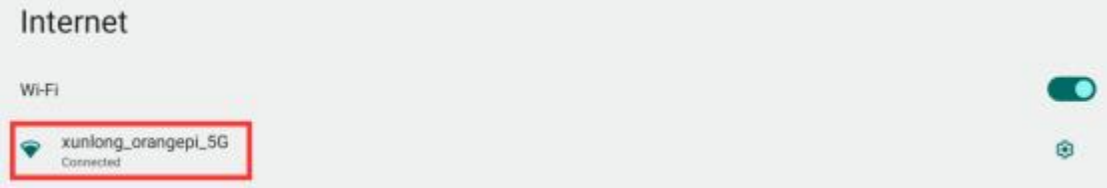
6) Then select the Wi-Fi you want to connect to, and the password input interface shown in the figure below will pop up



7) Then use the keyboard to enter the password corresponding to Wi-Fi, and then use the mouse to click the Enter button in the virtual keyboard to start connecting to Wi-Fi



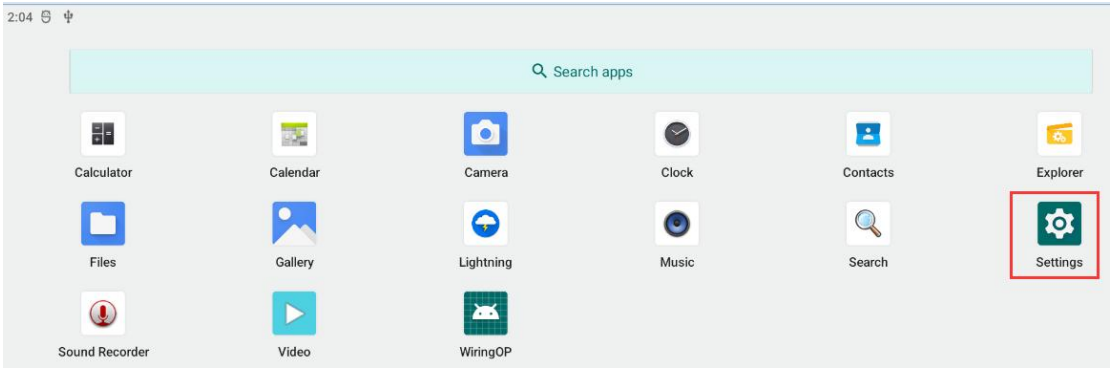
8) The display after successful Wi-Fi connection is shown in the figure below：



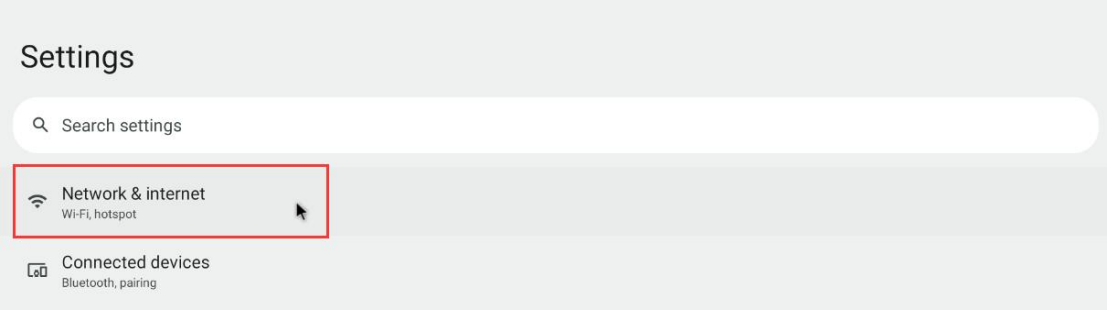
10. 6. How to use Wi-Fi hotspot

1) First, please make sure that the Ethernet port is connected to the network cable and can access the Internet normally

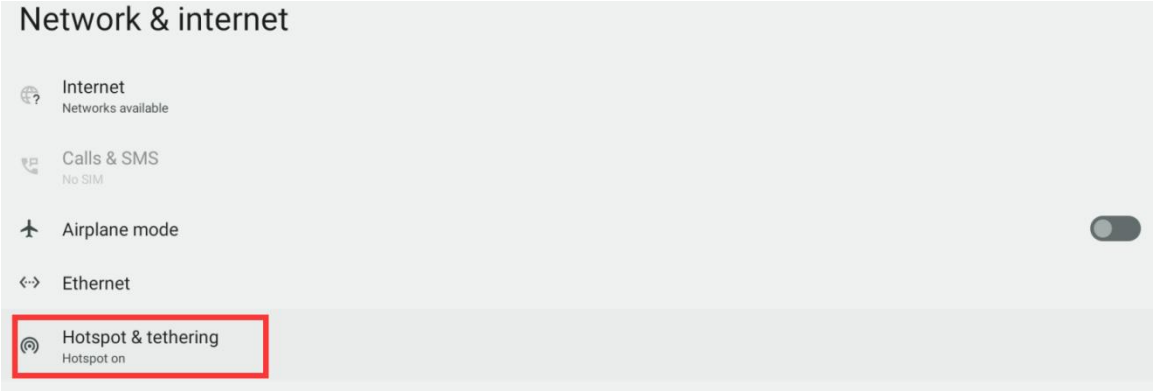
2) Then select **Settings**



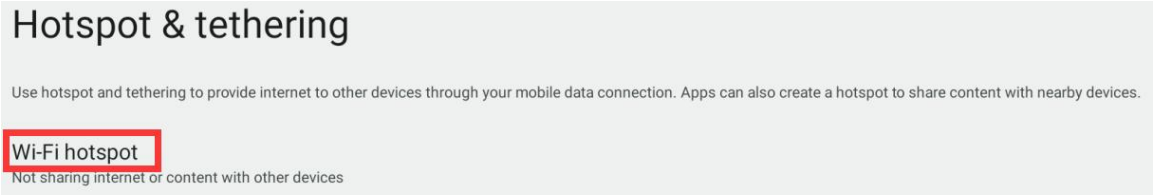
3) Then select **Network & internet**



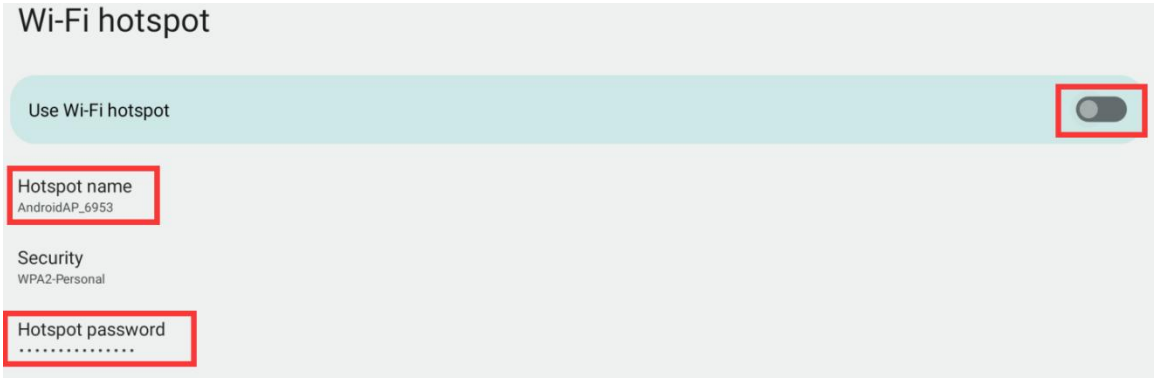
4) Then select **Hotspot & tethering**



5) Then select **Wi-Fi hotspot**



6) Then turn on the **Wi-Fi hotspot**, you can also see the name and password of the generated hotspot in the figure below, remember them, and use them when connecting to the hotspot **(if you need to modify the name and password of the hotspot, you need to turn off the Wi-Fi first -Fi hotspot before modification)**



7) At this point, you can take out your mobile phone. If everything is normal, you can find the WIFI hotspot with the same name (**here AndroidAP_6953**) displayed under the **Hotspot name** in the above picture in the WI-FI list searched by the mobile phone. Then you can click **AndroidAP_6953** to connect to the hotspot, and the password can be seen under the **Hotspot password** in the above picture

8) After the connection is successful, it will be displayed as shown in the figure below (the interface of different mobile phones will be different, the specific interface is subject to the display of your mobile phone). At this point, you can open a webpage on your mobile phone to see if you can access the Internet. If you can open the webpage normally, it means that the **WI-FI Hotspot** of the development board can be used normally.

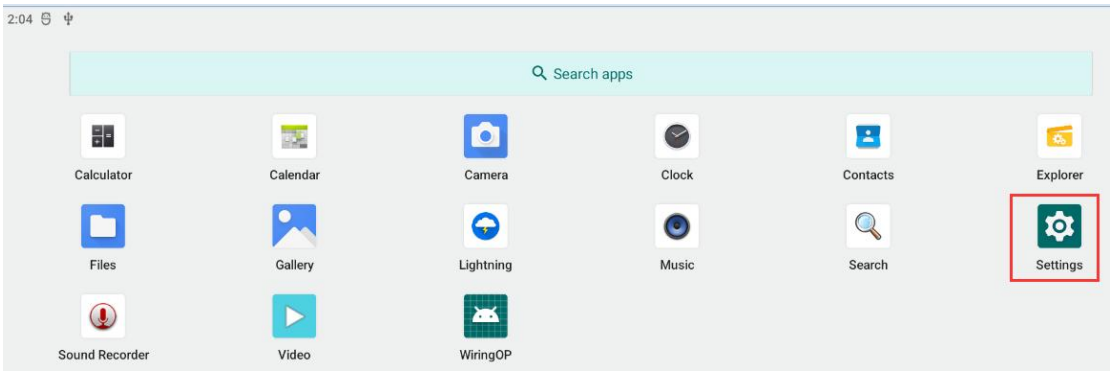
10. 7. Bluetooth test method

Please note that there is no Bluetooth module on the Orange Pi 5 Plus development board, and an external PCIe network card with Bluetooth or a USB network card with Bluetooth is required to use the Bluetooth function.

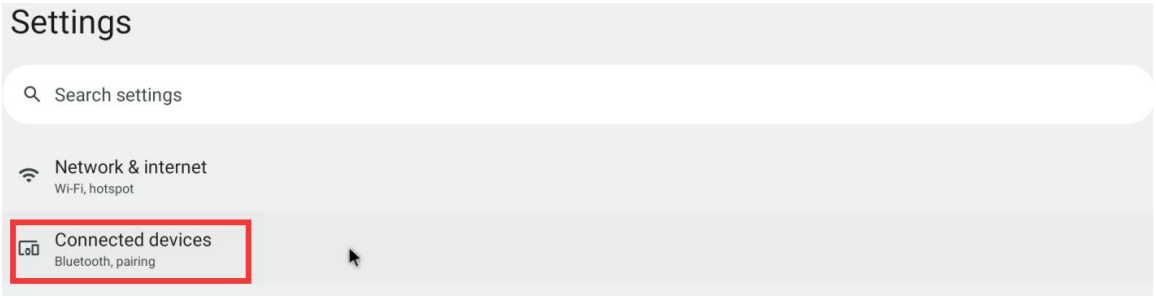
For instructions on using the external PCIe network card, please refer to the section on how to use the M.2 E-Key PCIe WIFI6+Bluetooth module.

For instructions on using the external USB network card, please refer to the section on how to use the USB wireless network card.

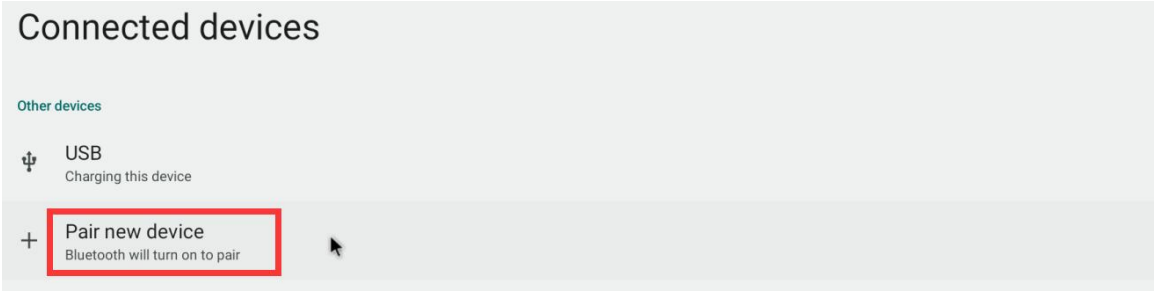
1) First click to enter the **Setting**



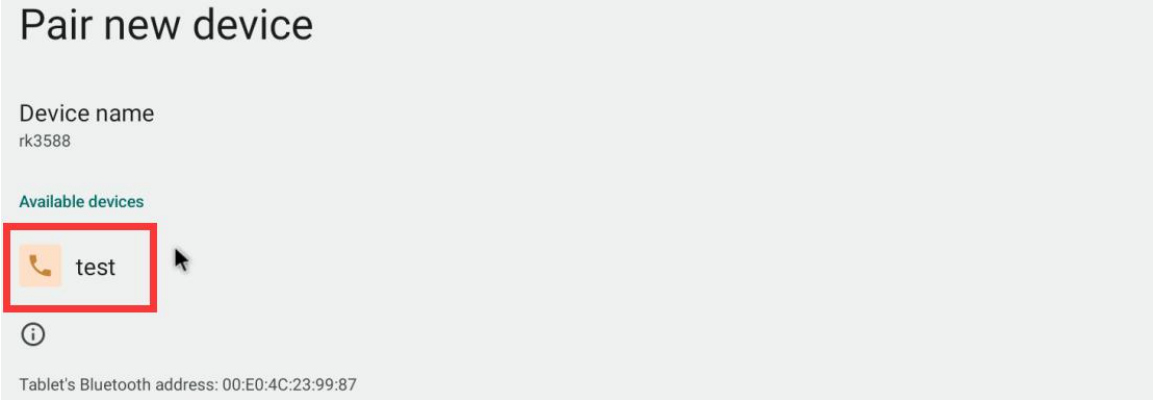
2) Then select **Connected devices**



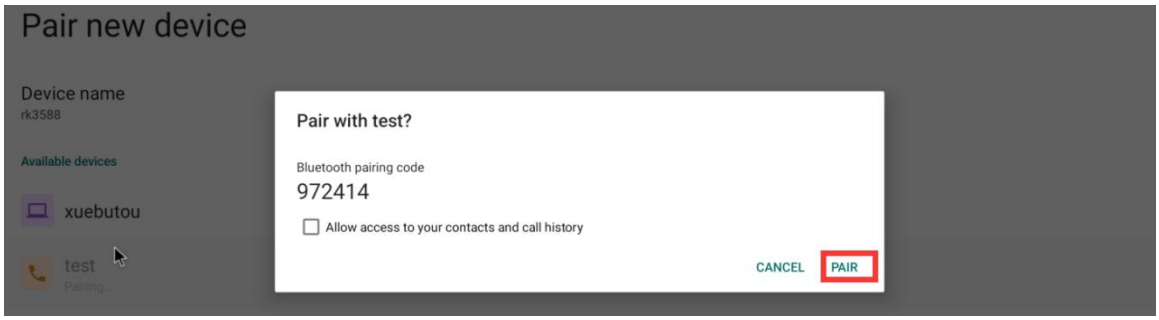
3) Then click **Pair new device** to turn on Bluetooth and start scanning the surrounding Bluetooth devices



