Lesson 1: Boot and PS2 controller control

Step 1：Robot boot

Robot switch, charging interface and network port position.

Vehicle type		Robot switch	charging interface	network port position
	Panda			

Step 2：PS2 controller remote control

Small hands use PS2 wireless controller for remote control, the longest control distance is about 5-8 meters.

1.For the remote control handle, turn on the power switch and observe the handle indicator.

Both lights are off：	Press START to start, or check to replace the battery
Red light on, green light off：	Press the MODE key to connect
The red light is on and the green light is blinking：	The car's too far away or the receiver's not plugged in

On the remote control handle, the left rocker controls the robot to move forward and backward, and the right rocker controls the robot to turn left and right. The rocker is a proportional rocker, and the larger the push amplitude, the faster the movement speed.

The default maximum speed limit is 0.5 times the maximum speed of the robot, which is increased/decreased by 0.1 each time through the maximum speed limit, with a maximum of 1 and a minimum of 0.1.

Attention:Turn on the power switch of the remote control handle, the green indicator is the power indicator, the red indicator is the MODE indicator, and the rocker mode is on. If the red indicator is not on, press the "mode" key to switch the mode. If the green indicator on the handle is not on, the handle is in sleep mode. Press START to wake it up. If the handle is not used for a long time, remove the battery from the handle to avoid leakage damage.

2.The receiver is attached to the car and no operation is required.

When the handle is connected normally, the handle receiver on the car should also be both lights on.

If the handle is off or too far away, it should be RX slow flash.

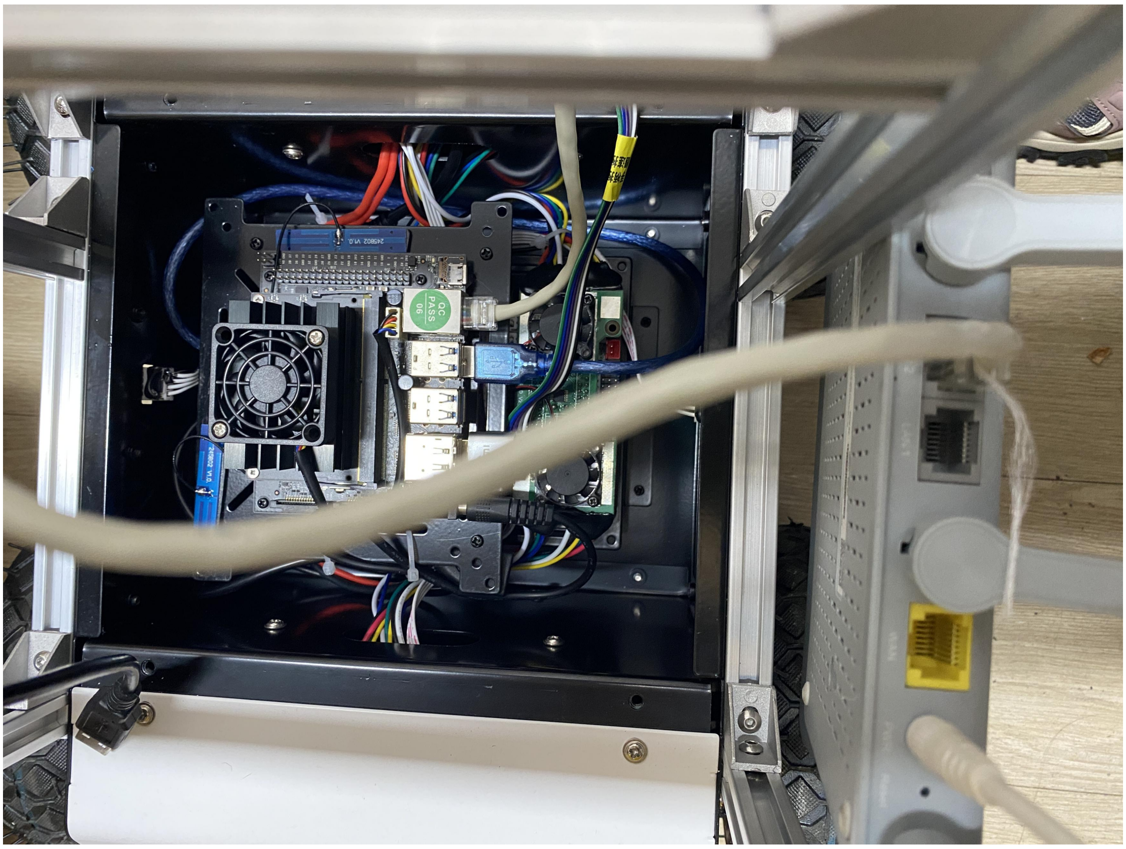
Lesson 2: Robot connection network

Step 0：Preparation before use

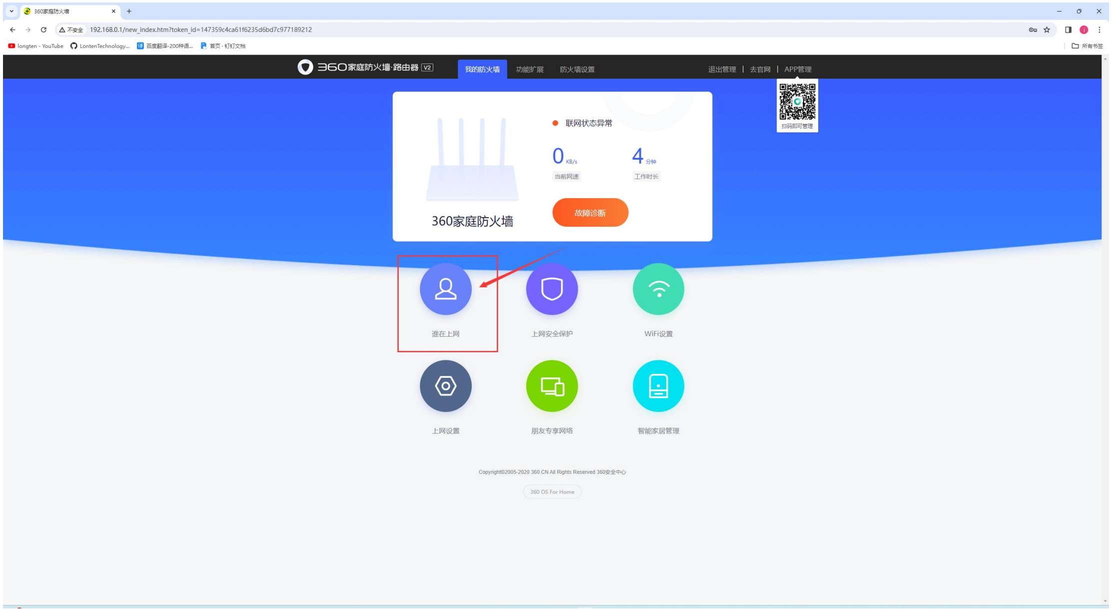
①To install Nomachine software on your PC, you can download it from Nomachine official website or use the installation package provided by us.
②Prepare a working router (do not use a network environment with unknown network structure such as campus network or enterprise network).
③Turn on the robot power switch and connect the robot network port to the router LAN port using a network cable.
④PC Computers are connected to the same router via cable or WiFi.

Step 1：Connect the network cable to find the robot IP

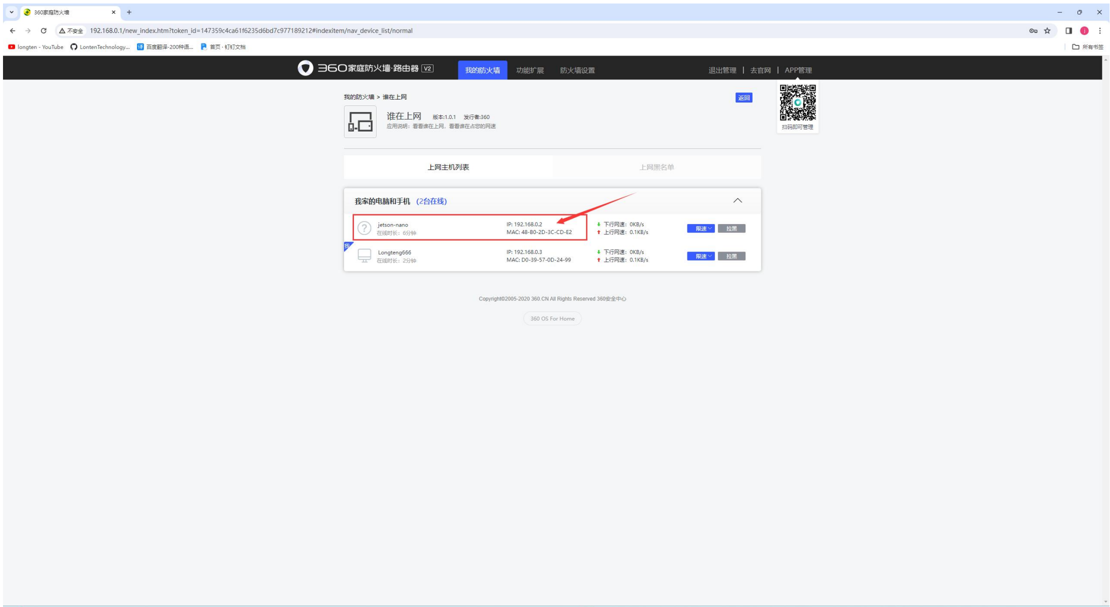
The router does not need to be connected to the Internet, and so does a router that does not have Internet access.



