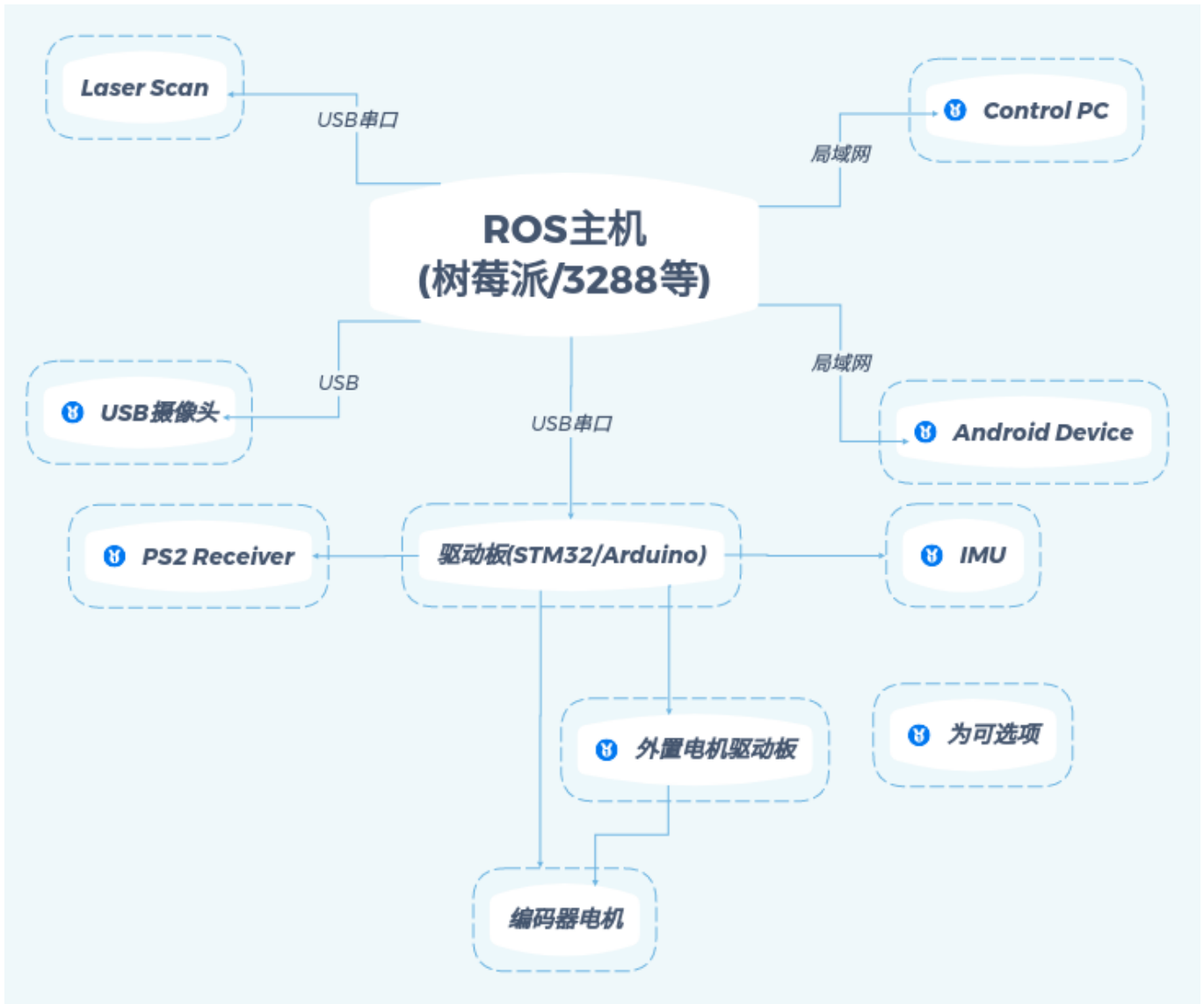


- 1. 硬件连接与安装
  - 1.1 硬件连接示意图
  - 1.2 安装
  - 1.3 接线
- 2. 环境搭建与配置
  - 2.1 配置
  - 2.2 联网配置
  - 2.3 PIBOT代码包编译与配置
- 3. 建图与导航测试
  - 3.1 测试硬件连接
  - 3.2 建图
  - 3.3 保存地图
  - 3.4 导航
  - 3.5 Android手机APP
- 3.6 模拟器

