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Ubuntu Configuration Tutorial

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Release notes:

Version	The date of	Content description
V3.5	2021/03/09	First release

The preface

The complete tutorial of ROS Navigation Robot includes three documents: "STM32 Moving Chassis Development Manual", "Ubuntu Configuration Tutorial" and "ROS Development Tutorial". For Moving Chassis Development Tutorial based on STM32, please see the document "STM32 Moving Chassis Development Manual"; For tutorials on ROS development, see "ROS Development Tutorials."

This document is mainly used for: Ubuntu configuration of virtual machine and Ubuntu of ROS host, as well as some system Settings and development environment construction. The basics of Ubuntu are not covered in this document due to the length of the document. Instructions for using Linux instructions can be found on both the ROS website and the Ubuntu website. This document provides some necessary tutorials on how to configure the development environment. If you're new to the Linux environment, check out Chapter 17, "Some basics about Ubuntu."

In this document, there are two types of Ubuntu: Ubuntu on the ROS host and Ubuntu on the virtual machine. For detailed information about the user names and passwords of these two systems, please refer to Table 0-0:

Table 0-0 ROS host account password

ROS host	Login Account Name	The login password	The name of the WiFi	WiFi password	Static IP
Raspberry pi	wheeltec	dongguan	To view Table 2-0	dongguan	192.168.0.100
Jetson nano	wheeltec	dongguan		dongguan	192.168.0.100
Jetson Tx2	wheeltec	dongguan		dongguan	192.168.0.100
Industrial PC	wheeltec	dongguan		dongguan	192.168.0.100

Table 0-1 Virtual machine account password for remote control

The client	Login Account Name	The login password	Static IP
The virtual machine	passoni	raspberry	Custom configuration

Table 0-2 WiFi names corresponding to different car models

Car models	The name of the WIFI
Differential series	WHEELTEC88
Ackermann series	WHEELTEC77
Mecanum wheel series	WHEELTEC66
Omnidirectional wheel series	WHEELTEC66

The following mentioned have been configured by us in the ROS host and virtual machine images we provide . You can use our images directly, or you can change the configuration according to your requirements.

Directory

1. Install Ubuntu and ROS on the virtual machine

1. 1 Ubuntu Installation on theVirtual Machine and Utility Plug-in Installation

① Ubuntu installation

To run Ubuntu on Windows, first install VMware Workstation on the Windows and then install Ubuntu18.0.4 on the virtual machine.

The installation of VMware Workstation software is relatively simple, so it will not be talked here, you can select all the default conditions during installation. To install Ubuntu on the virtual machine, you need to use the image file. You can choose the image file provided by us or download the Ubuntu image file with the version you need directly from the official website.

② Terminal plugin installation

Because multiple terminals need to be opened at the same time when using ROS, and the terminals overlap with each other may affect the use experience, it is recommended that you can install a plug-in that splits Terminal. Ubuntu downloads are made from software sources, so here we can update the software source by entering the instructions shown in Figure 1-1.

```
passoni@passoni:~$ sudo apt-get install
```

图 1-1 sudo apt-get update

After updating the list of software sources, enter the installation instructions shown in Figure 1-2.

```
passoni@passoni:~$ sudo apt-get install terminator
```

图 1-2 sudo apt-get install terminator

After the installation is completed, open a new terminal, this time you can see that the interface of the terminal is different, click the mouse right click on the

terminal, it will pop up the "Terminator" plug-in executable operation, you can choose horizontal division and vertical division.

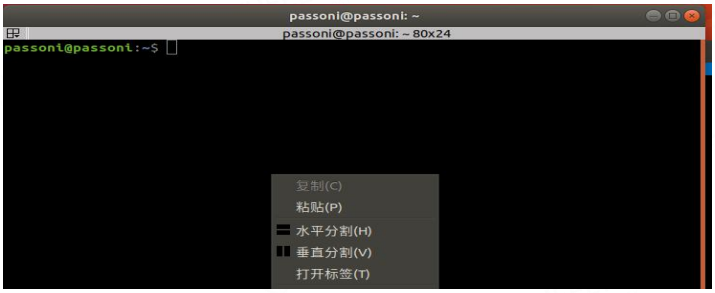

图 1-3 Terminator plug-in operation interface

Use a horizontal segmentation and a vertical segmentation respectively, we can see the effect, it should be noted here that the segmenting terminal is using the same window, if it is closed, all the segmenting Windows will be closed.

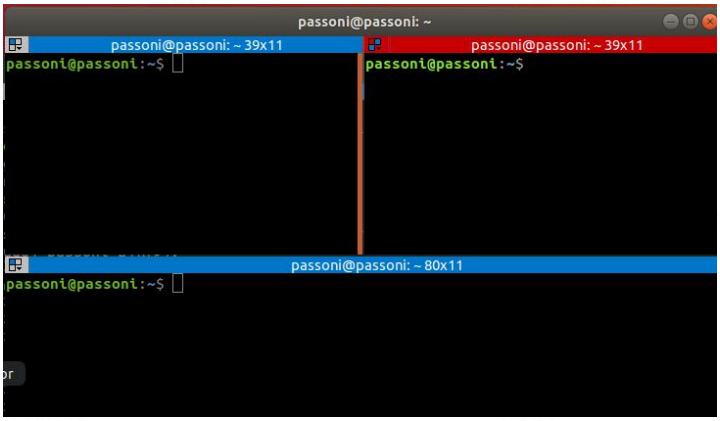

图 1-4 Terminator plug-in rendering

1.2 ROS installation with Ubuntu

For the installation of ROS, please refer to the official ROS installation guide page:

http://wiki.ros.org/melodic/Installation/Ubuntu。

The choice here is the Melodic version of Ubuntu18 ROS. Here you just need to follow the tutorial on the website to install it step by step.

1.3 Establish the ROS workspace

To communicate using ROS on a virtual machine and ROS on Raspberry Pi, you need to be in the ROS workspace environment. It is therefore necessary to create a workspace on the virtual machine as well.

① Create a workspace

The first step is to create the folder of the workspace, the folder name of the workspace can be customized, the name of the author's custom workspace here is CATKIN_WS, the folder path can also be customized, here we select the root directory to create a new folder CATKIN_WS. It is recommended to use the command line to create a new folder. Follow the instructions shown in Figure 1-5 to create a new folder.

```
passoni@passoni:~$ mkdir catkin_ws
```

图 1-5 mkdir catkin_ws

Step 2: Go into catkin_ws and create a folder called src. Make sure the name of the folder is src. Follow the instructions shown in Figure 1-6 to create a new folder.

```
passoni@passoni:~/catkin_ws$ mkdir src
```

图 1-6 mkdir src

Step 3: Enter the src folder, execute the instructions as shown in Figure 1-7, and generate the file "CmakeLists. txt", as shown in Figure 1-8.

```
passoni@passoni:~/catkin_ws/src$ catkin_init_workspace
Creating symlink "/home/passoni/catkin_ws/src/CMakeLists.txt" pointing to "/opt/
ros/melodic/share/catkin/cmake/toplevel.cmake"
```

图 1-7 catkin_init_workspace

```
passoni@passoni:~/catkin_ws/src$ ls
CMakeLists.txt
```

图 1-8 Generate the cmakerlists.txt file

② Compile workspace

Step 4: Return to the previous directory (catkin_ws) and execute the instructions as shown in Figure 1-9 to compile the workspace. After compilation, you can see that there are build and devel folders in the workspace folder as shown in Figure 1-10.

```
passoni@passoni:~/catkin_ws/src$ cd ..
passoni@passoni:~/catkin_ws$ catkin_make
```

图 1-9 catkin_make

```
passoni@passoni:~/catkin_ws$ ls
build  devel  src
```

图 1-10 ls

③ Set environment variables

Step 5: Set the environment variables using the instructions shown in Figure 1-11. After setting the environment variables, the environment variables can be checked with the instructions shown in Figure 1-12.

```
passoni@passoni:~/catkin_ws$ source devel/setup.bash
```

图 1-11 source devel/setup.bash

```
passoni@passoni:~/catkin_ws$ echo $ROS_PACKAGE_PATH
/home/passoni/catkin_ws/src:/opt/ros/melodic/share
```

图 1-12 echo $ROS_PACKAGE_PATH

Note that you should restart the terminal window after modifying the environment variables to take effect. At this point the ROS workspace is set up.

1.4 Configure static IP address with Ubuntu on the Virtual Machine

The Ubuntu of the virtual machine and the Ubuntu of the ROS host (Raspberry Pi is taken as an example here) need to know the IP address of each other when communicating. By default, the system uses the dynamically assigned IP address, and the IP address may change constantly in the process of using, so setting the static IP address can reduce a lot of trouble in the future. Let's demonstrate how to set a static IP address on the virtual machine side.

① Set the network connection of the virtual machine

The first is to change the network connection mode of the virtual machine to be "bridge mode". If you don't change it to "bridge mode", the network may not be able to use after modifying the IP address. There is one more issue that needs to be noted: if you use a Windows system that connect the network cable and use WiFi at the same time, the virtual machine network may be unable to use after the network configuration change, so it is recommended to use only the WiFi.

Figure 1-13. Changing the network connection mode of the virtual machine

Click "Edit (E)" at the top left of VMware, and click "Virtual Web Editor (N)..." ", and then click"Change Settings (C)" in the virtual web editor interface.

Figure 1-14 Virtual Web Editor

Change the device [bridged to (G)] to a computer network card, so that we can SSH the car through WiFi. If we want to connect the virtual machine to the Internet again, we only need to change the device [bridged to (G)] to an Ethernet device.

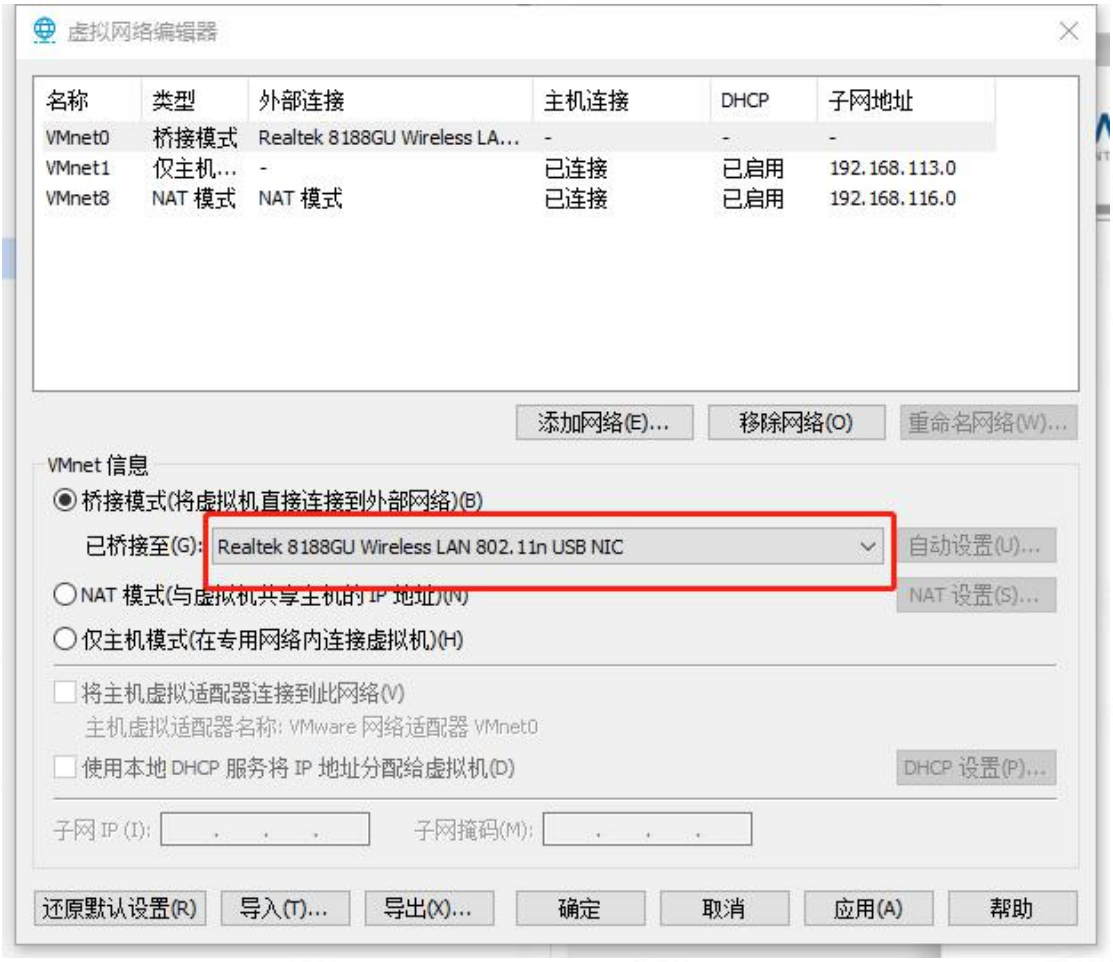

Figure 1-15 Virtual Web Editor - Changing Settings

② Create a new Ubuntu network connection setting

Enter the Ubuntu system, find the network button in the upper right of the Ubuntu desktop, and open the network setting interface according to steps 1-14 in Figure 1.

Figure 1-16 Modifying Ubuntu's network configuration

Then click the gear button, here you need to check the dynamic IP address and gateway information of the current system in use.

Figure 1-17 Default network configuration

Record the current network configuration information first. It will be used to set the static IP address later. After recording, click "Cancel" in the upper left to return to the previous interface.

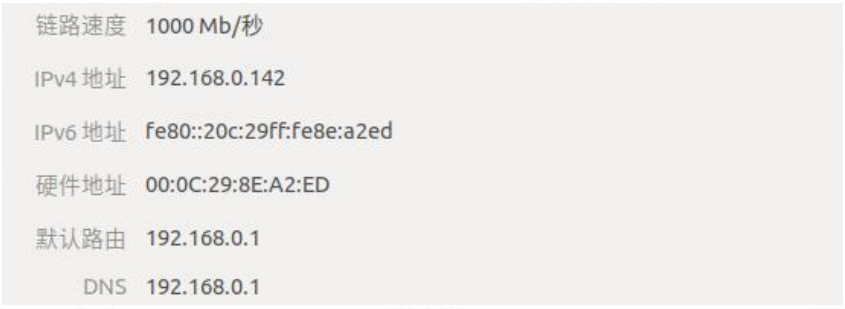

Figure 1-18 network Settings for dynamic allocation of the silent system

Then we create a new custom network configuration, change the network configuration to static IP, here we click "+" to add a new network configuration.

Figure 1-19 New network configuration

③ Configure static IP

First, you need to set the name of the setting, for the sake of distinction, change the name of the setting to "Static IP"

Figure 1-20 Custom setting names

By continuing to set the static IPv4 IP, here will use the information just seen,

because it is easy to lose access to the Internet if all the Settings are custom, so it is best to fix it to the static IP based on the available dynamic IP .

This step needs to be filled in according to the information previously found. DNS and IP address are consistent with the information just found. Subnet mask is 255.255.255.0 by default; The gateway will change the last bit of your IP address to 1 according to your network segment. If your IP address is 192.168.1.126, then your network segment is generally filled 192.168.1.1; Routing is automatic. "IPv6" and "security" do not need to be configured, here the static IP setting is completed, click "add" in the upper right to save then exit.

Figure 1-21 Configuring static IP address information

After you save and exit, you can see that you have a new network configuration. Click on the configuration to switch to "Static IP".

Figure 1-22 available network configuration options

2. Configure Ubuntu and ROS on Raspberry Pi

2. 1 Configure Ubuntu on Raspberry Pi

The prerequisite for using ROS on the Raspberry Pi in your car is of course running Ubuntu on the Raspberry Pi, but you can't install Ubuntu Desktop Edition directly on the Raspberry Pi, so you have to install the Server version first and then install a desktop. It is recommended that you attach a screen to Raspberry Pi when configuring Ubuntu on Raspberry Pi. Here's a quick look at how to configure Ubuntu and ROS on Raspberry Pi.

① Download Ubuntu image files

First of all, you need to go to the Ubuntu official website to download the Ubuntu image file suitable for Raspberry Pi:
https://ubuntu.com/download/raspberry-pi。

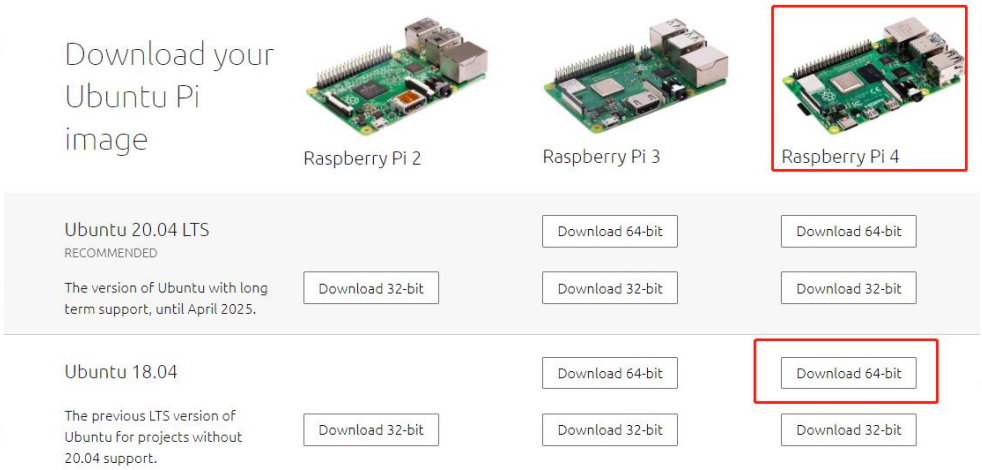

Figure 2-1 Download the Ubuntu image for Raspberry Pi from the Ubuntu website

② Recover the image file to the SD card

After the image download is completed, the image will be burned to the SD card, SD card here recommended to use 32G size, 16G prone to lack of space. See Chapter 12 "12. Raspberry Pi Mirroring Burning and Backup" for detailed instructions on how to recover and backup Raspberry Pi image files.

③ Turn on Raspberry Pi

Insert the memory card with recovered image files into Raspberry Pi. For the first time, you need to input the login account and password. The default is Ubuntu, and you need to change the password after successful login. After you change your password, you can start using it normally. But at this time, Ubuntu system is the server version, it will be more troublesome to use, you need to install a desktop for it. Because Ubuntu in Server state cannot implement screenshots, please note the spaces in the instructions that appear at the bottom of this chapter.

④ Change the software source

Before installing the desktop, we need to change a software source, because the download time will be slow if we use Ubuntu's default source. Direct input “sudo vim/etc/apt/sources”. This command is to open/etc/apt/sources.list file (for the use of the vim editor here no longer narrative),comment out the original source with a #, then add the following source of tsinghua, after adding the source, you can perform “sudo apt-get the update”, check to see if you can successfully refresh the software source.

```
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco main restricted universe multiverse
deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco main restricted universe multiverse
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-updates main restricted universe multiverse
deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-updates main restricted universe multiverse
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-backports main restricted universe multiverse
deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-backports main restricted universe multiverse
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-security main restricted universe multiverse
deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-security main restricted universe multiverse
deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-proposed main restricted universe multiverse
deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu-ports/ disco-proposed main restricted universe multiverse
```

⑤ Installing the desktop interface

Enter the following instructions to install the desktop of the system:

sudo apt-get install xubuntu-desktop

After the installation is complete, you need to restart the system. The instruction to restart the system is: "reboot". When the restart is completed, you will see that there is no longer a black Server interface, but a system desktop. At this time, you can enter the system password to log in to the desktop

⑥ Installing the desktop environment

After installing the desktop, you also need to install the desktop environment. After entering the system, there is nothing on the desktop. You need to open a terminal (Ctrl + Alt +T) using the shortcut keys and input the following commands to install the desktop environment:

sudo apt-get install gnome --fix-missing

Once the installation is complete, restart Ubuntu and you're ready to start working normally.