Open the router management page, different brands of router management page address management page address and interface are different, you can find on the sticker on the back of the router or Baidu search.



In the router device list/who found the robot device in the Internet, the robot device is named "**jetson-nano**" and record the IP address of the robot. For example, the current IP address of my robot wired network is **192.168.0.2**.

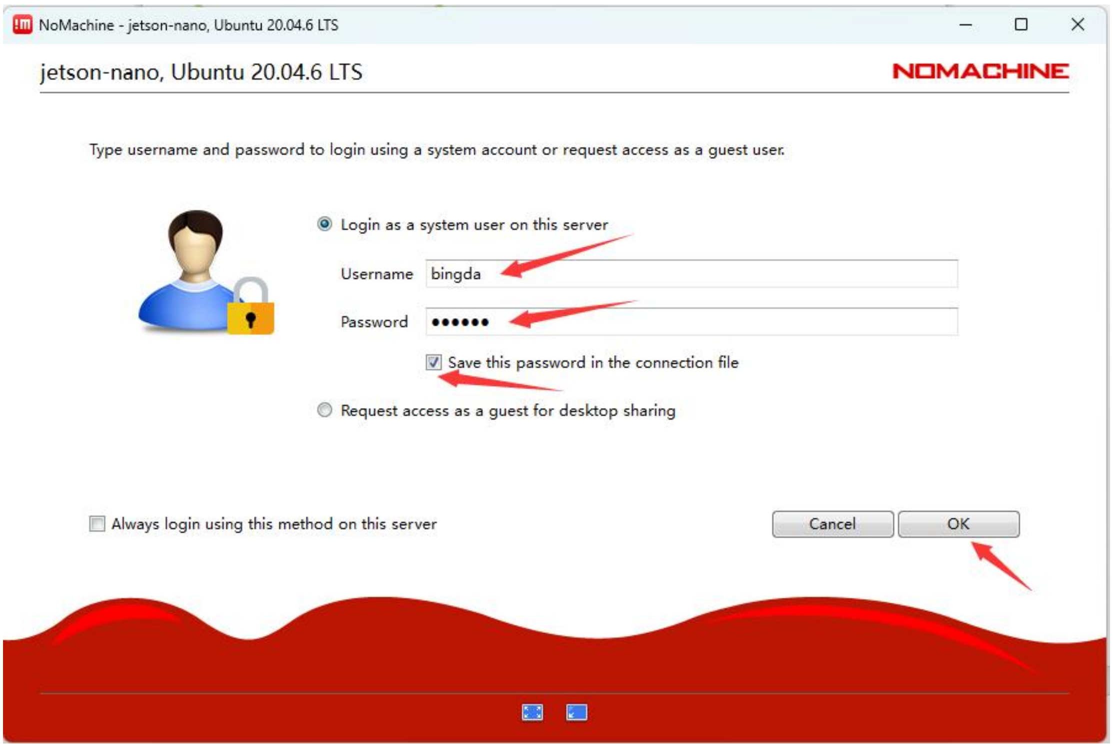


Step 2: Nomachine Remote desktop connection robot

Open the Nomachine software, enter the IP address of the robot in the address box, and click”**Connect to new host xxx.xxx.xxx.xxx**“.

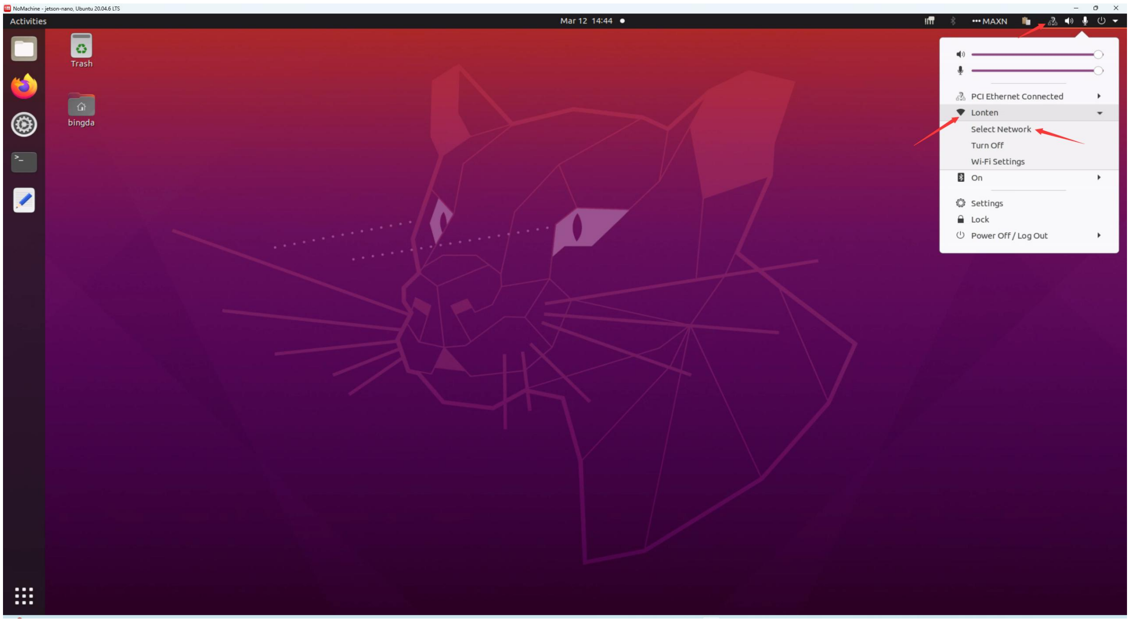
Tips： If the robot device in the yellow box appears after opening the Nomachine software, that is, Nomachine has automatically scanned and found the device, you can directly double-click to start the connection.

In the dialog box that pops up, enter the username and password. All our images use the username and password"**bingda**"， Can also check"**Save this password in the connection file**".



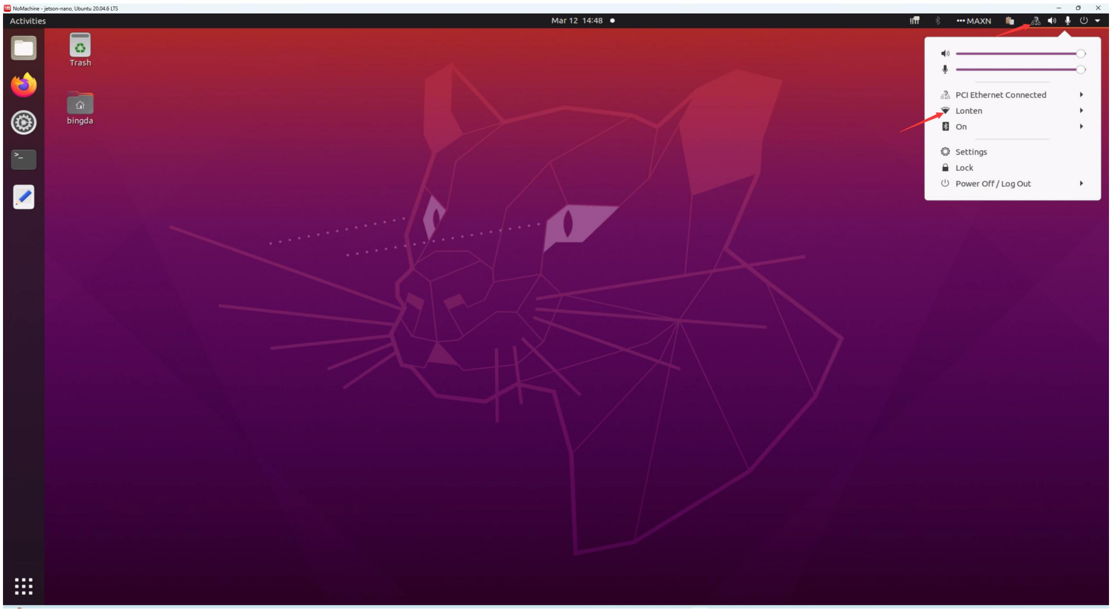
Step 3: The robot connects to WiFi and views the IP

Click the network button on the desktop, find your WiFi name in the pop-up menu, if it is not displayed, you can click”**Select a network**“See more networks. Tap the WiFi you want to connect.