4) The searched Bluetooth devices will be displayed under **Available devices**



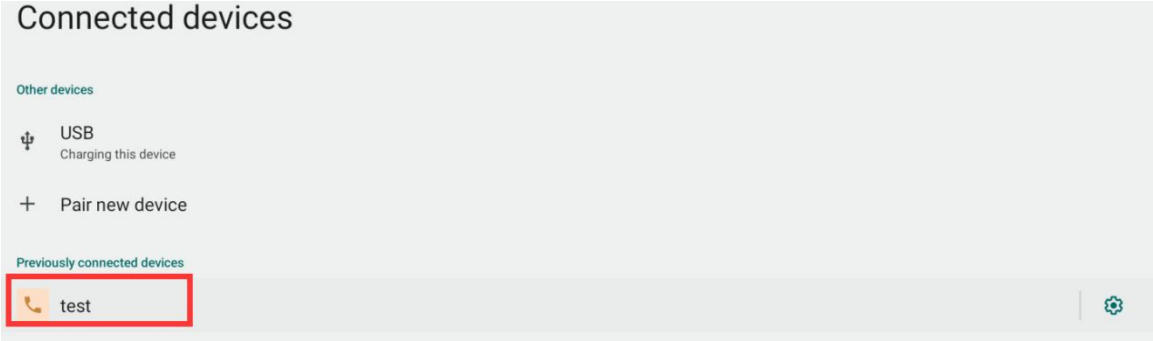
5) Then click the Bluetooth device you want to connect to start pairing. When the following interface pops up, please use the mouse to select the **Pair** option



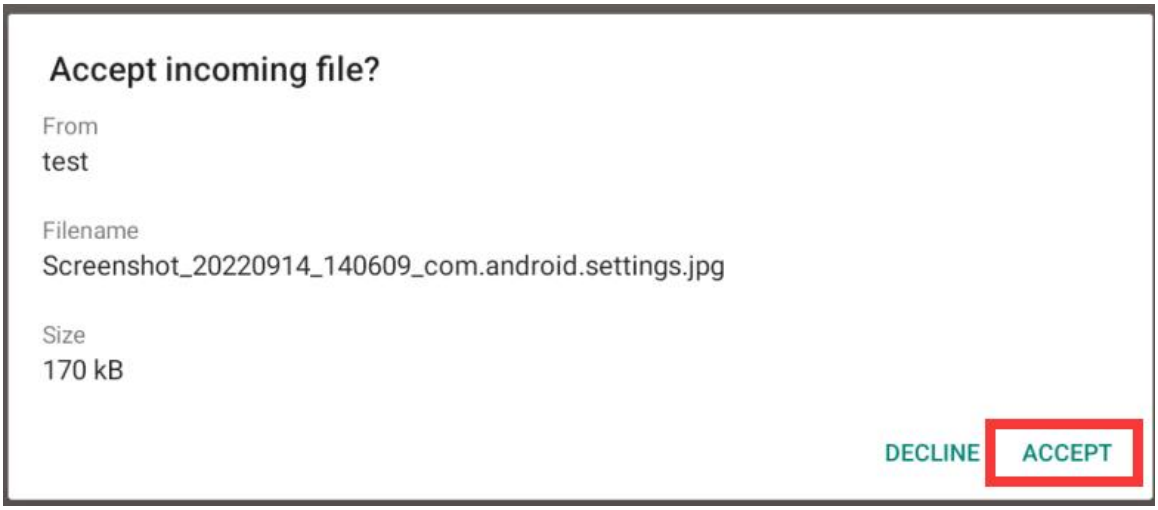
6) The test here is the configuration process of the development board and the Bluetooth of the Android mobile phone. At this time, the following confirmation interface will pop up on the mobile phone. After clicking the pairing button on the mobile phone, the pairing process will start

7) After the pairing is completed, you can see the paired Bluetooth device as shown in

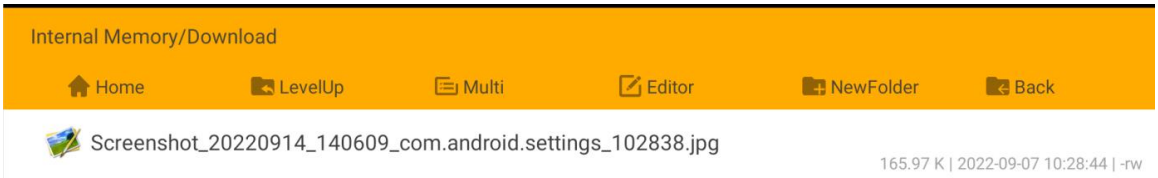
the figure below



8) At this time, you can use the Bluetooth of your mobile phone to send a picture to the development board. After sending, you can see the following confirmation interface in the Android system of the development board, and then click **Accept** to start receiving the picture sent by the mobile phone.

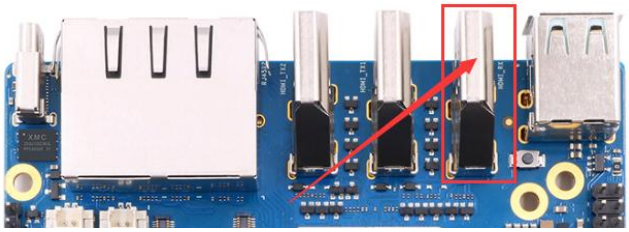


9) You can open the **Download** directory in the file manager to view the pictures received by the Android system Bluetooth of the development board



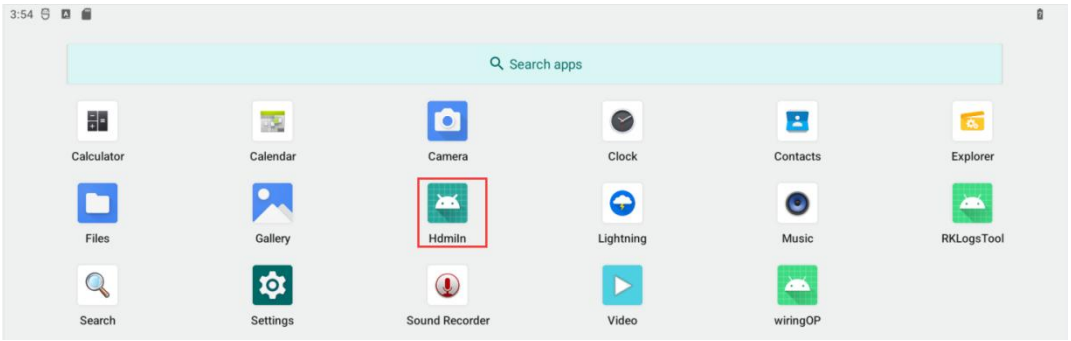
10. 8. Test method of HDMI In

4) The location of the HDMI In interface on the development board is as follows：

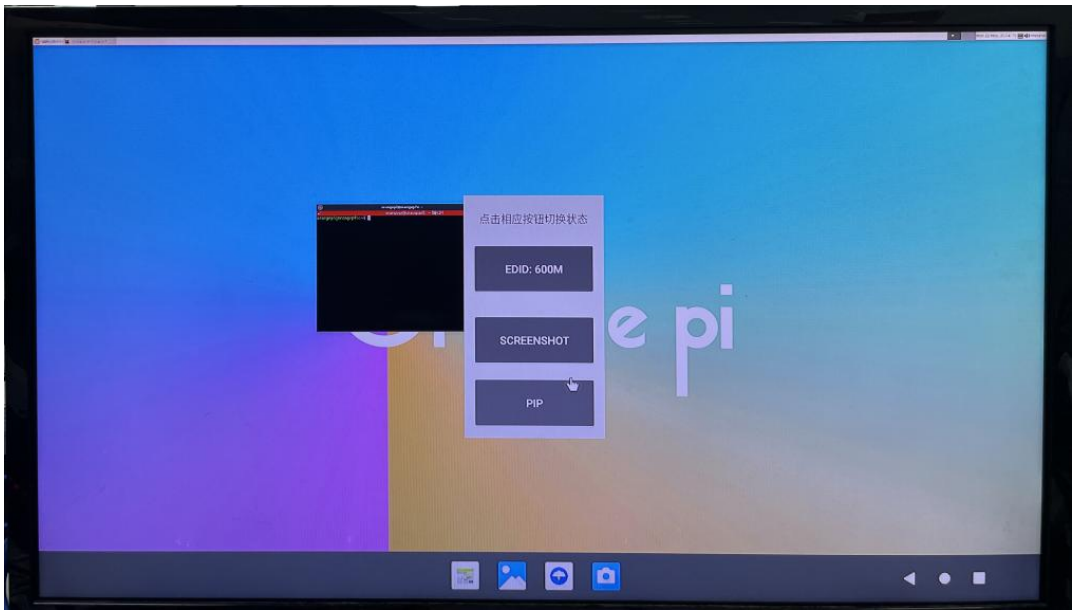


5) Then use the HDMI to HDMI cable shown in the figure below to connect the HDMI output of other devices to the HDMI In interface of the development board

6) Make sure that the HDMI output of the device connected to the HDMI In interface is normal, and then open the HDMI In test APP



7) Then you can see the video input of HDMI In, and the audio input of HDMI In will also be output from the HDMI TX interface or headphone interface of the development board. The figure below shows the desktop of the Linux system of the OPi5 development board input through HDMI In.



10. 9. How to use 10.9.10.1 inch MIPI screen

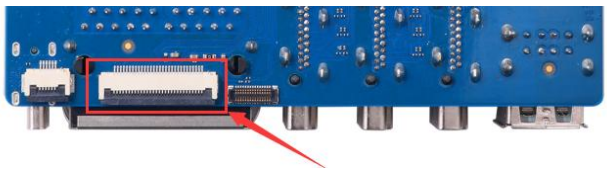
Please make sure that the Android image used is the image of the following two versions：

OrangePi5Plus_RK3588_Android12_lcd_v1.x.x.img

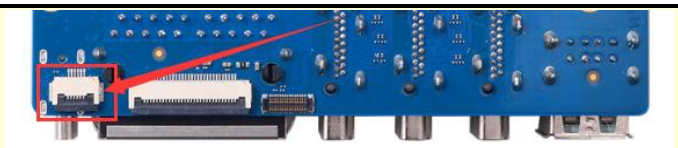
OrangePi5Plus_RK3588_Android12_spi-nvme_lcd_v1.x.x.img

1) The screen needs to be assembled first, please refer to the assembly method of the 10.1-inch MIPI screen

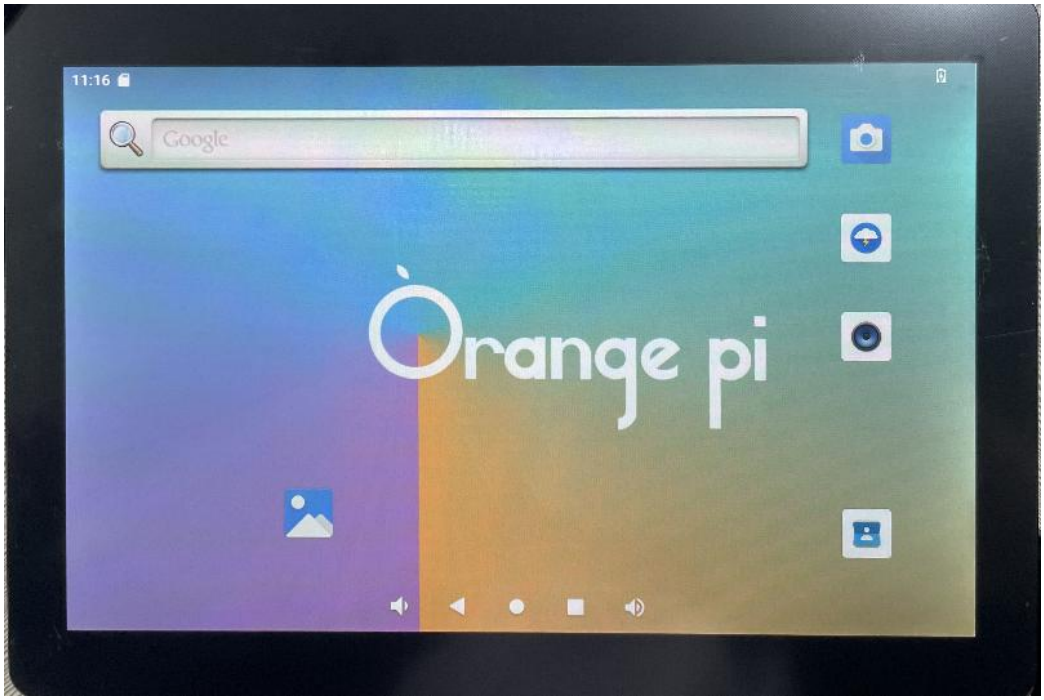
2) The interface position of the LCD on the development board is shown in the figure below：



Note that the touch interface below is not for the LCD MIPI screen. It is currently a spare interface and cannot be used.