2.2 Install ROS on Ubuntu of Raspberry Pi

After the installation of Ubuntu Desktop Edition is complete, you can start to install ROS on it. Please refer to the official ROS tutorial in Section 1.2 for the installation of ROS, which is not covered here.

3. Environmental configuration of Jetson Nano

Jetson Nano is an embedded motherboard with a shape and external interface similar to Raspberry Pi. It is equipped with a quad-core Cortex-A57 processor. The GPU is an NVIDIA Maxwell graphics card with 128 NVIDIA CUDA cores, 4GB LPDDR4 memory, 16GB EMMC 5.1 storage and 4K 60Hz video decoding support. Here is a simple explanation of how to configure the Jetson Nano environment.

3. 1 Configure Ubuntu in Jetson Nano

Before starting the NVIDIA Jetson Nano:

Prepare a SD card. Jetson Nano requires a minimum SD card of 16G, but about 13G of SD card is used after the whole system is swiped. Some other machine learning frameworks will need to be installed at a later stage, so a minimum 32GB SD card is required. The SD Card Formatter is used to format the SD Card, which is basically the same as the image card preparation of Raspberry Pi.

Prepare a power cord, Jetson nano not including power supply, you need to prepare a 5V⎓2A Micro USB power cord;you can also prepare a 5V⎓4A power adapter, so as to ensure the power supplies for subsequent increase in succession of peripherals. When using DC power supply, two contacts of J48 need to be short connected (plug in the jumper cap), otherwise it will be powered by USB port by default.

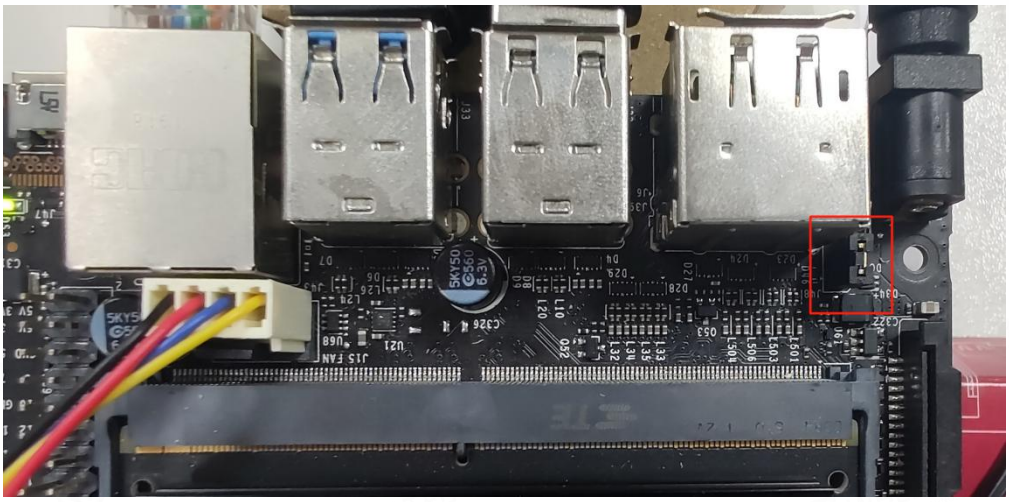

Figure 3-1 J48 jumper cap

① Jetson Nano image download

Before using the development kit, the SD card has to be written with the operating system and other components needed for the Jetpack project. First, download the official Jetson Nano image file from:

https://developer.nvidia.com/embedded/downloads

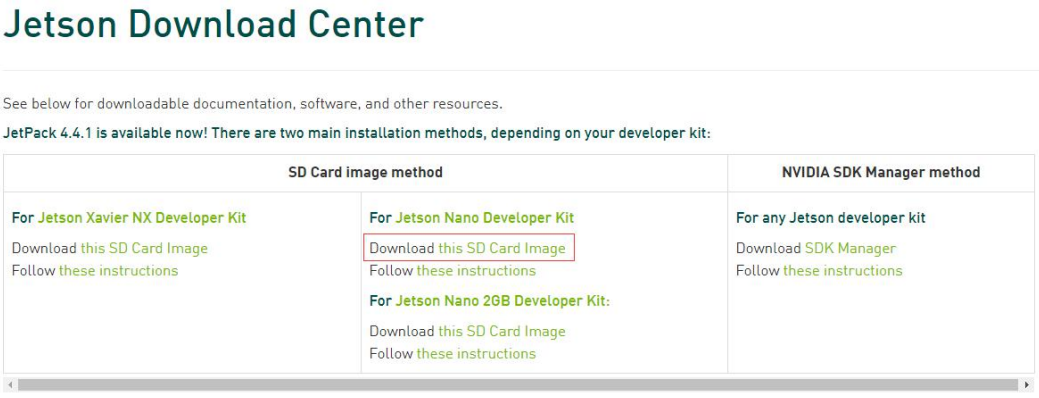

Figure 3-2 Ubuntu image for Jetson Nano download from Ubuntu official website

It should be noted that the system image Jetpack4.4 CUDA version is 10.2, OpenCV version is 4.1.1, Jetpack4.3 CUDA version is 10.0, if you want to use OpenCV3.4, you can download by yourself.

② Jetson nano boot

Insert the SD card with recovered image file into Jetson Nano. For the steps of Jetson Nano image recovery, please refer to the detailed instructions in Chapter 12 "Jetson Nano image backup and recovery".

After Jetson Nano starts up, it is necessary to set the login account and password by yourself. After setting the account, you can log into the system and start normal use.

After Jetson Nano is installed using the official image, Jetpack, CUDA, OpenCV and other components have been installed in the system, and the environment variables need to be modified before it can be used. The modification steps are as follows:

a) Use gedit to open.bashrc file: sudo gedit ~./bashrc

b) Add the following three lines at the end of the file:

```
export PATH=/usr/local/cuda-10.0/bin:$PATH
export LD_LIBRARY_PATH=/usr/local/cuda/lib64:$LD_LIBRARY_PATH
export CUDA_HOME=$CUDA_HOME:/usr/local/cuda-10.0
```

c) Re-execute the.bashrc file: source ~./bashrc

d) Enter the command nvcc-V to test. If the following information is displayed, it is proved that the modification is correct.

```
wheeltec@wheeltec:~$ nvcc -V
nvcc: NVIDIA (R) Cuda compiler driver
Copyright (c) 2005-2018 NVIDIA Corporation
Built on Sun_Sep_30_21:09:22_CDT_2018
Cuda compilation tools, release 10.0, V10.0.166
```

③ Internet connection for the Jetson Nano

There are three ways to get the Jetson Nano online. The most convenient way is to plug the LAN port of the router with the network cable, and then you can network. The second way is to use a USB wireless network card to connect to the network. The third option is to install a wireless module (purchased separately).

M.2 Key E interface is reserved on the main board of Jetson Nano, which can be connected to wireless network card. Note that this interface can only be connected to wireless network card. To install the wireless module, the main chip of Jetson Nano needs to be removed from the motherboard: remove the two screws, and then gently remove the card locks on both sides of the radiator. At this time, the main chip board and the radiator will pop up, gently pull them out of the slot, install the wireless module in the slot located on the motherboard, and reinstall the main chip board.

Figure 3-3 USB network card of Jetson Nano

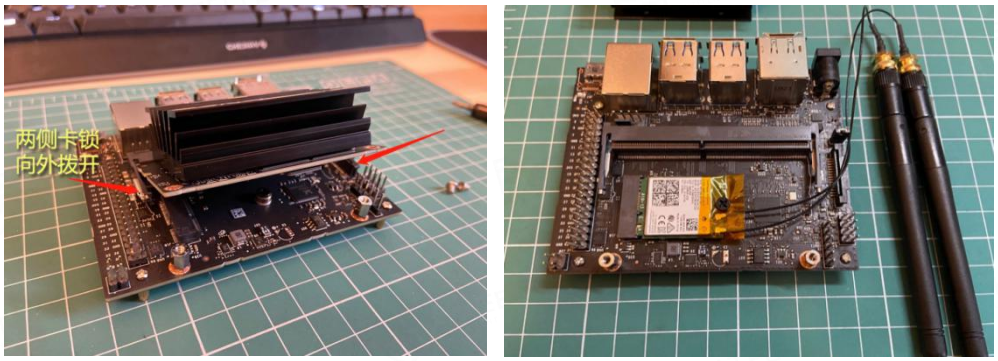

Figure 3-4 Wireless module installation of Jetson Nano

Install the wireless module, and find the WIFI signal to connect after boot.

④ Source switching and static IP configuration of Jetson Nano

Since the operation of source replacement and static IP configuration of Jetson Nano is the same as the configuration steps of Raspberry Pi, please refer to Section 2.1 for the method of software source replacement, and refer to Chapter 7 for the configuration of WiFi and static IP configuration of Jetson Nano.

⑤ SD card formatting for the Jetson Nano system

Since the SD card that written with the Jetson Nano image can not be recognized when inserted into Windows, if you need to format, you should perform the following steps:

a) Enter DiskPart in the CMD interface of Windows;
b) Enter the command "List Disk" in the new pop-up window to view the disk information;
c) Enter the command to select the disk(29 GB) on which the memory card resides: select disk 2;

d) Enter the clean command :clean;

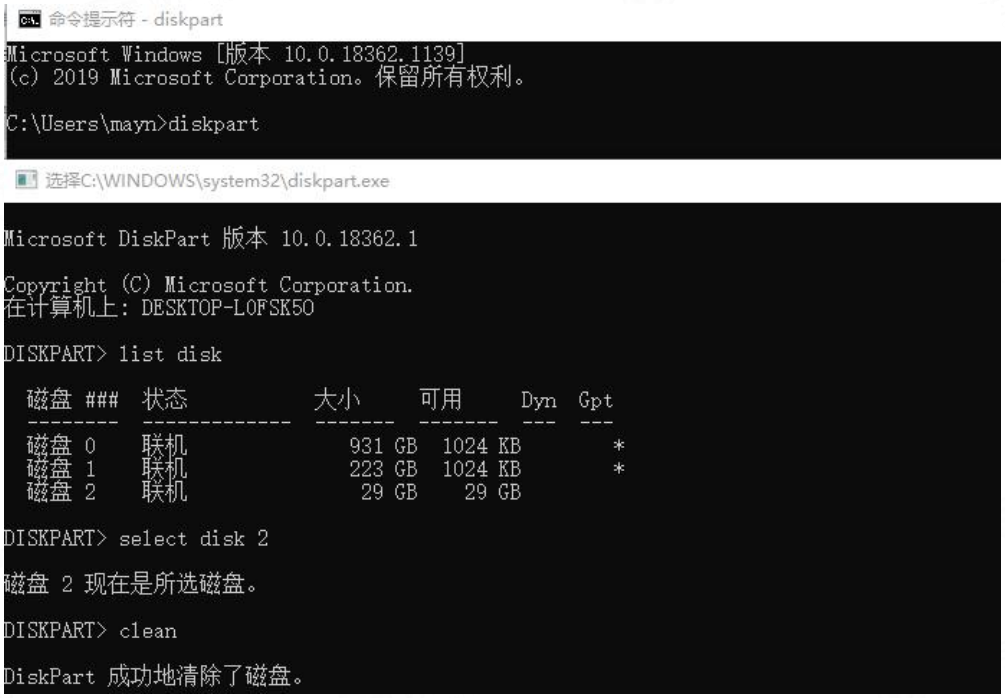

Figure 3-5 Using the command line on Windows to clear the SD card of the existing system

It should be noted that after clear the system in the SD card, although Windows can successfully identify the disk, it still cannot open the disk directory. In this case, it needs to use SDFormatter software to format the disk. Please see Section 12.2.1 for relevant information.

Figure 3-6 Disk after clearing the SD card

3. 2 Install ROS in Jetson Nano

After completing the environment configuration of Jetson Nano, you can start to install ROS. For the ROS installation, please refer to the ROS official tutorial in Section 1.2, which will not be repeated here.

4. Configure Ubuntu and ROS in Jetson TX2

The Nvidia Jetson TX2 ships with Ubuntu16.04. Please connect to the HDMI display directly on the Jetson TX2, HDMI to VGA is not recommended. Power supply with power adapter, switch on the display, keyboard and mouse. Currently, Jetson TX2 is not powered on and started, so users need to press the POWER switch on the board after accessing the POWER, and "POWER BTN" is printed on the circuit board. The key [19], as shown in Figure 4-1, allows you to access the default Ubuntu 16.04 system, while other versions need to be rebooted, which will be explained later. Here it should be noted that the system startup mode of Jetson TX2 and Jetson Nano is different. The system of Jetson TX2 is started with the EMMC module, while the system of Jetson Nano is installed on the SD card. For the first start, the screen will display some system prompts. Enter the following commands according to the steps:

```
cd ~/NVIDIA-INSTALL      # Go to the NVIDIA installation directory
sudo ./install.sh        # Run the installation script to unpack and install the driver
reboot                   # to restart
```

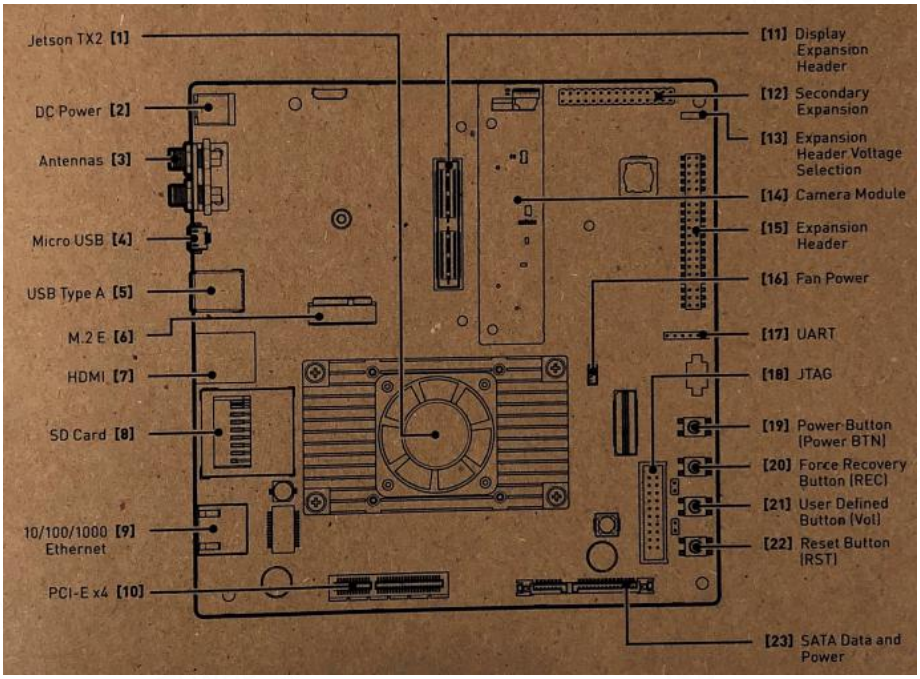

Figure 4-1 Jetson TX2 connection system layout

4. 1 Flash the Jetson TX2

Only the NVIDIA driver is installed on the shipped Ubuntu system. If your TX2 needs do not require the use of other image processing and deep learning functions, you can use it without a flash. If you still need an image processing or deep learning application, use Nvidia Jetpack once and 70% of the underlying libraries and application layer interface will be installed. If you don't use Jetpack, you will have to download, install and debug them one by one.

① Jetson TX2 flash preparation

Before flashing, the user needs to do the following preparing work:

a) A Ubuntu host ,or can be operated by a virtual machine, and the hard disk space should be more than 80G, which is convenient for later image backup. The Ubuntu version is 16.04. Since the backup and recovery of the subsequent images will use a flash.sh file generated by flash, be careful not to delete the virtual machine image easily.

b) A HDMI transfer line. The Jetson TX2 needs to be connected with the display screen + an original flashing cable + a mouse and keyboard

c) Download and install Jetpack4.4 from the Ubuntu host's browser to the NVIDIA website. Download at

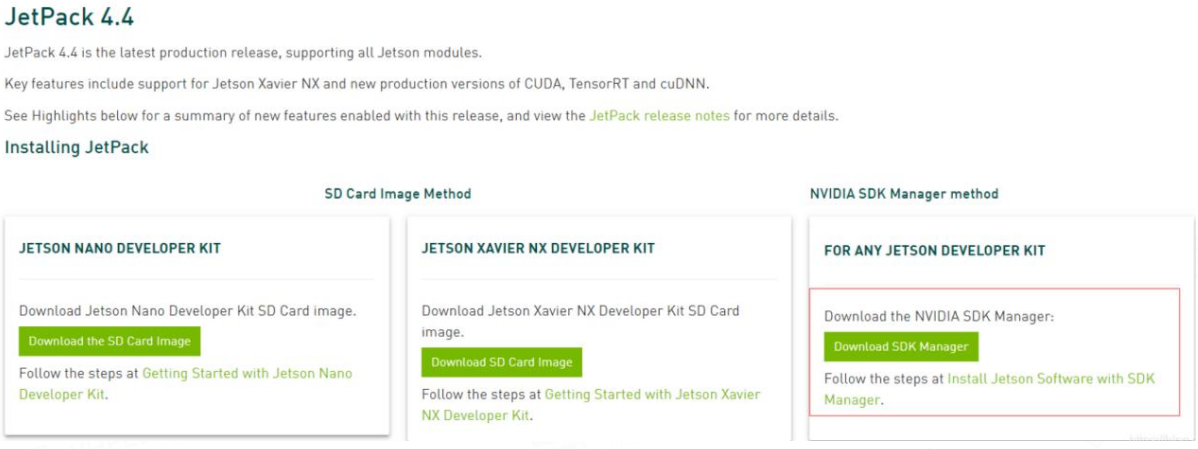

Figure 4-2 Download the JetPack file for the Jetson TX2 from the NVIDIA website

Select "Download" and save the.deb file, then open a terminal in the directory where the file is located and type the command: sudo apt

install./sdkmanager_1.3.1-7110_amd64.deb to install. You can re-source your Ubuntu environment before proceeding to the next step. The re-source procedure was mentioned earlier and will not be explained here.

② Flash the Jetson TX2

Open a terminal in the Ubuntu host, enter SDKManager, open the software SDKManager package, and select Developer on the login page to log in.

Select the development environment: select Jetson in the Product Category; , select Host Machine and Target Hardware (Jetson TX2) in the Hardware Configuration. Select the version of Jetpack (4.4) in the Target Operating System, choose Deepstream, and click Continue to proceed to the next step.

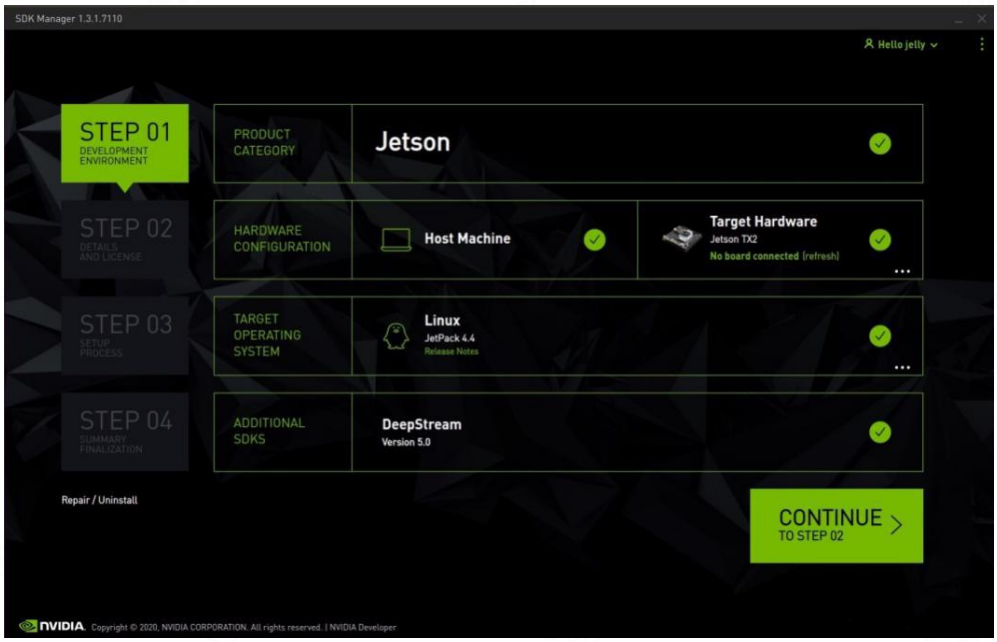

Figure 4-3 The first step of running SDKManager

After checking the Consent Agreement in the second step, check another option to download the file before installing it.