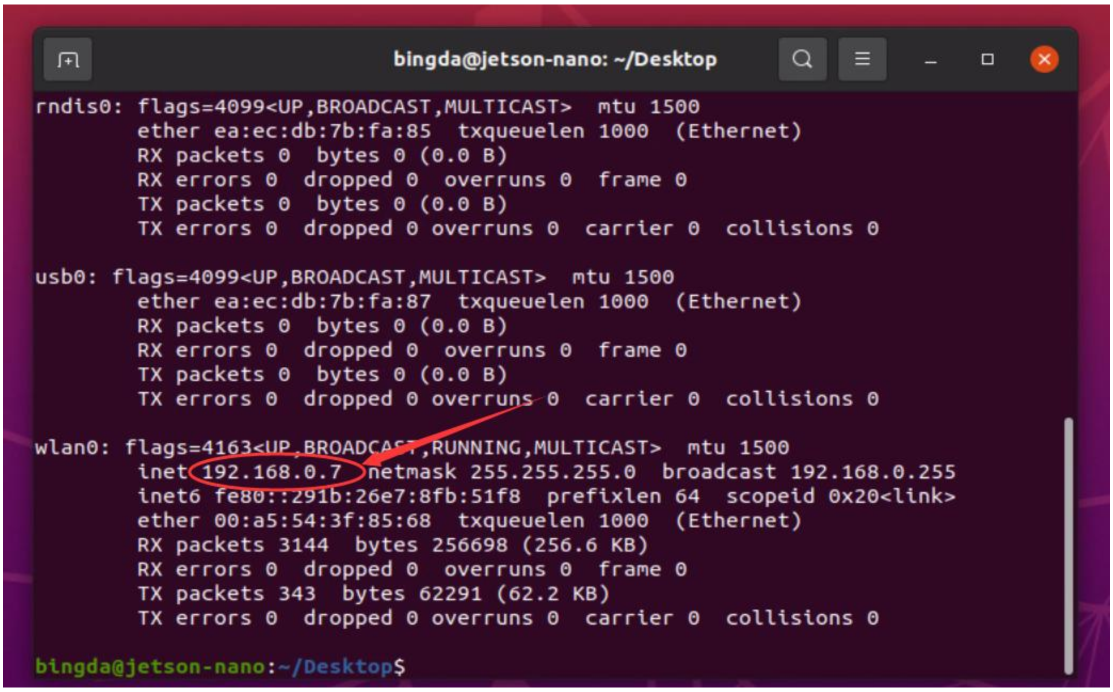
Enter your WiFi password in the dialog box that pops up and click the button “Connect” .

Click the Network button again. If the connection is successful, it will show that you are currently connected to the target WiFi. If it does not appear, check the WiFi name and password and try again.



Step 4：Connect the robot using wireless IP

Once the WiFi connection is successful, you can use the wireless IP address to connect to the NoMachine. First we need to know the IP address of the wireless.
Method: Right-click in NoMachine, choose **Open in Terminal**, open the terminal, and run the **ifconfig** command to find the wireless IP address.



Tips1： It is recommended to set wireless IP and wireless MAC address binding in the router, so that the robot can obtain the same IP address every time it starts up in the future, so as to avoid IP address changes that need to be searched through the router management page after the startup.

Next, turn off the Nomachie, unplug the network cable between the robot and the router, and after the robot is powered off and restarted, connect the robot using the obtained wireless IP address.

Lesson 3: Robot configuration file detection and modification

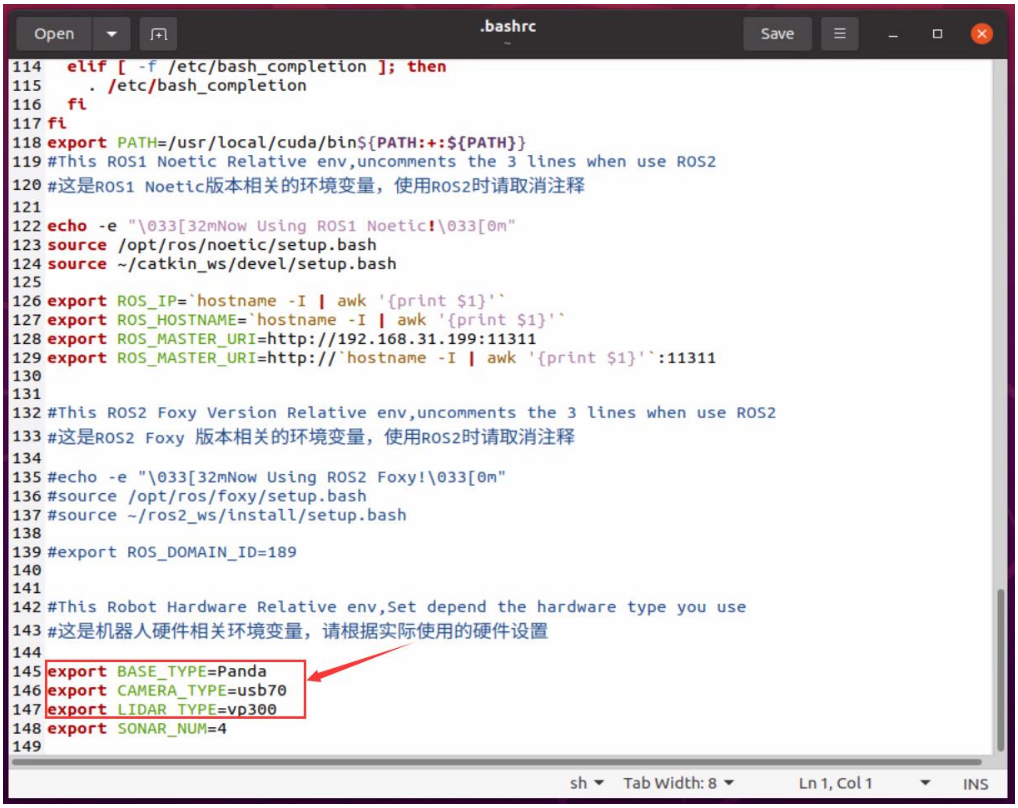
The factory default is configured. You can skip this section
You need to read this chapter only after the system is damaged and re-burned.

Step 1: Open configuration file

Open a new terminal on your desktop and enter the following command:

`gedit ~/.bashrc`

In the editor that pops up, drag the slider to the end of the file and find the three lines in the red box.




```
  elif [ -f /etc/bash_completion ]; then
    . /etc/bash_completion
  fi
fi
export PATH=/usr/local/cuda/bin${PATH:+:${PATH}}
#This ROS1 Noetic Relative env,uncomments the 3 lines when use ROS2
#这是ROS1 Noetic版本相关的环境变量，使用ROS2时请取消注释

echo -e "\033[32mNow Using ROS1 Noetic!\033[0m"
source /opt/ros/noetic/setup.bash
source ~/catkin_ws/devel/setup.bash

export ROS_IP=`hostname -I | awk '{print $1}'`
export ROS_HOSTNAME=`hostname -I | awk '{print $1}'`
export ROS_MASTER_URI=http://192.168.31.199:11311
export ROS_MASTER_URI=http://`hostname -I | awk '{print $1}'`:11311


#This ROS2 Foxy Version Relative env,uncomments the 3 lines when use ROS2
#这是ROS2 Foxy 版本相关的环境变量，使用ROS2时请取消注释

#echo -e "\033[32mNow Using ROS2 Foxy!\033[0m"
#source /opt/ros/foxy/setup.bash
#source ~/ros2_ws/install/setup.bash

#export ROS_DOMAIN_ID=189


#This Robot Hardware Relative env,Set depend the hardware type you use
#这是机器人硬件相关环境变量，请根据实际使用的硬件设置

export BASE_TYPE=Panda
export CAMERA_TYPE=usb70
export LIDAR_TYPE=vp300
export SONAR_NUM=4