## 1. 硬件连接与安装

---

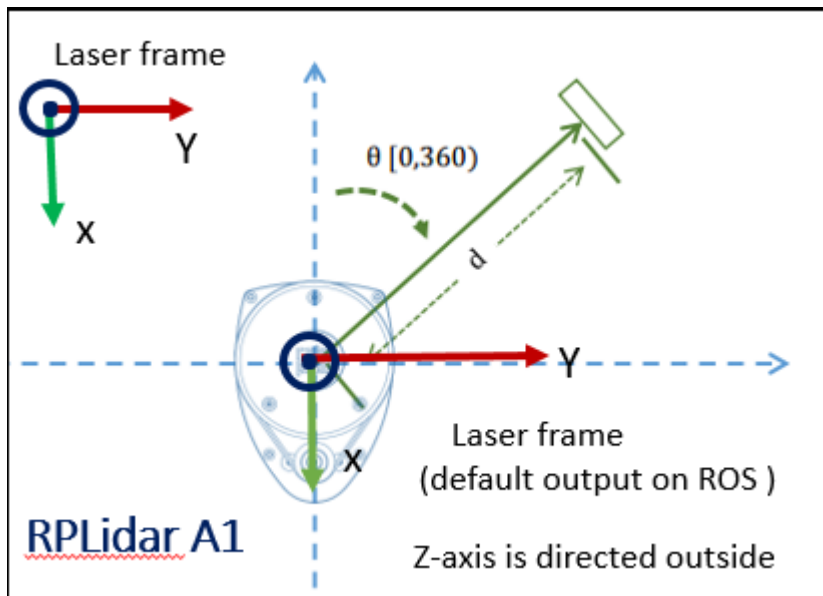
### 1.1 硬件连接示意图



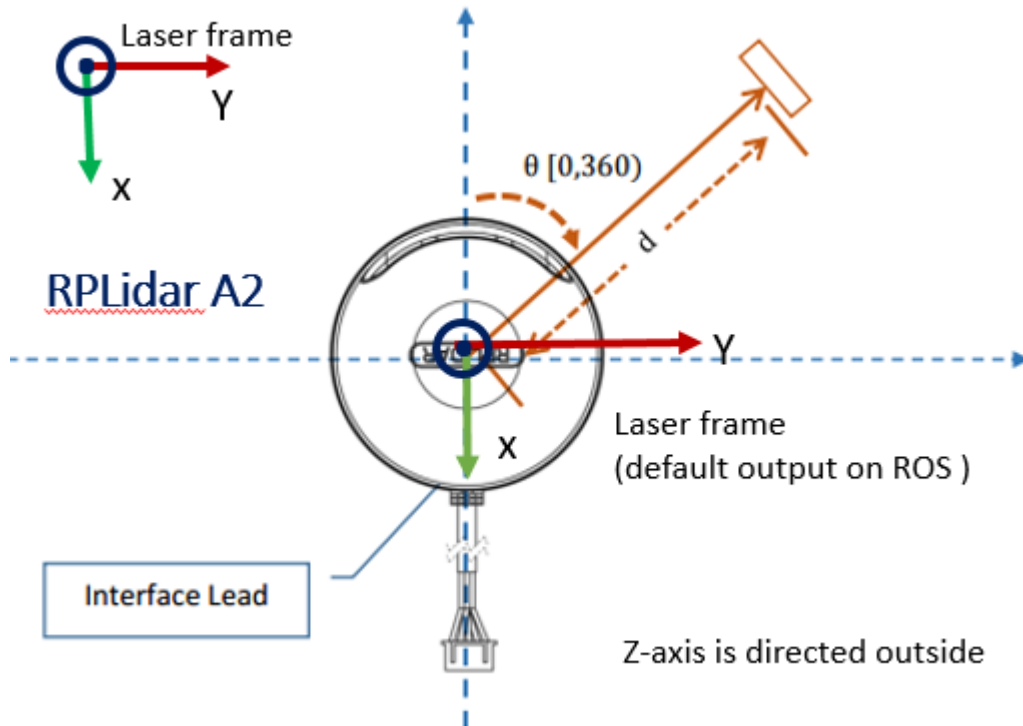
## 1.2 安装

PIBOT调试完成后整体交付，只需要安装雷达或者摄像头支架至顶层板即可

- 雷达安装
  - 思岚A1 使用M2.5螺丝拧好至固定孔位即可



- 思岚A2/A3 使用M3螺丝拧好至固定孔位即可，不同于A1，A2/A3的固定孔位使得雷达前后调转照样可以按照，遵循ROS的坐标系，规定A2/A3线头执行前方



### 1.3 接线

- 电池分别接到电源板和主板给其供电
- 上位机ROS主板/主机供电，主板分2种，一种为5V供电，另一种为12V的
  - 5V供电，通过底板的USB母座提供输出，包括树莓派3b/3b+, nanopi(RK3399)，可参考下面图 [hades 树莓派 rplidar-A2](#)
  - 12V供电，通过底板的USB母座提供输出，包括Firefly(RK3399),X86工控机，可参考下面图 [apollo rk3399 rplidar-A1](#)
- 通讯端口
  - 下位机的通讯口，主板通过usb micro口连接至主机(树莓派/RK3288/RK3399/TK1/TX1/TX2/X86主机)(下图中黄色USB线)
  - 雷达通讯口，A1需要连接好串口板后再通过usb micro口连接至主机(树莓派/RK3288/RK3399/TK1/TX1/TX2/X86主机)(下图中黄色USB线)

**STM32F1/F4核心板上也有micro usb口，该口作为核心板供电用，不是通讯端口，无需接线**



# 安装指示图

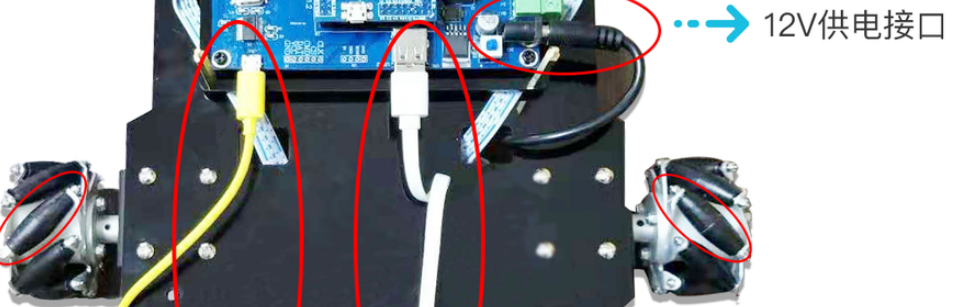


启用小扳手松开小螺丝，对好轴承，再紧上螺丝，轮子有方向，拧好成“X”型



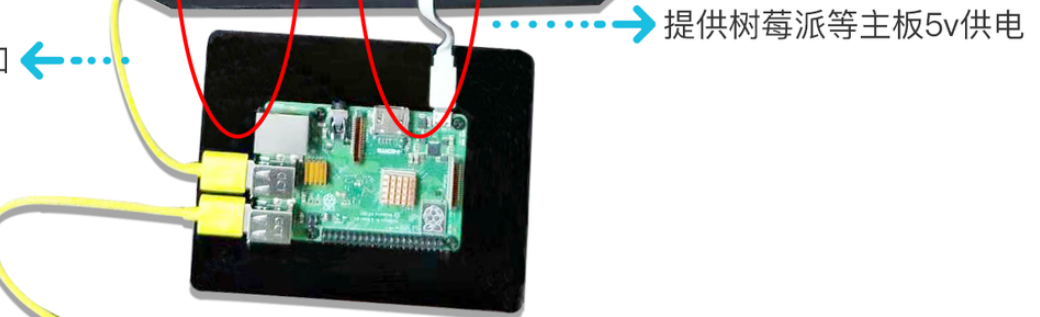
充电接口

车架+底层驱动



12V供电接口

主板usb通讯接口



提供树莓派等主板5v供电

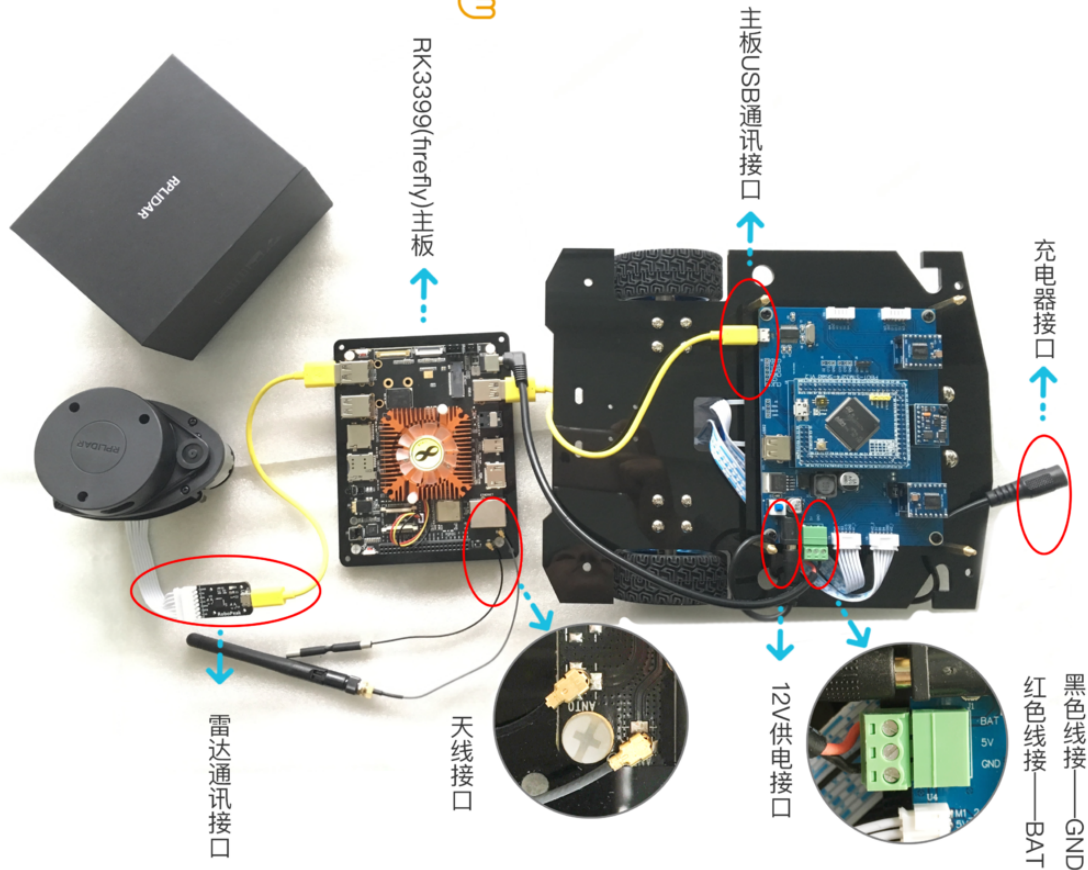


激光雷达通讯接口





## 安装指示图



## 2. 环境搭建与配置

- **PIBOT**下位机 Arduino/STM32F1/F4主板
- **PIBOT**上位机 树莓派/RK3399/X86工控机/TK1/TX1/TX2等车上的安装ROS的主机
- 用户主机 用户使用的Windows或者Ubuntu的PC