3) Connect the assembled screen to the LCD interface, connect the Type-C power supply to the board, and power on. After the system starts, you can see the screen display as shown in the figure below

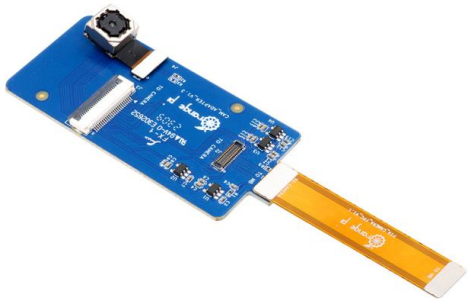


10. 10. OV13850 and OV13855 MIPI camera test method

Currently the development board supports two MIPI cameras, OV13850 and OV13855, the specific pictures are as follows：

a. OV13850 camera with 13 million MIPI interface

b. OV13855 camera with 13 million MIPI interface



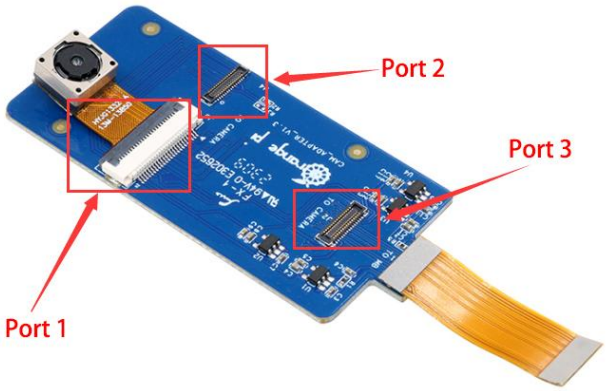
The adapter boards and FPC cables used by the OV13850 and OV13855 cameras are the same, but the positions of the two cameras connected to the adapter boards are different. The FPC cable is shown in the figure below. Please note that the FPC cable has a direction. The end marked **TO MB** needs to be inserted into the camera interface of the development board, and the end marked **TO CAMERA** needs to be inserted into the camera adapter board.

There are a total of 3 camera interfaces on the camera adapter board, and only one can be used at a time, as shown in the figure below, of which:

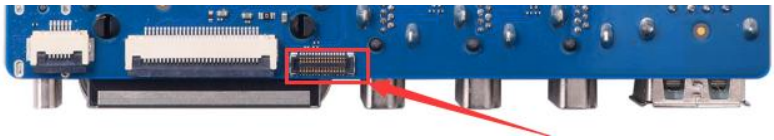
a. **No.1 port is connected to OV13850 camera**

b. **No.2 interface is connected to OV13855 camera**

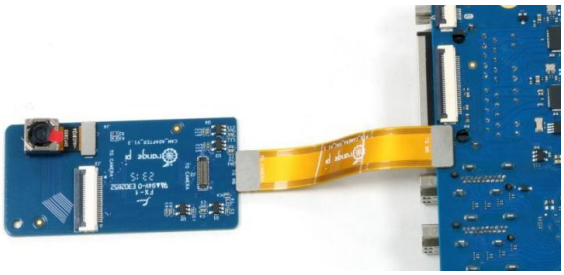
c. No. 3 interface is not used, just ignore it



The location of the camera interface on the Orange Pi 5 Plus development board is shown in the figure below:

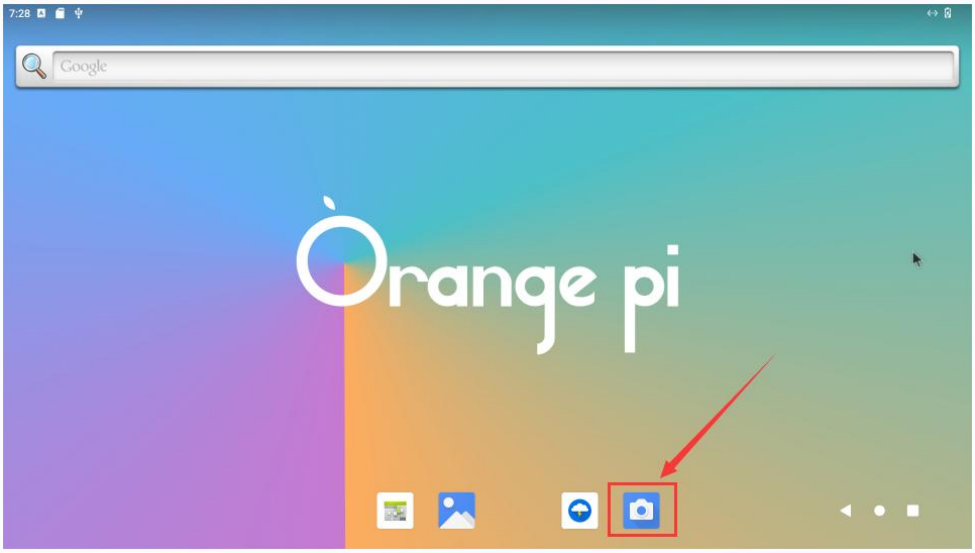


The method of inserting the camera into the CAM interface of the development board is as follows:

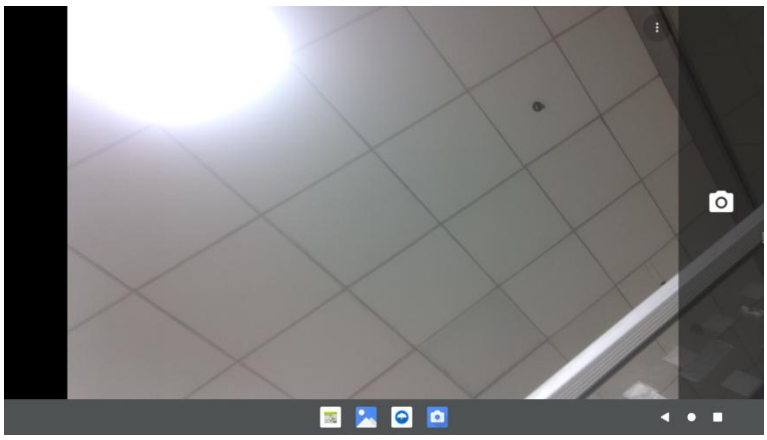


After connecting the camera to the development board, we can use the following method to test the camera：

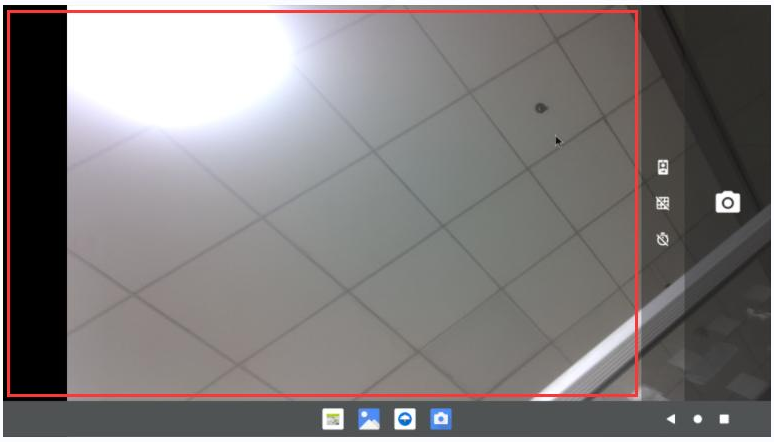
a. Open the camera APP on the desktop



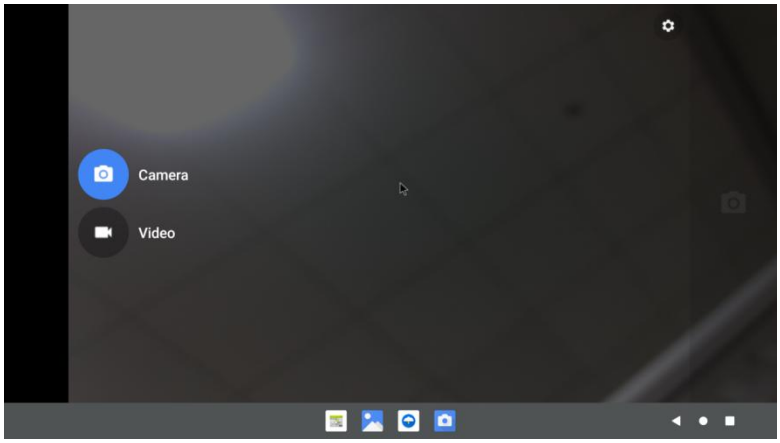
b. Then you can see the preview screen of the camera



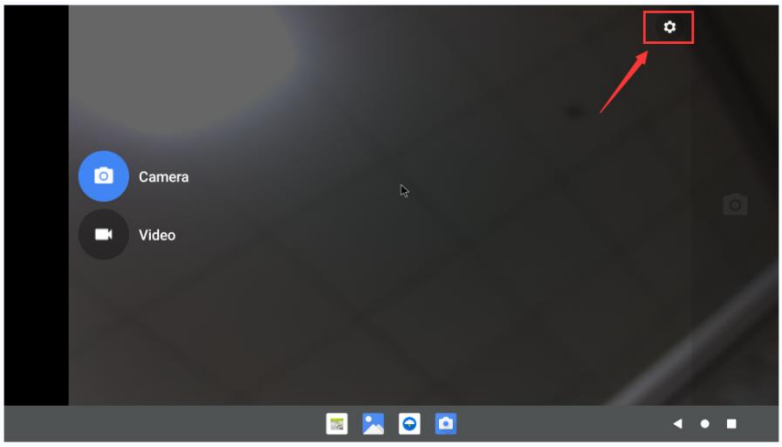
Press and hold the mouse in the area shown in the red box in the picture below of the camera APP and then drag to the right to call up the switching interface for taking pictures and recording



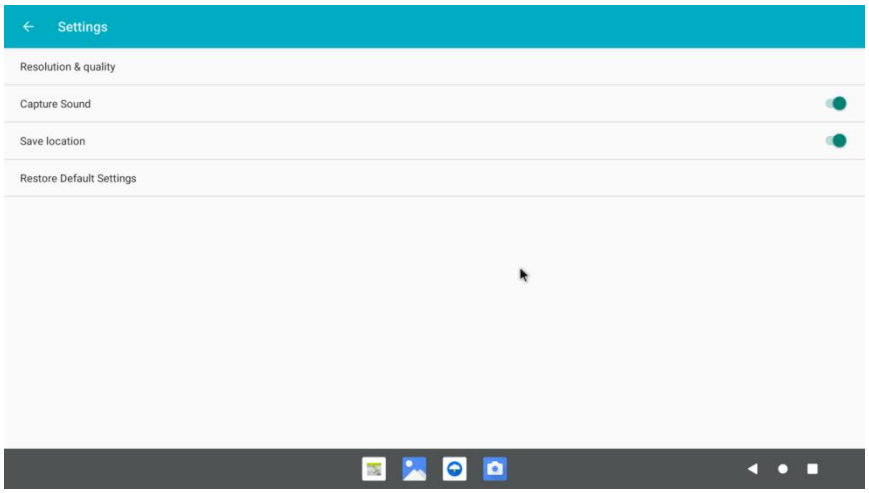
The switching interface of taking pictures and recording is as follows, click Video to switch to **video** recording mode



Click the position shown in the figure below to enter the camera setting interface



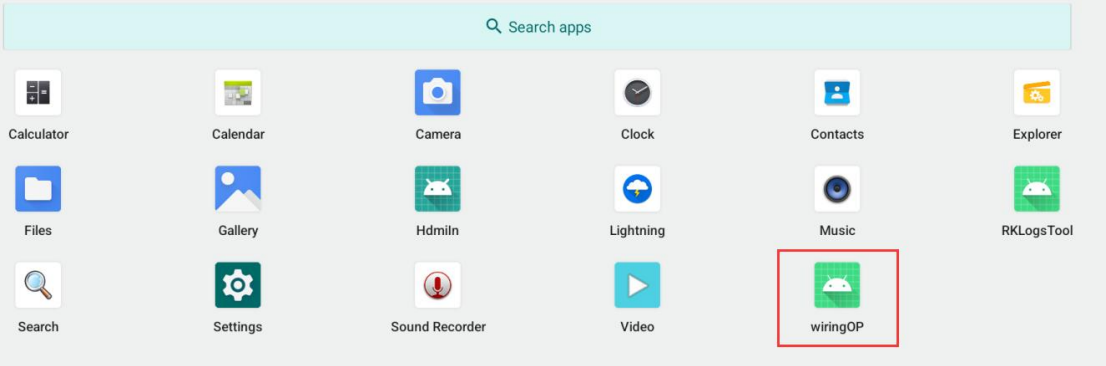
The setting interface of the camera is as follows：



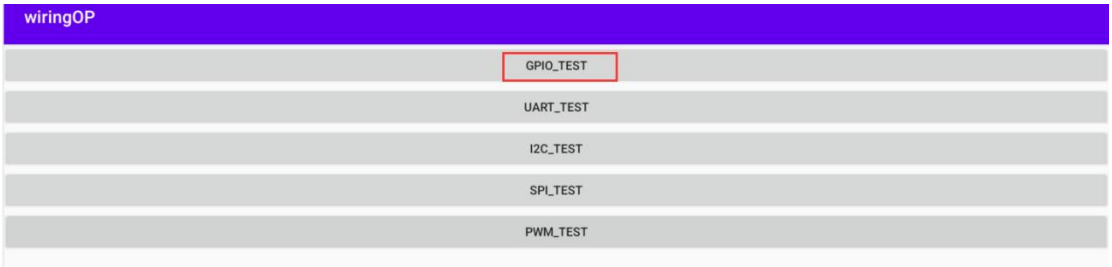
10. 11. 40pin interface GPIO, UART, SPI and PWM test