```

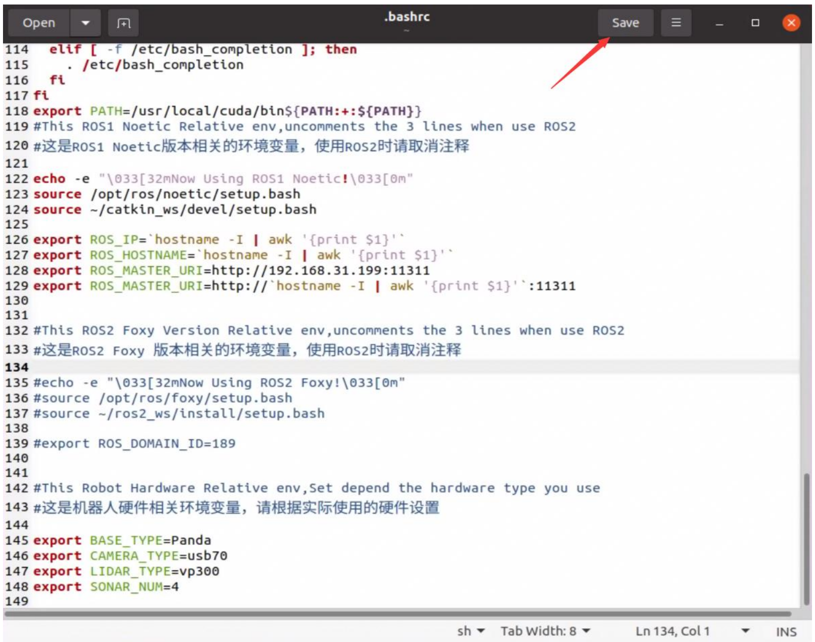
Step 2: Modify the configuration based on the actual hardware

BASE_TYPE=Used to configure the chassis model，**CAMERA_TYPE=**Used to configure the camera model，**LIDAR_TYPE=**Models used to configure LiDAR.
You need to configure the hardware based on the actual hardware model. The following figure shows the hardware model:

Base plate		Camera		radar	
appearance	Model number	appearance	Model number	appearance	Model number
	Panda		usb70		vp300
			astras		

Step 3: Save configuration file

Click the '**Save**' button to save, and click the close button to close the file editor. Close all open terminals after closing the file



Lesson 4: Robot chassis control

Step1: Start the robot chassis node

Open a terminal on your desktop and type the following command.

```
roslaunch base_control base_control.launch
```

After you press Enter to run the command, the following chassis information is displayed on the terminal, and the robot buzzer beeps for a long time.

```
/home/bingda/catkin_ws/src/bingda_ros1_noetic/base_cont...
 * /rosversion: 1.16.0

NODES
  /
    base_control (base_control/base_control.py)
    robot_state_publisher (robot_state_publisher/robot_state_publisher)

auto-starting new master
process[master]: started with pid [9724]
ROS_MASTER_URI=http://192.168.0.7:11311

setting /run_id to 034007f4-e040-11ee-a5ef-57cffa2d2904
process[rosout-1]: started with pid [9739]
started core service [/rosout]
process[robot_state_publisher-2]: started with pid [9742]
process[base_control-3]: started with pid [9744]
[INFO] [1710227608.965719]: Panda base control ...
[INFO] [1710227609.092231]: Opening Serial
[INFO] [1710227609.099647]: Serial Open Succeed
[INFO] [1710227609.618712]: Move Base Hardware Ver 2.0.0,Firmware Ver 1.2.0
[INFO] [1710227611.393512]: SN:00290025524b500820373548
[INFO] [1710227611.411612]: Type:4WD Motor:37GB545-ChiHai Ratio:90.0 WheelDiamet
er:156.0
```

Step2：Start the keyboard remote node

Keep the robot chassis node running and open a new terminal. Enter the following command in the newly opened terminal.

rosrun teleop_twist_keyboard teleop_twist_keyboard.py

The following message is displayed on the terminal after you press Enter.

```
bingda@jetson-nano: ~/Desktop
---------------------------
Moving around:
   u    i    o
   j    k    l
   m    ,    .

For Holonomic mode (strafing), hold down the shift key:
---------------------------
   U    I    O
   J    K    L
   M    <    >

t : up (+z)
b : down (-z)

anything else : stop

q/z : increase/decrease max speeds by 10%
w/x : increase/decrease only linear speed by 10%
e/c : increase/decrease only angular speed by 10%

CTRL-C to quit

currently:      speed 0.5       turn 1.0
```

Now you can control the robot movement through the keys on the keyboard. Note that the current keyboard is not enabled caps lock, that is, the keyboard remains in lowercase mode

The use method is centered on the 'k' key, respectively, the 'i' key controls forward, the ', 'key controls backward, and so on.

The default speed values for keyboard control are line speed 0.5m/s and angular speed 1.0rad/s

The line speed can be increased by pressing the 'w' key and decreased by the 'x' key, increasing/decreasing the line speed by 10% with each press

The angular speed can be increased by pressing the 'e' key and decreased by the 'c' key, increasing/decreasing the angular speed by 10% with each press

If you need to adjust the angular speed and linear speed at the same time, you can increase it by pressing the 'q' key, decrease it by the 'z' key, and increase/decrease the linear speed and angular speed by 10% each time you press it

Note 1: When using the keyboard control node, keep the input cursor on the terminal running the keyboard control node; otherwise, the input is invalid.

Note 2: For the robot with the Ackerman steering structure, the j and l buttons cannot control the robot rotation because the robot cannot turn in place.

Note 3: For the McNamum wheel model, if you need to control the lateral movement of the robot, you need to switch the keyboard to uppercase mode or combine the shift key to control.

Step3: Close node

Press 'Ctrl'+'C' in the terminal at the same time to end the application in the current terminal.

Shut down all nodes and close the terminal after the experiment is over.

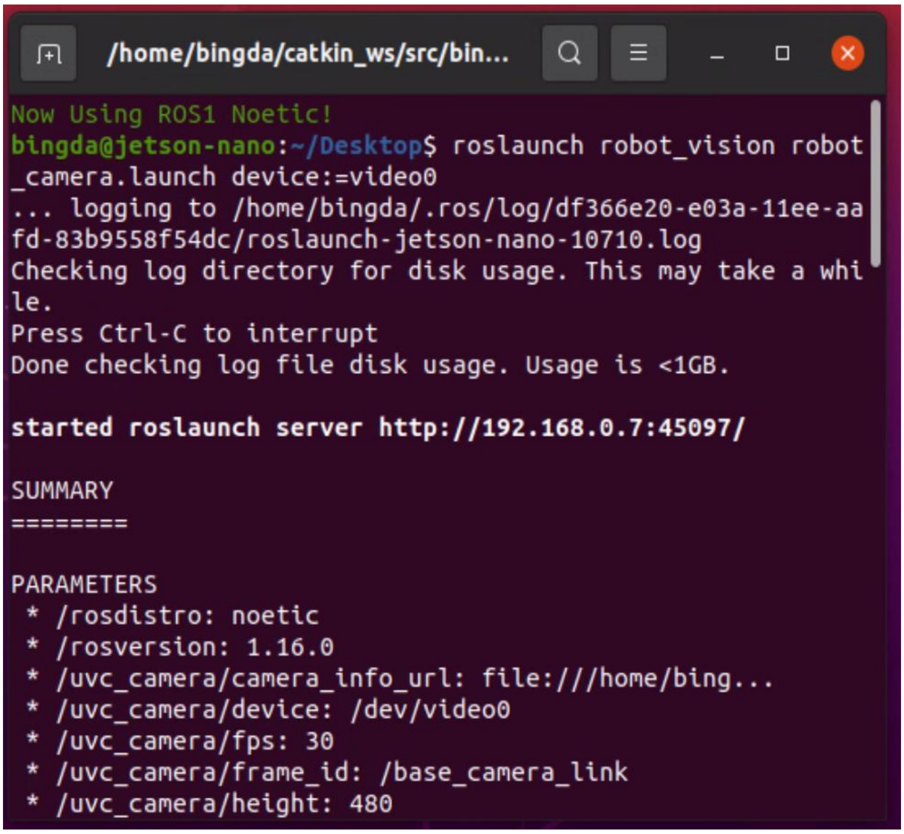
Lesson 5: Using a robot camera

Step1：Open the robot camera node

Open a terminal on the desktop and enter the command to start the camera node.