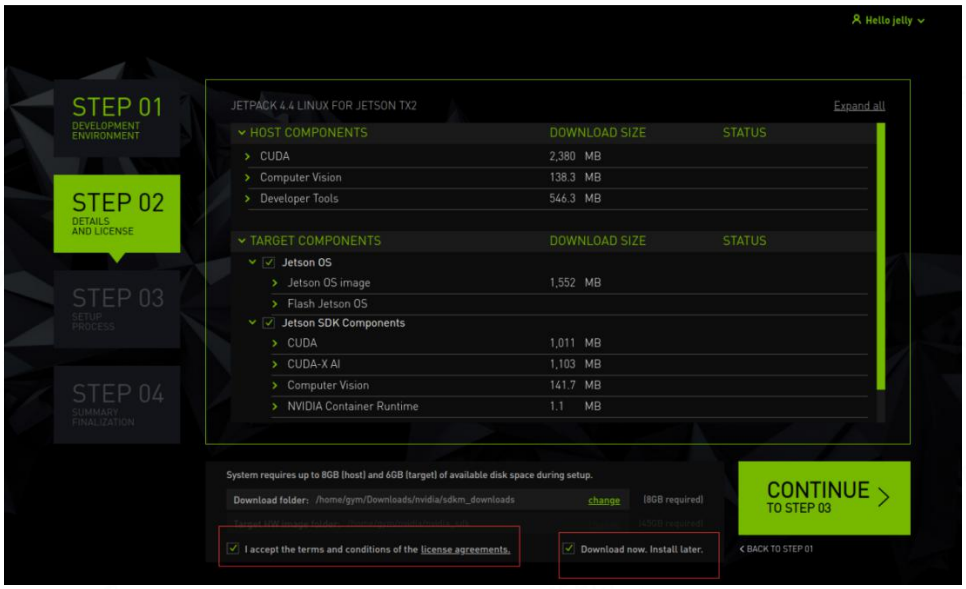

Figure 4-4 Step 2 of running SDKManager: Consent protocol needs to be checked

In the installation process, an interactive pop-up window will appear. Manual swiping mode should be selected, and the user name and password in JetsontX2 should be set. You can click "Skip" to skip this step first, and then connect Jetson TX2 to PC for flashing after the progress bar is full

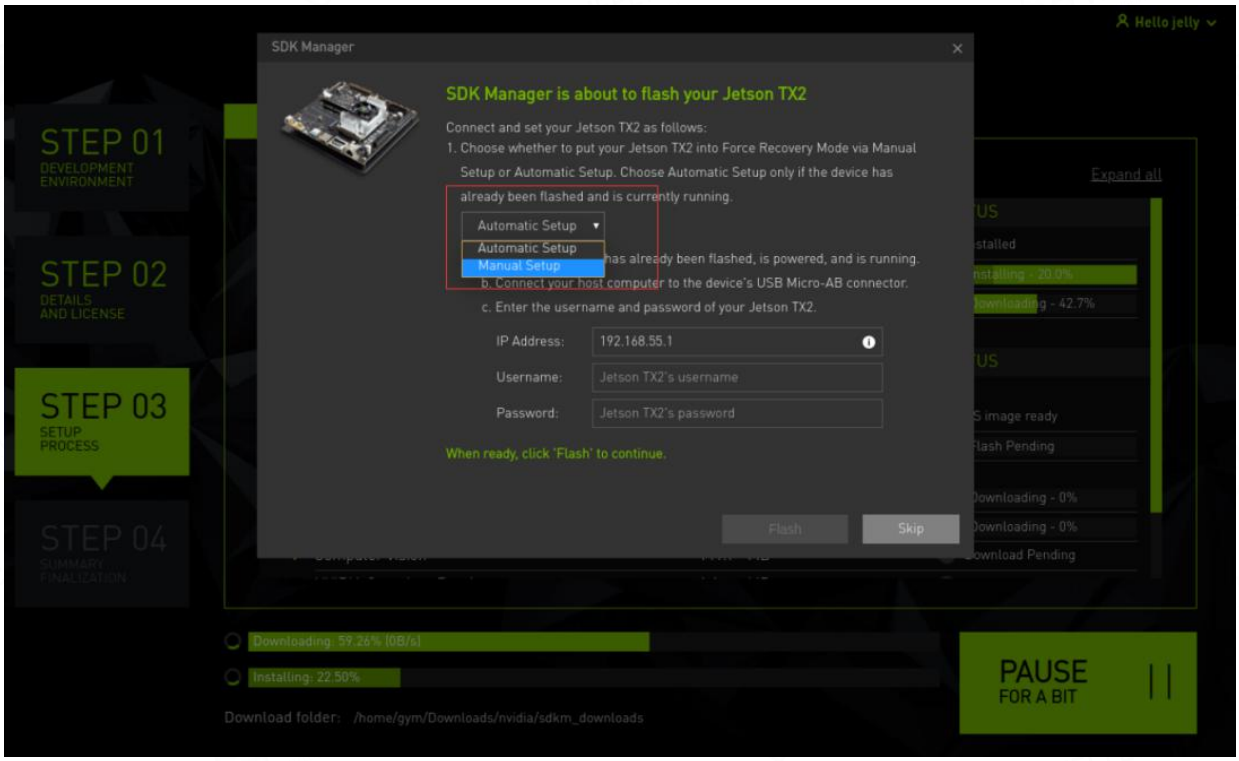

Figure 4-5 SDKManager's prompt for selecting the flash mode

If not skip, then connect Jetson TX2 to PC with the flash cable at this time, and

Jetson TX2 should enter the RECOVERY mode. The steps are as follows:

a) Power off the Jetson TX2 and unplug the power adapter.

b) Reconnect the power.

c) Press the POWER/ [19] button to start the machine

d) Press the Force Recovery /[20] key and hold

e) Then press the RESET/[22] key

f) Hold Force Recovery /[20] key for more than two seconds and release

g) Check whether the PC terminal is connected to Jetson TX2, enter lsusb at the terminal, and the following prompt indicates successful connection.

```
wheeltec@wheeltec:~$ lsusb
Bus 001 Device 007: ID 0955:7c18 NVidia Corp.
Bus 001 Device 005: ID 1058:2626 Western Digital Technologies, Inc.
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 002 Device 003: ID 0e0f:0002 VMware, Inc. Virtual USB Hub
Bus 002 Device 002: ID 0e0f:0003 VMware, Inc. Virtual Mouse
Bus 002 Device 001: ID 1d6b:0001 Linux Foundation 1.1 root hub
```

Jetson TX2 will restart automatically after the machine is flashed. Enter the command nvcc-V at the terminal to check whether the machine is flashed successfully. The following prompts indicate that the machine is flashing completed.

```
wheeltec@wheeltec:~$ nvcc -V
nvcc: NVIDIA (R) Cuda compiler driver
Copyright (c) 2005-2019 NVIDIA Corporation
Built on Wed_Oct_23_21:14:42_PDT_2019
Cuda compilation tools, release 10.2, V10.2.89
```

③ Jetson TX2 network Settings

The steps of Jetson TX2 to configure wireless WiFi are the same as those of other ROS hosts in the document. Please refer to Chapter 7 for relevant information. If WiFi cannot be found, you need to modify the contents of a file.

Using the command “sudo gedit /etc/modprobe.d/bcmdhd.conf” to modify, add “options bcmdhd op_mode=2”, restart after modified can be the hot spot model, needs to be restored to the received signal model, comment out the “options bcmdhd op_mode=2”, restart it.

4.2 Install ROS on Jetson TX2

After completing the Jetson TX2 flash, enter the Ubuntu18.04 system and start installing ROS. For the ROS installation, please refer to the ROS official tutorial in Section 1.2, which will not be repeated here.

5. Configure Ubuntu and ROS on the IPC

5. 1 Install Ubuntu on the IPC

① Download the Ubuntu image file

First of all, you need to go to the Ubuntu official website to download the Ubuntu image file suitable for industrial PC. The download address of Ubuntu image is:

https://ubuntu.com/download/alternative-downloads

Figure 5-1 Ubuntu system ISO image download page

② Make a USB flash drive for Ubuntu system installation

Before production, we need to prepare a formatted USB flash drive as the startup disk. The software Rufus -3.11.exe is used to make the USB flash drive. The download address of Rufus is：https://Rufus.en.softonic.com

Select the USB flash drive you want to make, or you can use the combination of memory card and card reader, select the Ubuntu system image file you want to install, and click Start.

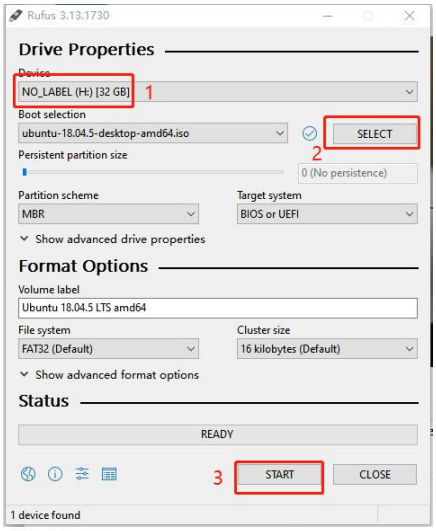

Figure 5-2 Rufus -3.11 Software

Click [OK] and select to write in ISO image mode, If this fails, choose to write in DD Image mode:

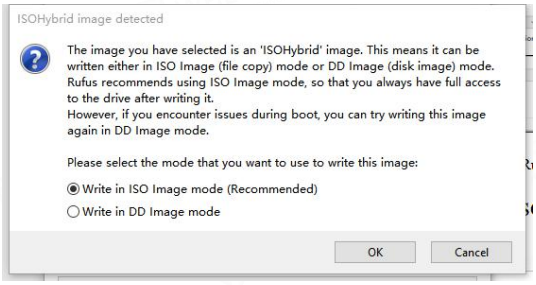

Figure 5-3 image recovery prompt

Click OK to start making.

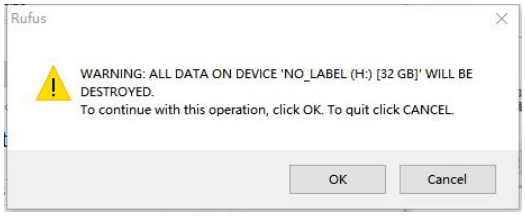

Figure 5-4 image recovery prompt

Wait for the image recovery completed, insert the U disk which has be written with the system into the industrial computer, ready for the next operation.

③ Install Ubuntu using a USB flash drive

Press the F11 key to select the startup mode, press the Delete key to enter the BIOS interface of the IPC, and select U disk start.

Starts to enter the Ubuntu desktop system installation.Double-click on the top

left of the desktop [Installubuntu 18.04.05 LTS]. The installation process is the same as that in the virtual machine. Select all the default conditions during the installation process and install Ubuntu to the industrial computer after following the prompts for system Settings.

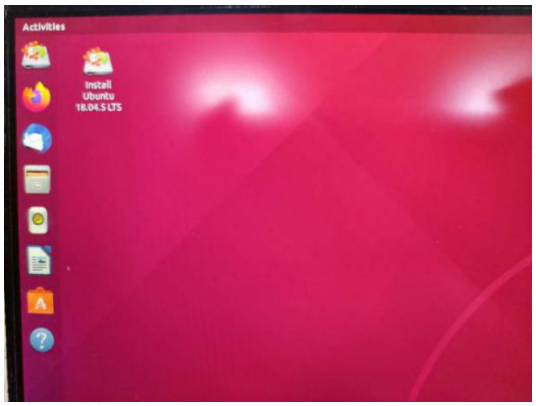

Figure 5-5 Ubuntu system installation desktop

5. 2 Install ROS in IPC

After the installation of Ubuntu Desktop Edition is complete, you can start to install ROS on it. Please refer to the official ROS tutorial in Section 1.2 for the installation of ROS, which is not covered here.

5. 3 Configure wireless WiFi and static IP with Ubuntu on IPC

How to configure WiFi and static IP in the Ubuntu environment on an IPC can be viewed in Chapter 6. If there is no WiFi editing window in the Ubuntu status bar when creating a hotspot, you can open it by typing this command at the terminal: nm-connection-editor.

If the client SSH login on the IPC (host) fails, it is necessary to enter the command on the IPC (host) to manually install the SSH function: sudo apt-get install openssh-server

6. Configure Ubuntu and ROS in Jetson Xavier NX

There are two startup modes for Jetson Xavier NX, namely EMMC startup and TF card startup. At present, our robot uses Jetson Xavier NX, which uses the TF card to start the system.

6. 1 Install Ubuntu in Jetson Xavier NX

① Download the Ubuntu image file

After the purchase of Jetson Xavier NX, the development environment has been set up, and users do not need to set up the environment again. If you want to download the original image file and build your own environment, you need to do the following preparations:

First of all, you need to download the Ubuntu image file for Jetson Xavier NX from the official website of NVIDIA. The download address is:

https://developer.nvidia.com/zh-cn/embedded/downloads#?search=Jetson%20Xavier%20NX%20Developer%20Kit%20User%20Guide

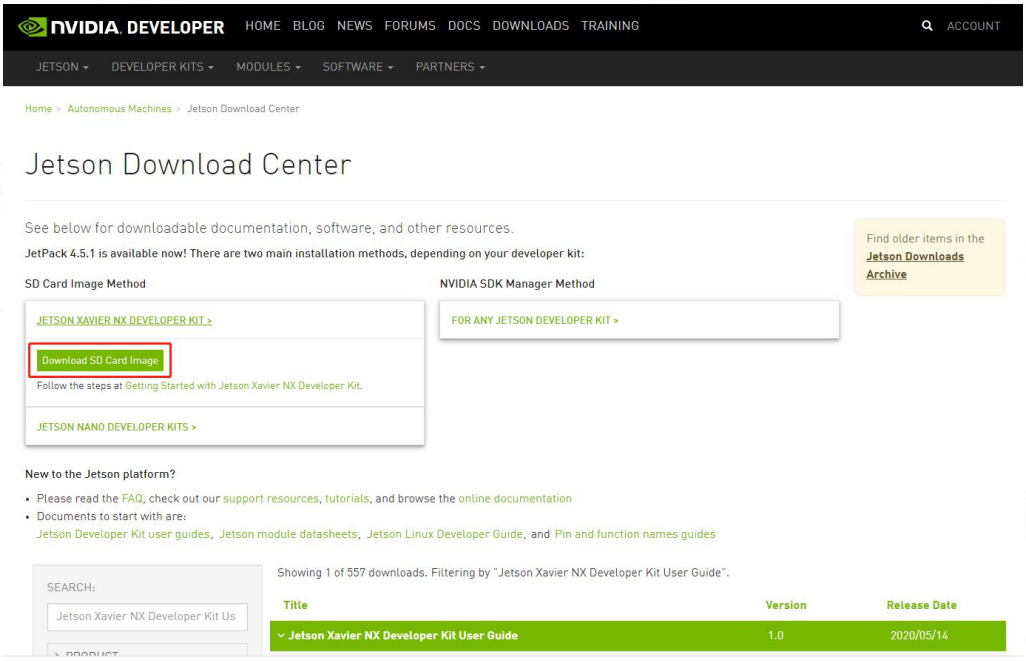

Figure 6-1 Jetson Xavier NX image download

② Recover the image file to the TF card

After the image download is complete, you need to do the following preparations:

1. Prepare an Ubuntu computer, save the downloaded image file into the computer, and use the card reader to connect the prepared TF card to the Ubuntu computer.

2. Prepare a TF card. The minimum configuration of 16G TF card is required, but about 13G of TF card is used after the whole system is swiped. Some other machine learning frameworks will need to be installed at a later stage, so a minimum of 32GB TF card is required. The SD Card Formatter is used to format the TF Card. The SD Card Formatter is used to format the TF Card. The SD Card Formatter is used to format the TF Card.

For detailed instructions on how to burn and backup the image files of Raspberry Pi, see "16. Jetson Xavier NX Mirror Burning and Backup" in Chapter 16.

③ Network connection of Jetson Xavier NX

Jetson Xavier NX comes with wireless network card and antenna, no need to install another network card, after boot can directly set the transmission and reception of WIFI.

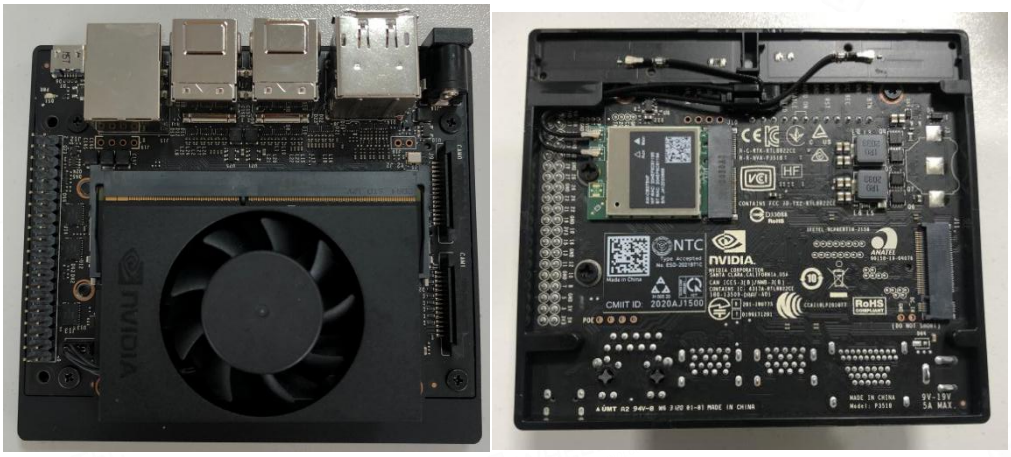

Figure 6-2 Jetson Xavier NX main control board

For details on how to configure WiFi and static IP in the Ubuntu environment in Jetson Xavier NX, go to Chapter 7.

④ Jetson Xavier NX SD card formatting

Since the SD card with Jetson Xavier image is not recognized when inserted into Windows, if formatting is needed, the formatting steps are the same as those of the SD card of Jetson Nano, which can be checked in Chapter 3.

⑤ Jetson Xavier NX fan control

The fan of Jetson Xavier NX has a set of automatic temperature and speed control algorithms in the system core, and usually starts the fan to heat the board at about 40 degrees Celsius.

If you want to manually turn on the fan for cooling, open the terminal and enter the following commands and execute them.

```
sudo sh -c 'echo xxx > /sys/devices/pwm-fan/target_pwm'
```

XXX represents the PWM duty cycle parameter of the fan, which ranges from 0 to 255. 0 represents the complete stop of the fan, and 255 represents the full duty cycle output.

6.2 Install ROS in Jetson Xavier NX

Once you have installed your Ubuntu system, you can start installing ROS. Please refer to the official ROS tutorial in Section 1.2, which will not be covered here.