### 2.1 配置

这里用户主机以Windows主机为例

1. 安装XShell工具，用于远程登入ROS上位机，请参考[XShell怎么登陆linux](#)
  - 树莓派3B/3B+用户名密码均为pibot
  - firefly RK3288、RK3399用户名密码均为firefly
  - nanopi RK3399用户名密码均为pi\*\*
2. 使用Vmware安装Ubuntu虚拟机以及,请参考[Windows下安装Ubuntu虚拟机及ROS](#)
3. 安装Androd App至手机

### 2.2 联网配置

**PIBOT**上位机联网有两类方式，一类是释放无线网的，另外一种是需要连接至路由器的

- 释放无线网，(树莓派3b/3b+, nanopi(RK3399)上电后会释放出无线网络，名称和密码为pibot\_ap,这种情况PIBOT上位机固定IP为192.168.12.1) 用户主机通过无线连接该网络

- 不释放无线网, (**firefly(RK3399)**,X86工控机,TK1,TX1,TX2等需要通过HDMI接口连接显示器, 在通过鼠标键盘操作连接至可用的路由器, 同时记下**PIBOT**上位机的IP地址, 假定这里获取的为**192.168.2.35**) 用户主机通过无线网/有线网连接到该路由器

对于用户主机**Windows**需要配置虚拟机网卡连接为桥接模式, 保障**ubuntu**中IP跟主机IP一个网段, 且能互相**ping**通, 请参考[Windows下安装Ubuntu虚拟机及ROS,桥接网络的配置](#)

## 2.3 PIBOT代码包编译与配置

拷贝升级或者从git仓库clone代码到主目录, 这里**PIBOT**上位机和用户主机都需要配置和编译

- 复制**pibot\_ros.tar.bz2**至主目录, 打开终端输入

```
tar jxvf pibot_ros.tar.bz2
cd ~/pibot_ros/
git pull # 拉取最新的代码 需连接外网
./pibot_init_env.sh #这里根据提示输入小车类型, 控制板类型, 雷达类型, Machine类型
source ~/.bashrc
```

如果是车型为**hades** 雷达类型**rplidar**, **PIBOT**上位机端(树莓派/RK3399等) 和用户主机(虚拟机) 配置分别如下 **PIBOT**上位机

```
pibot@pibot-desktop:~/pibot_ros$ ./pibot_init_env.sh
please specify piobot model(0:apollo,1:apolloX,2:zeus,3:hera,4:hades,other for user defined):
0
please specify piobot driver board type(0:arduino(mega2560),1:stm32f103,2:stm32f407,other for user defined):
2
please specify your piobot lidar(0:rplidar(a1,a2),1:rplidar(a3),2:eai(x4),3:eai(g4),4:xtion,5:astrax,6:kinectV1,other for user defined):
0
please specify the current machine(ip:192.168.2.231) type(0:onboard,other:remote):
0
*****
model:      apollo
lidar:      rplidar
local_ip:   192.168.2.231
onboard_ip: 192.168.2.231
*****
please execute source ~/.bashrc to make the configure effective
*****
```

小车类型  
驱动板类型  
雷达类型 (包括使用摄像头模拟)  
主机类型 (车载端or控制端)  
生效配置

用户主机 (虚拟机)

```
pibot@pibot-desktop:~/pibot_ros$ ./piobot_init_env.sh
please specify piobot model(0:apollo,1:apolloX,2:zeus,3:hera,4:hades,other for user defined):
0
please specify piobot driver board type(0:arduino(mega2560),1:stm32f103,2:stm32f407,other for user defined):
2
please specify your piobot lidar(0:rplidar(a1,a2),1:rplidar(a3),2:eai(x4),3:eai(g4),4:xtion,5:astrax,6:kinectV1,other for user defined):
0
please specify the current machine(ip:192.168.2.177) type(0:onboard,other:remote):
2
please specify the onboard machine ip for commication:
192.168.2.231
*****
model:      apollo
lidar:      rplidar
local_ip:   192.168.2.177
onboard_ip: 192.168.2.231
*****
please execute source ~/.bashrc to make the configure effective
*****
```

小车类型  
主板类型  
雷达类型 (包括使用摄像头模拟)  
主机类型 (小车or控制端)  
指定控制端, 需要指定小车IP  
生效配置

- 编译 分别在 **PIBOT**上位机(树莓派/RK3399等) 和用户主机 (虚拟机) 编译

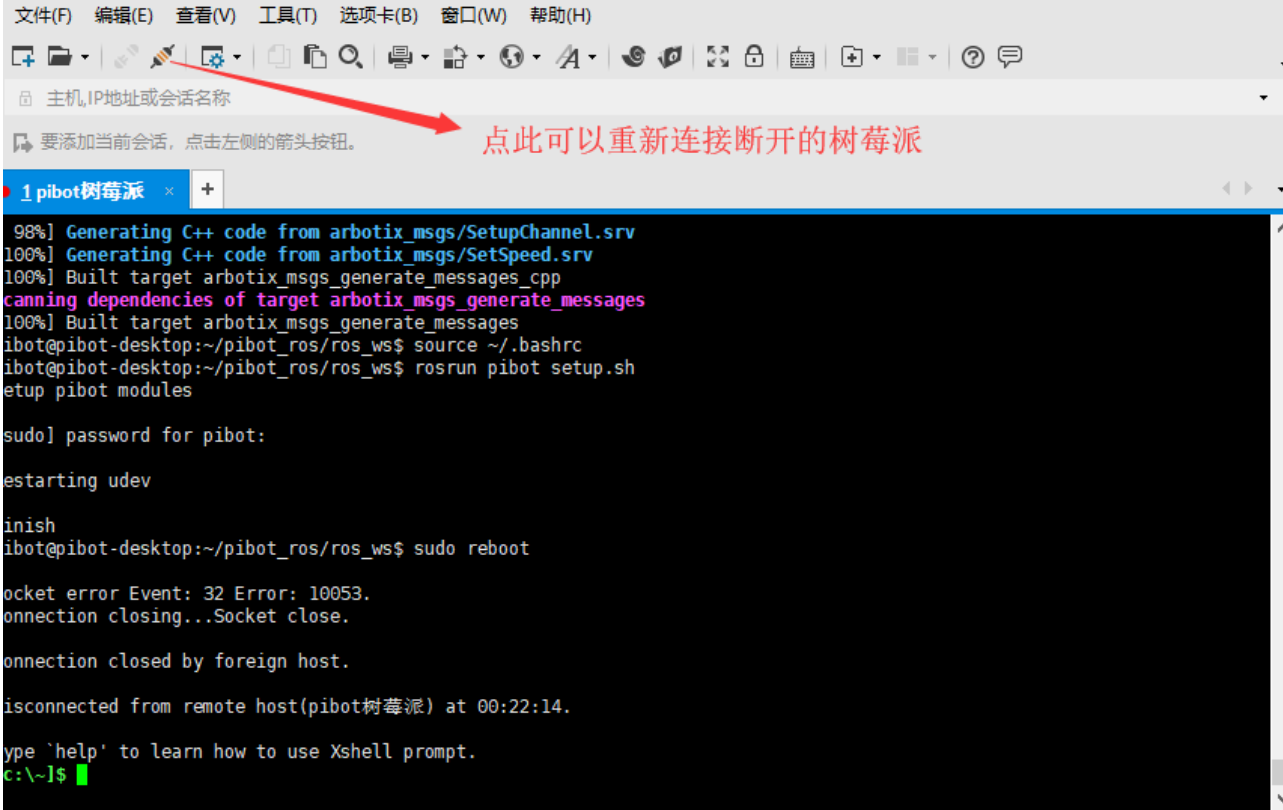
```
cd ~/pibot_ros/ros_ws/
catkin_make
source ~/.bashrc
```