`roslaunch robot_vision robot_camera.launch device:=video0`

After the command is executed, the following information is displayed on the terminal.



In the output information may contain such a yellow warning message, do not ignore, does not affect the use of the camera.

```
[ WARN] [1710225397.936306453]: Camera calibration file /home/bingda/catkin_ws/src/bingda_ros1_noetic/robot_vision/config/usb70.yaml not found.
```

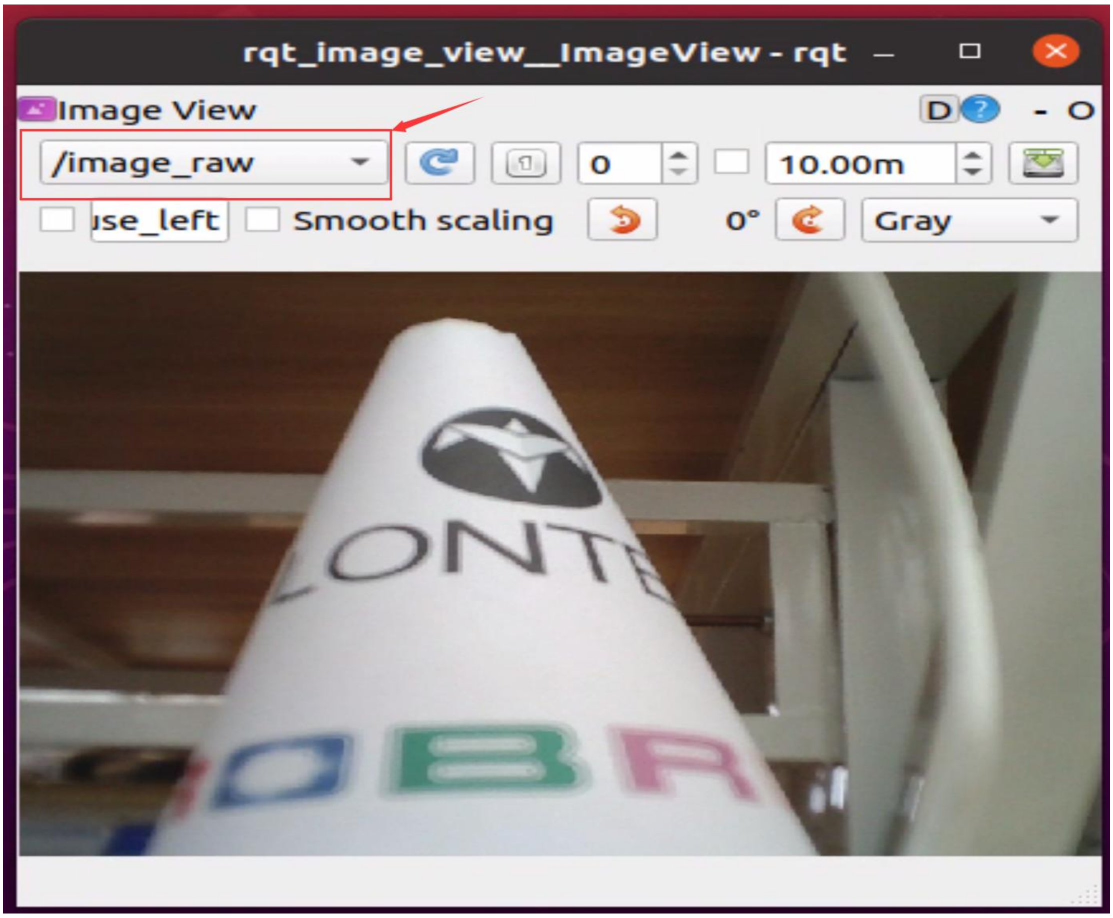
If an error message is displayed in red, check whether the entered command matches the host model.

Step2: Open the image view window

Open a new terminal and enter the following command.

`rosrun rqt_image_view rqt_image_view`

In the pop-up window, click the topic selection button and select /image_raw image topic. Select the rear window to display the camera screen.

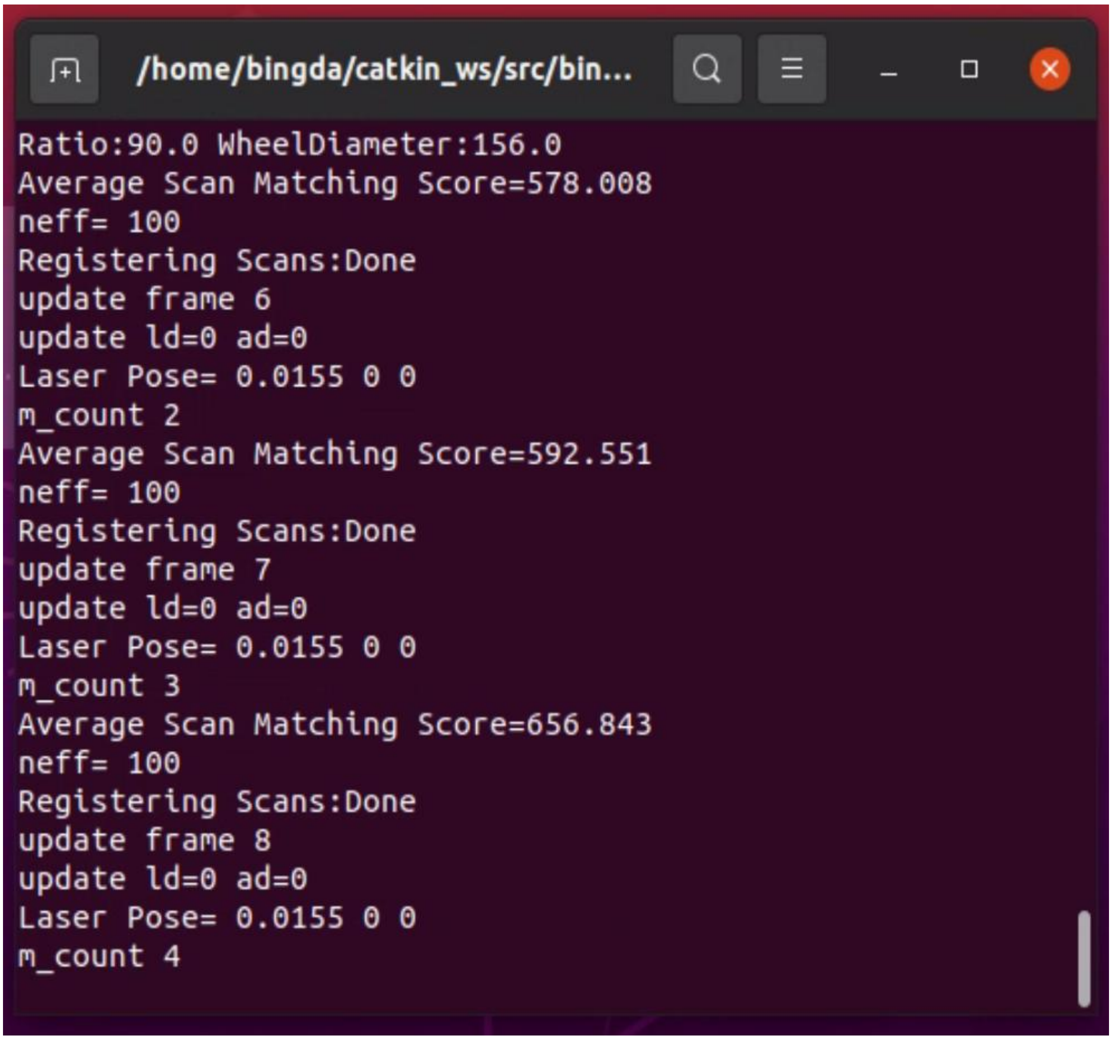


Shut down all nodes and close the terminal after the experiment is over.

Lesson 6: Laser SLAM mapping

Step1：Start robot SLAM construction

Open a terminal on your desktop and enter the command to start SLAM:
roslaunch robot_navigation robot_slam_laser.launch
After the command is executed, there is no red error message in the terminal, and the information output of SLAM continues, indicating that the operation is normal.