7. Configure wireless WiFi and static IP with Ubuntu

In this chapter, Ubuntu refers to the ROS host. The communication between Ubuntu on the ROS host (take the Raspberry Pi as an example) and Ubuntu on the virtual machine needs to use the same network. In this case, Ubuntu on the Raspberry Pi needs to send WiFi, and the virtual machine connect to WiFi, so as to realize the communication with the same network. The IP address of both parties is needed in the communication process, but the default IP address is the dynamic IP address automatically assigned by the system, so it is necessary to set a static IP address.

7. 1 Configure wireless WiFi with Ubuntu

Opening WiFi and setting static IP addresses with Ubuntu on Raspberry Pi requires the display interface, which makes setting up easier and faster. The Raspberry Pi is connected to the display screen first. It should be noted that the configuration process described in this chapter is operated with the display screen interface.

Locate the Network button in the upper right of the display, right-click it, and select “Edit Connections”.

Figure 7-1 New WiFi 1

Enter the interface of network connection creation, which is blank by default, and click "+" to create new WiFi.

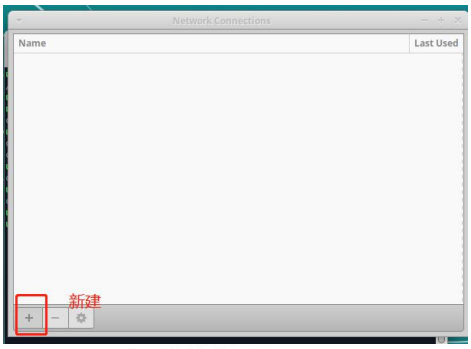

Figure 7-2 New WiFi 2

Select to create a "Wi-Fi", click "Create", will take you to the WiFi Settings.

Figure 7-3 New WiFi 3

In the setting interface of WIFI, we first need to set the name and mode of WIFI (host mode). The name of WiFi and the name of the Settings can be customized.

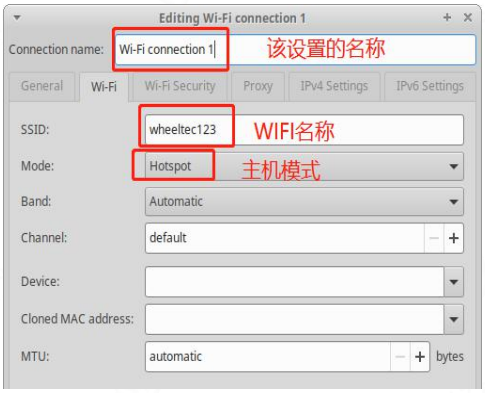

Figure 7-4 New WiFi 4

By default, there is no password for the newly created WiFi. You need to set the password manually. Click "WiFi Security" and you can see that the password is "None".

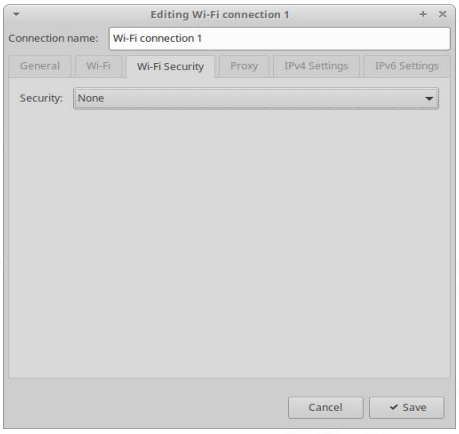

Figure 7-5 New WiFi 5

Select "WPA &WPA2 Personal" for password mode, then input the password and the WiFi configuration is complete. After the WiFi configuration is completed, do not rush to save and exit, we also need to set the static IP.

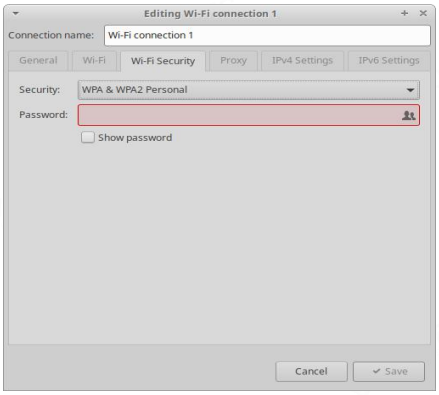

Figure 7-6 New WiFi 6

7.2 Ubuntu configures static IP

Continue to set Ubuntu's static IP address under this window. Click "IPv4_setting", you can see that there is no setting here, then click "Add" to Add static IP address.

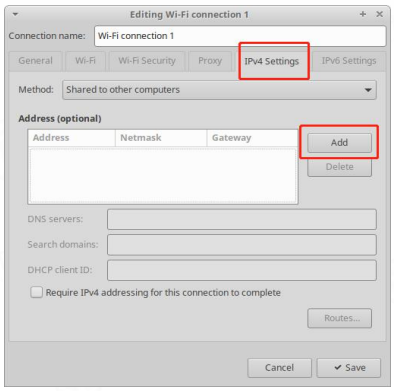

Figure 7-7 Create New WiFi 7

Enter static IP address, netmask and gateway respectively according to Figure 7-8. At this time, static IP setting is completed. Click Save to exit.

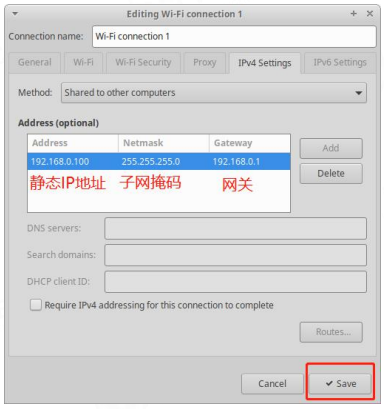

Figure 7-8 New WiFi 8

After saving, you can see that the network arrow symbol in the upper right has changed to the WiFi signal symbol. The popover also shows that the connection is set successfully.

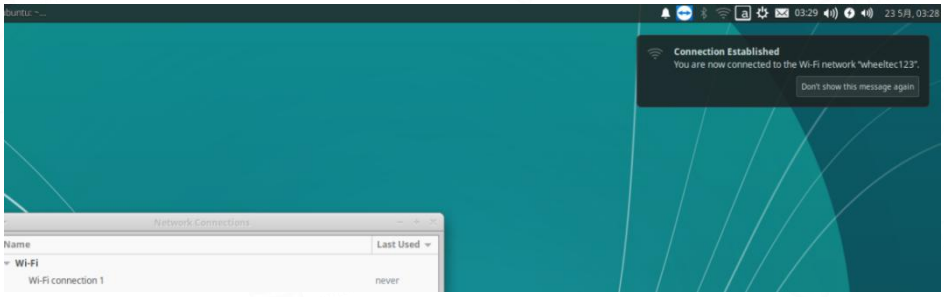

Figure 7-9 New WiFi 9

At this point the WiFi is set up, the static IP is set up, and we restart Ubuntu. After the restart, open the terminal, enter "IP A" or "ifconfig" instruction to check the IP address, you can see that the IP address has been modified to 192.168.0.100.

Here are some tips on how to turn on WiFi in Ubuntu：

①WiFi is self-starting when turn on by default, no other operation is required；

②With only one wireless card (the one that comes with the Raspberry Pi), Ubuntu cannot connect to WiFi and transmit WiFi at the same time (you can connect to the cable and transmit WiFi at the same time). Therefore, if Ubuntu on Raspberry Pi needs to connect to the available network via WiFi, you need to first turn off the transmitted WiFi and then connect to the available network.

③If you want to restart WiFi after turning off WiFi, you can only restart Ubuntu and it will automatically restart WiFi.

8. The NFS mount

If you want to remotely access and modify files with Ubuntu on the ROS host, you can do so via NFS mount. The Ubuntu system on the virtual machine can access the files of the Ubuntu system on the ROS host by means of NFS, which consists of server mount and client access. Here Ubuntu on the virtual machine acts as the client, Ubuntu on the ROS host acts as the server, and Ubuntu on the virtual machine mounts the Ubuntu files on the Raspberry Pi locally.

8. 1 Configure the NFS server

The server first needs to mount its own file before it can be accessed by the client. The following steps ① -- ⑥ are performed on the server (Ubuntu on the ROS host).

① Install the NFS server

```
wheeltec@wheeltec:~$ sudo apt-get install nfs-kernel-server
```

Figure 8-1 sudo apt-get install nfs-kernel-server

② Add the NFS shared directory (the folder to mount)

```
wheeltec@wheeltec:~$ sudo vim /etc/exports
```

Figure 8-2 sudo vim /etc/exports

Save exit after adding the following command at the end of the text. This directive is preceded by the file path to be mounted. * means that any system with network segment IP is allowed to access the NFS directory.

```
# Example for NFSv4:
# /srv/nfs4        gss/krb5i(rw,sync,fsid=0,crossmnt,no_subtree_check)
# /srv/nfs4/homes  gss/krb5i(rw,sync,no_subtree_check)
/home/wheeltec/wheeltec_robot *(rw,sync,no_root_squash)
```

Figure 8-3 /home/wheeltec/wheeltec_rebot *(rw,sync,no_root_squash)

③ Set permissions for mounted directories and modify file users

```
wheeltec@wheeltec:~$ sudo chmod -R 777 /home/wheeltec/wheeltec_robot
```

Figure 8-4 sudo chmod -R 777 /home/wheeltec/wheeltec_robot

```
wheeltec@wheeltec:~$ sudo chown -R 777 /home/wheeltec/wheeltec_robot
```

Figure 8-5 sudo chown -R 777 /home/wheeltec/wheeltec_robot

I should mention here that since the "wheeltec_robot" folder has subfolders, adding "-r" to the command indicates that the scope of the command includes that folder and all subfolders it contains.

④ start the NFS

When starting NFS for the first time, you need to start NFS and then restart it, as shown in Figures 8-6 and 8-7.

```
wheeltec@wheeltec:~$ sudo /etc/init.d/nfs-kernel-server start
```

Figure 8-6 sudo /etc/init.d/nfs-kernel-server start // Start the NFS service

```
wheeltec@wheeltec:~$ sudo /etc/init.d/nfs-kernel-server restart
```

Figure 8-7 sudo /etc/init.d/nfs-kernel-server restart // Restart the NFS service

⑤ Mount NFS

This directive mounts the local /home/wheeltec/wheeltec_robot path to the local /mnt path. Here "192.168.0.100" is the IP address of the server.

```
wheeltec@wheeltec:~$ sudo mount -t nfs -o nolock 192.168.0.100:/home/wheeltec/wheeltec_robot  /mnt
```

Figure 8-8 sudo mount -t nfs -o nolock 192.168.0.100:/home/wheeltec/wheeltec_robot /mnt

⑥ Check to see if the mount was successful

You can open the /mnt directory directly to see if /home/wheeltec/wheeltec_robot is the same, or you can use the df -h command to see all the mounted projects.

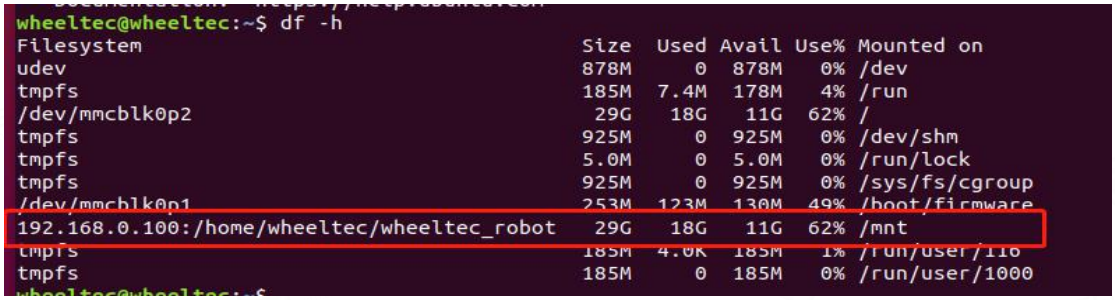

Figure 8-9 df -h

Note: The NFS mount will fail after each restart and will need to be remounted manually. The boot mount is set up in the image we provided for Raspberry Pi, so you do not need to mount it automatically after each boot. See the next chapter, "9. Boot Execution Scripts," for details on how to implement the boot execution script.

8. 2 Configure the NFS client

After explaining how the server mounts files, this section describes how the client mounts the server files locally. The following steps (① -- ③) are performed on the client side.

① Install the NFS client

Figure 8-10 sudo apt-get install nfs-common

② Mount the server files locally

Mount is a Mount command, which is used in the format sudo[space] Mount [space]-t[space] NFS [space][server IP address][colon][server Mount file path][space][Mount to client path]. See Figure 8-11 for a mount example. The mount directory and IP address of the server can be changed according to actual needs. This is mainly used as a tutorial.

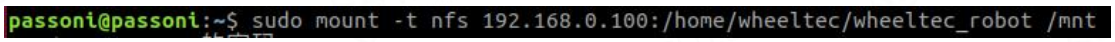

Figure 8-11 sudo mount -t nfs 192.168.0.100:/home/wheeltec/wheeltec_robot /mnt

③ Check to see if the mount was successful

You can open the /mnt directory to see if there is a "src, devel, build" directory, or just use the "df -h" directive to see all the mounted directories.

9. Execute the script at boot time

Sometimes we need to do repetitive actions, such as NFS mount, these can be added to the boot automatic run, this way you don't need to do it manually after each boot is finished. Here is how to implement the boot execution script. The boot auto-execution script tutorial is universal to both the Raspberry Pi and the virtual machine side. Due to space constraints, the following will only demonstrate the boot run script on the ROS host (in the case of Raspberry Pi).

① Create a new script file to run

First into the/etc/init.d, under the path of the directory to create a new script, the script name can be custom, the author here to create a new script name is: mount_test. sh.On Linux, if you open a text file, if the text file doesn't exist, you create the text directly.

Figure 9-1 sudo vim mount_test.sh

② Edit script

The commands to be executed on boot are written into the script. Figure 9-2 shows the commands for auto-mounting NFS on boot. This is not to say that a single instruction to write a script, but a script can write more than one instruction, each instruction should pay attention to the line feed.

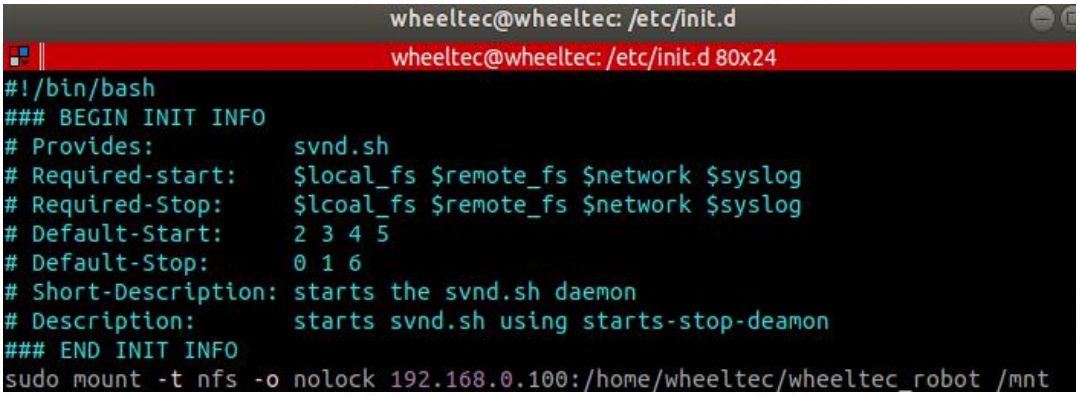

Figure 9-2 sudo mount -t nfs -o nolock 192.168.0.100:/home/wheeltec/wheeltec_robot /mnt

The important thing to note here is that in addition to the command you want to

execute, you must include the following statement at the beginning:

```
#!/bin/bash
### BEGIN INIT INFO
# Provides:          svnd.sh
# Required-start:    $local_fs $remote_fs $network $syslog
# Required-Stop:     $lcoal_fs $remote_fs $network $syslog
# Default-Start:     2 3 4 5
# Default-Stop:      0 1 6
# Short-Description: starts the svnd.sh daemon
# Description:       starts svnd.sh using starts-stop-deamon
### END INIT INFO
```

③ Modify the permissions to execute the script

```
wheeltec@wheeltec:/etc/init.d$ sudo chmod 777 mount_test.sh
```

Figure 9-3 sudo chmod 777 mount_test.sh

④ Add the script to the queue for startup execution

```
wheeltec@wheeltec:/etc/init.d$ sudo update-rc.d mount_test.sh defaults 90
```

Figure 9-4 sudo update-rc.d mount_test.sh defaults 90

⑤ Restart the Ubuntu

Then we restart Ubuntu, enter the instructions shown in Figure 9-5 to look at the mount, and you can see that the mount has been automatically implemented.

```
wheeltec@wheeltec:/etc/init.d$ df -h
Filesystem                                  Size  Used Avail Use% Mounted on
udev                                        878M     0  878M   0% /dev
tmpfs                                       185M  7.4M  178M   4% /run
/dev/mmcblk0p2                               29G   18G   11G  62% /
tmpfs                                       925M     0  925M   0% /dev/shm
tmpfs                                       5.0M     0  5.0M   0% /run/lock
tmpfs                                       925M     0  925M   0% /sys/fs/cgrou
p
/dev/mmcblk0p1                              253M  123M  130M  49% /boot/firmwar
e
192.168.0.100:/home/wheeltec/wheeltec_robot   29G   18G   11G  62% /mnt
tmpfs                                       185M  4.0K  185M   1% /run/user/116
```

Figure 9-5 df -h

⑥ Cancel boot operation automatically

If you want to cancel the boot execution, it is also easy to cancel the boot

execution by going into /etc/init.d and following the instructions shown in Figure 9-6.

```
wheeltec@wheeltec:/etc/init.d$ sudo update-rc.d -f mount_test.sh remove
```

Figure 9-6 sudo update-rc.d -f mount_test.sh remove

After the modification, restart Ubuntu, enter the instructions as shown in Figure 9-7 to check the mount items, and you can see that NFS is not mounted. Bootup has been cancelled successfully.

```
wheeltec@wheeltec:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            878M     0  878M   0% /dev
tmpfs           185M  7.3M  178M   4% /run
/dev/mmcblk0p2   29G   18G   11G  62% /
tmpfs           925M     0  925M   0% /dev/shm
tmpfs           5.0M     0  5.0M   0% /run/lock
tmpfs           925M     0  925M   0% /sys/fs/cgroup
/dev/mmcblk0p1  253M  123M  130M  49% /boot/firmware
tmpfs           185M  4.0K  185M   1% /run/user/116
tmpfs           185M     0  185M   0% /run/user/1000
```

Figure 9-7 df -h

10. SSH remote login

If you want to use ROS on the ROS host of Raspberry Pi or Jetson series or IPC, you need to input instructions. Moreover, when the ROS host (taking Raspberry Pi as an example here) is mounted on the robot, it is very inconvenient to use the keyboard and monitor. The best way to do this is to remotely log into Ubuntu of Raspberry Pi using Ubuntu of the virtual machine. Typing commands on the virtual machine is the same as typing commands on Raspberry Pi. The most commonly used method for remote login is SSH. Here is how to use SSH remote login and some tips for ssh remote login.

By default, SSH is already installed on Ubuntu. Let's show you how to use SSH to implement master (virtual machine) control slave (Raspberry Pi). Of course, the premise of realizing ssh remote login is that the host and the slave are in the same network environment. The solution is let the host (virtual machine) connect to the WiFi network emitted from the machine (Raspberry Pi). The slave IP: 192.168.0.100, and the slave user name: wheeltec.