10. 11. 1. 40pin GPIO port test

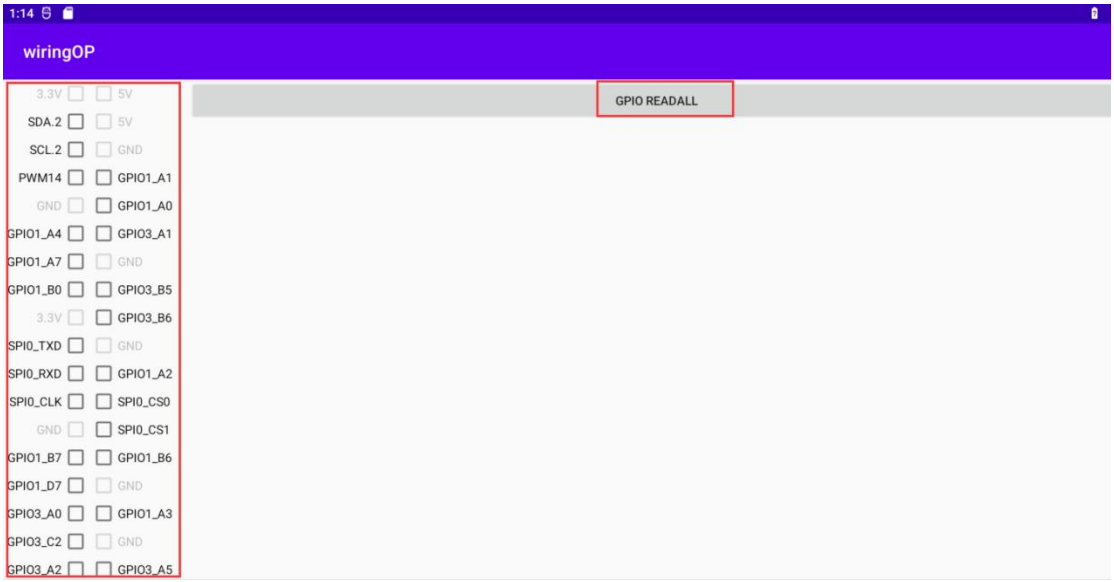
1) First click on the wiringOP icon to open the wiringOP APP



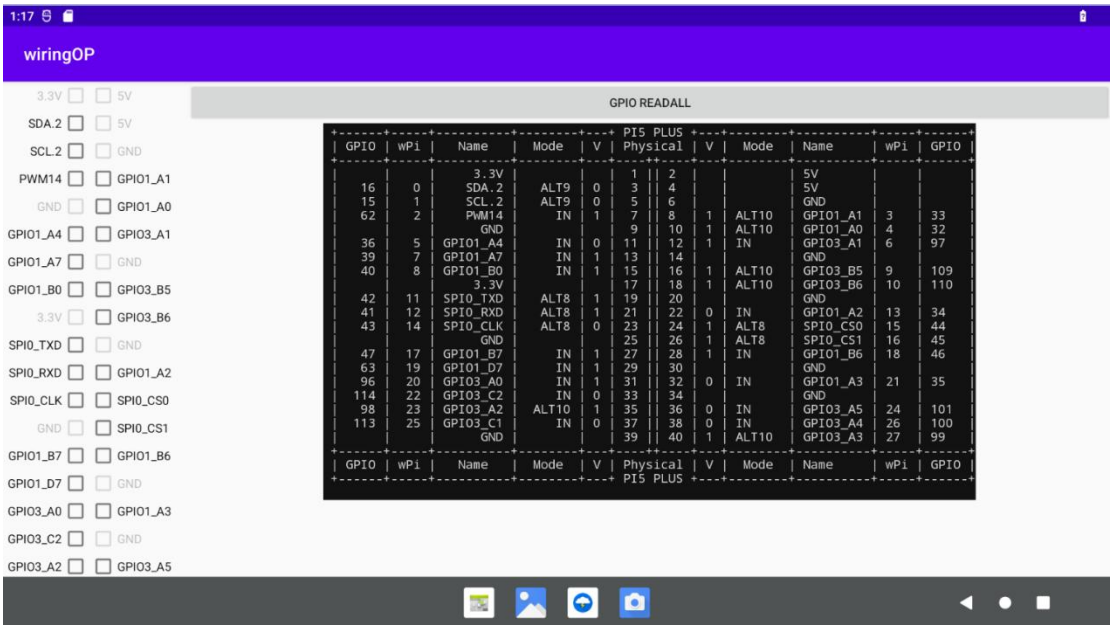
2) The main interface of wiringOP APP is displayed as shown in the figure below, and then click the **GPIO_TEST** button to open the GPIO test interface



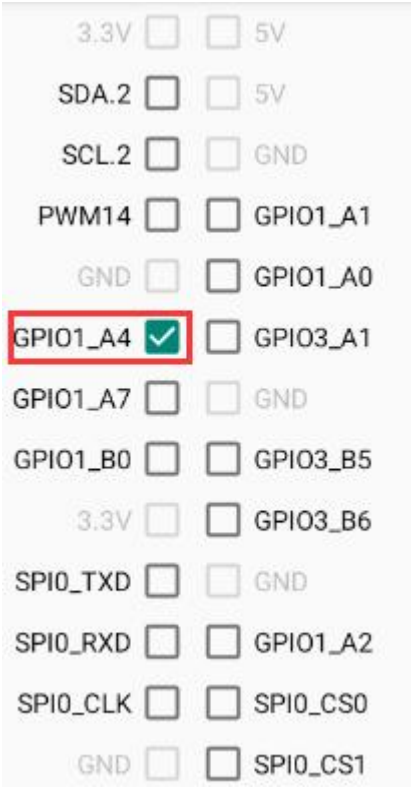
3) The GPIO test interface is shown in the figure below. The two rows of **CheckBox** buttons on the left are in one-to-one correspondence with the 26pin pins. When the **CheckBox** button is checked, the corresponding GPIO pin will be set to **OUT** mode, and the pin level will be set to high level; when the checkbox is unchecked, the GPIO pin level will be set to low level; When the **GPIO READALL** button is pressed, information such as the wPi number, GPIO mode, and pin level can be obtained.



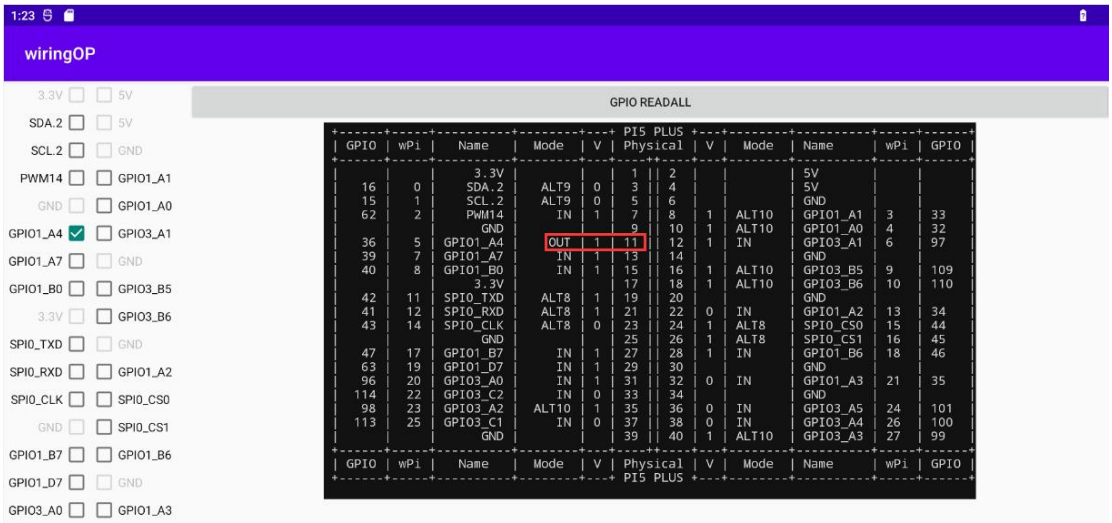
4) Then click the **GPIO READALL** button, the output information is as shown in the figure below：



5) There are a total of 28 GPIO ports in the 40pins of the development board that can be used. The following uses pin 11 — the corresponding GPIO is GPIO1_A4 — the corresponding wPi serial number is 5—as an example to demonstrate how to set the high and low levels of the GPIO port. First click the **CheckBox** button corresponding to pin 11. When the button is selected, pin 11 will be set to high level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is **3.3v**, it means setting high level success

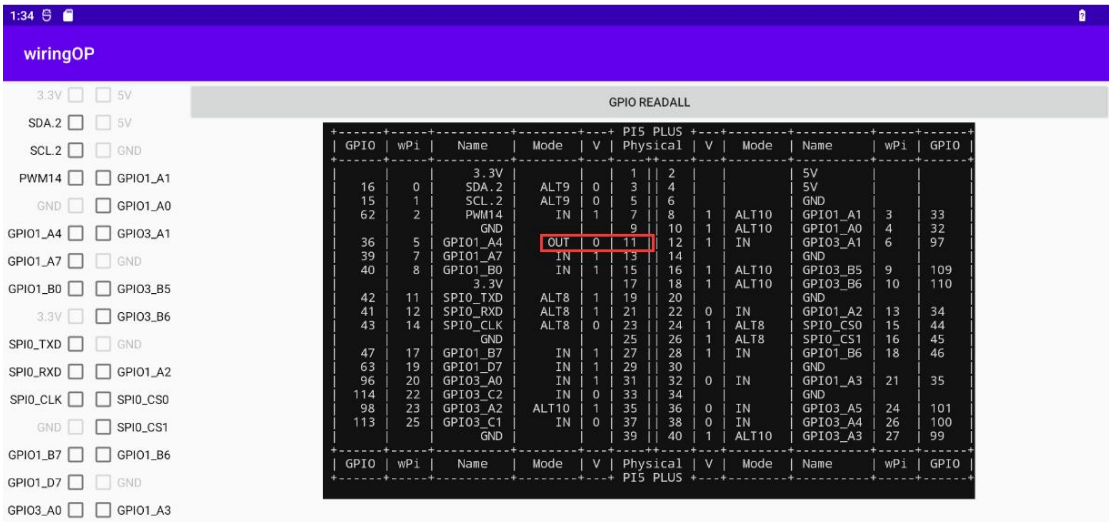


6) Then click the **GPIO READALL** button, you can see that the current pin 7 mode is **OUT**, and the pin level is high



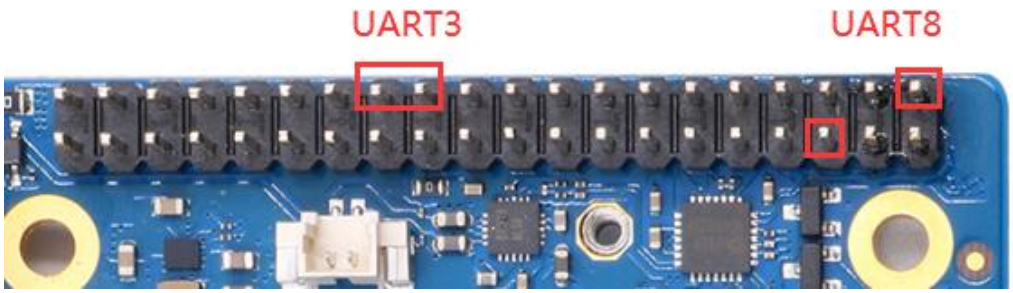
7) Click the **CheckBox** button in the figure below again to cancel the check status. Pin 11 will be set to low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is **0v**, it means that the low level is set successfully.

8) Then click the **GPIO READALL** button, you can see that the current mode of pin 11 is OUT, and the pin level is low

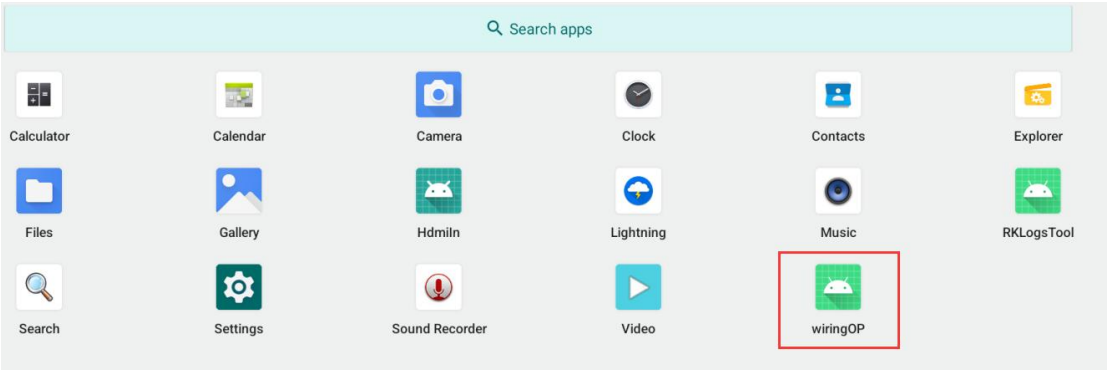


10.11.2. 40pin UART test

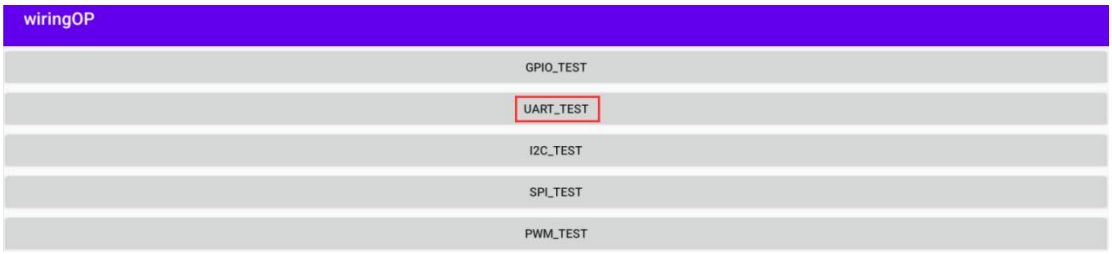
1) **UART3** and **UART8** are enabled by default in Android. The position of the 40pin is shown in the figure below, and the corresponding device nodes are /dev/ttyS3 and /dev/ttyS8 respectively