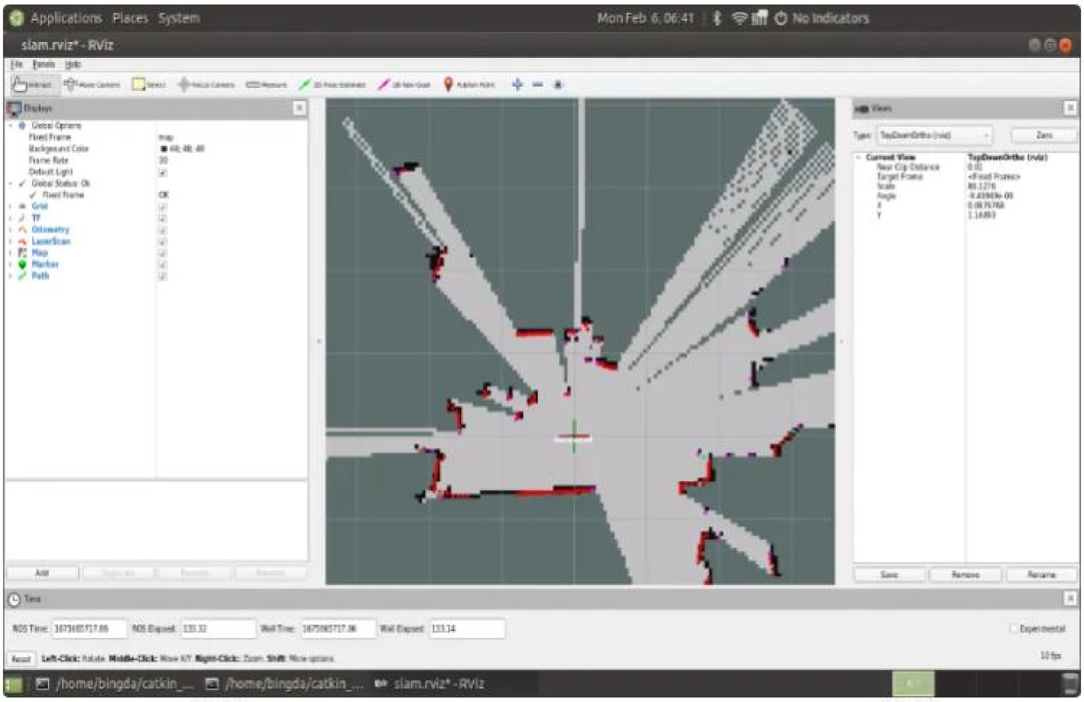


Step2：Launch the visual graphical interface

Open a terminal on your desktop and enter the command to start SLAM:
roslaunch robot_navigation slam_rviz.launch

After executing the command, a visualization map window will pop up, where the gray area is the map that has been built, the black is the map boundary, and the red is the data scanned by the LiDAR.

In the map display area, scroll the mouse wheel to zoom in and out of the map, hold down the mouse wheel to move the mouse to move the display area, and adjust the map display to a suitable position.



Step3: Control the movement of the robot in the area that needs to be mapped

Method 1: Use the PS2 remote control handle equipped with the robot

Method 2: Use the keyboard to control the node

A new terminal is opened. Enter the following command in the newly opened terminal.

```
rosrun teleop_twist_keyboard teleop_twist_keyboard.py
```

In SLAM construction, the robot movement speed should not be too fast, it is recommended to adjust the keyboard control speed, the line speed is not more than 0.3m/s, the angular speed is not more than 0.7rad/s.

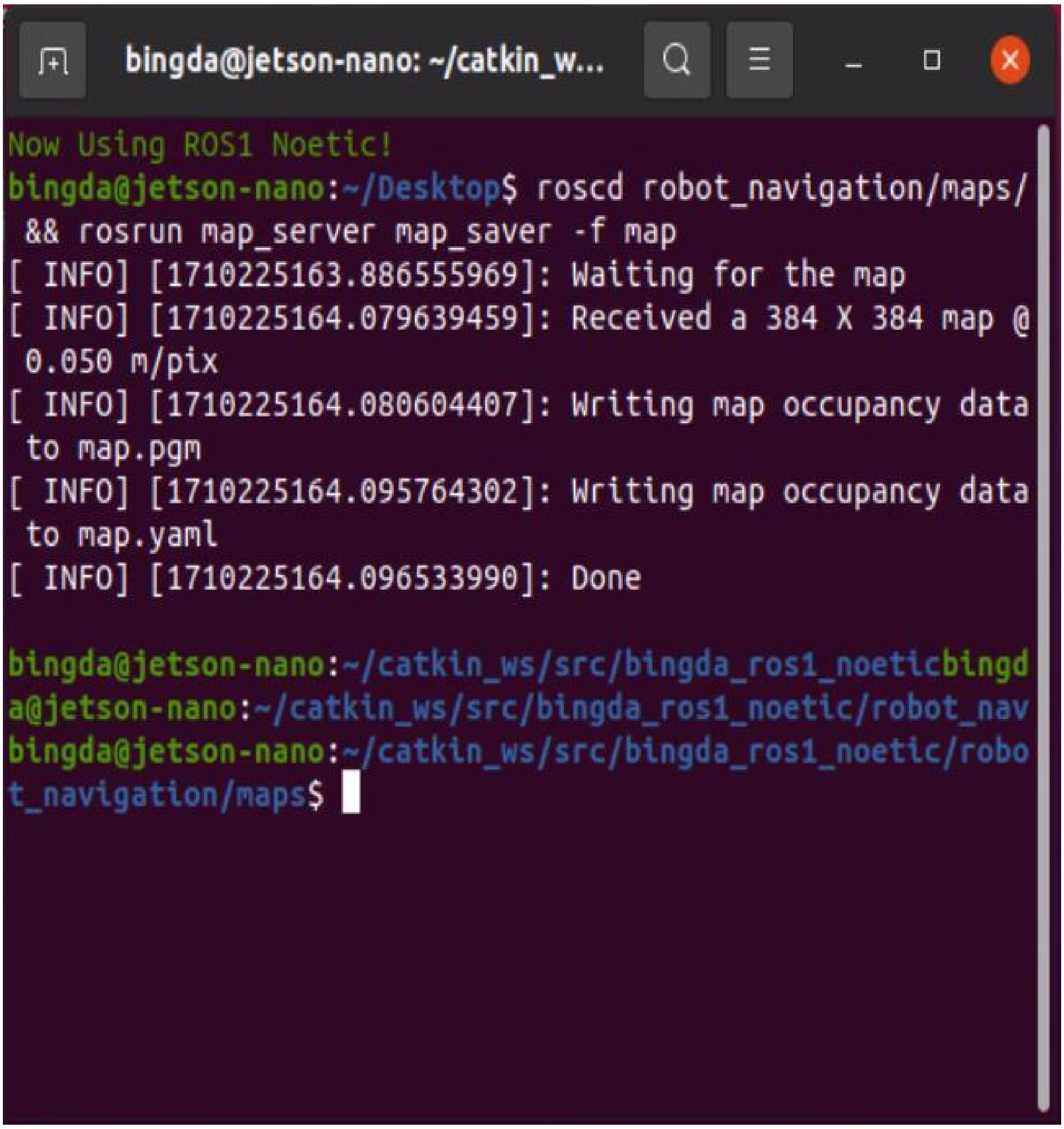
Step4: Save map

Once the robot has built a map of the area you need, it can save the map for subsequent navigation experiments.

Open a new terminal, enter the following command to change the directory in the terminal, and then run the save map command.

roscd robot_navigation/maps/ && rosrun map_server map_saver -f map

If Done is displayed on the terminal, the file is saved successfully.



Shut down all nodes after the experiment is over.