① Communication test

Use the instructions shown in figure 10-1 to see if the host can ping the slave. If you Ping the network, you will be able to log in to SSH remotely.

```
passoni@passoni:~$ ping 192.168.0.100
PING 192.168.0.100 (192.168.0.100) 56(84) bytes of data.
64 bytes from 192.168.0.100: icmp_seq=1 ttl=64 time=7.60 ms
64 bytes from 192.168.0.100: icmp_seq=2 ttl=64 time=8.56 ms
64 bytes from 192.168.0.100: icmp_seq=3 ttl=64 time=3.10 ms
```

Figure 10-1 Ping 192.168.0.100

② the SSH login

If the connection is successful, it will prompt you to enter the password of the slave. After entering the password, you can log in the slave.

```
passoni@passoni:~$ ssh wheeltec@192.168.0.100
wheeltec@192.168.0.100's password:
```

Figure 10-2 ssh wheeltec@192.168.0.100

③ Log out of SSH

If you want to log out of the remote but do not want to close the terminal, enter the logout command as shown in Figure 10-3.

Figure 10-3 exit

④ Set password free login to SSH

But the above situation will need to use a password login every time when connecting, will be more cumbersome, the following explain how to achieve direct login without a password.

Start by entering the secret key instruction for generating SSH login as shown in Figure 10-4：

Figure 10-4 ssh-keygen

Next, press "Enter" when the prompt pops up. If the overwriting reminder appears in the middle, enter "Y" to confirm the overwriting.

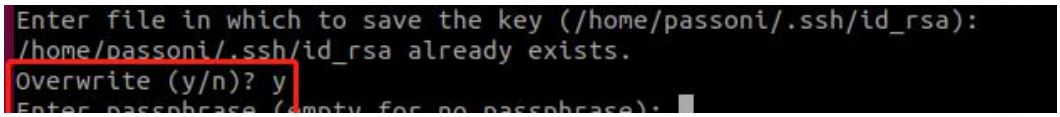

Figure 10-5 Secret key overlay reminder

You can see that the two sentences framed in Figure 10-6 indicate that the public key and the secret key have been generated and saved.

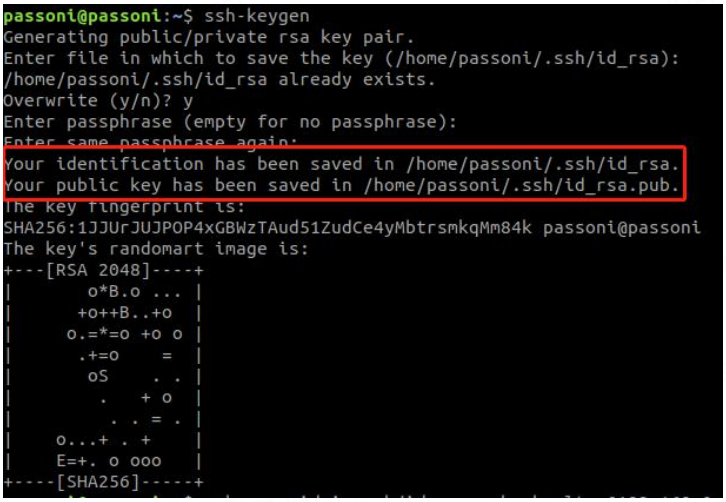

Figure 10-6 The process of generating a secret key

After generating the secret key, we need to enter the instructions as shown in Figure 10-7 to copy the secret key. After inputting the instructions, it will prompt us to enter the password of the slave machine. After inputting the password, we have successfully bound the password-free SSH login. The last part of the copy secret key instruction is the slave's user name and IP address, which can be modified according to the slave's information.

```
passoni@passoni:~$ ssh-copy-id -i .ssh/id_rsa.pub wheeltec@192.168.0.100
```

Figure 9-7 ssh-copy-id -i .ssh/id_rsa.pub wheeltec@192.168.0.100

At this time, the password free login has been set. Next, let's enter the instructions as shown in Figure 10-8 to try to log in. We can see that we have logged in without the reminder of entering the password

```
passoni@passoni:~$ ssh wheeltec@192.168.0.100
Welcome to Ubuntu 18.04.4 LTS (GNU/Linux 5.3.0-1023-raspi2 aarch64)
```

Figure 10-8 ssh wheeltec@192.168.0.100

⑤ Set no IP address to login

After password-less login is implemented, you can also simplify the SSH login process, namely, no IP login. But no IP login does not mean that you don't need an IP address to log in, it just means that there is a mapping done in the system, and entering a name is equal to entering the IP. Start by opening the /etc/hosts file by entering the instructions shown in Figure 10-9.

```
passoni@passoni:~$ sudo vim /etc/hosts
```

Figure 10-9 sudo vim /etc/hosts

Enter the mapping of the IP address and the name of the slave under the file. Pay attention to the space between the IP address and the name. The rest of the content does not need to be modified.

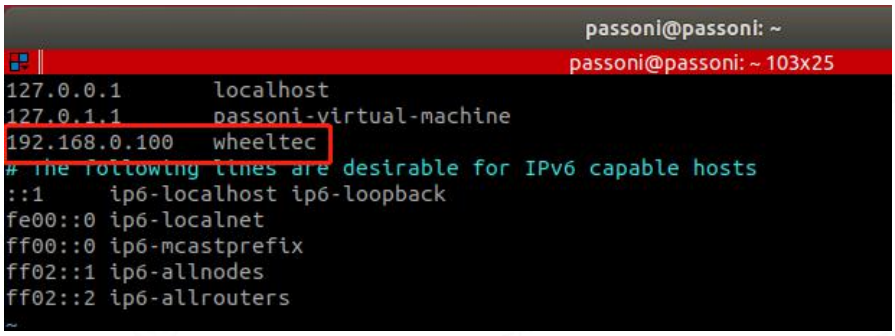

Figure 10-10 192.168.0.100 wheeltec

Save to log out, and then try using no IP address login, as you can see here.

Figure 10-11 ssh wheeltec@wheeltec

11. ROS multi-machine communication setup

To realize multi-machine (topic) communication of ROS, the.bashrc file needs to be configured. Open the file nano.bashrc in the root directory.

```
passoni@passoni:~$ nano .bashrc
```

Figure 11-1 nano .bashrc

Drag to the bottom of the file and modify the configuration as shown in Figure 11-2：

source /opt/ros/melodic/setup.bash

source /home/passoni/catkin_ws/devel/setup.bash

export ROS_MASTER_URI=http://192.168.0.100:11311

export ROS_HOSTNAME=192.168.0.142

export SVGA_VGPU10=0

The first line is the environment variable set when ROS is installed;

The second line is the environment variable for the ROS workspace on the virtual machine (host);

The third line is the IP address of the slave. 11311 after the colon does not need to be changed.

The fourth line is the host (local) IP address;

The above content needs to be changed according to the actual situation.

```
  fi
fi

source /opt/ros/melodic/setup.bash
source /home/passnoi/catkin_ws/devel/setup.bash
export ROS_MASTER_URI=http://192.168.0.100:11311
export ROS_HOSTNAME=192.168.0.142
export SVGA_VGPU10=0
```

Figure 11-2 Configuring environment variables and IP addresses

After saving the.bashrc file and exit, use the source command to make the changes take effect。

Figure 11-3 source .bashrc

12. Raspberry Pi image backup and recovery

There is a problem that needs to be paid attention to, whether it is recovering Raspberry Pi image or backup Raspberry Pi in the process, do not plug other U disk, otherwise it will backup or recovery errors.

12.1 Raspberry Pi image backup

① Create a new blank.img file

Create a new blank txt file, and then rename the txt suffix to img suffix, the file name can be customized (preferably in English).

Figure 12-1 Creating a blank img file

One prerequisite for a successful backup: Assuming the memory card used on the Raspberry Pi is 32GB, the backup image file is also 32GB, so the blank img file needs to be built on a 32GB disk, otherwise the backup will fail.

② Connect the memory card to the computer

At this time, the pop up window of the formatted reminder will pop up and click Cancel. This step is very important, click format disk is to delete the file that you want to backup!!

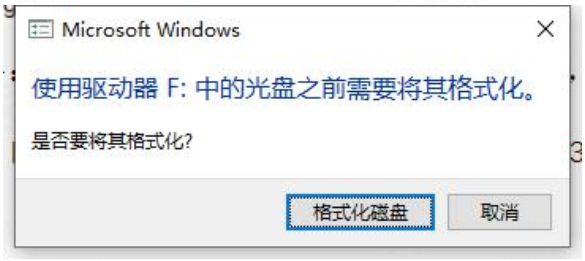

Figure 12-2. Formatting reminder popups

③ Image copy

Open Win32Disk, select the blank img file you just created, and click "Read".

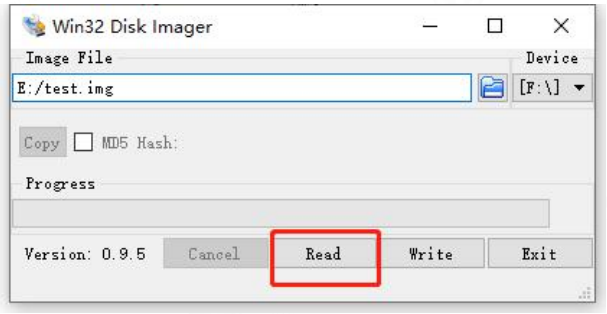

Figure 12-3 Win32Disk software operation interface

A warning popup will pop up for the overwrite write, and click "Yes".

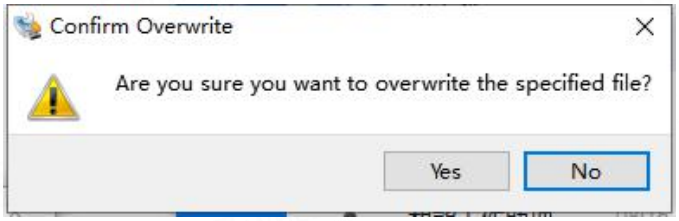

Figure 12-4 overrides the write reminder popup

Wait patiently (the image backup time for 32G is about 30 minutes). After completion, a popup window of success will pop up. Click OK.

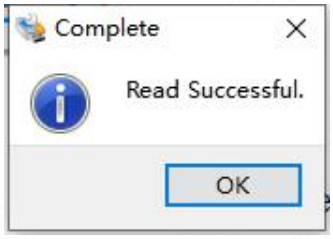

Figure 12-5. A successful image backup pop-up window

Next exit the Win32Disk software and click Exit. Unplug memory card, image backup successful.

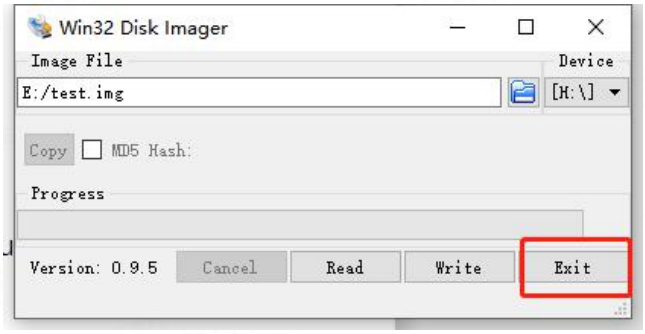

Figure 12-6 Exit the Win32Disk software

Check the size of the backup image file here, it is the same size as the memory card.

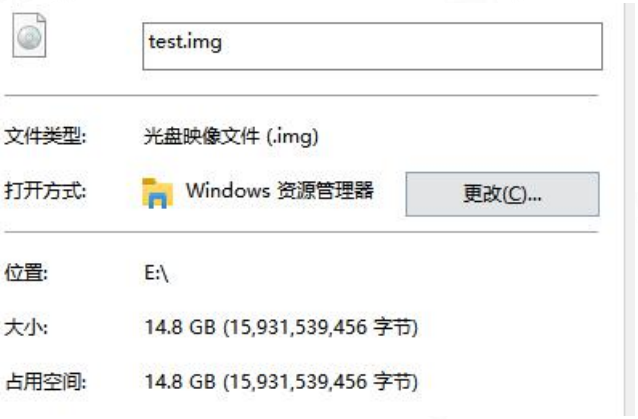

Figure 12-7 Backup image files

12.2 Raspberry Pi image recovery

① Formatted memory card

Connect the memory card to the computer through the card reader and open SDFormatter software.

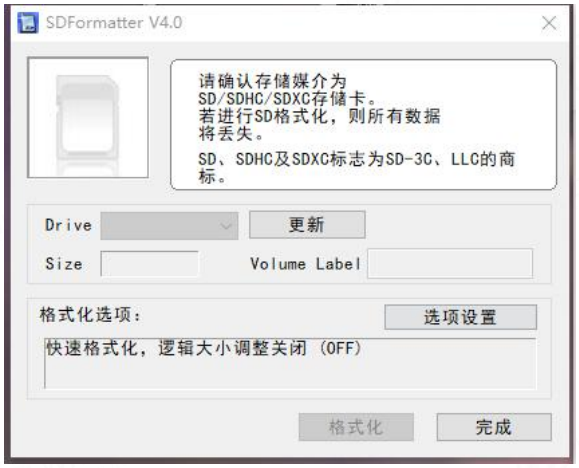

Figure 12-8 SDFormatter software interface

Click "Update" to automatically select the memory card. The default mode is quick format. Click "Format".

Figure 12-9 Formatting a memory card

A quick formatting reminder will pop up and click OK.

Figure 12-10. Quick-format reminder popups

The start formatting pop up window, click OK.

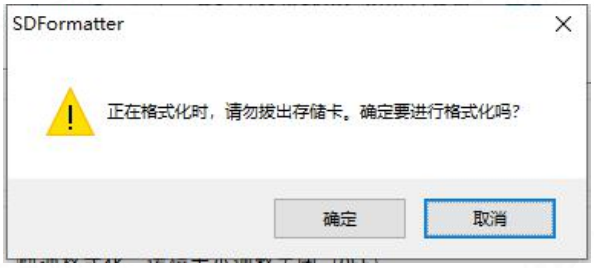

Figure 12-11 starts formatting popups

If the prompt "Formatting failed" pops up, click OK and then click Formatting again.

Figure 12-12 Formatting failed popups

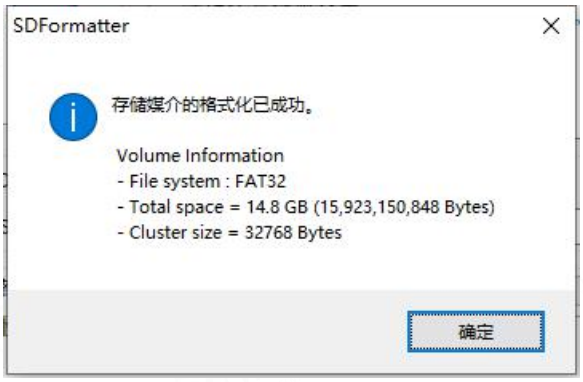

Figure 12-13 successfully formatted popover

If it fails again, the name of the memory card may be too long. After changing the name of the memory card (change a simple number, such as 1), click Format again.

Figure 12-14 Modifying the memory card name

After the formatting is completed, it is recommended to replug the memory card to confirm whether the formatting is really successful. As you can see here, the memory card is blank and formatted successfully.

Figure 12-15 Blank memory card

② Open Win32Disk software and import the image

Select the image file and memory card and click "Write".

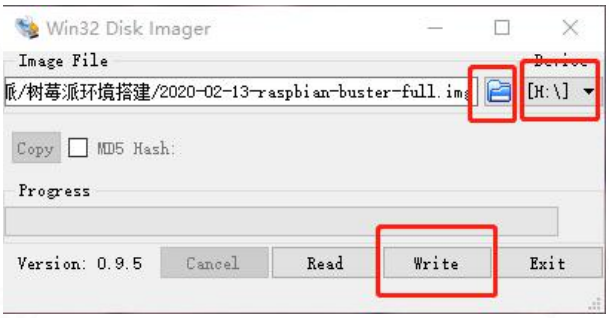

Figure 12-16 Win32Disk software interface

The overwrite write warning popup, click "Yes"

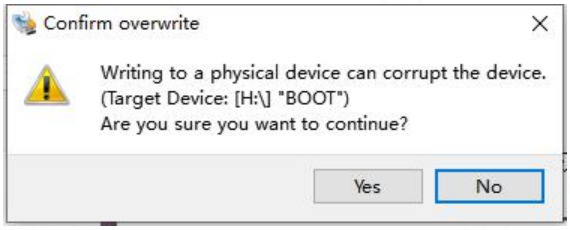

Figure 12-17 overrides the write warning popup

Wait patiently (the image recover time for 32G is about 30 minutes). After writing successfully, a popup window will pop up to remind you to format. At this time, do not click "Forformat" and click "Cancel".

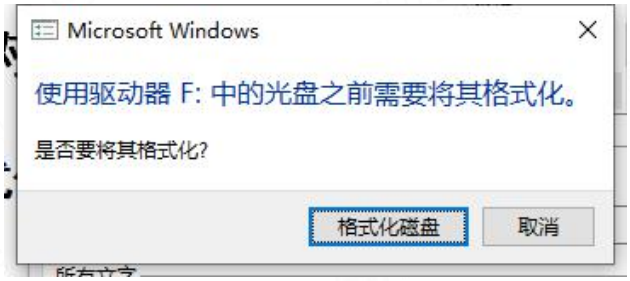

Figure 12-18 Format reminder popup after successful write

The writing succsss pop up window,click “OK”

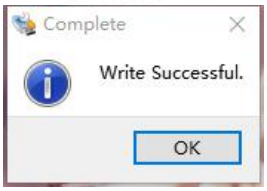

Figure 12-19 Format reminder popup after successful write

This is where the image is written to the memory card, unplug the memory card, insert it into the Raspberry Pi, and you're ready to use.

13. Jetson Nano image backup and recovery

Here's how to backup, save and restore the Jetson Nano image.

13.1 Jetson Nano image backup

① Image backup

Insert the Jetson Nano card into an Ubuntu computer with a hard disk space greater than 32GB using a card reader. Note that you can't use a virtual machine for backup because Windows can't read the memory card with the Jetson Nano system. The backup process is as follows:

a) First open a terminal and enter the command sudo fdisk -u -l to see the disk number;

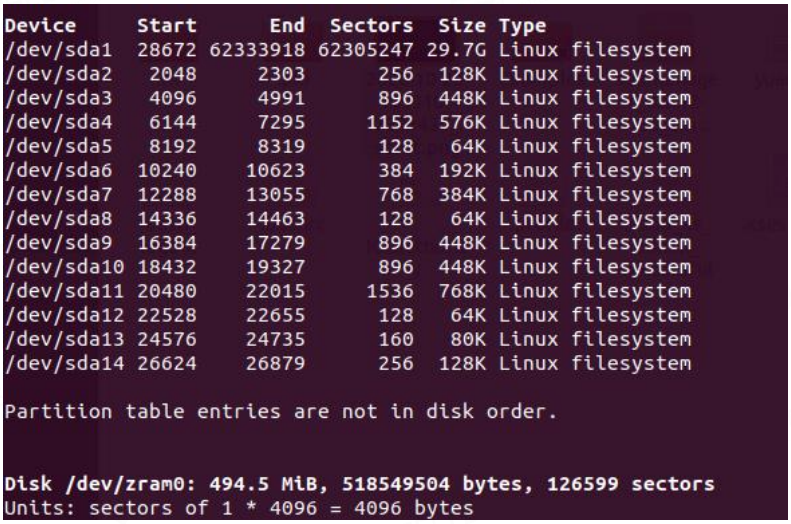

Figure 13-1 Use sudo fdisk-u -- l to view the disk number

b) Use sudo -s or sudo su to enter root mode for backup;

c) Enter the command at the terminal to start backup (confirm sda/b/c first) :

d) sudo dd if=/dev/sda | gzip>/home/wheeltec_nano.img.gz

e) Open a new terminal command: sudo pkill -USR1-n-x dd to view the backup process, when the backup is completed in the home directory to generate a mirror file named wheeltec_nan.img.gz, directly open the home file did not see this file, need to

view from the file -Other locations-Computer-home, then you can use U disk to copy the mirror directly out.