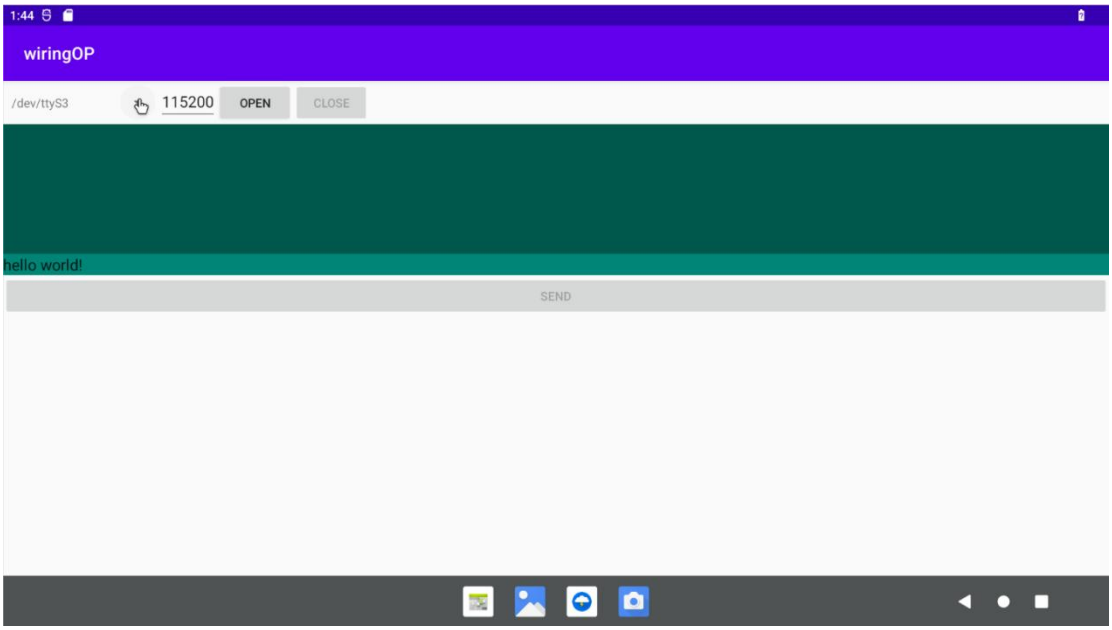
2) First click on the wiringOP icon to open the wiringOP APP



3) The main interface of wiringOP APP is displayed as shown in the figure below, and then click the **UART_TEST** button to open the UART test interface

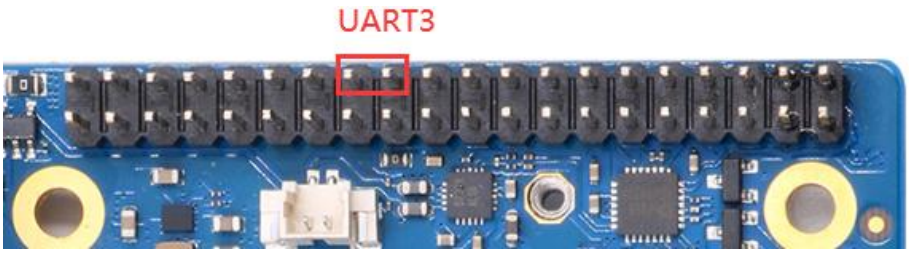


4) The serial port test interface of the APP is shown in the figure below



5) Take the test of **UART3** as an example below, select the **/dev/ttyS3** node in the selection box, enter the baud rate you want to set in the edit box, and then click the **OPEN** button to open the **/dev/ttyS3** node. After opening successfully, click the **OPEN** button becomes unselectable, and the **CLOSE** button and **SEND** button become selectable

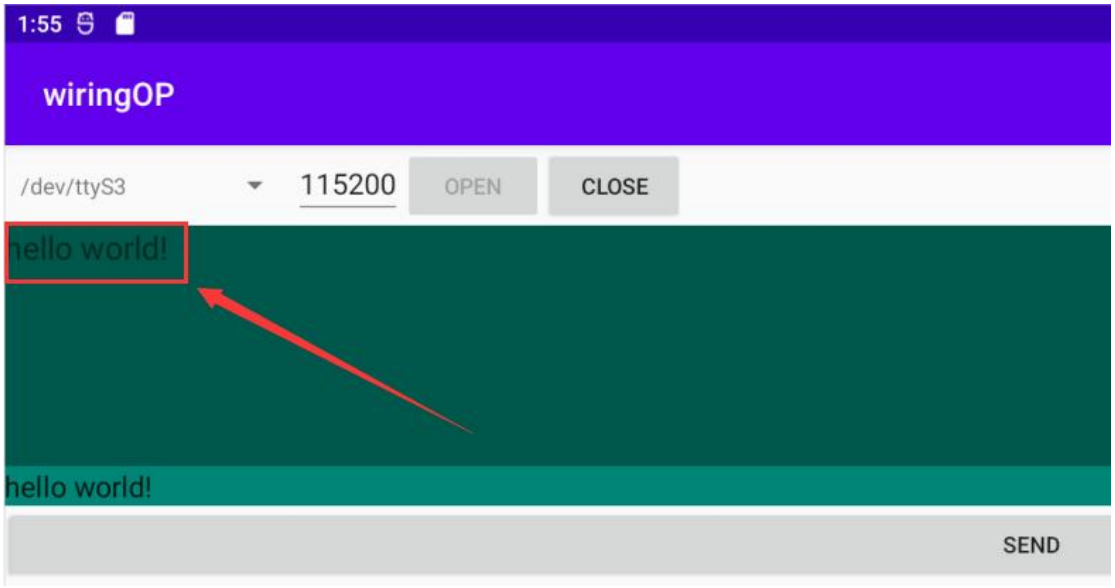
6) Then use Dupont wire to short the RXD and TXD pins of uart3



7) Then you can enter a character in the send edit box below, and click the **SEND** button

to start sending

8) If everything is normal, the received string will be displayed in the receiving box

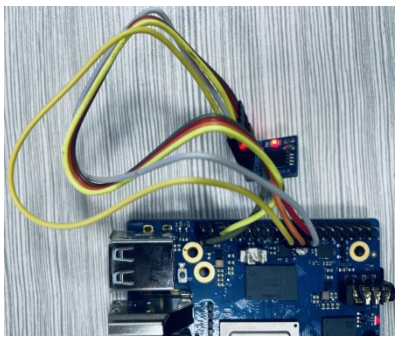


10. 11. 3. 40pin SPI test

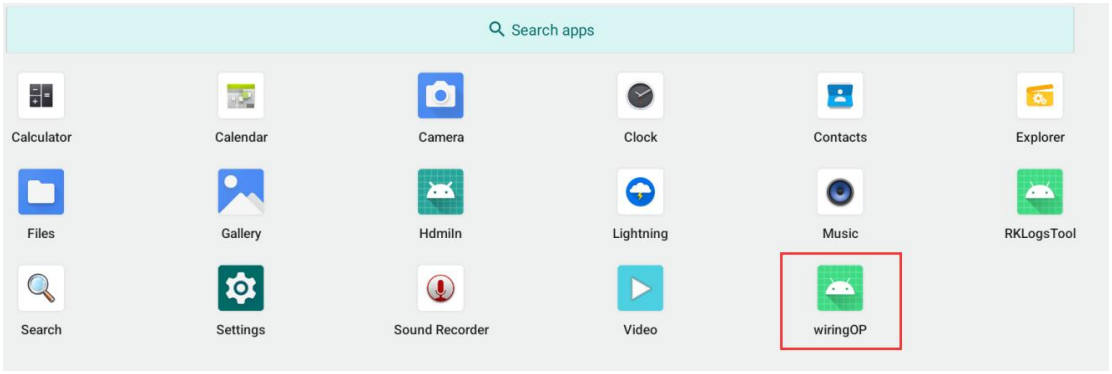
1) From the table below, the available SPIs for Orange Pi 5 Plus are SPI0 and SPI4

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	复用功能
			3.3V		1	2		5V				
CAN0_RX_M0	PWM1_M0（fd8b0010）	I2C2_SDA_M0	GPIO0_C0	16	3	4		5V				
CAN0_TX_M0	PWM0_M0（fd8b0000）	I2C2_SCL_M0	GPIO0_B7	15	5	6		GND				
UART1_RTSN_M1	I2C8_SCL_M2	PWM14_M2（febf0020）	GPIO1_D6	62	7	8	109	GPIO1_A1	UART6_TX_M1	I2C2_SCL_M4	SPI4_MOSI_M2	
			GND		9	10	110	GPIO1_A0	UART6_RX_M1	I2C2_SDA_M4	SPI4_MISO_M2	
			GPIO1_A4	36	11	12	97	GPIO3_A1		SPI4_MOSI_M1	PWM11_IR_M0（febe0030）	
			GPIO1_A7	39	13	14		GND				
			GPIO1_B0	40	15	16	32	GPIO3_B5	UART3_TX_M1	CAN1_RX_M0	PWM12_M0（febf0000）	
			3.3V		17	18	33	GPIO3_B6	UART3_RX_M1	CAN1_TX_M0	PWM13_M0（febf0010）	
	UART4_RX_M2	SPI0_MOSI_M2	GPIO1_B2	42	19	20		GND				
		SPI0_MISO_M2	GPIO1_B1	41	21	22	34	GPIO1_A2	UART6_RTSN_M1	I2C4_SDA_M3	SPI4_CLK_M2	PWM0_M2（fd8b0000）
	UART4_TX_M2	SPI0_CLK_M2	GPIO1_B3	43	23	24	44	GPIO1_B4	SPI0_CS0_M2	UART7_RX_M2		
			GND		25	26	45	GPIO1_B5	SPI0_CS1_M2	UART7_TX_M2		
PWM13_M2（febf0010）	UART1_RX_M1	I2C5_SDA_M3	GPIO1_B7	47	27	28	46	GPIO1_B6	I2C5_SCL_M3	UART1_TX_M1		
	UART1_CTSN_M1	I2C8_SDA_M2	GPIO1_D7	63	29	30		GND				
PWM10_M0（febe0020）	SPI4_MISO_M1		GPIO3_A0	96	31	32	35	GPIO1_A3	UART6_CTSN_M1	I2C4_SCL_M3	SPI4_CS0_M2	PWM1_M2（fd8b0010）
		PWM14_M0（febf0020）	GPIO3_C2	114	33	34		GND				
	SPI4_CLK_M1	UART8_TX_M1	GPIO3_A2	98	35	36	101	GPIO3_A5	UART8_CTSN_M1			
			GPIO3_C1	113	37	38	100	GPIO3_A4	UART8_RTSN_M1	SPI4_CS1_M1		
			GND		39	40	99	GPIO3_A3	UART8_RX_M1	SPI4_CS0_M1		

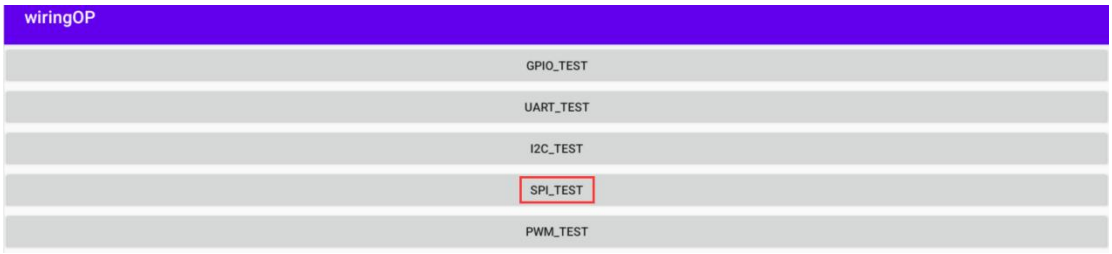
2) The Android system opens the SPI0 configuration by default. Here is a demonstration to test the SPI0 interface through the w25q64 module. First, connect the w25q64 device to the SPI0 interface.



3) Then click the wiringOP icon to open the wiringOP APP

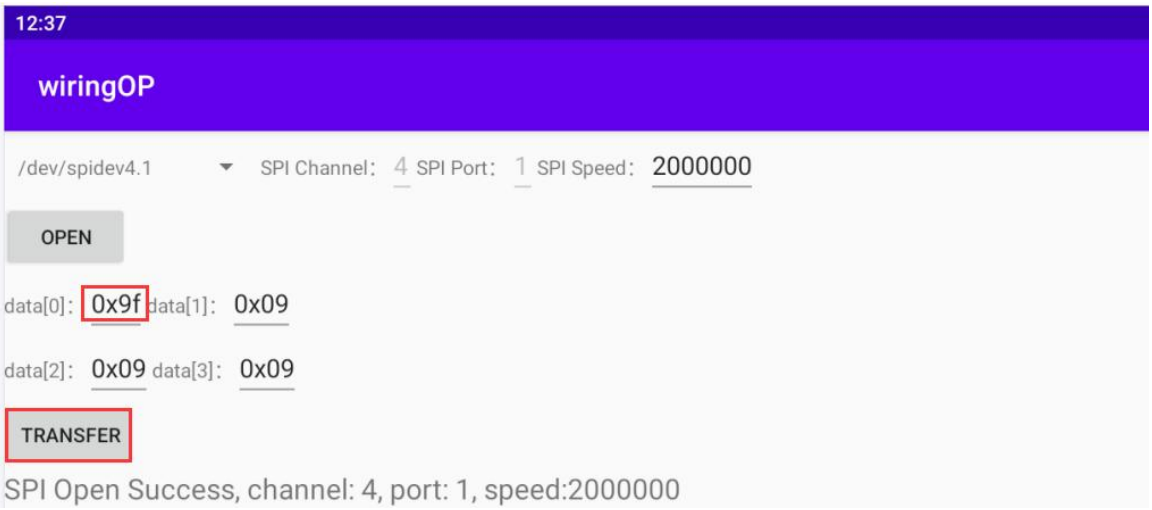


4) The main interface of wiringOP APP is displayed as shown in the figure below, click the **SPI_TEST** button to open the SPI test interface