## 3. 建图与导航测试

### 3.1 测试硬件连接

- a. 在用户主机通过ssh连接PIBOT上位机 输入命令`ls /dev/pibot -l`检查主板是否连接



The screenshot shows an Xshell terminal window titled "pibot树莓派 - Xshell 5". The terminal output includes ROS build steps, a successful `roslaunch pibot setup.sh` command, and a `sudo` password prompt. Following the reboot, there are several error messages: "Socket error Event: 32 Error: 10053. Connection closing...Socket close." and "Connection closed by foreign host." The terminal ends with a disconnected message and a prompt to type 'help' for Xshell usage. A red arrow points from the text "点此可以重新连接断开的树莓派" to the session tab "1 pibot树莓派".

```
98%] Generating C++ code from arbotix_msgs/SetupChannel.srv
100%] Generating C++ code from arbotix_msgs/SetSpeed.srv
100%] Built target arbotix_msgs_generate_messages_cpp
canning dependencies of target arbotix_msgs_generate_messages
100%] Built target arbotix_msgs_generate_messages
ibot@pibot-desktop:~/pibot_ros/ros_ws$ source ~/.bashrc
ibot@pibot-desktop:~/pibot_ros/ros_ws$ roslaunch pibot setup.sh
etup pibot modules

sudo] password for pibot:

estarting udev

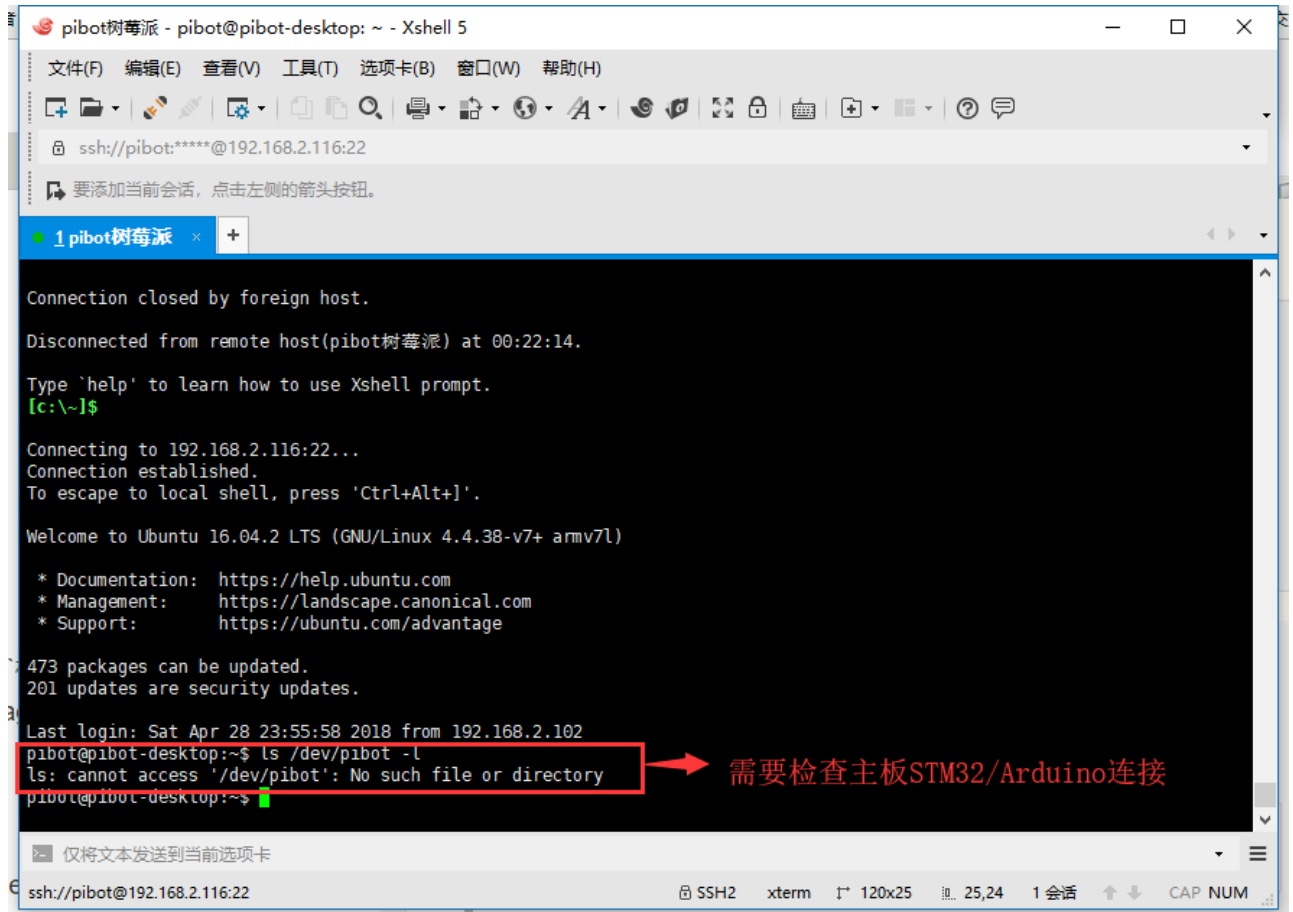
inish
ibot@pibot-desktop:~/pibot_ros/ros_ws$ sudo reboot

ocket error Event: 32 Error: 10053.
onnection closing...Socket close.

onnection closed by foreign host.

isconnected from remote host(pibot树莓派) at 00:22:14.

ype 'help' to learn how to use Xshell prompt.
c:\~]$
```



正常连接输出如下图

```

pibot@pibot-desktop:~$ ls /dev/pibot -l
lrwxrwxrwx 1 root root 7 4月 29 00:24 /dev/pibot -> ttyUSB0

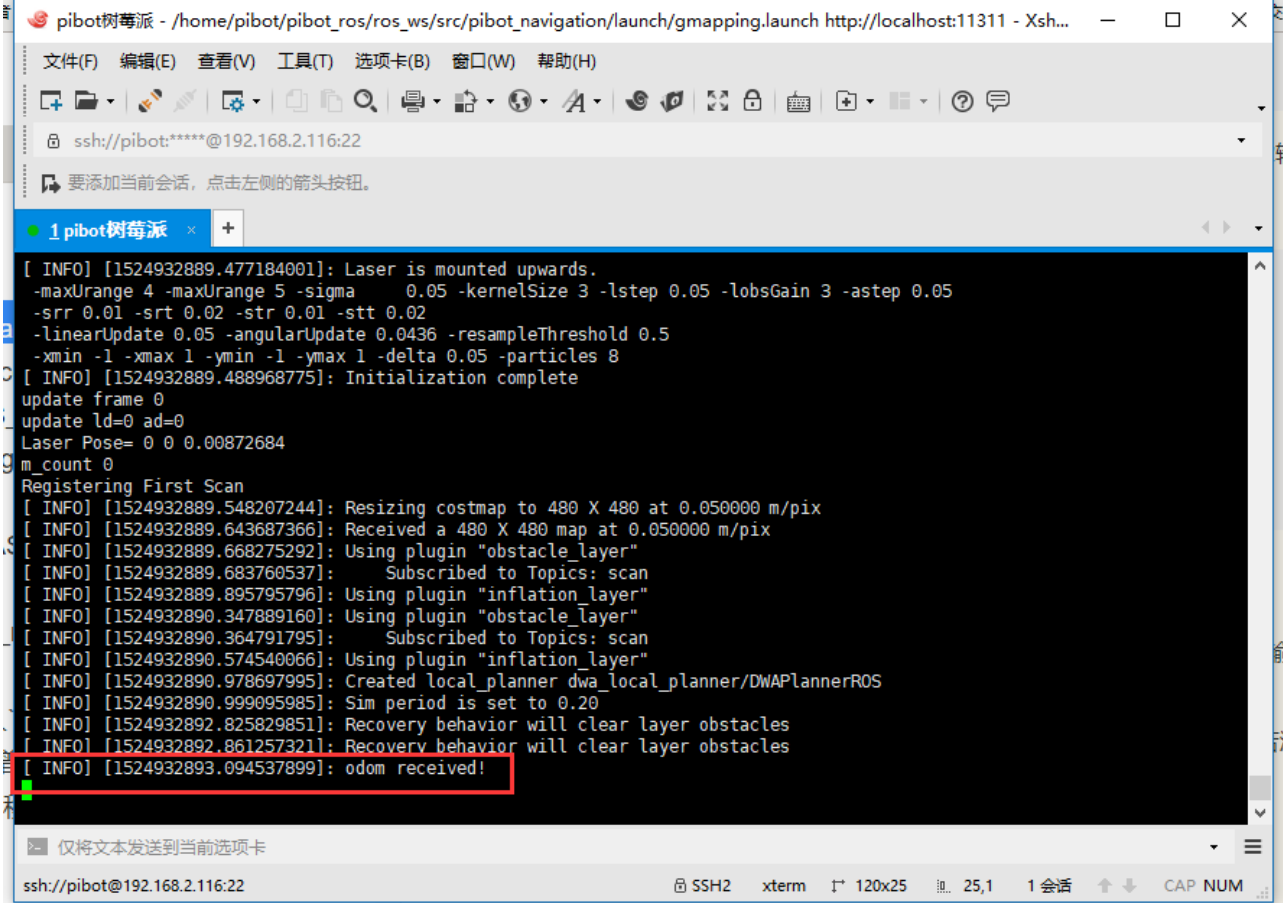
```