13. 2 Jetson Nano image recovery

There are two ways to recover the Jetson Nano image. They are the command line recover and use the image making tool Etcher to recover the image. First, format the SD card that needs to burn the image. The formatting steps are the same as those of the SD card in Raspberry Pi.

① Use the command line to restore

a) Insert the SD card that needs to recover the image into the Ubuntu computer with the backup image, and then the SD card has been formatted.

b) Enter the SD card directory to open the terminal and enter the command sudo fdisk-u -l to check the disk number;

c) Enter root mode with sudo -s or sudo su to get ready to recover the image;

d) Enter the command to recover the image at the terminal (confirm sda/b/c first) :

input command: sudo gzip - dc/home/wheeltec_nano. img. gz | sudo dd of = / dev/sda Start the recovery, the /home here is image storage directory, /dev/sda is the second step to check the results。

e) To view the recovery process, type the command: sudo pkill -usr1-n-x dd in the terminal.

② Use the Etcher to recover

Download the image making tool Etcher, download address is:https://www.balena.io/etcher/

Use Etcher software to write the image. Open the Etcher software and click [Select Image] to open the downloaded image file -->[Select Drive] Select the microSD card -- >[Flash!] To recover.

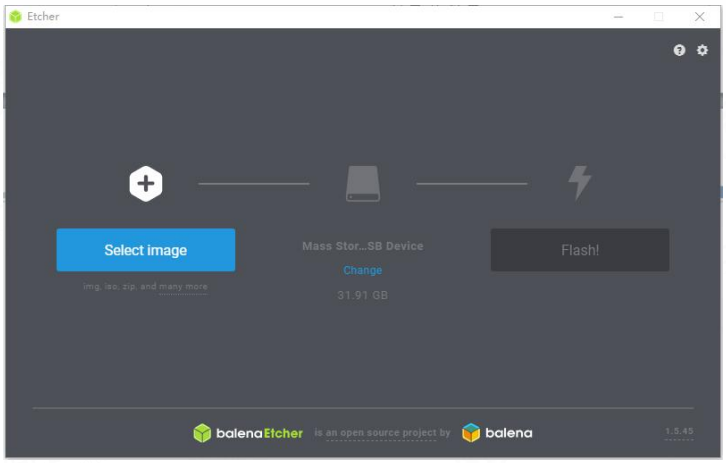

Figure 13-2. The image making tool Etcher

14. Jetson TX2 image backup and recovery

The backup and recovery of the Jetson TX2 image require a flsah.sh file generated by the flash, so it is necessary to backup and recover the image in the previous flash environment.

For either image backup and recovery, Jetson TX2 needs to be connected to the computer using the flash cable and enter the RECOVERY mode. Please refer to the relevant content in 4.1.2 for details. Enter the command lsusb at the terminal to check if there is 0955:7140 Nvidia Corp to check whether the Jetson TX2 has successfully connected to the PC.

14. 1 Jetson TX2 image backup

The backup steps for the Jetson TX2 image are:

a) Connect to PC and enter RECOVERY mode

b) Find the flsah.sh file on the previous computer, the file path in the/home/wheeltec/nvidia/nvidia_sdk/JetPack_4. 4 _linux_jetson_tx2 / Linux_for_Tegra this directory.

c) Enter commands at the terminal

```
cd /home/wheeltec/nvidia/nvidia_sdk/JetPack_4.4_Linux_JETSON_TX2/Linux_for_Tegra
```

d) Enter the directory, or directly open the terminal in this directory and use the command:

```
sudo ./flash.sh -r -k APP -G my_backup.img jetson-tx2 mmcblk0p1
```

To make a backup operation.

e) After the backup is completed, two image files will be generated, one about 30G and the other about 5G. The images are in the /home/gym/nvidia/nvidia_sdk/JetPack_4. 4 _linux_jetson_tx2 / Linux_for_Tegra this directory. You can use the hard disk to copy the image directly.

14. 2 Jetson TX2 image recovery

The recovery steps for the Jetson TX2 image are:

a) Connect to PC and enter Recovery mode

b) Enter the directory where the image file is located,

cd /home/wheeltec/nvidia/nvidia_sdk/JetPack_4.4_Linux_JETSON_TX2/Linux_for_Tegra

c) Copy the image to the subdirectory bootloader and use the command

sudo cp my_backup.img system.img

Rename it to system.img. Note that there are two images in the directory, one with the.raw suffix and the other with the.img suffix. The contents of both images are the same, so you can copy either image.

d) There is a system. img file in the bootloader directory, and you can choose to delete it or backup it. The backup command is:

mv system.img system_bak.img.bak

e) Move the generated new image file to the bootloader directory: mv .. /system.img system.img

f) Back to the previous directory: cd..

Use the command to start recovering：

sudo ./flash.sh -r jetson-tx2 mmcblk0p1

15. IPC image backup and recovery

15.1 IPC image backup

① Install the systemback software

Backup of IPC requires installation of the backup tool [systemback] in Ubuntu on IPC.Directly using the command to install: sudo apt-get install systemback

② Open the SystemBack software

Open a terminal, directly enter SystemBack to open the backup tool, and select the "Create Live System" option under the storage folder.

Figure 15-1-1 SystemBack software interface

Check "Include User Data File" and select "Create New" in the Live mode option to start the backup.

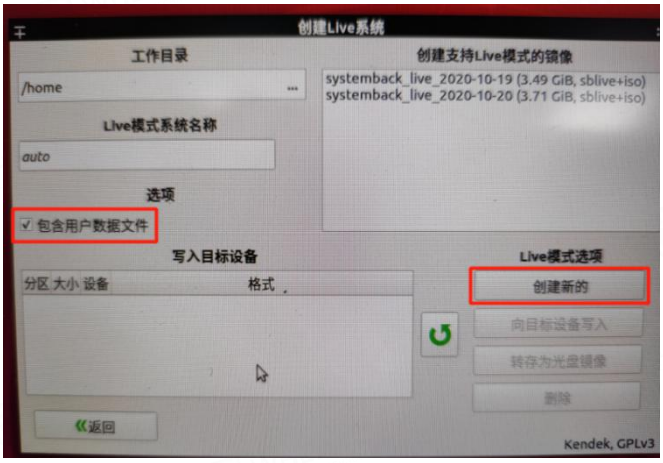

Figure 15-1-2 SystemBack software interface

Wait for the image to be created, that is, the ISO image can be found in the [Home] folder.

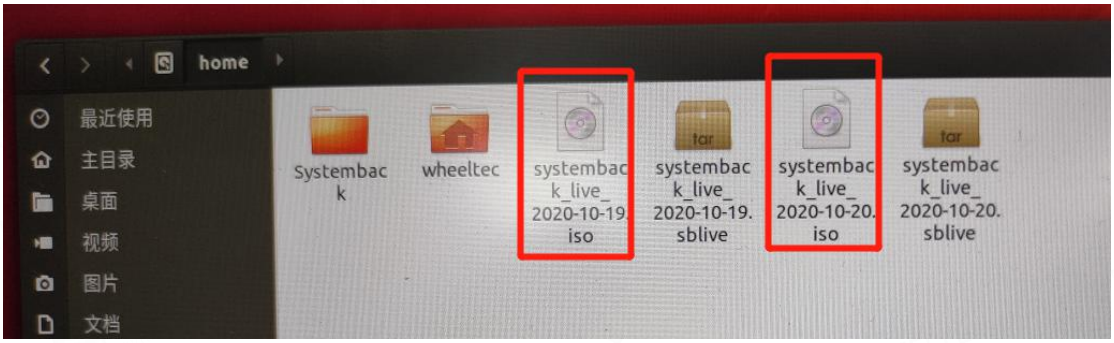

Figure 15-1-3 [Home] folder

It is important to note that when using the SystemBack tool for backup, the ISO file cannot be generated if the generated sblive file is larger than 4G. This is due to the limitations of the ISO file itself, iso9600 has limitations for the file, a single file can not exceed 2G, the total ISO file can not exceed 4G. The solution is:

```
#Create a new folder called sblive and unzip the image:
mkdir sblive
tar -xf /home/systemback_live_2016-04-27.sblive -C sblive
#Rename syslinux to isolinux:
mv sblive/syslinux/syslinux.cfg sblive/syslinux/isolinux.cfg
mv sblive/syslinux sblive/isolinux
#Install cdtools
aria2c -s 10 https://nchc.dl.sourceforge.net/project/cdrtools/alpha/cdrtools-3.02a07.tar.gz
tar -xzvf cdrtools-3.02a07.tar.gz
cd cdrtools-3.02
make
sudo make install
#Generate ISO file:
/opt/schily/bin/mkisofs -iso-level 3 -r -V sblive -cache-inodes -J -l -b
isolinux/isolinux.bin -no-emul-boot -boot-load-size 4 -boot-info-table -c
isolinux/boot.cat -o sblive.iso sblive
```

③ Make Ubuntu system backup USB disk

Use the software [Rufus-3.11.exe] to make the Ubuntu system USB flash drive. Select the ISO image we made using SystemBack, and do the same as in Chapter 5.

④ Use Ubuntu system directly to backup U disk as a system

After the production is completed, insert into the industrial computer or

computer, select the U disk to start.

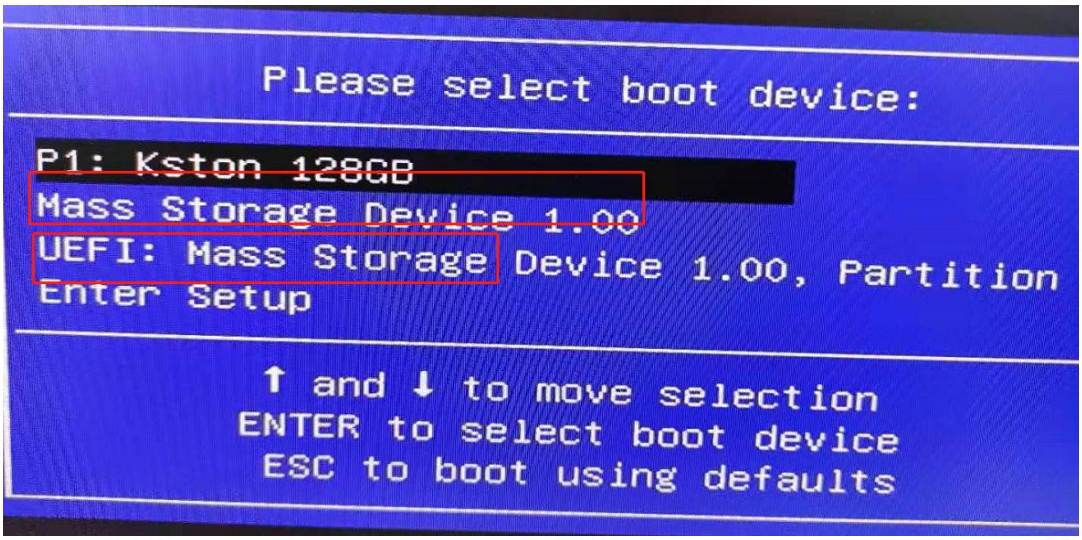

Figure 15-1-4 Select a USB drive to boot

Note that it will have two USB drive startup options: [Mass Storage Device 1.00] and [UEFI :Mass Storage Device 1.00, Partition]. We should select [Mass Storage Device 1.00], which affects the installation of Ubuntu for the computer. If we select UEFI, the installation will fail.

These two startup options also have different interfaces, as shown in Figure 15-1-5 and 15-1-6 below.

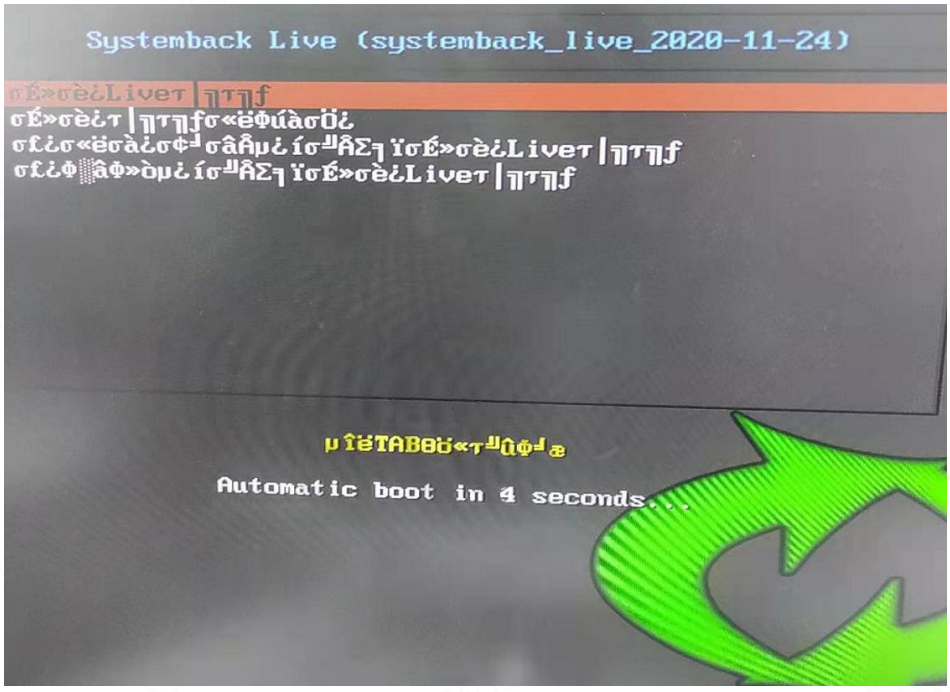

Figure 15-1-5 [Mass Storage Device 1.00] Interface

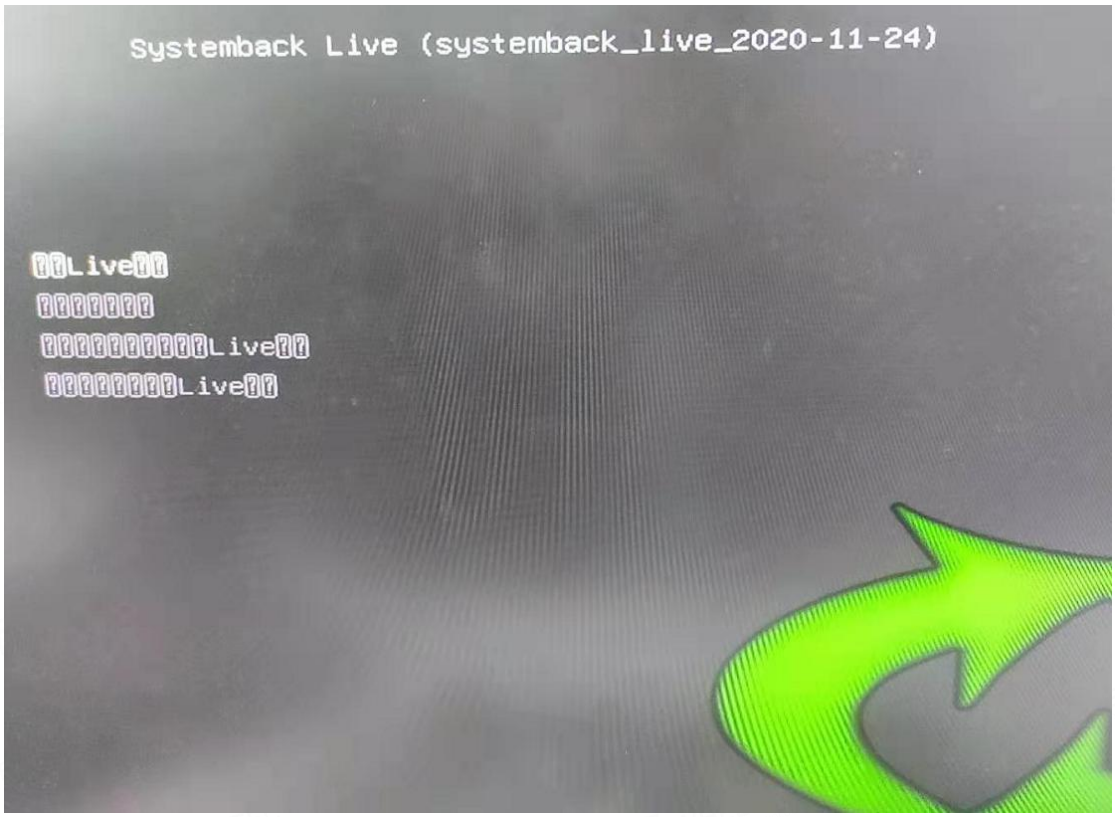

Figure 15-1-6 [UEFI :Mass Storage Device 1.00, Partition] interface

After startup, 15-1-5 and 15-1-6 interfaces will be displayed as shown above. Select the first option to enter the Ubuntu system you just backed up. Note that we are on the Live system and cannot be backed up again.

From top to bottom, the four options on the 15-1-5 and 15-1-6 screens are: Start Live System, Start System Installer, Start Live System in Safe Image Mode, and Start Live System in Debug Mode.

⑤ Using Ubuntu system backup U disk for computer to install Ubuntu

Select the first option [Start the Live system], which is convenient, but cannot be backed up again.

Select the second option: Start System Setup to install the real Ubunutu system, not the Live system, for your computer

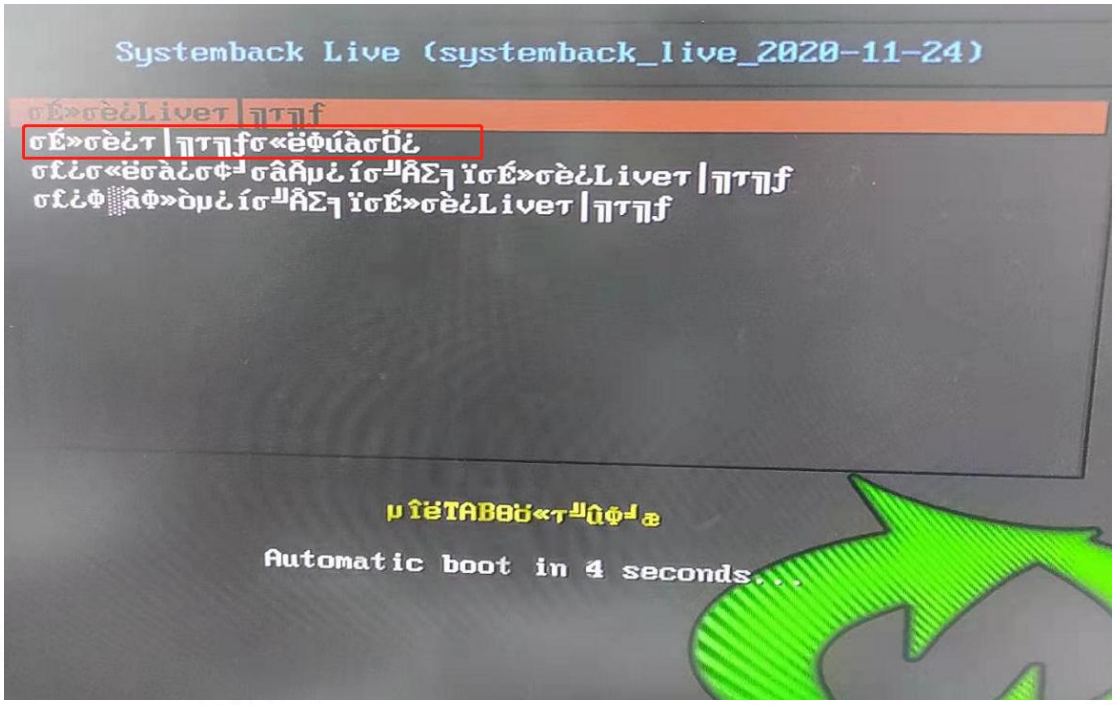

Figure 15-1-7. Select the second option: Start the system installer

Enter your password to log in.