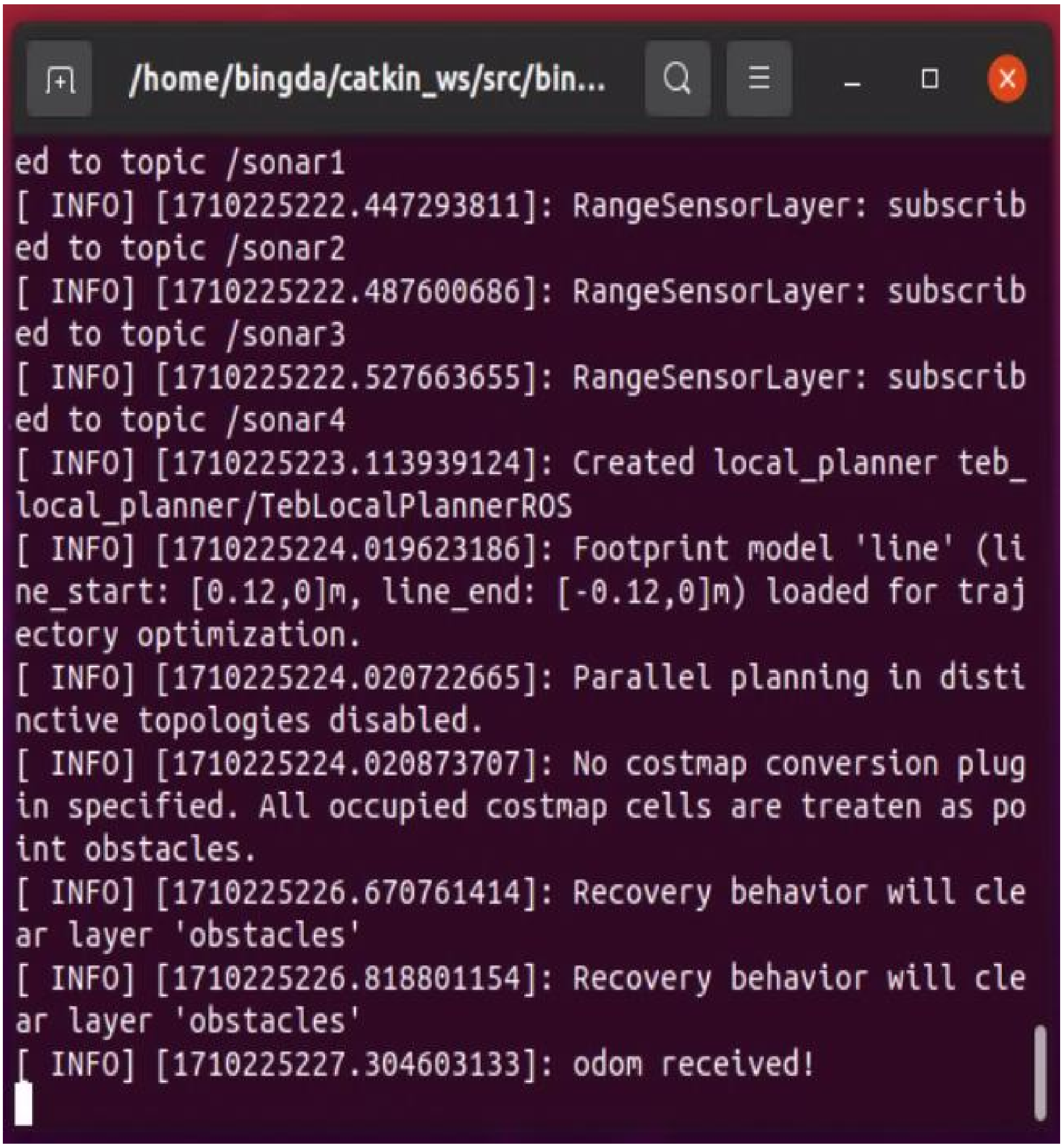
Lesson 7: Robot laser navigation

Step 1: Start robot navigation

Open a terminal on your desktop and enter a command to start the robot's navigation.

`roslaunch robot_navigation robot_navigation.launch`

After the command is executed, the terminal displays the following information. No error message is displayed in red and “odom received!”, The startup is successful.

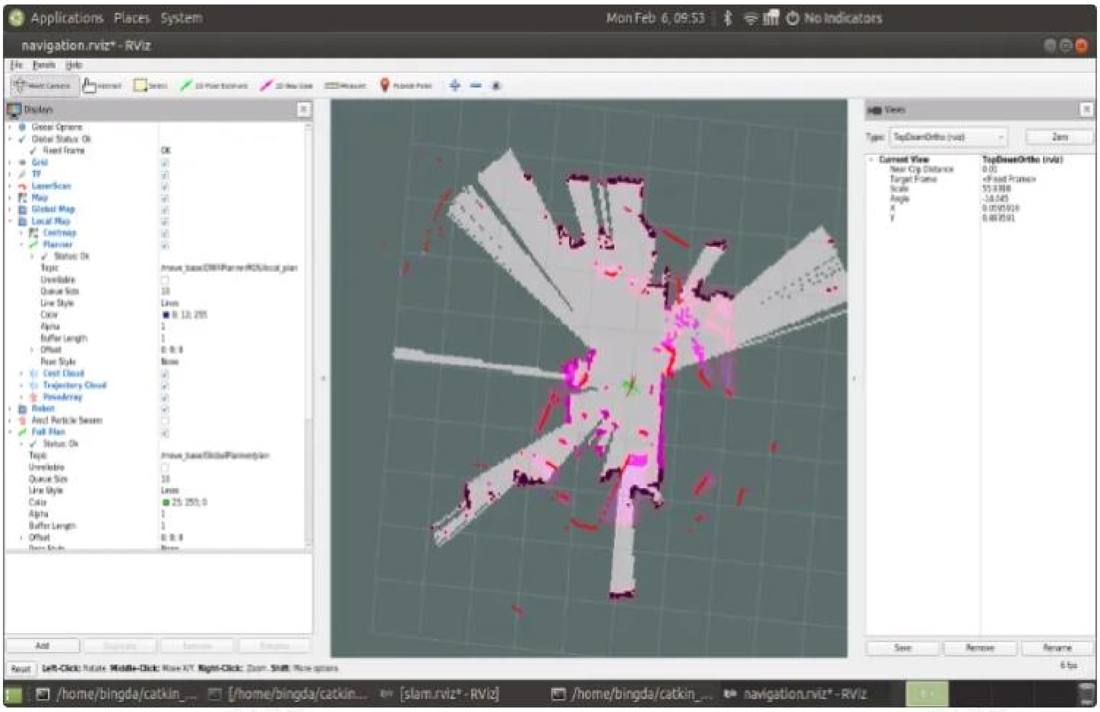


Step 2: The navigation GUI is displayed

Open a new terminal and execute the following command in the terminal:

```
roslaunch robot_navigation navigation_rviz.launch
```

After execution, the following window will appear, adjust the map to the appropriate display position and scale by using the mouse wheel.