- b.继续输入`ls /dev/ydlidar -l`或者`ls /dev/rplidar -l`(eai输入前者，思岚A1/A2/A3输入后者)，检查激光雷达是否连接

## 3.2 建图

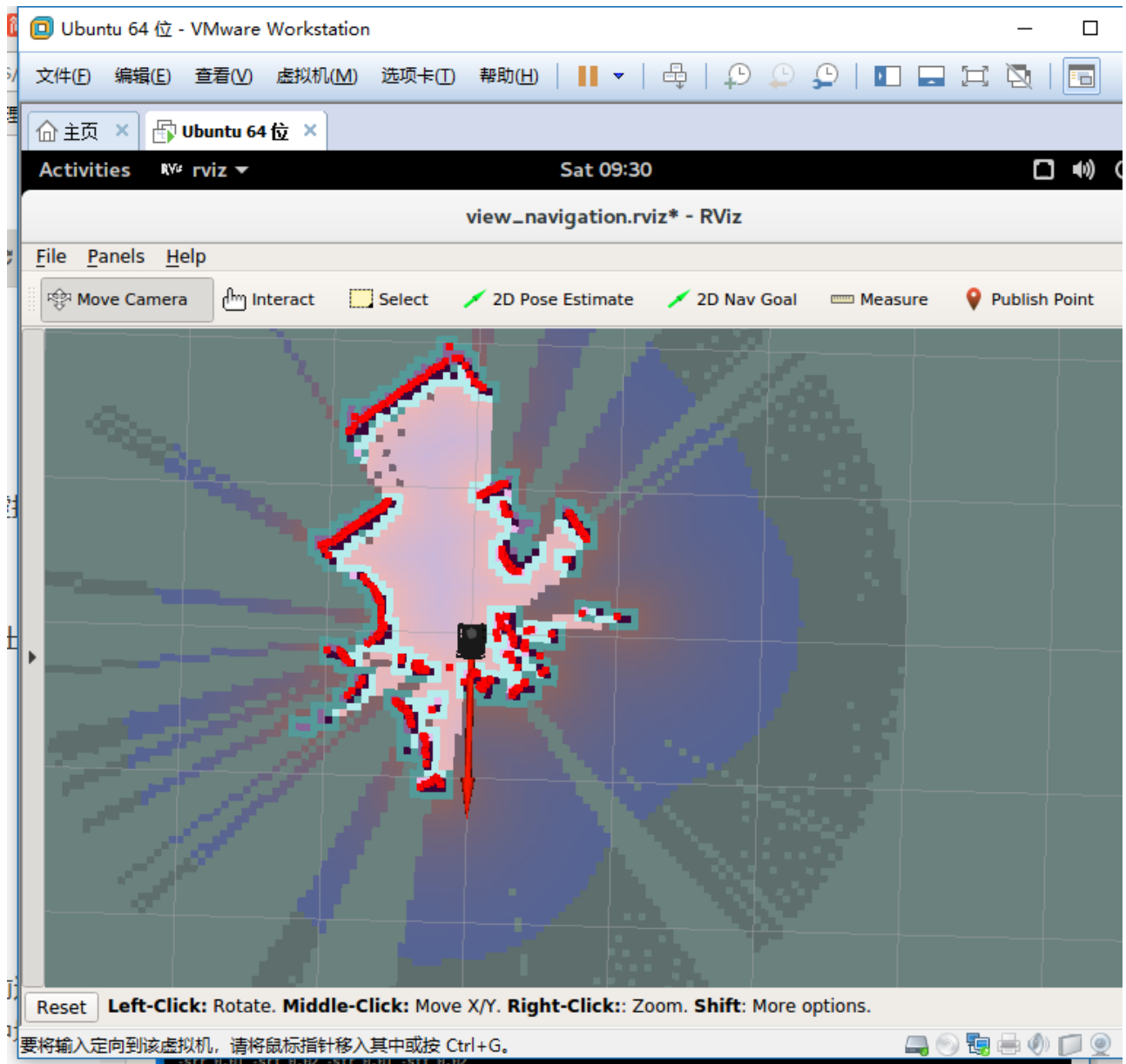
- a.在用户主机通过ssh连接PIBOT上位机，输入运行`pibot_gmapping`或者`roslaunch pibot_navigation gmapping.launch`启动建图节点，收到最后输出`odom received`表示正常