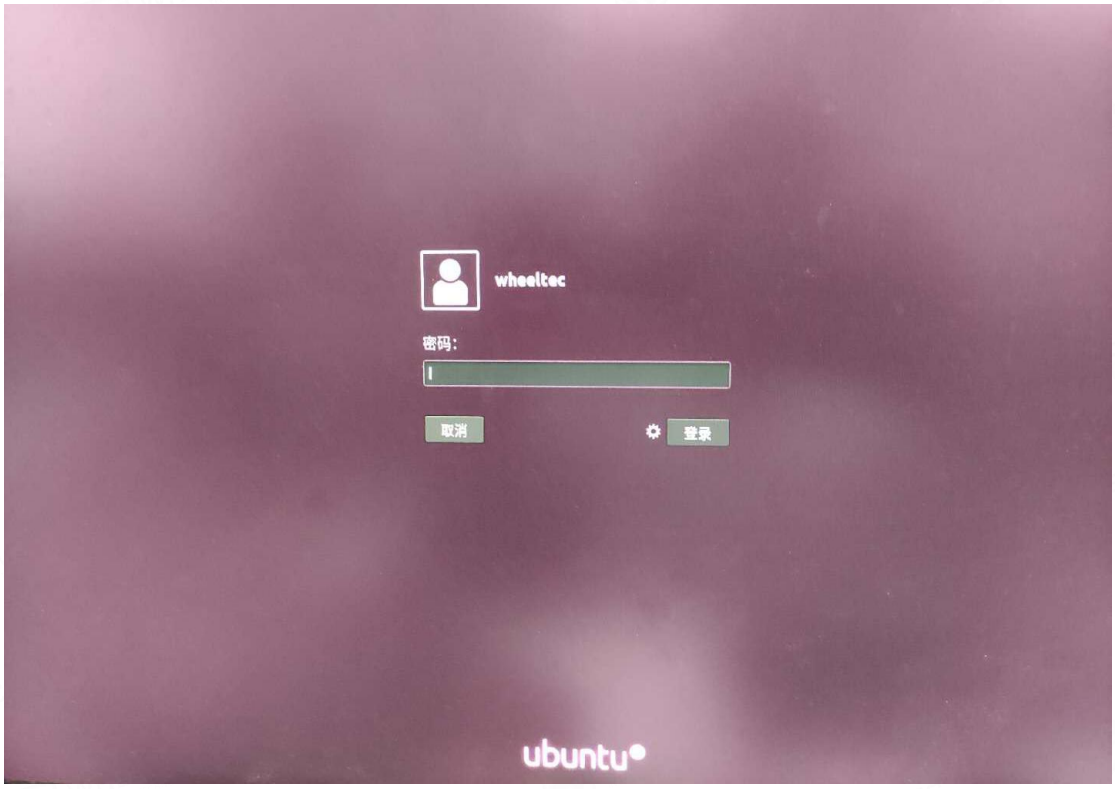

Figure 15-1-8 Enter your password to log in

Enter the system installation interface and enter information about the system you want to create. Click Next.

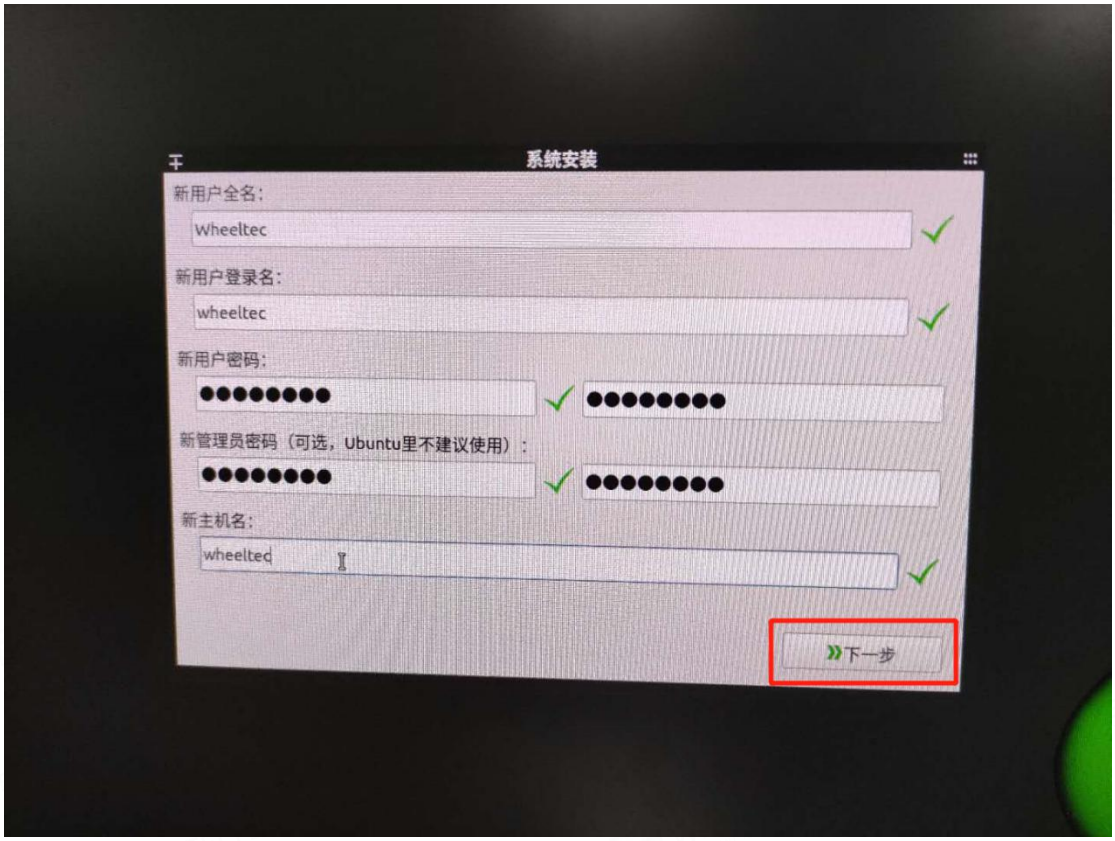

Figure 15-1-9 Ubuntu System Process 1

Select the hard disk partition you want to install, and click Uninstall.

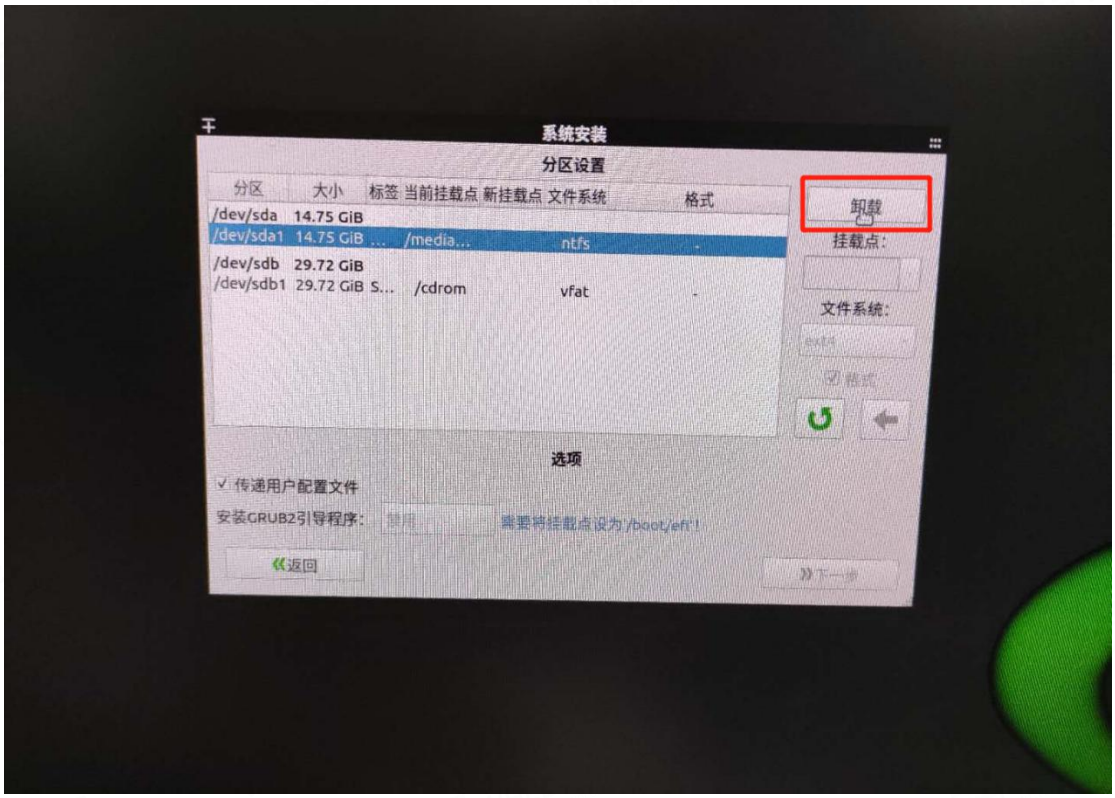

Figure 15-1-10 Ubuntu system process 2

Select the disk partition you want to install again and click Delete.

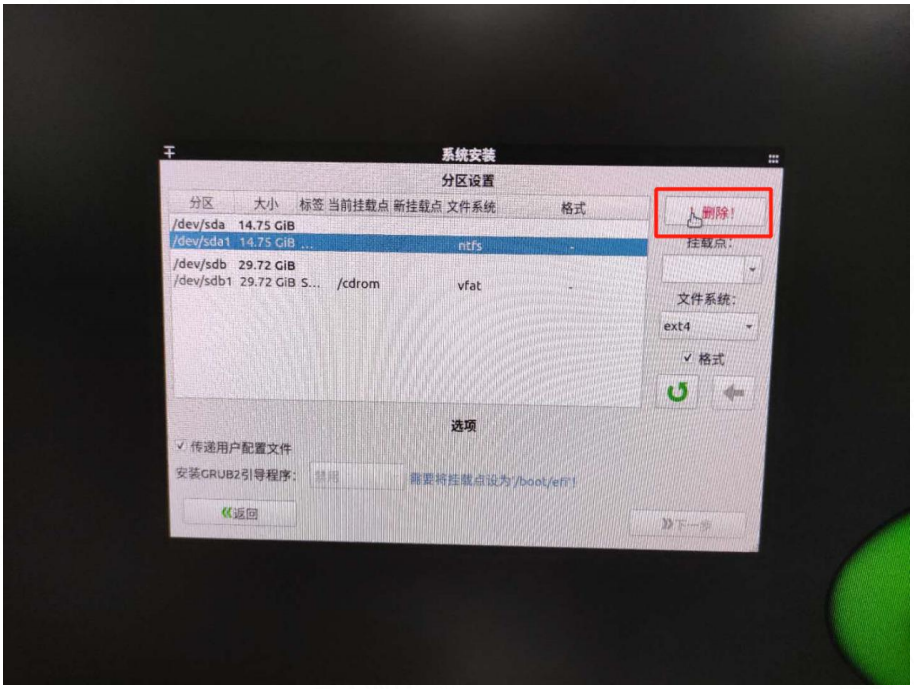

Figure 15-1-11 Ubuntu system process 3

Select the hard disk partition you want to install again and click the green left arrow.

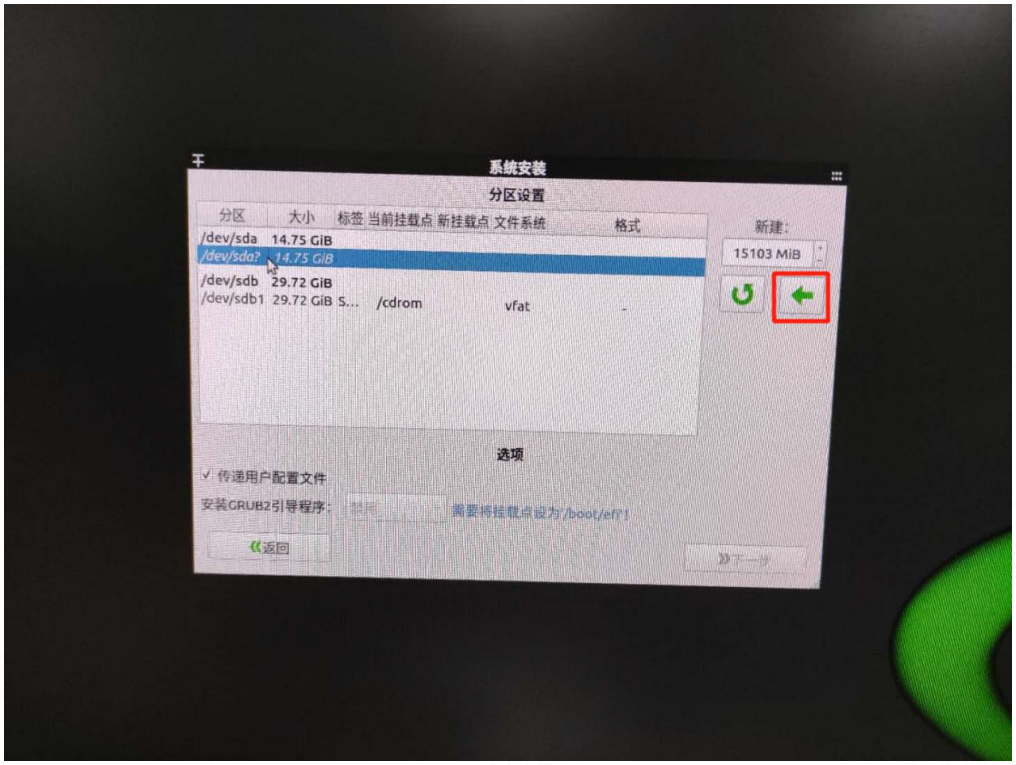

Figure 15-1-12 Ubuntu system process 4

Select the mount point [/].

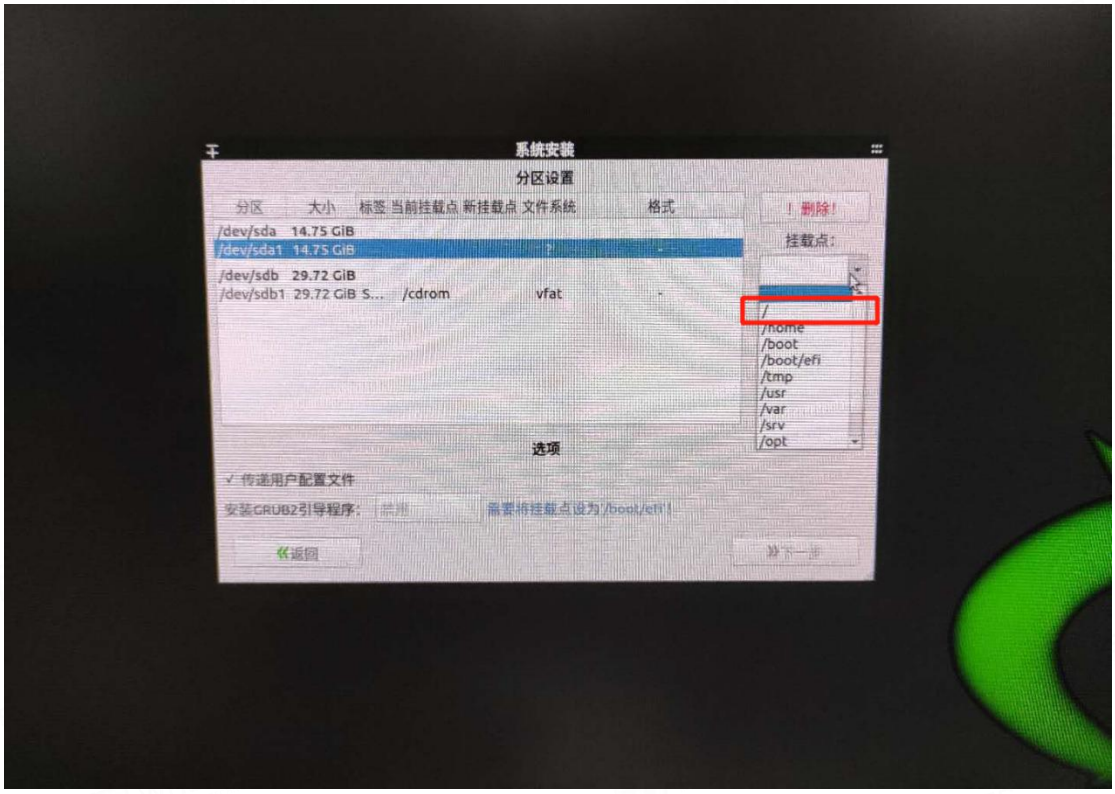

Figure 15-1-13 Ubuntu System Process 5

Click the green left arrow.

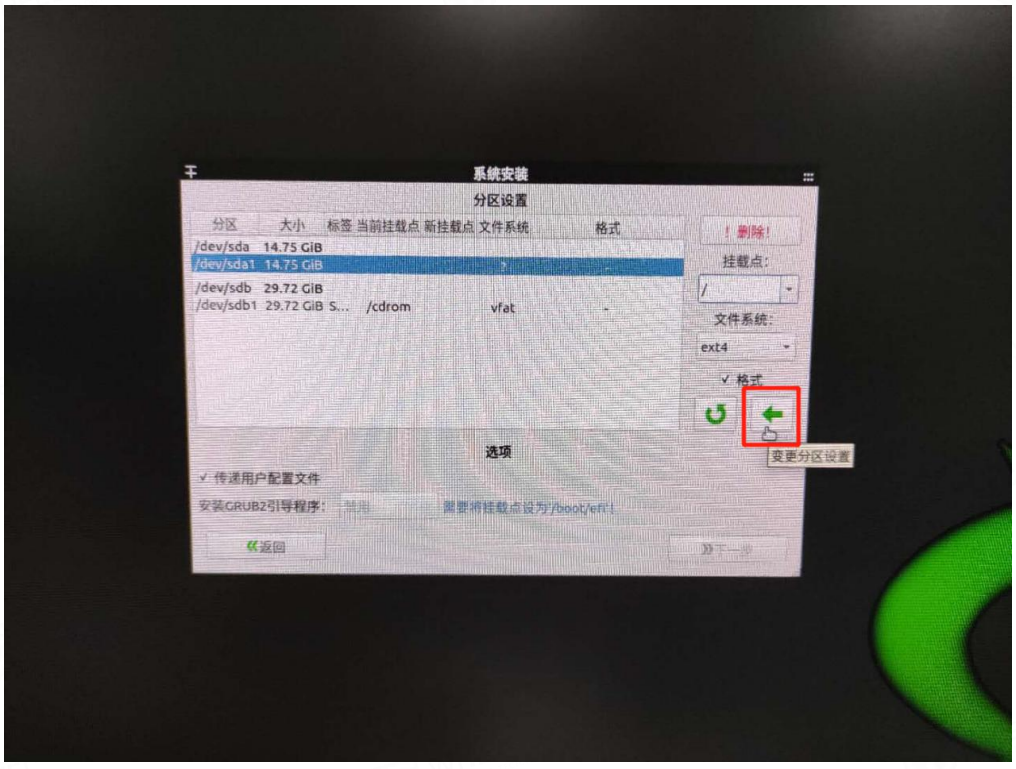

Figure 15-1-14 Ubuntu system process 6

Click Next.

