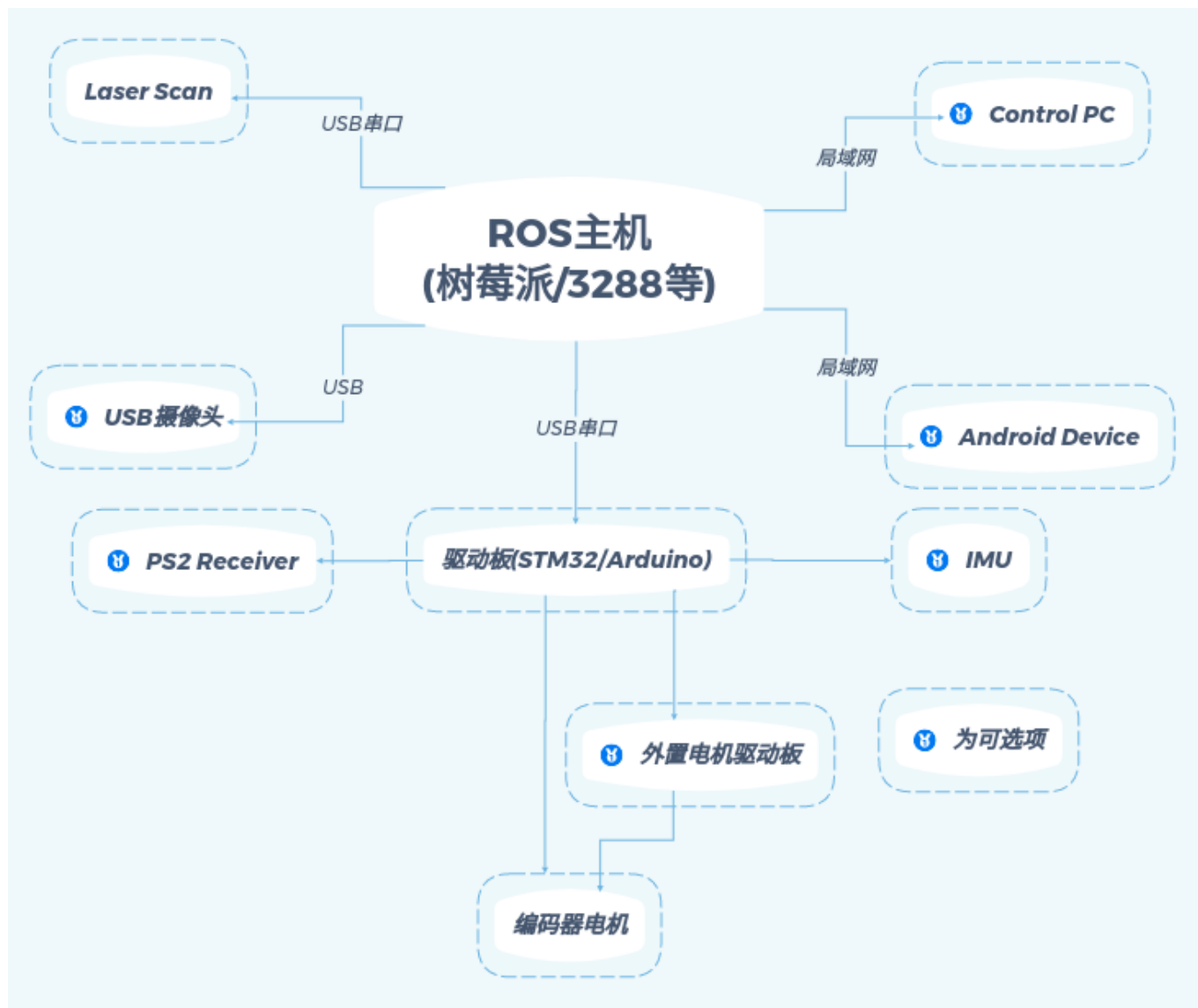


- 1. 硬件连接与安装
  - 1.1 硬件连接示意图
  - 1.2 安装
  - 1.3 接线
- 2. 环境搭建与配置
  - 2.1 联网配置
  - 2.2 配置小车端环境
  - 2.3. 配置虚拟机环境
  - 2.4. 安装Android App至手机
- 3. 建图与导航测试
  - 3.1 测试硬件连接
  - 3.2 建图
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  - 3.4 导航
  - 3.5 Android手机APP