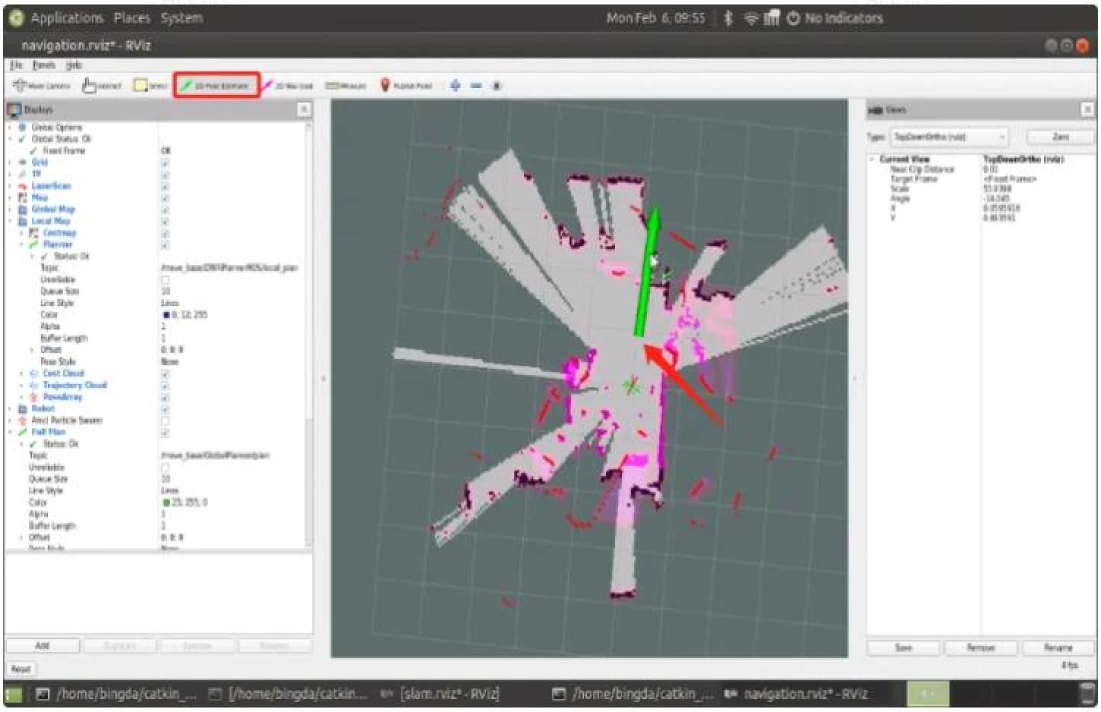


Step 3: Set the initial position of the robot

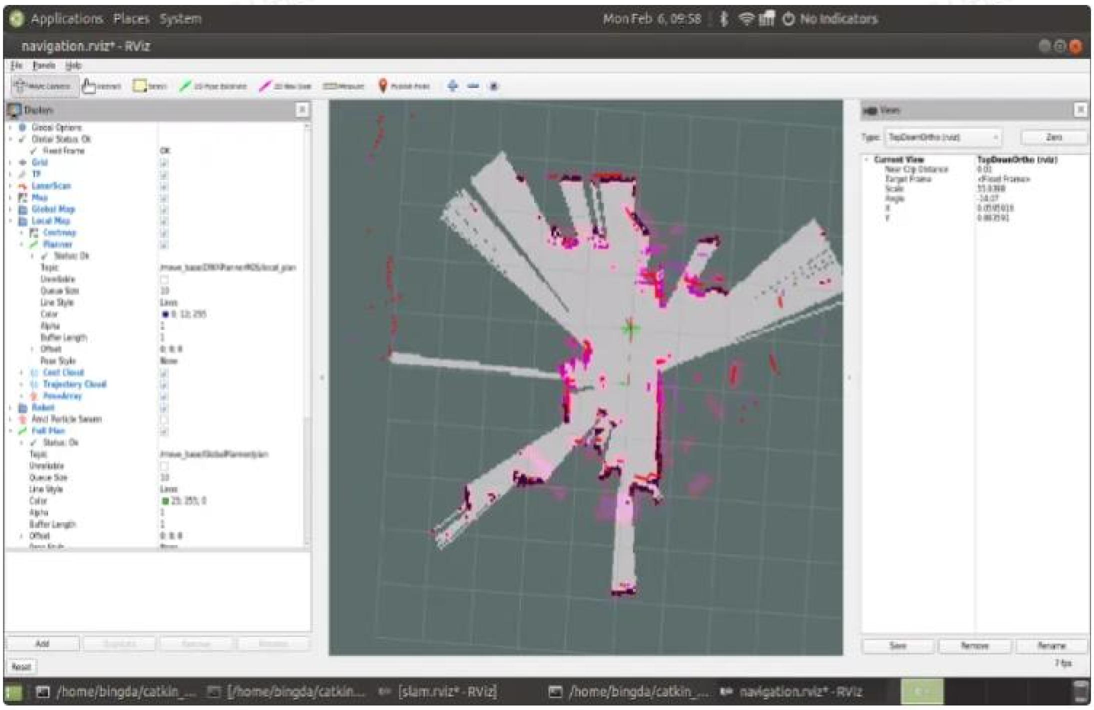
After the robot navigation is started, the default position of the robot is the origin of the map (the position of the robot when SLAM construction is started).

However, the current location of the robot may not be far away from the map, so you need to manually specify the initial location of the robot.

Click the button in the red box below, and then long press the left mouse button in the actual location of the robot in the map, and then move the mouse to adjust the direction, and release the left mouse button after adjusting to the current direction of the robot.

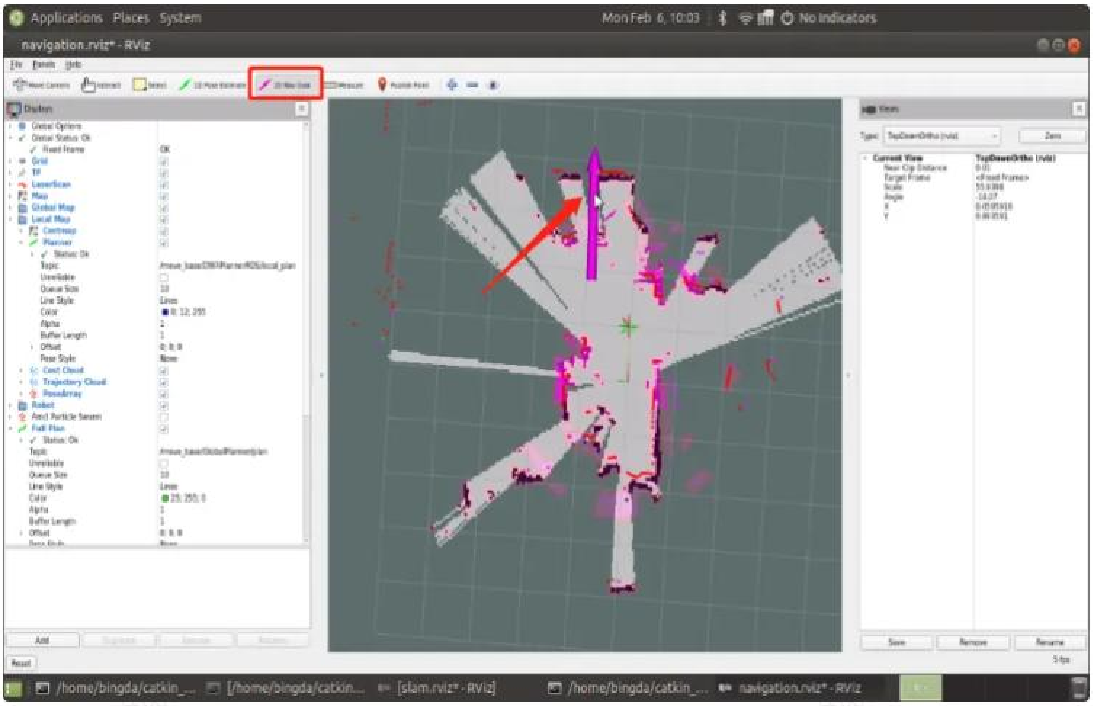


After several adjustments, the liDAR point and the map part of the boundary can be basically coevent.



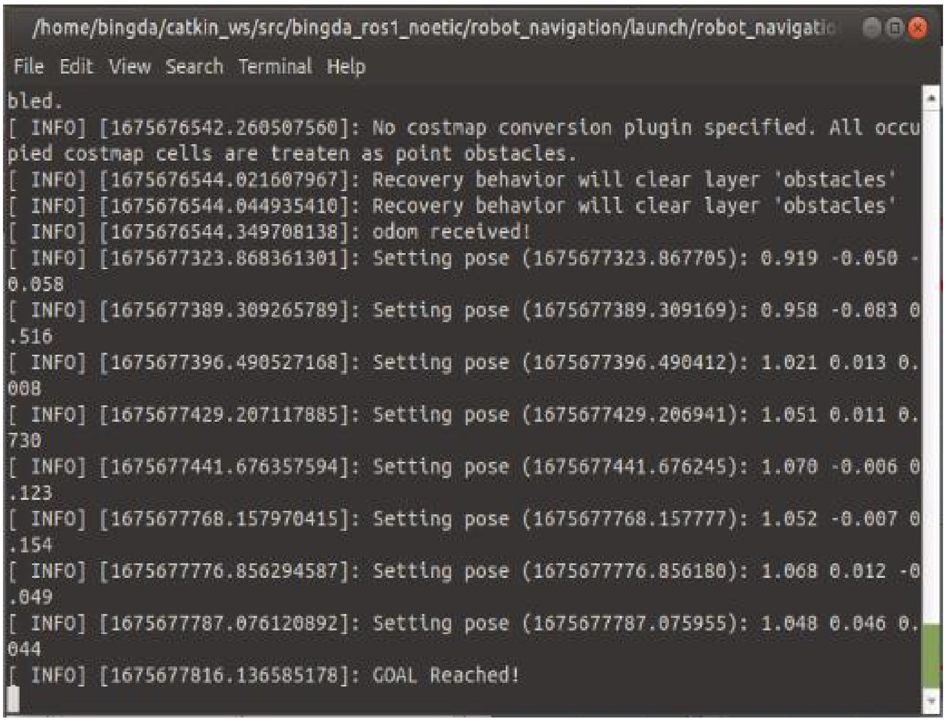
Step 4: Specify the robot navigation target point

Click the button in the red box below, and then long press the left mouse button in the target point on the map, and then move the mouse to adjust the direction, adjust to the target direction you need to navigate. Release the mouse and the robot will automatically move towards the target point.



Step 5: Navigation result check

When the robot reaches the target point, it will automatically stop, and the terminal running the navigation will output "**GOAL Reached!**" Prompt message.



If the robot cannot reach the currently specified target point, the terminal will also output a warning or error message. The robot will abandon the current navigation task and try to navigate again after re-assigning other target points.