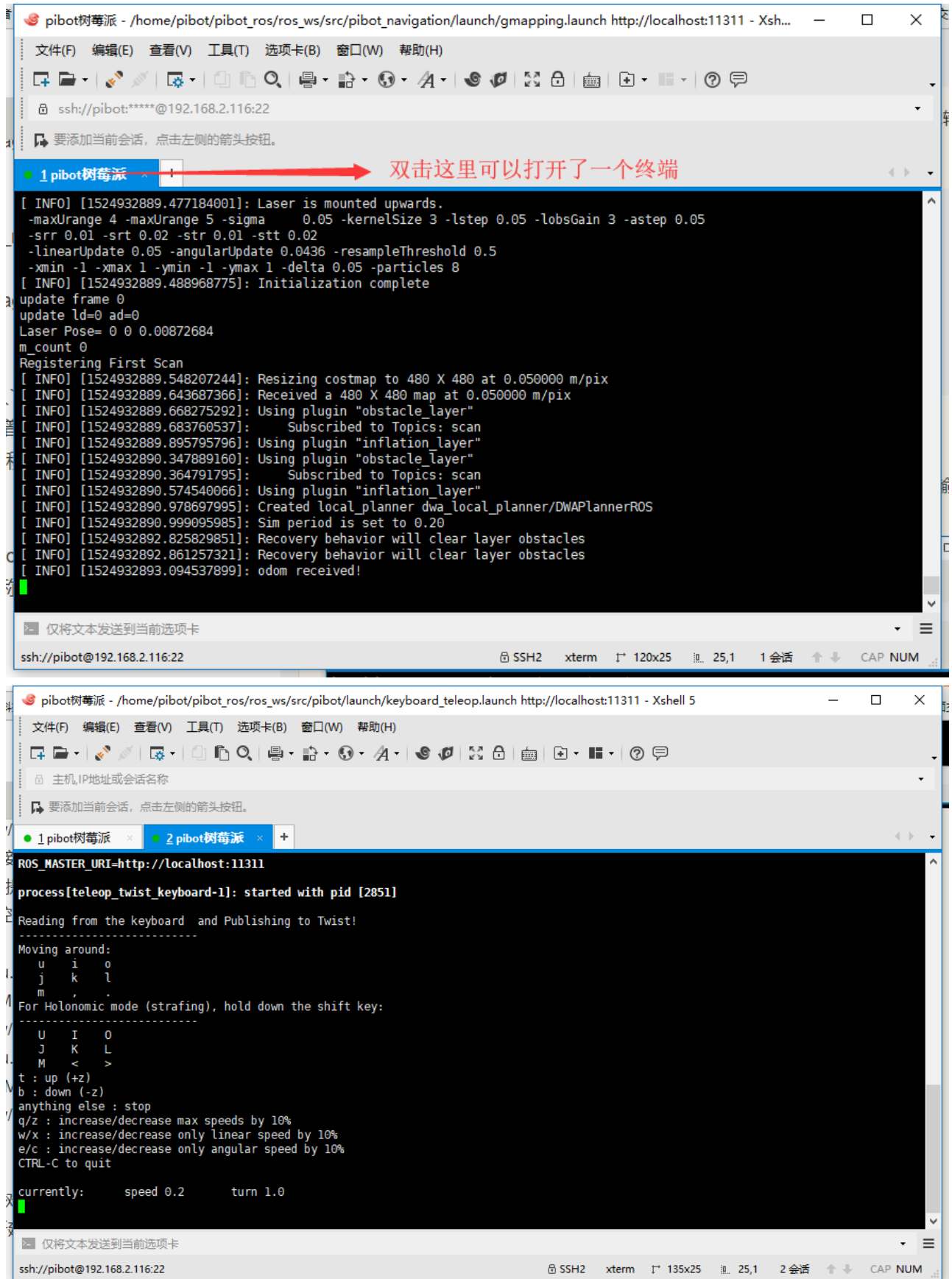


```
ssh://piBOT:*****@192.168.2.116:22
要添加当前会话，点击左侧的箭头按钮。
1 piBOT树莓派 x +
[ INFO ] [1524932889.477184001]: Laser is mounted upwards.
-maxUrange 4 -maxUrange 5 -sigma 0.05 -kernelSize 3 -lstep 0.05 -lobsGain 3 -astep 0.05
-srr 0.01 -srt 0.02 -str 0.01 -stt 0.02
-linearUpdate 0.05 -angularUpdate 0.0436 -resampleThreshold 0.5
-xmin -1 -xmax 1 -ymin -1 -ymax 1 -delta 0.05 -particles 8
[ INFO ] [1524932889.488968775]: Initialization complete
update frame 0
update ld=0 ad=0
Laser Pose= 0 0 0.00872684
m_count 0
Registering First Scan
[ INFO ] [1524932889.548207244]: Resizing costmap to 480 X 480 at 0.050000 m/pix
[ INFO ] [1524932889.643687366]: Received a 480 X 480 map at 0.050000 m/pix
[ INFO ] [1524932889.668275292]: Using plugin "obstacle_layer"
[ INFO ] [1524932889.683760537]: Subscribed to Topics: scan
[ INFO ] [1524932889.895795796]: Using plugin "inflation_layer"
[ INFO ] [1524932890.347889160]: Using plugin "obstacle_layer"
[ INFO ] [1524932890.364791795]: Subscribed to Topics: scan
[ INFO ] [1524932890.574540066]: Using plugin "inflation_layer"
[ INFO ] [1524932890.978697995]: Created local_planner dwa_local_planner/DWAPlanerROS
[ INFO ] [1524932890.999095985]: Sim period is set to 0.20
[ INFO ] [1524932892.825829851]: Recovery behavior will clear layer obstacles
[ INFO ] [1524932892.861257321]: Recovery behavior will clear layer obstacles
[ INFO ] [1524932893.094537899]: odom received!
仅将文本发送到当前选项卡
ssh://piBOT@192.168.2.116:22 SSH2 xterm 120x25 25,1 1 会话 CAP NUM
```

- b.在用户主机的UBUNTU虚拟机终端，输入`piBTT_view`或者`roslaunch piBOT_navigation view_nav.launch`启动RViz节点,查看地图



- c. 在用户主机通过ssh连接PIBOT上位机，输入`pibot_control`或者`roslaunch pibot keyboard_teleop.launch`启动控制节点，根据提示输入q/z增减速度，输入i/,控制前进后退，输入j/l控制左转右转。控制小车在房间移动，同时观察虚拟机中地图构建情况



### 3.3 保存地图

- 在用户主机通过ssh连接PIBOT上位机，输入

```
roslaunch pibot_navigation save_map.launch map_name:=xxx
```

或者

```
roscd piBOT_navigation/maps
roslaunch map_server map_saver -f xxx    #(xxx)为设置新建好的地图名称
```

```
Documents Music piBOT_lab.yaml piBOT_ros_ws-v1.1.tar.bz2 Public Videos
piBOT@piBOT-desktop:~$ ls piBOT_lab.* -l
-rw-rw-r-- 1 piBOT piBOT 230456 4月 29 00:33 piBOT_lab.pgm
-rw-rw-r-- 1 piBOT piBOT 137 4月 29 00:33 piBOT_lab.yaml
piBOT@piBOT-desktop:~$ clear
piBOT@piBOT-desktop:~$ roslaunch map_server map_saver -f piBOT_lab
[ INFO ] [1524933258.373166643]: Waiting for the map
[ INFO ] [1524933258.631356860]: Received a 480 X 480 map @ 0.050 m/pix
[ INFO ] [1524933258.631782370]: Writing map occupancy data to piBOT_lab.pgm
[ INFO ] [1524933258.658277750]: Writing map occupancy data to piBOT_lab.yaml
[ INFO ] [1524933258.659125854]: Done

piBOT@piBOT-desktop:~$ ls piBOT_lab.* -l
-rw-rw-r-- 1 piBOT piBOT 230456 4月 29 00:34 piBOT_lab.pgm
-rw-rw-r-- 1 piBOT piBOT 137 4月 29 00:34 piBOT_lab.yaml
piBOT@piBOT-desktop:~$
```