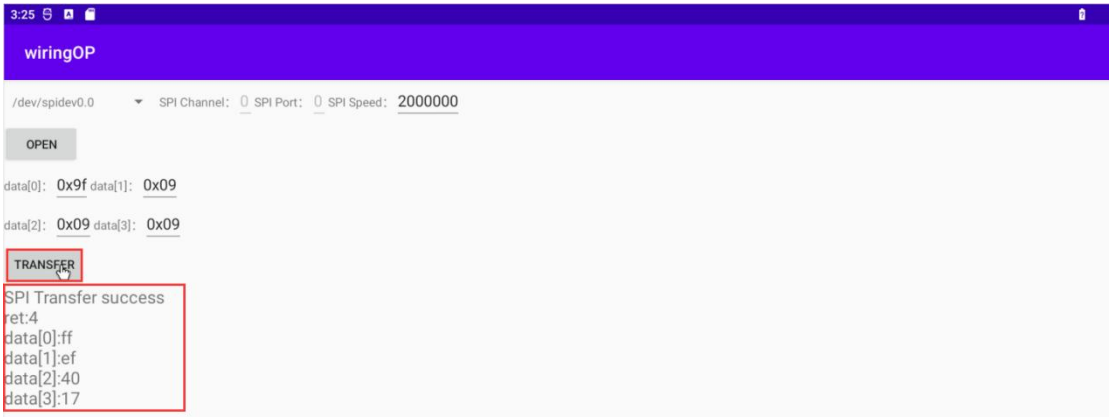


5) Then click the **OPEN** button to initialize the SPI

6) Then fill in the bytes that need to be sent, such as reading the ID information of w25q64, fill in the address 0x9f in data[0], and then click the **TRANSFER** button



7) Finally, the APP will display the read ID information



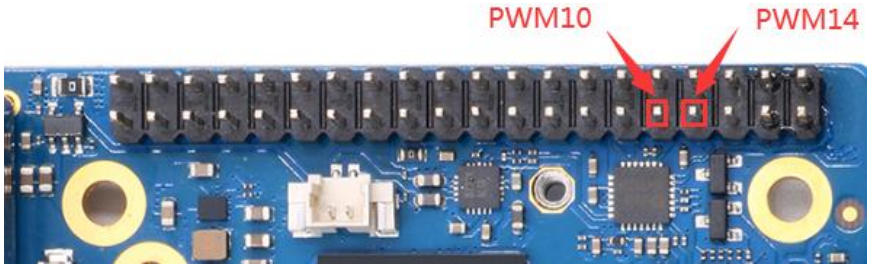
8) The MANUFACTURER ID of the w25q64 module is EFh, and the Device ID is 4017h, corresponding to the value read above (h stands for hexadecimal)

MANUFACTURER ID	**(MF7 - MF0)**	
Winbond Serial Flash	EFh	
Device ID	**(ID7 - ID0)**	**(ID15 - ID0)**
Instruction	**ABh, 90h, 92h, 94h**	**9Fh**
W25Q64FV (SPI)	16h	4017h
W25Q64FV (QPI)	16h	6017h

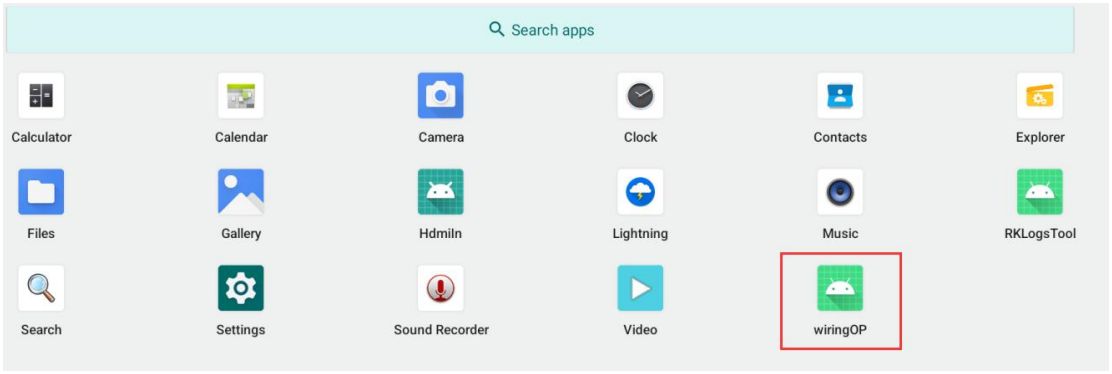
10. 11. 4. 40pin PWM test

1) Android enables **PWM10** and **PWM14** by default, and the corresponding pins are

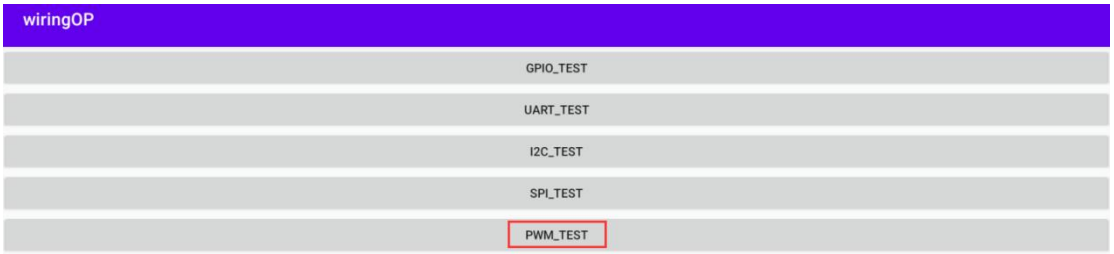
located at 40pin as shown in the figure below：



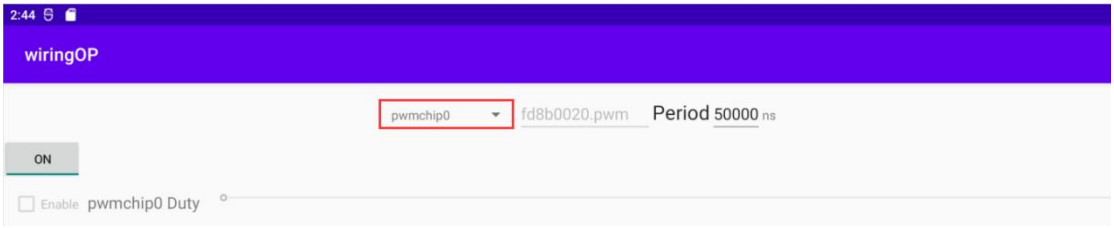
2) First click on the wiringOP icon to open the wiringOP APP



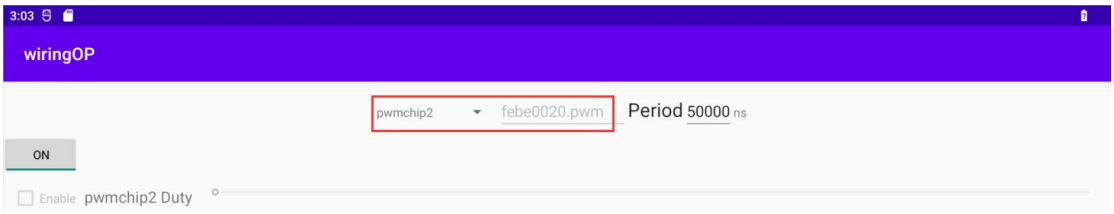
3) Then click the **PWM_TEST** button on the main interface of wiringOP to enter the PWM test interface



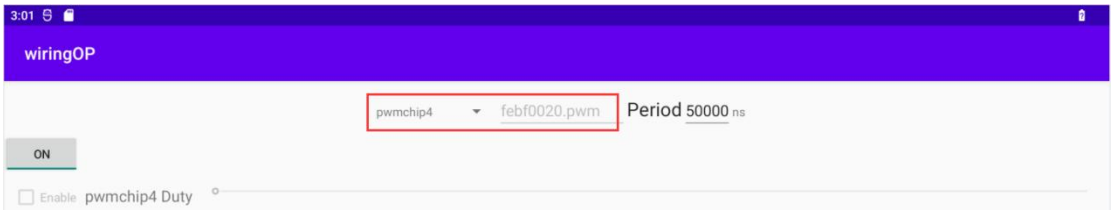
4) The base address corresponding to PWM10 is **febe0020**, and the base address corresponding to PWM14 is **febf0020**. Here, **fd8b0020.pwm** is displayed on the right of pwmchip0. At this time, you need to click the drop-down option to select other pwmchips until **febe0020** or **febf0020** is displayed on the right.



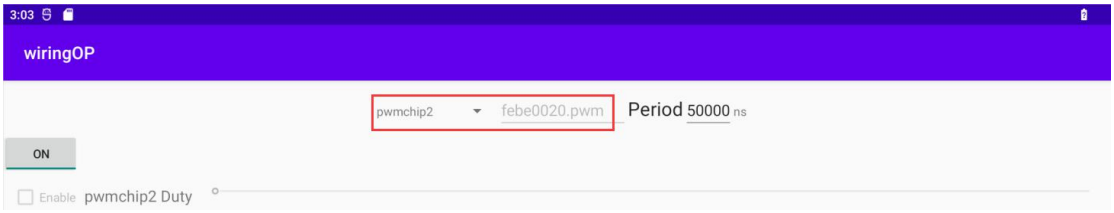
5) When the drop-down option menu selects **pwmchip2**, the corresponding base address of **PWM10** is **febe0020** on the right



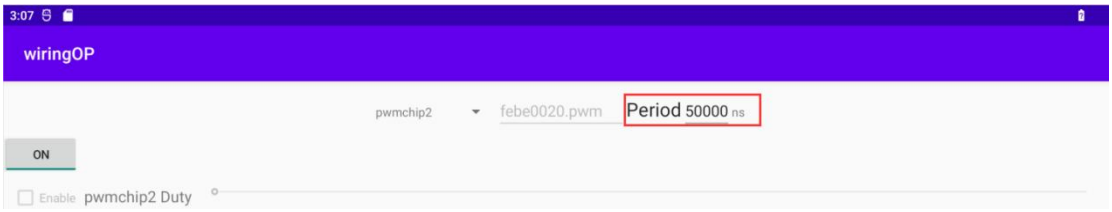
6) When the drop-down option menu selects **pwmchip4**, the corresponding base address of **PWM14** is **febe0020** on the right



7) Take the test of PWM10 as an example, we need to select **pwmchip2**

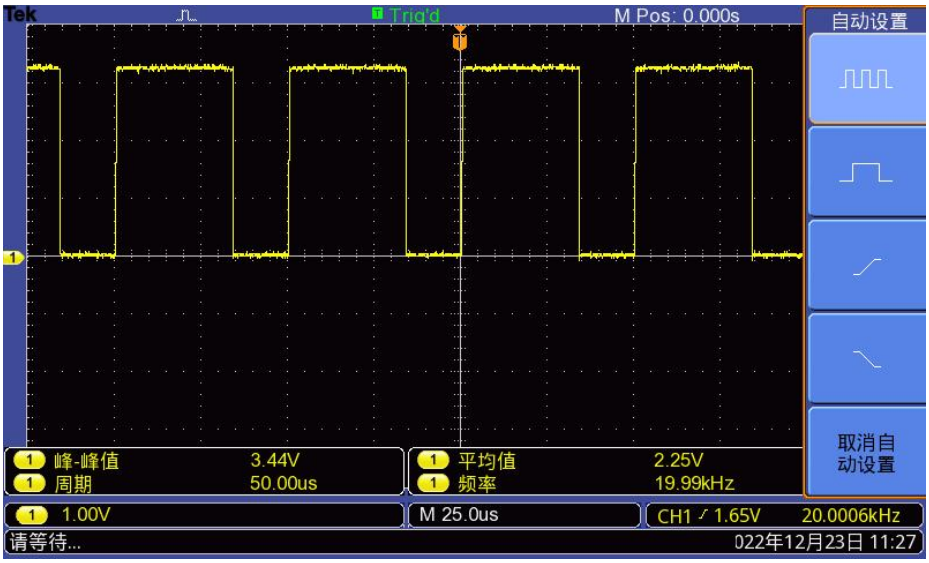


8) Then confirm the PWM period, the default configuration is **50000ns**, converted to PWM frequency is **20KHz**, you can modify it yourself, click the open button to export **PWM10**



9) Then drag the drag bar below to change the PWM duty cycle, and then check Enable to output the PWM waveform

10) Then use an oscilloscope to measure the 31st pin in the 40pin of the development board, and you can see the following waveform

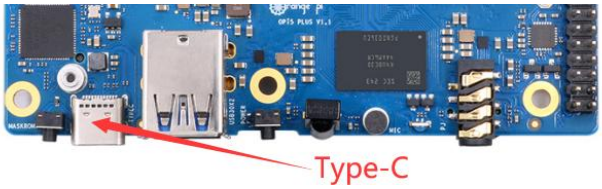


10. 12. How to use ADB

10. 12. 1. Use the data cable to connect to adb debugging

1) First prepare a good quality Type-C data cable

2) Then connect the development board and Ubuntu PC through the Type-C data cable. The position of the Type-C interface of the development board is shown in the figure below:



3) Then install the adb tool on the Ubuntu PC

```
test@test:~$ sudo apt update
test@test:~$ sudo apt -y install adb
```

4) You can view the identified ADB devices through the following command

```
test@test:~$ adb devices
List of devices attached
S63QCF54CJ      device
test@test:~$ lsusb
Bus 003 Device 006: ID 2207:0006
```

5) Then you can log in to the android system through the adb shell on the Ubuntu PC

```
test@test:~$ adb shell
console:/ $
```

6) Execute the following command to remount the Android system

```
test@test:~$ adb root
test@test:~$ adb remount
```

7) Then you can transfer files to the Android system

```
test@test:~$ adb push example.txt /system/
```

10.12.2. Use network connection adb debugging

Using the network adb does not require a data cable of the Typc-C interface to connect the computer and the development board, but to communicate through the network, so first of all, please ensure that the wired or wireless network of the development board has been connected, and then obtain the IP address of the development board, and then to use.