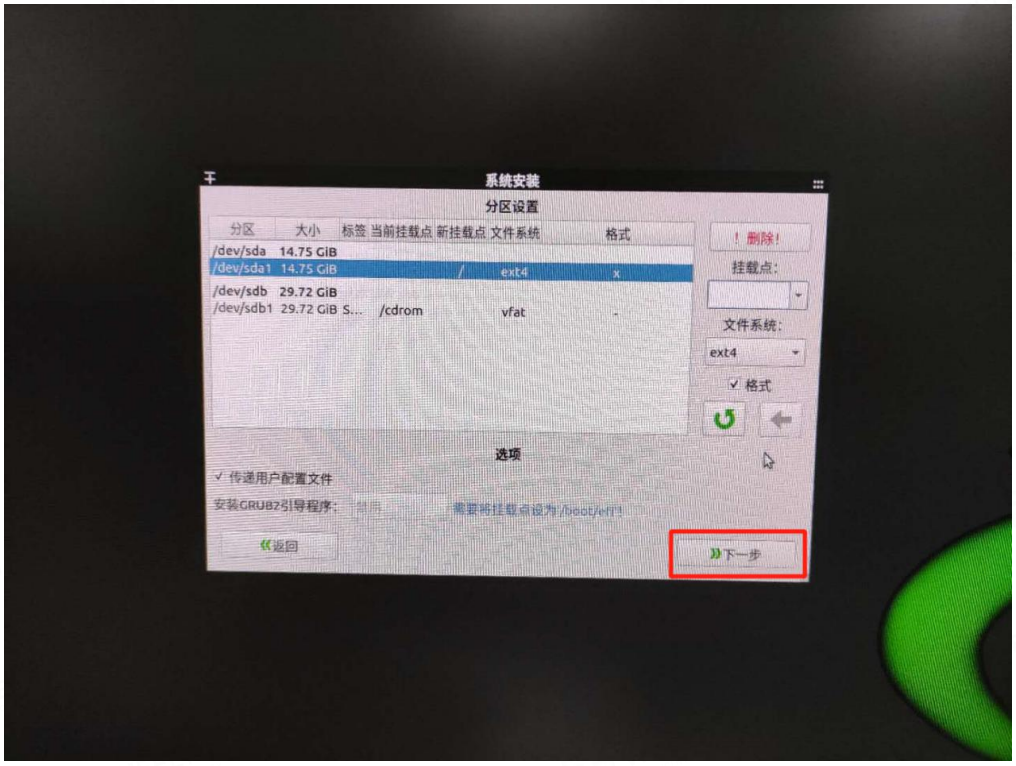

Figure 15-1-15 Ubuntu System Process 7

Click "Start".

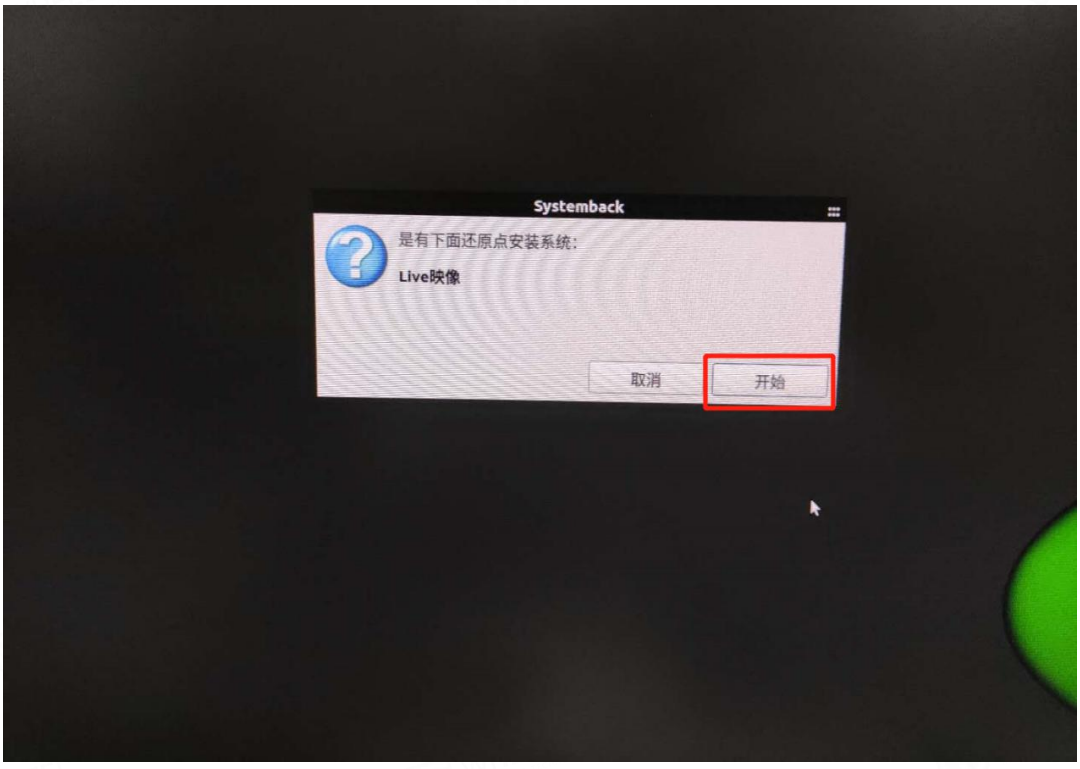

Figure 15-1-15 Ubuntu system process 8

Wait for the installation to complete.

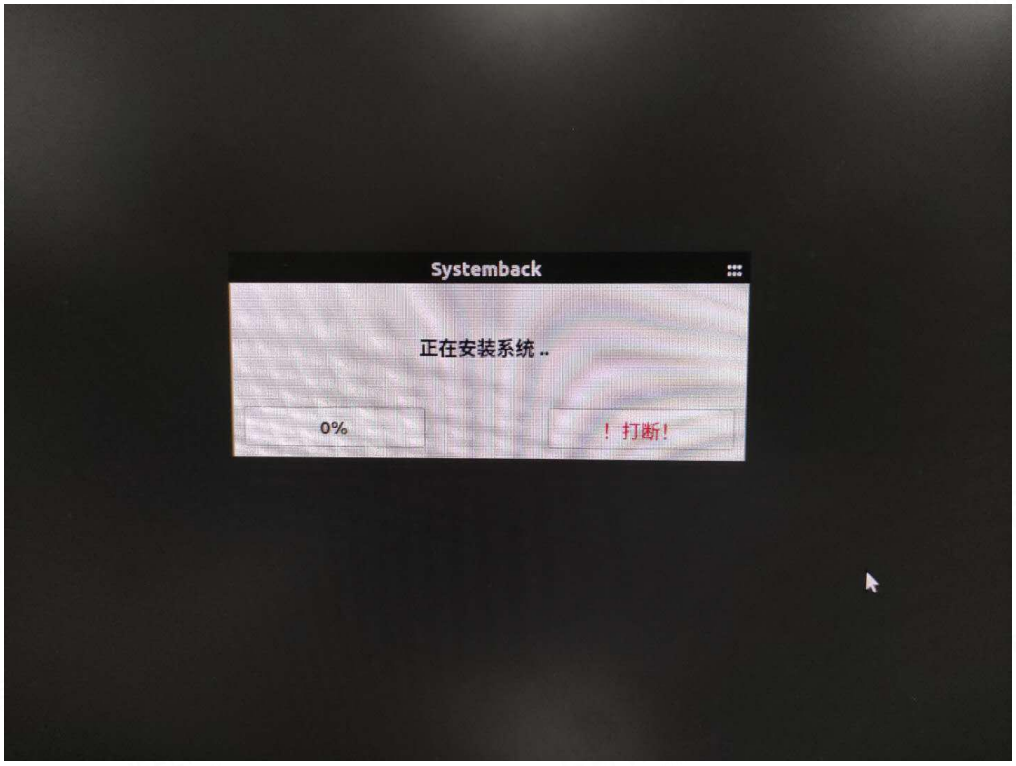

Figure 15-1-16 Ubuntu System Process 9

When the installation is complete, click [OK].

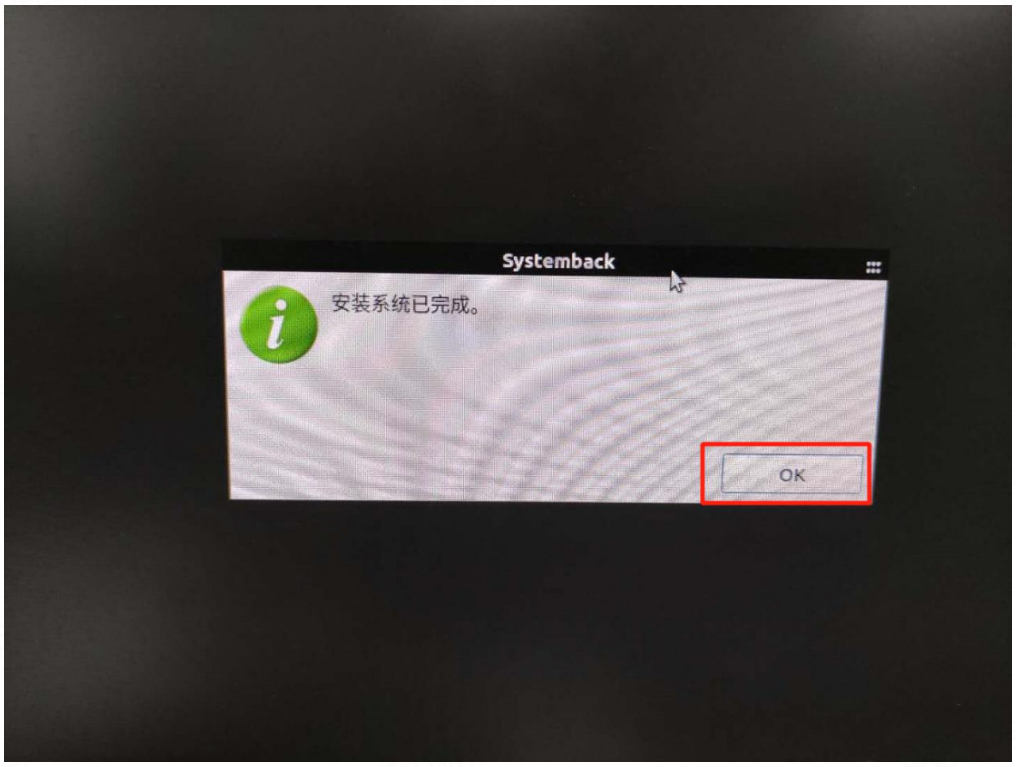

Figure 15-1-16 Ubuntu system process 10

Click [Restart].

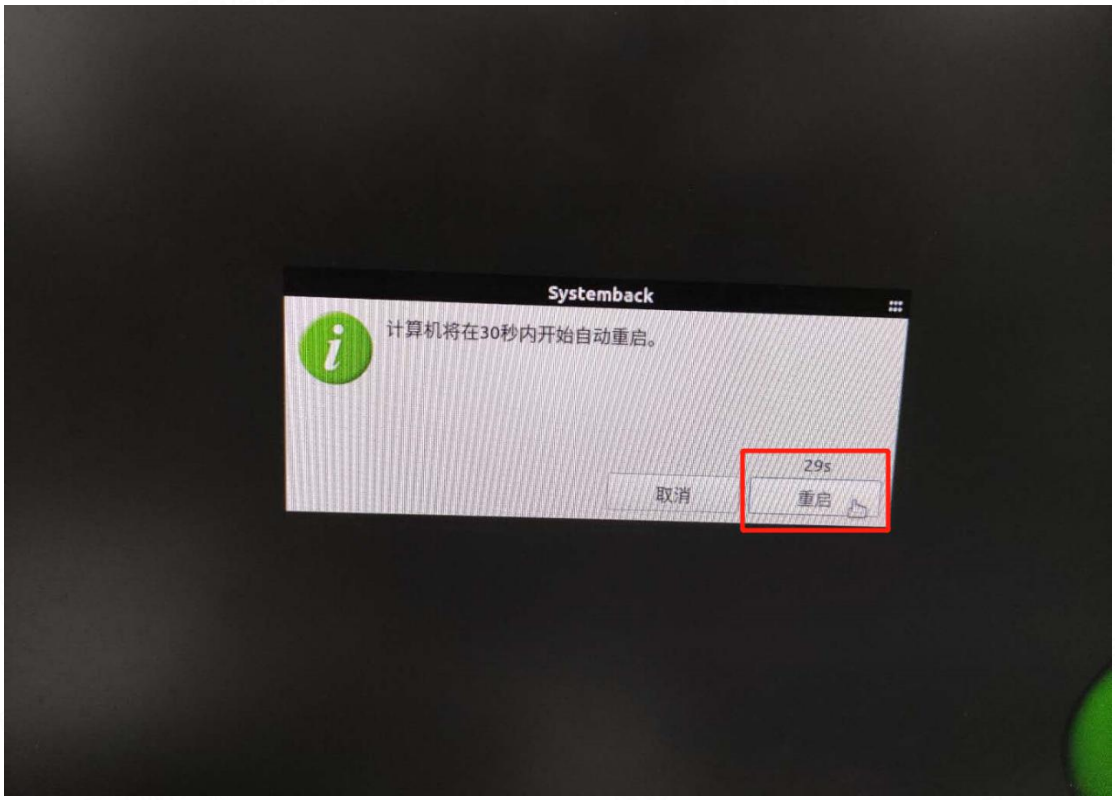

Figure 15-1-17 Ubuntu system process 11

15.2 IPC image recovery

IPC image recovery is the installation of Ubuntu system in the IPC, refer to the relevant content in Chapter 5, replace the image file selected during the image making process with the generated image file backed up by the SystemBack tool in the system will be OK.

16. Jetson Xavier NX image backup and recovery

Here is how to backup and recover the image of Jetson Xavier NX.

16.1 Jetson Xavier NX image backup

① Image backup

Preparation:

You need an Ubuntu computer, a card reader, and a TF card to back up the image.

Insert the Jetson Xavier NX card into an Ubuntu computer with a hard disk space greater than 32GB using a card reader. Note that you cannot use a virtual machine for backup because Windows cannot read the memory card with the Jetson Xavier NX system. The backup process is as follows:

A) First open a terminal and type the following command to check the disk number:

```
sudo fdisk -u  - l
或
sudo parted -l
```

```
Device     Start      End  Sectors  Size Type
/dev/sda1  28672 62333918 62305247 29.7G Linux filesystem
/dev/sda2   2048     2303      256  128K Linux filesystem
/dev/sda3   4096     4991      896  448K Linux filesystem
/dev/sda4   6144     7295     1152  576K Linux filesystem
/dev/sda5   8192     8319      128   64K Linux filesystem
/dev/sda6  10240    10623      384  192K Linux filesystem
/dev/sda7  12288    13055      768  384K Linux filesystem
/dev/sda8  14336    14463      128   64K Linux filesystem
/dev/sda9  16384    17279      896  448K Linux filesystem
/dev/sda10 18432    19327      896  448K Linux filesystem
/dev/sda11 20480    22015     1536  768K Linux filesystem
/dev/sda12 22528    22655      128   64K Linux filesystem
/dev/sda13 24576    24735      160   80K Linux filesystem
/dev/sda14 26624    26879      256  128K Linux filesystem

Partition table entries are not in disk order.


Disk /dev/zram0: 494.5 MiB, 518549504 bytes, 126599 sectors
Units: sectors of 1 * 4096 = 4096 bytes
```

Figure 16-1 Use sudo fdisk-u -- l to view the disk number

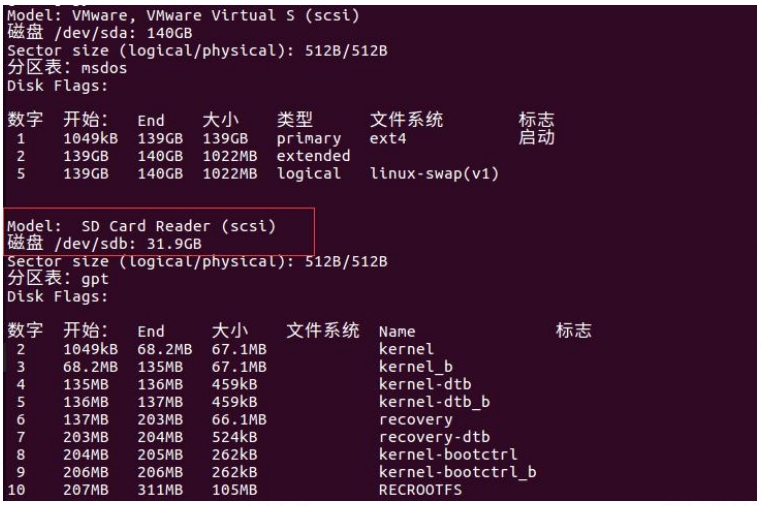

Figure 16-2. Use sudo parted-l to view the disk number

B) Enter root mode with sudo -i or sudo su to prepare backup;

C) Enter the command at the terminal to start backup (confirm sda/b/c first) :

```
sudo dd if=/dev/sdb conv=sync,noerror bs=64k | gzip -c > jetson-xavier-nx.img.gz
```

D) Open a new terminal and enter the following command to view the backup process:

```
sudo pkill -USR1 -n -x dd
```

E) The image file generated by backup is named jetson-xavier-nx.img.gz, which is stored in /home directory. Note that if you open the home file directly, you can not see this file, so you need to check it from file-other locations-computer-home, then you can use the hard disk to copy the image directly.

16.2 Jetson Xavier NX image recovery

① Image recovery

There are two ways to recover the Jetson Xavier NX image. They are respectively the command line restore and use the image production tool Etcher or Win32DiskImager to recover the image. First, format the TF card that needs to burn the mirror image. The formatting steps are the same as those of the TF card in Raspberry Pi.

② Recover using the command line

A) Insert the TF card that needs to recover the image into the Ubuntu computer with the backup image, and then the TF card has been formatted.

B) Open the terminal and enter the following command to check the disk number;

```
sudo fdisk - u - l
```

C) Enter root mode with sudo -i or sudo su to get ready to recover the image;

Enter the command to recover the image at the terminal (confirm sda/b/c first) :

D) Input the instruction and begin to recover. Here, /home is the directory where the image is stored, and /dev/sda is the result found in the second step.

```
gunzip -c jetson-xavier-nx.img.gz | dd of=/dev/sda bs=64k
```

E) Enter the command at the terminal to view the recovery process

```
sudo pkill -USR1 -n -x dd
```

③ Use the mirror recover tool for recovery

The steps of Jetson Xavier NX mirror recovering are the same as the operation of Jetson Nano mirror recovery. Please refer to Chapter 13 for specific operation.

17. The basics of Ubuntu

This chapter mainly briefly explains some information about Ubuntu environment permissions switching and the use of the editor.

①Folders in a Windows environment are often called paths in Ubuntu.

②Ubuntu is very strict about permissions, many files are only allowed to be modified by root by default. In the command line, sudo means to increase the user's permissions. To switch to root, type: sudo su. In Ubuntu, you will need to enter a password in many cases, so keep it simple and easy to remember.

③The commonly used editors are Vim, Nano, and GEdit, of which Vim and Nano are the most commonly used on the command-line interface. If you want to modify a file, you need to use sudo to increase permissions. For example, if you want to modify the file /etc/bash.sh, then I type sudo vim /etc/bash.sh (this is the Vim editor, and if here vim is changed to nano, the nano editor is used).

How to use the Vim editor: In the Vim editor, you can't directly modify the text content when you enter the Vim editor at the beginning. You need to press "I" to change to "Insert" (the lower right of the document) before you can enter it. Press "Esc" to switch back to read-only mode. When you need to exit after changing the text, switch back to read-only mode, and then enter: (here we need to enter a colon), and then enter the command, ": q" is exit, ": wq" is save and exit, if you change the content but do not want to save exit is ": q!" If you are using a file and want to force to save exit is ": wq!"

Figure 17-1 Exit the Vim editor

How to use Nano editor: It is different from Vim editor. After entering Nano editor, you can directly modify the text content. After modifying the text, you need to save it.Press "ctrl + o", it will displays the file name at this moment, if don't modify the file name and then press enter, the files have been saved well, press "ctrl + x" exit the editor.

Figure 17-2 The Nano editor prompts for the file name to save