给定一个名称，则可以保存地图

这两个为地图相关文件

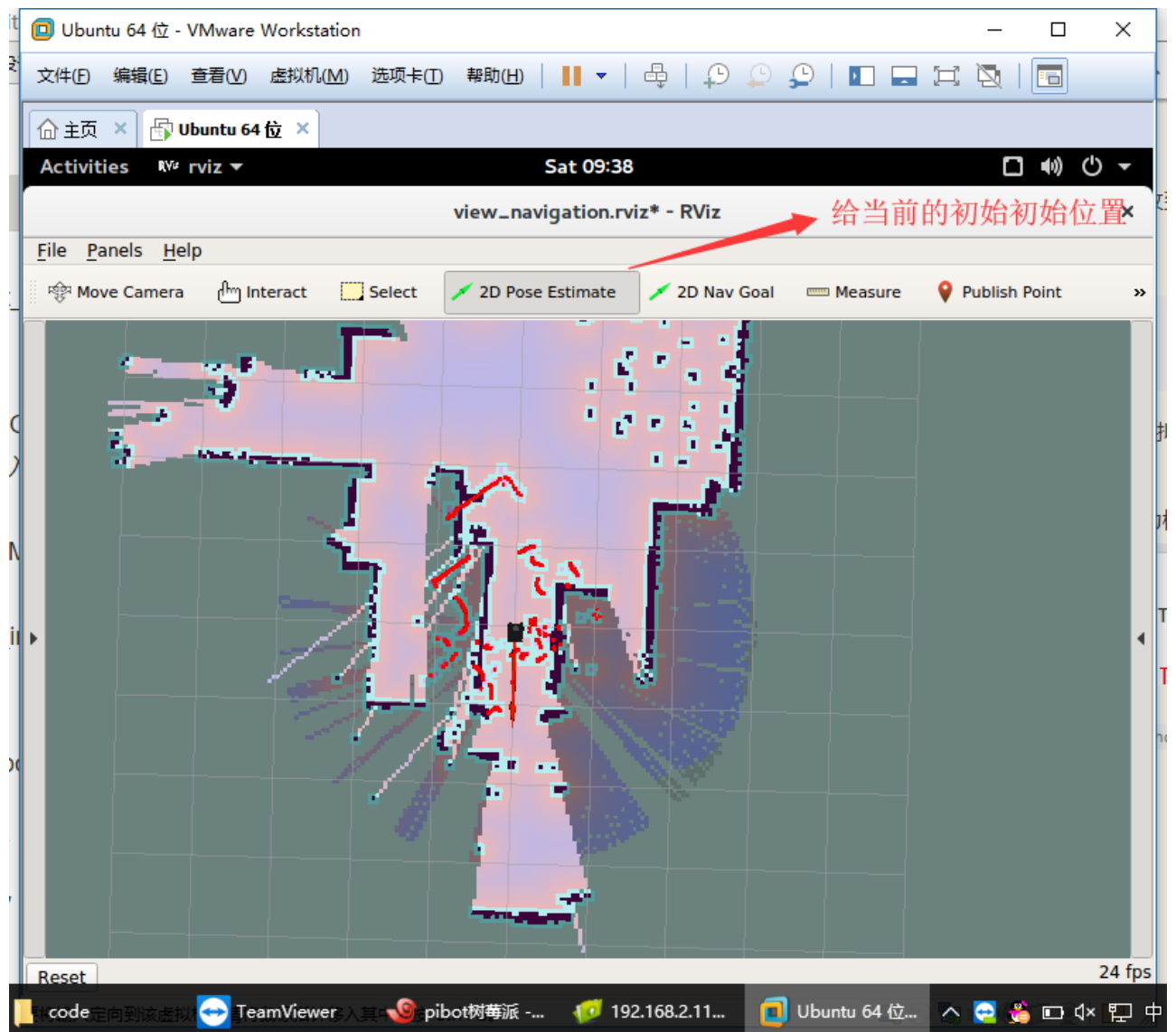
### 3.4 导航

- a.接上面，继续输入运行piBOT\_navigation或者roslaunch piBOT\_navigation nav.launch map\_name:=xxx.yaml启动导航节点，收到最后输出odom received表示正常(xxx为之前新建好的地图名称)

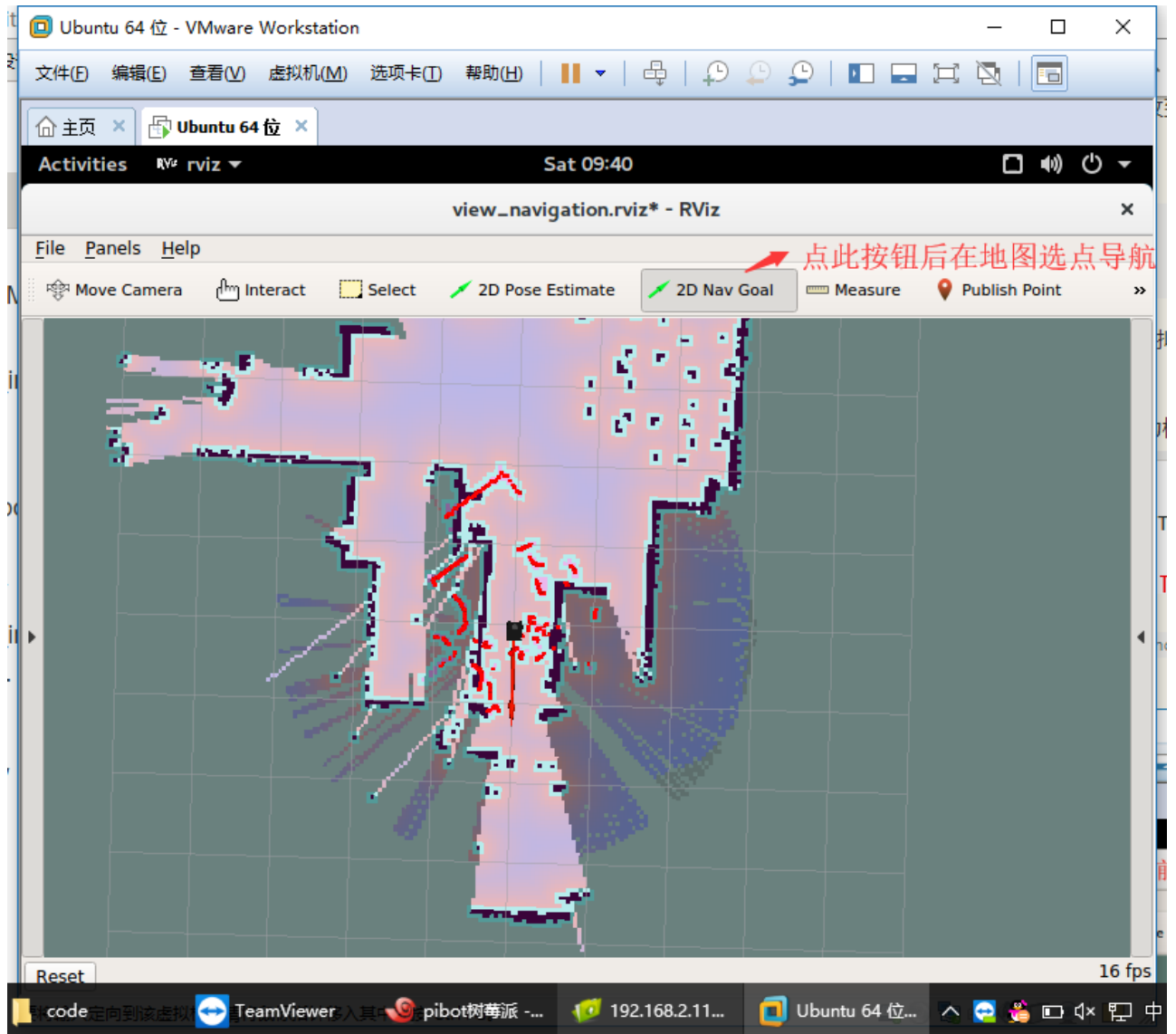
这里需要先退出gmapping建图

- b.在控制PC中，输入piBOT\_view或者roslaunch piBOT\_navigation view\_nav.launch启动RViz节点,查看地图