1) Make sure that the **service.adb.tcp.port** of the Android system is set to port number 5555

```
console:/ # getprop | grep "adb.tcp"
[service.adb.tcp.port]: [5555]
```

2) If **service.adb.tcp.port** is not set, you can use the following command to set the port number of network adb

```
console:/ # setprop service.adb.tcp.port 5555
console:/ # stop adbd
console:/ # start adbd
```

3) Install adb tool on Ubuntu PC

```
test@test:~$ sudo apt update
test@test:~$ sudo apt install -y adb
```

4) Then connect network adb on Ubuntu PC

```
test@test:~$ adb connect 192.168.1.xxx      (The IP address needs to be changed to the IP address of the development board)
* daemon not running; starting now at tcp:5037
* daemon started successfully
connected to 192.168.1.xxx:5555

test@test:~$ adb devices
List of devices attached
192.168.1.xxx:5555          device
```

5) Then you can log in to the android system through the adb shell on the Ubuntu PC

```
test@test:~$ adb shell
console:/ #
```

10. 13. 2.4G USB remote control tested by Android Box

1) A 2.4G USB remote control that has been tested so far is shown in the figure below
   a. Contains a remote control

b. A USB wireless receiver

2) The Android Box system does not require any configuration, it can be used after plugging it in

10.14. How to use the infrared remote control of the Android Box system

1) The development board comes with an infrared receiver, and its location is shown in the figure below：

2) Before testing infrared reception, we need to prepare an infrared remote control

Note: The Android system provided by Orange Pi only supports the remote control provided by Orange Pi by default, and the remote control of TV or air conditioner cannot be used.

3) The Android Box system has been adapted to this remote control, and it can be used directly without other settings.

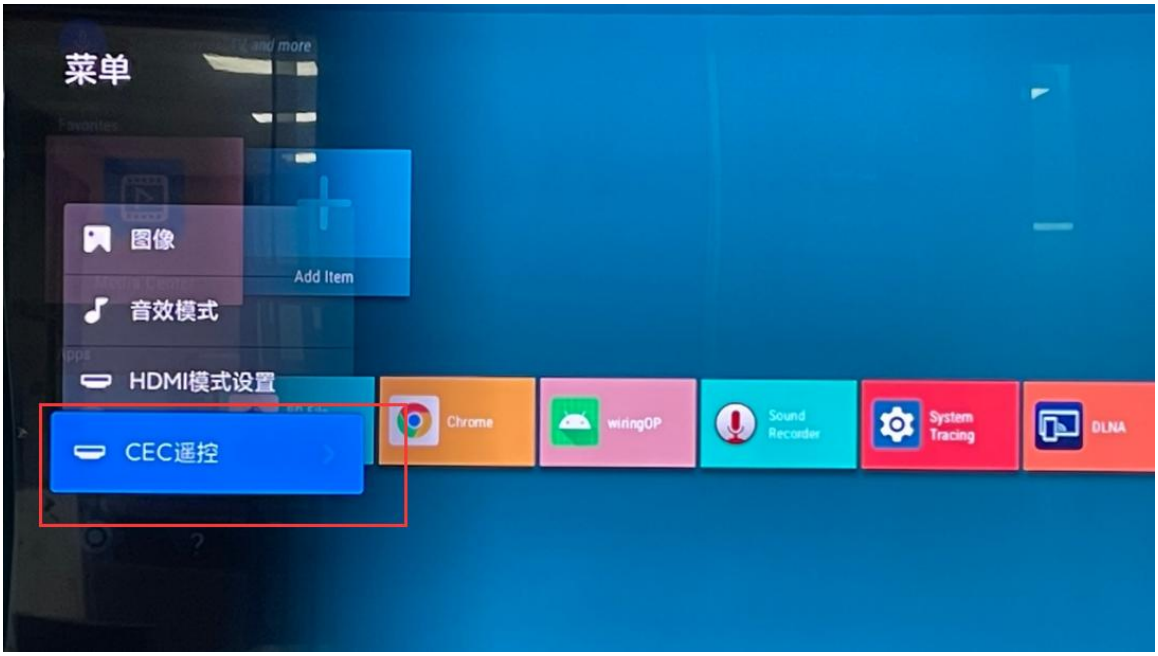
10. 15. How to use HDMI CEC function in Android Box system

HDMI CEC allows users to control all connected devices through HDMI with only one remote control. Based on this function, we can control the development board with the remote control of the TV.

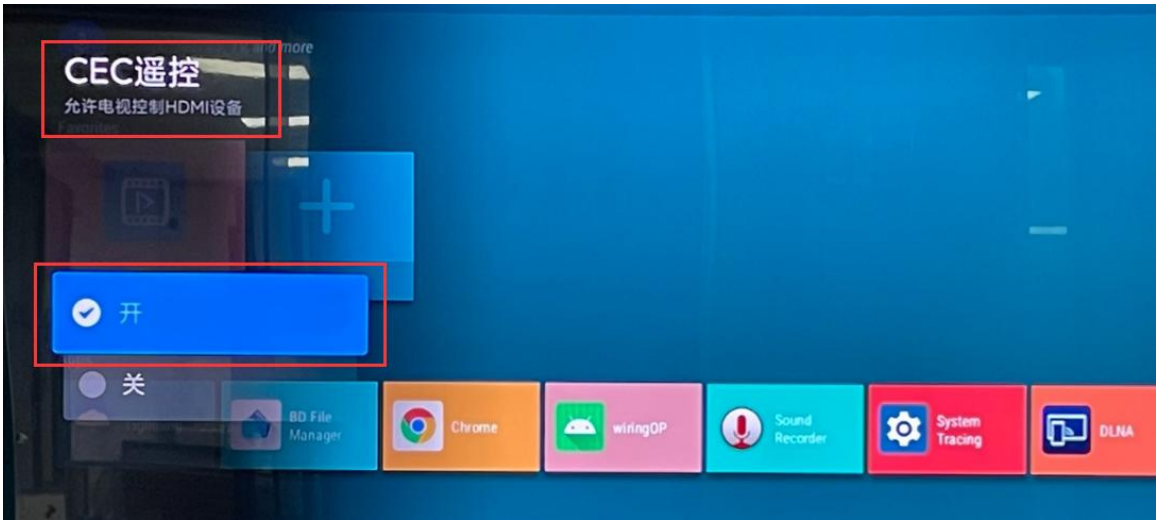
Before testing this function, please make sure your TV supports HDMI CEC.

1) First connect the development board to the TV through the HDMI cable, then power on and start

2) Then turn on the HDMI CEC function in the TV settings. Different TVs may have different ways to turn it on. Here we take Xiaomi TV as an example. Press the menu button on the remote control, then select CEC remote control and press the confirmation button



3) Then select **"On"** to open the HDMI CEC remote control

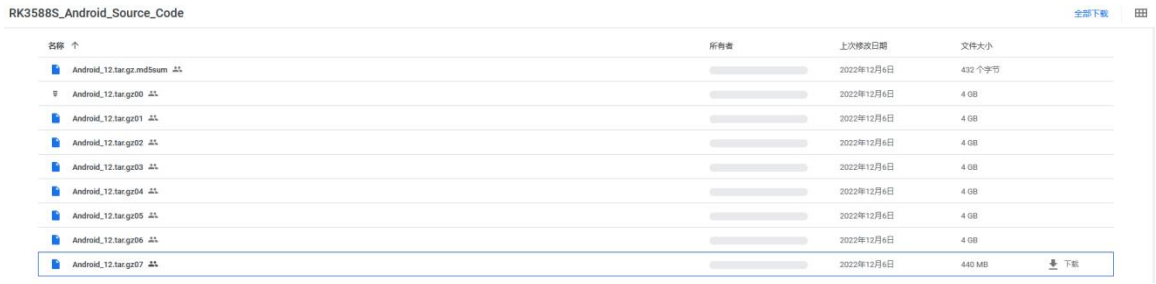


4) At this point, you can control the Android Box system of the development board through the remote control of the TV

11. How to compile Android 12 source code

11. 1. Download Android 12 source code

1) First download the Android 12 source code sub-volume compressed package from Google network disk



2) After downloading the sub-volume compression package of the Android 12 source code, please check whether the MD5 checksum is correct, if not, please download the source code again

```
test@test:~$ md5sum -c Android_12.tar.gz.md5sum
Android_12.tar.gz00: confirm
Android_12.tar.gz01: confirm
Android_12.tar.gz02: confirm
Android_12.tar.gz03: confirm
Android_12.tar.gz04: confirm
Android_12.tar.gz05: confirm
Android_12.tar.gz06: confirm
Android_12.tar.gz07: confirm
```

3) Then you need to merge multiple compressed files into one, and then decompress

```
test@test:~$ cat Android_12.tar.gz0* > Android_12.tar.gz
test@test:~$ tar -xvf Android_12.tar.gz
```

11. 2. Compile the source code of Android 12

1) First install the software packages required to compile the Android12 source code

```
test@test:~$ sudo apt-get update
test@test:~$ sudo apt-get install -y git gnupg flex bison gperf build-essential \
zip curl zlib1g-dev gcc-multilib g++-multilib libc6-dev-i386 \
lib32ncurses5-dev x11proto-core-dev libx11-dev lib32z1-dev ccache \
libgl1-mesa-dev libxml2-utils xsltproc unzip
test@test:~$ sudo apt-get install -y u-boot-tools
```

2) There is a build.sh compilation script in the source code, and the compilation parameters are as follows

a.-**U**: compile uboot

b.-**K**: compile kernel

c.-**A**: compile android

d.-**u**: package and generate update.img and update_spi_nvme.img

e.-**o**: Compile the OTA package

f.-**d**: specify kernel dts

3) Compile uboot, kernel, android and package them into update.img

a. The command to compile and support HDMI 8K display image (LCD off by default) is as follows：

```
test@test:~$ cd Android_12
test@test:~/ Android_12$ source build/envsetup.sh
test@test:~/ Android_12$ lunch rk3588_s-userdebug
test@test:~/ Android_12$ ./build.sh -AUKu
```

b. The command to compile and support LCD display image is as follows：

```
test@test:~$ cd Android_12
test@test:~/ Android_12$ export DUAL_LCD=true
test@test:~/ Android_12$ source build/envsetup.sh
test@test:~/ Android_12$ lunch rk3588_s-userdebug
test@test:~/ Android_12$ ./build.sh -AUKu
```

c. The command to compile the image of the Box version is as follows：

```
test@test:~$ cd Android_12
test@test:~/ Android_12$ export BOARD=orangepi5plus
test@test:~/ Android_12$ source build/envsetup.sh
```

```
test@test:~/ Android_12$ lunch rk3588_box-userdebug
test@test:~/ Android_12$ ./build.sh -AUKu
```

4) After the compilation is complete, the following information will be printed

```
********rkImageMaker ver 2.1********
Generating new image, please wait...
Writing head info...
Writing boot file...
Writing firmware...
Generating MD5 data...
MD5 data generated successfully!
New image generated successfully!
Making update.img OK.
Make update image ok!
```

5) The final image file will be placed in the **rockdev/Image-rk3588_s** directory. Among them, **update.img** is the boot image that supports TF card and eMMC, and **update_spi_nvme.img** is the boot image of NVME SSD

```
test@test:~/Android_12$ cd rockdev/Image-rk3588_s
test@test:~/Android_12/rockdev/Image-rk3588_s $ ls update*
update.img update_spi_nvme.img
```

6) If you compile the image of the Box version, the final generated image file will be placed in the **rockdev/Image-rk3588_box** directory

```
test@test:~/Android_12$ cd rockdev/Image-rk3588_box
test@test:~/Android_12/rockdev/Image-rk3588_box$ ls update*
update.img update_spi_nvme.img
```

12. Instructions for using the Orange Pi OS Droid system

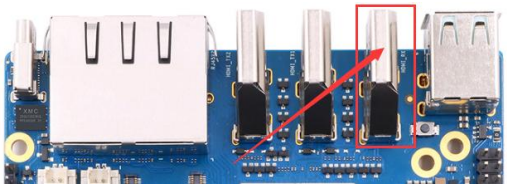
12. 1. Function adaptation of OPi OS Droid system

Function	OPi OS Droid function adaptation
HDMI TX1 display	OK
HDMI TX1 Audio	OK
HDMI TX2 display	OK
HDMI TX2 Audio	OK
HDMI RX display	OK
HDMI RX Audio	OK
USB2.0X2	OK
2.5G PCIe network port X2	OK
2.5G PCIe network port light	OK
Debug serial port	OK
RTC	OK
FAN interface	OK
eMMC extension interface	OK
AP6275P-WIFI	OK
AP6275P-BT	OK
AX200-WIFI	NO
AX200-BT	NO
AX210-WIFI	NO
AX210-BT	NO
RTL8852BE-WIFI	OK
RTL8852BE-BT	OK
Recovery button	OK
Type-C interface USB3.0 function	OK
Type-C interface ADB function	OK
Type-C interface DP display function	OK

Type-C interface DP audio playback	OK
USB3.0 Hub	OK
switch button	OK
infrared function	OK
led light	OK
Onboard MIC	OK
headphone playback	OK
headphone recording	OK
SPK Horn	OK
40PIN GPIO	OK
40PIN I2C	OK
40PIN SPI	OK
40PIN UART	OK
40PIN PWM	OK
TF card start	OK
SPI Flash+NVME solid state boot	OK
OV13850 camera	OK
OV13855 camera	OK
GPU	OK
VPU	OK
NPU	OK
MIPI LCD	NO
HDMI CEC	NO

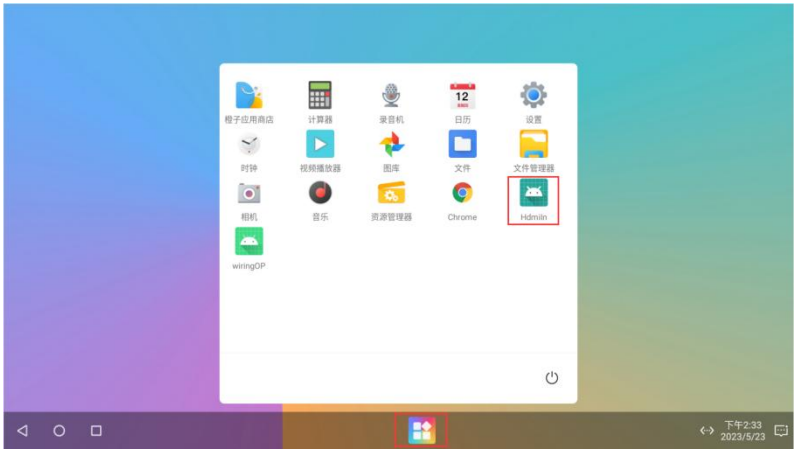
12. 2. Test method of HDMI In

1) The location of the HDMI In interface on the development board is as follows：

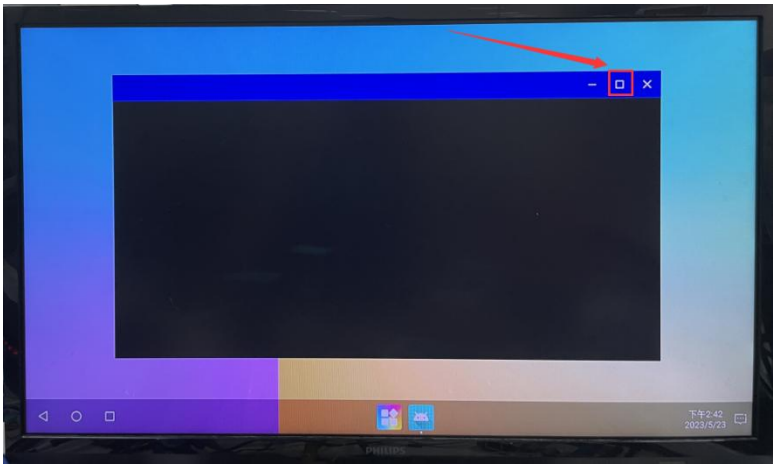


2) Then use the HDMI to HDMI cable shown in the figure below to connect the HDMI output of other devices to the HDMI In interface of the development board

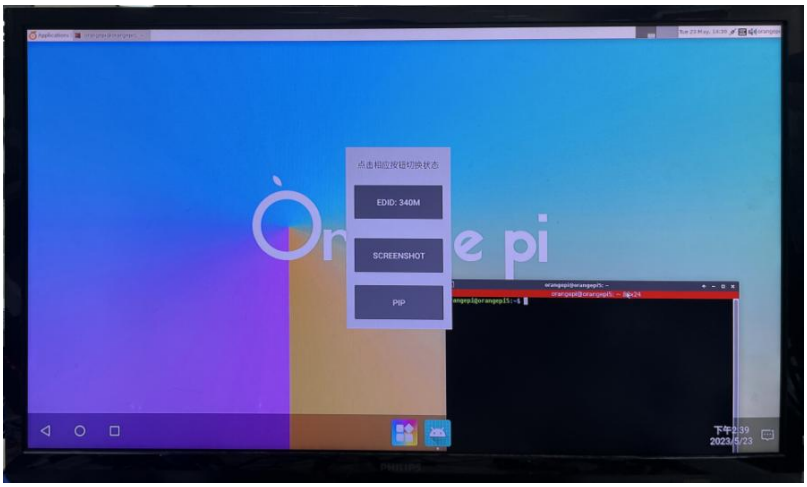
3) Make sure that the HDMI output of the device connected to the HDMI In interface is normal, and then open the HDMI In test APP



4) Then the window shown in the figure below will appear. At this time, the video input of HDMI In cannot be seen. You need to click the position marked in the red box in the figure below to enlarge it to full screen



5) Then you can see the video input of HDMI In, and the audio input of HDMI In will also be output from the HDMI TX interface or headphone interface of the development board. The figure below shows the desktop of the Linux system of the OPi5 development board input through HDMI In.


点击相应按钮切换状态
EDID: 340M
SCREENSHOT
PIP

13. Appendix

13. 1. User Manual Update History

version	Date	Updated Notes
v1.0	2023-05-22	initial version
v1.1	2023-05-24	1. How to use the infrared remote control of the Android Box system 2. Instructions for using the Orange Pi OS Droid system
v1.2	2023-05-26	1. Ubuntu/Debian: HDMI IN test method 2. Delete the instructions for using the RTL8821CU USB WIFI module, this module is not recommended
v1.3	2023-05-29	1. Update the method of using RKDevTool to burn the image to spiflash+ssd 2. Use RKDevTool to clear SPIFlash
v1.4	2023-05-31	1. Update the usage method of M.2 E-Key PCIe WIFI6+Bluetooth module 2. Ubuntu/Debian: How to use the ZFS file system 3. Ubuntu/Debian: Turn off the green light and blue light by default when booting 4. Add the instructions for using the Debian12 system (scattered in multiple sections) 5. Instructions for using the 5v pin in the 40pin interface of the development board to supply power
v1.5	2023-06-07	1. Add the picture of eMMC module 2. Correct the picture of the cooling fan interface 3. Add a method to check the temperature of nvme ssd
v1.6	2023-11-08	1. Method of using wiringOP hardware PWM 2. Ubuntu/Debian: How to use CasaOS
v1.7	2024-01-29	1. How to burn Orange Pi OS (OH) image to TF card 2. How to burn Orange Pi OS (OH) image into eMMC
v1.8	2024-02-02	1. Linux6.1 system adaptation situation 2. Linux：How to use NPU 3. Linux：RK3588 How to use Baidu Flying Plate
v1.9	2024-06-25	1. How to run RKLLM large model on RK3588

13. 2. Image update history

Date	Updated Notes
2023-05-19	Orangepi5plus_1.0.0_debian_bullseye_server_linux5.10.110.7z Orangepi5plus_1.0.0_debian_bullseye_desktop_xfce_linux5.10.110.7z Orangepi5plus_1.0.0_debian_bullseye_desktop_kde-plasma_linux5.10.110.7z Orangepi5plus_1.0.0_ubuntu_focal_server_linux5.10.110.7z Orangepi5plus_1.0.0_ubuntu_focal_desktop_xfce_linux5.10.110.7z Orangepi5plus_1.0.0_ubuntu_jammy_server_linux5.10.110.7z Orangepi5plus_1.0.0_ubuntu_jammy_desktop_xfce_linux5.10.110.7z Orangepi5plus_1.0.0_ubuntu_jammy_desktop_gnome_linux5.10.110.7z Opios-droid-aarch64-opi5plus-23.05-linux5.10.110.tar.gz Opios-droid-aarch64-opi5plus-23.05-linux5.10.110-spi-nvme.tar.gz OrangePi5Plus_RK3588_Android12_v1.0.0.tar.gz OrangePi5Plus_RK3588_Android12_lcd_v1.0.0.tar.gz OrangePi5Plus-RK3588_Android12-box_v1.0.0.tar.gz OrangePi5Plus_RK3588_Android12_spi-nvme_v1.0.0.tar.gz OrangePi5Plus_RK3588_Android12_spi-nvme_lcd_v1.0.0.tar.gz OrangePi5Plus-RK3588_Android12-box_spi-nvme_v1.0.0.tar.gz openwrt-aarch64-opi5plus-23.05-linux5.10.110-ext4.img.gz * initial version
2023-05-22	Opios-arch-aarch64-gnome-opi5plus-23.05-linux5.10.110.img.xz openwrt-rockchip-armv8-xunlong_orangepi-5-plus-spi-squashfs-sysupgrade.bin * initial version
2023-05-24	Orangepi5plus_1.0.2_debian_bullseye_desktop_kde-plasma_linux5.10.110.7z * Fix the problem that desktop audio cannot be used * Update the chromium browser to chromium-browser_110.0, which supports video playback in h264, h265, vp8, vp9 and av1 formats
2023-05-26	Opios-arch-aarch64-gnome-opi5plus-23.05.1-linux5.10.110.img.xz * Taskbar: remove calendar and music, add shortcuts for command line terminal and browser

	* Support to open the command line terminal through the shortcut key of CTRL+ALT+T OrangePi5Plus_RK3588_Android12_v1.0.1.tar.gz OrangePi5Plus_RK3588_Android12_v1.0.1_lcd.tar.gz OrangePi5Plus_RK3588_Android12_v1.0.1_spi-nvme.tar.gz OrangePi5Plus_RK3588_Android12_v1.0.1_lcd_spi-nvme.tar.gz * pre-install google play store Orangepi5plus_1.0.4_debian_bullseye_desktop_kde-plasma_linux5.10.110.7z Support CTRL+ALT+T shortcut to open command line terminal * Added shortcuts for konsole terminal and chromium browser in taskbar * Optimized the displayed name of audio device * Optimized test_hdmiin.sh test script * Fixed the problem that spiflash+nvme ssd cannot start Orangepi5plus_1.0.4_debian_bullseye_desktop_xfce_linux5.10.110.7z * Support CTRL+ALT+T shortcut to open command line terminal * Optimized the displayed name of audio device * Optimized test_hdmiin.sh test script * Updated chromium browser to chromium-browser_110.0, supporting video hardware decoding playback in h264, h265, vp8, vp9 and av1 formats * Fixed spiflash+nvme Problem of SSD not being able to start Orangepi5plus_1.0.4_ubuntu_focal_desktop_xfce_linux5.10.110.7z Orangepi5plus_1.0.4_ubuntu_jammy_desktop_xfce_linux5.10.110.7z Orangepi5plus_1.0.4_ubuntu_jammy_desktop_gnome_linux5.10.110.7z * Support CTRL+ALT+T shortcut to open command line terminal * Optimize the name displayed by audio device * Optimize test_hdmiin.sh test script * Fix spiflash+nvme The problem of ssd not being able to start

	Orangepi5plus_1.0.4_debian_bullseye_server_linux5.10.110.7z Orangepi5plus_1.0.4_ubuntu_focal_server_linux5.10.110.7z Orangepi5plus_1.0.4_ubuntu_jammy_server_linux5.10.110.7z * Fix the problem of spiflash+nvme ssd not being able to start
2023-05-29	Opios-droid-aarch64-opi5plus-23.05.1-linux5.10.110-en.tar.gz Opios-droid-aarch64-opi5plus-23.05.1-linux5.10.110-en-spi-nvme.tar.gz * Pre-installed google play store (en in the above image name means English version, you need to go to Google network disk to download)
2023-06-01	Orangepi5plus_1.0.6_ubuntu_jammy_desktop_xfce_linux5.10.110.7z * Fix the problem that the zfs file system cannot be installed * Add rk3588-opi5plus-disable-leds.dtbo, used to turn off blue and green lights * Update the chromium browser to chromium-browser_110.0, which supports video playback in h264, h265, vp8, vp9 and av1 formats Orangepi5plus_1.0.6_debian_bullseye_desktop_xfce_linux5.10.110.7z Orangepi5plus_1.0.6_debian_bullseye_desktop_kde-plasma_linux5.10.110.7z * Update mpp package * Fix the problem that the zfs file system cannot be installed * Add rk3588-opi5plus-disable-leds.dtbo, used to turn off blue and green lights Orangepi5plus_1.0.6_ubuntu_focal_desktop_xfce_linux5.10.110.7z Orangepi5plus_1.0.6_ubuntu_jammy_desktop_gnome_linux5.10.110.7z Orangepi5plus_1.0.6_ubuntu_focal_server_linux5.10.110.7z Orangepi5plus_1.0.6_debian_bullseye_server_linux5.10.110.7z Orangepi5plus_1.0.6_ubuntu_jammy_server_linux5.10.110.7z * Add rk3588-opi5plus-disable-leds.dtbo, used to turn off blue and green lights * Fix the problem that the zfs file system cannot be installed Orangepi5plus_1.0.6_debian_bookworm_server_linux5.10.110

	Orangepi5plus_1.0.6_debian_bookworm_desktop_xfce_linux5.10.110 * initial version
2023-11-08	Orangepi5plus_1.0.8_ubuntu_focal_server_linux5.10.160.7z Orangepi5plus_1.0.8_ubuntu_jammy_server_linux5.10.160.7z Orangepi5plus_1.0.8_debian_bullseye_server_linux5.10.160.7z Orangepi5plus_1.0.8_debian_bookworm_server_linux5.10.160.7z Orangepi5plus_1.0.8_ubuntu_focal_desktop_xfce_linux5.10.160.7z Orangepi5plus_1.0.8_ubuntu_jammy_desktop_xfce_linux5.10.160.7z Orangepi5plus_1.0.8_debian_bullseye_desktop_xfce_linux5.10.160.7z Orangepi5plus_1.0.8_debian_bookworm_desktop_xfce_linux5.10.160.7z * Kernel version upgraded to 5.10.160
2024-02-02	Orangepi5plus_1.0.8_ubuntu_focal_server_linux6.1.43.7z Orangepi5plus_1.0.8_ubuntu_jammy_server_linux6.1.43.7z Orangepi5plus_1.0.8_debian_bullseye_server_linux6.1.43.7z Orangepi5plus_1.0.8_debian_bookworm_server_linux6.1.43.7z Orangepi5plus_1.0.8_ubuntu_focal_desktop_xfce_linux6.1.43.7z Orangepi5plus_1.0.8_ubuntu_jammy_desktop_xfce_linux6.1.43.7z Orangepi5plus_1.0.8_debian_bullseye_desktop_xfce_linux6.1.43.7z Orangepi5plus_1.0.8_debian_bookworm_desktop_xfce_linux6.1.43.7z * initial version
2024-06-25	Orangepi5plus_1.0.10_ubuntu_focal_server_linux5.10.160.7z Orangepi5plus_1.0.10_ubuntu_jammy_server_linux5.10.160.7z Orangepi5plus_1.0.10_debian_bullseye_server_linux5.10.160.7z Orangepi5plus_1.0.10_debian_bookworm_server_linux5.10.160.7z Orangepi5plus_1.0.10_ubuntu_focal_desktop_xfce_linux5.10.160.7z Orangepi5plus_1.0.10_ubuntu_jammy_desktop_xfce_linux5.10.160.7z Orangepi5plus_1.0.10_debian_bullseye_desktop_xfce_linux5.10.160.7z Orangepi5plus_1.0.10_debian_bookworm_desktop_xfce_linux5.10.160.7z Orangepi5plus_1.0.10_ubuntu_focal_server_linux6.1.43.7z Orangepi5plus_1.0.10_ubuntu_jammy_server_linux6.1.43.7z Orangepi5plus_1.0.10_debian_bullseye_server_linux6.1.43.7z Orangepi5plus_1.0.10_debian_bookworm_server_linux6.1.43.7z

	Orangepi5plus_1.0.10_ubuntu_focal_desktop_xfce_linux6.1.43.7z Orangepi5plus_1.0.10_ubuntu_jammy_desktop_xfce_linux6.1.43.7z Orangepi5plus_1.0.10_debian_bullseye_desktop_xfce_linux6.1.43.7z Orangepi5plus_1.0.10_debian_bookworm_desktop_xfce_linux6.1.43.7z *The kernel's rknpu version is upgraded to 0.9.6