- c.在RViz中，设置小车当前位置和方向



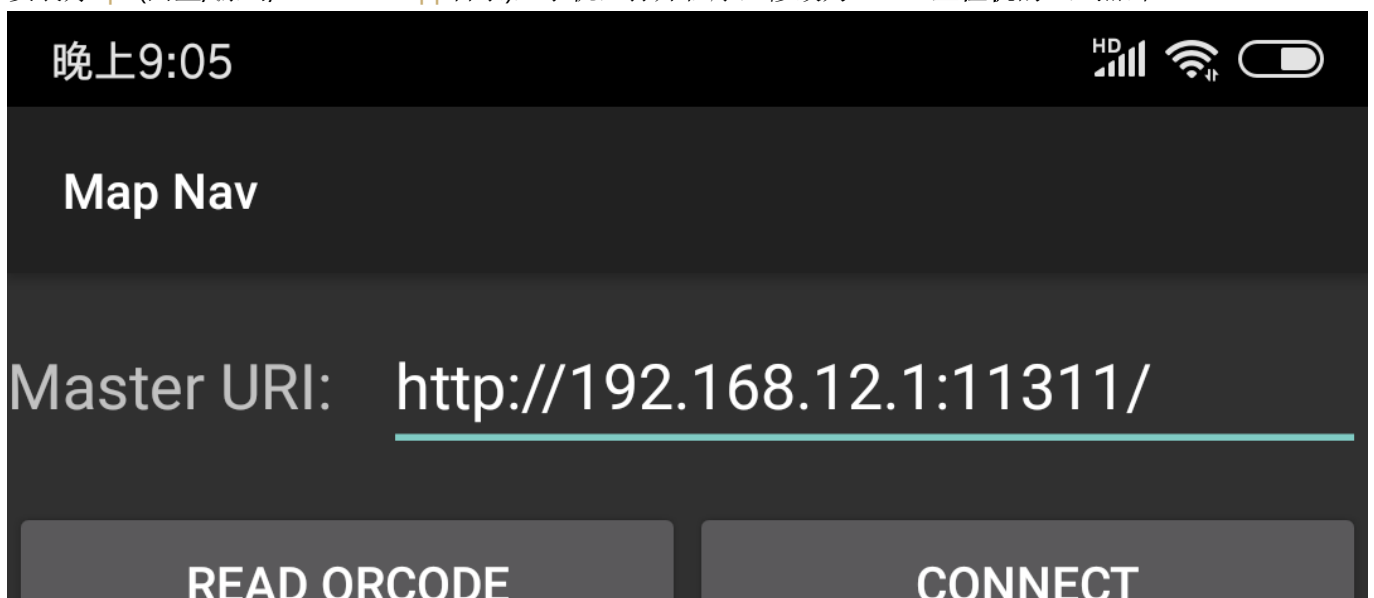
- d.在RViz中，设置小车目标位置和方向，即可开始导航



### 3.5 Android手机APP

连接与PIBOT上位机同一路由器(树莓派/nanopi rk3399则为其释放热点pibot\_ap)，开启建图或者导航程序

安装好apk(网盘/源码/Android App目录)至手机，打开程序，修改为PIBOT上位机的IP，点击CONNECT





Show advanced options

CANCEL



.

1

2

3



/

4

5

6

\*

+

7

8

9

#

-

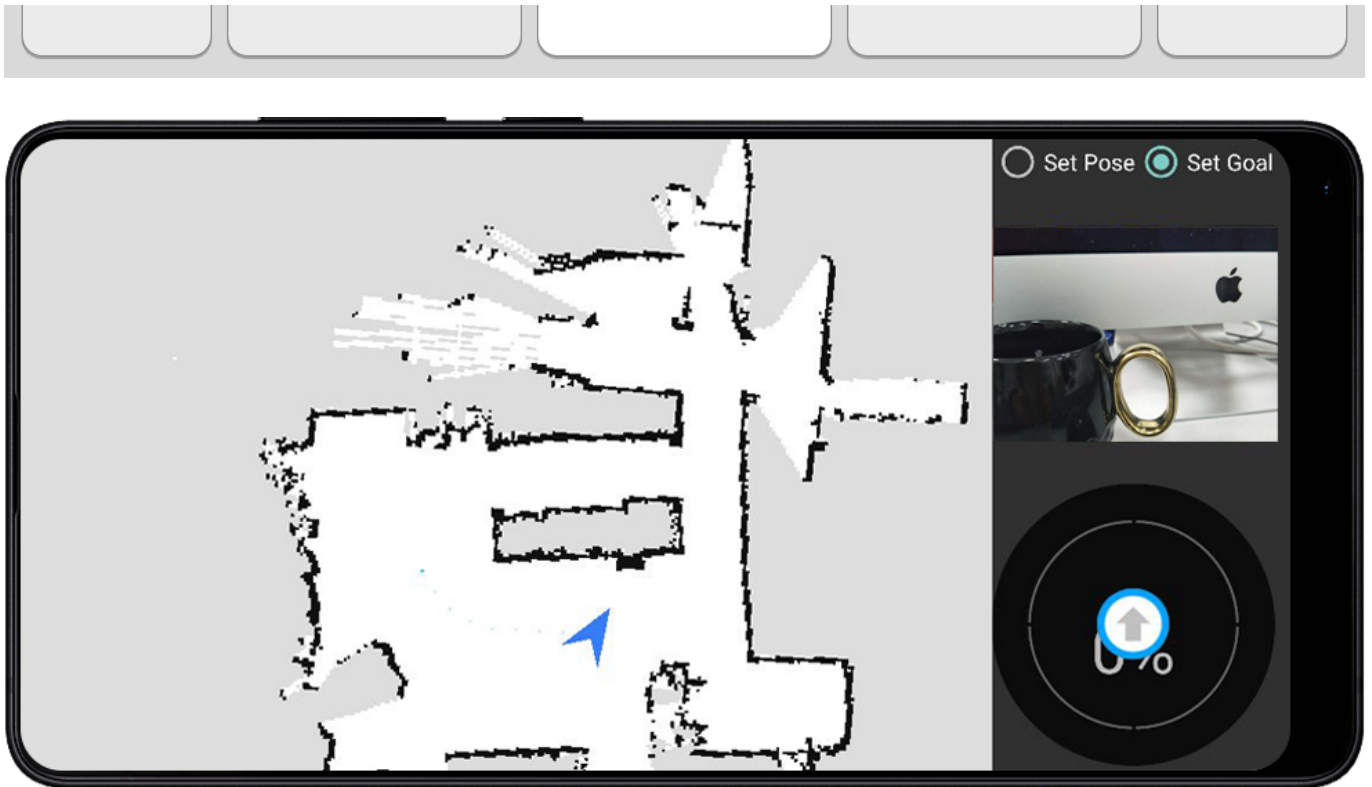
符

返回

0

空格





可以显示地图、设置位置和设置目标点、显示视频和控制行走

\*显示视频需要在PIBOT上位机连接摄像头以及开启相关程序

- usb 摄像头 `roslaunch pibot usb_camera.launch`

## 3.6 模拟器

PIBOT包内置了模拟器，可以直接运行模拟导航 模拟器需要配置为车载主机模式

```

pibot@pibot-desktop:~/pibot_ros$ ./pibot_init_env.sh
please specify pibot model(0:apollo,1:apolloX,2:zeus,3:hera,4:hades,other for user defined):
0
please specify pibot driver board type(0:arduino(mega2560),1:stm32f103,2:stm32f407,other for user defined):
2
please specify your pibot lidar(0:rplidar(a1,a2),1:rplidar(a3),2:eai(x4),3:eai(g4),4:xtion,5:astra,6:kinectV1,other for user defined):
0
please specify the current machine(ip:192.168.2.231) type(0:onboard,other:remote):
0
*****
model:      apollo
lidar:      rplidar
local_ip:   192.168.2.231
onboard_ip: 192.168.2.231
*****
please execute source ~/.bashrc to make the configure effective
*****

```

→ 小车类型  
→ 驱动板类型  
→ 雷达类型（包括使用摄像头模拟）  
→ 主机类型（车载端or控制端）  
→ 生效配置

- 运行 `pibot_simulator` 或者 `roslaunch pibot_simulator nav.launch`
- 运行 `pibot_simulator` 或者 `roslaunch pibot_navigation view_nav.launch` 这样无需小车也可以模拟导航了