## 1. 硬件连接与安装

---

### 1.1 硬件连接示意图

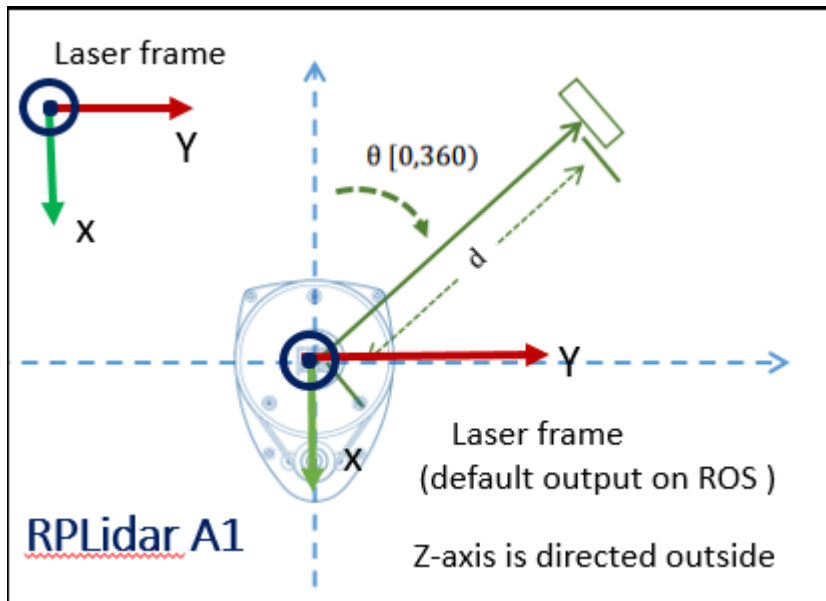


## 1.2 安装

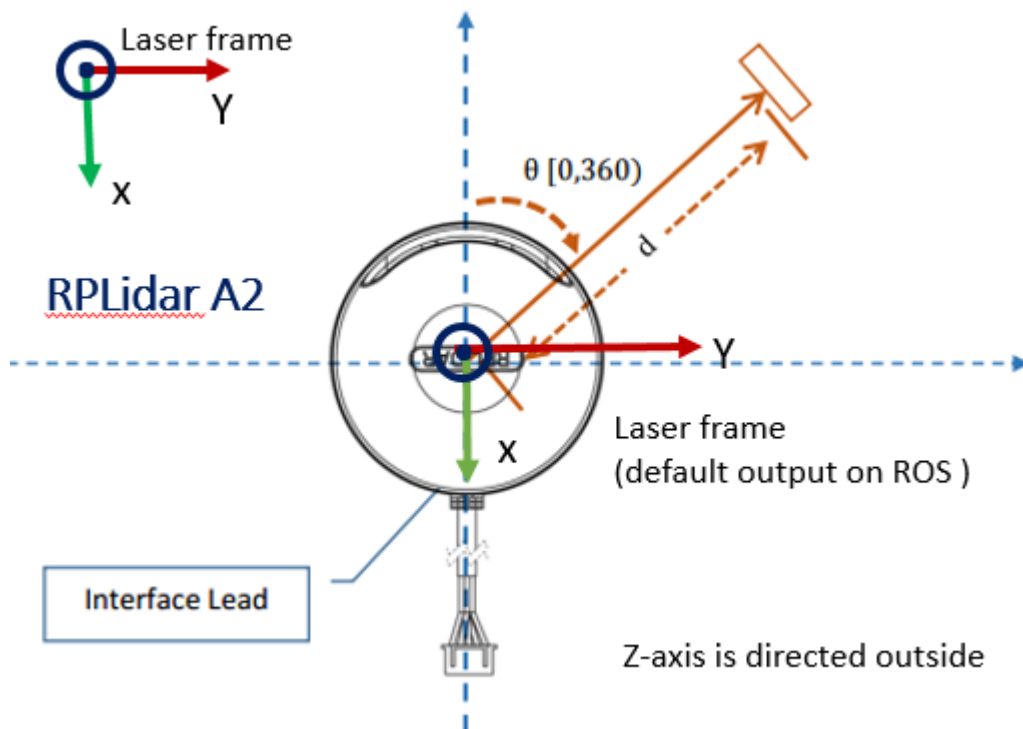
PIBOT调试完成后整体交付，只需要安装雷达或者摄像头支架至顶层板即可

- 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

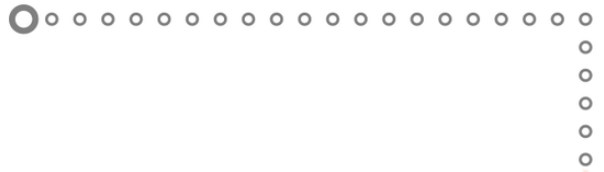


### 1.3 接线

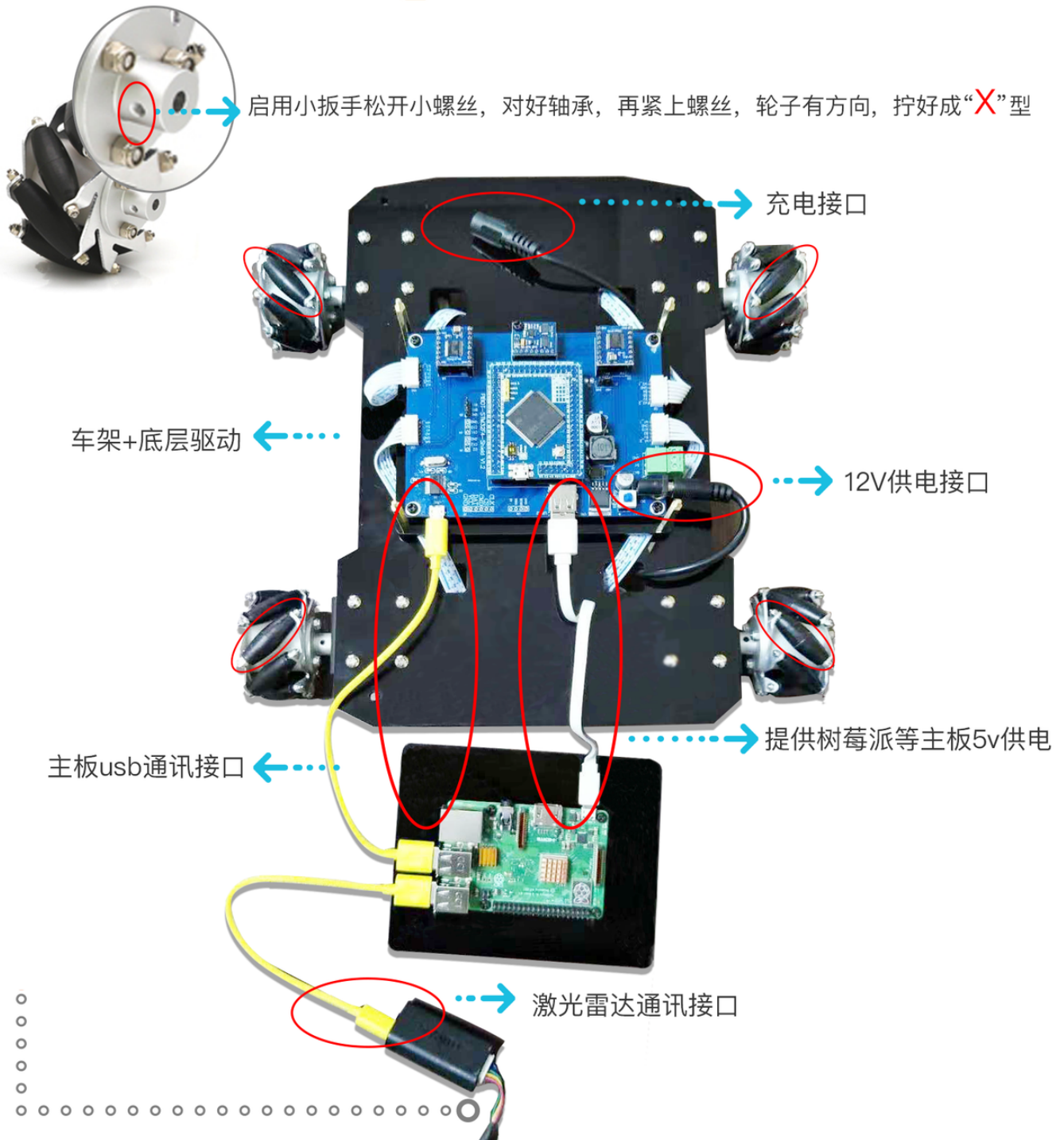
- 电池分别接到电源板和主板给其供电
- 上位机ROS主板/主机供电，主板分2种，一种为5V供电，另一种为12V的
  - 5V供电，通过底板的USB母座提供输出，包括树莓派3b/3b+, nanopi(RK3399)，可参考下面图 [hades 树莓派 rplidar-A2](#)
  - 12V供电，通过底板的USB母座提供输出，包括Firefly(RK3399),X86工控机，可参考下面图 [apollo rk3399 rplidar-A1](#)
- 通讯端口
  - 下位机的通讯口，主板通过usb micro口连接至主机(树莓派/RK3288/RK3399/TK1/TX1/TX2/X86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



## 2. 环境搭建与配置

---

## 硬件列表

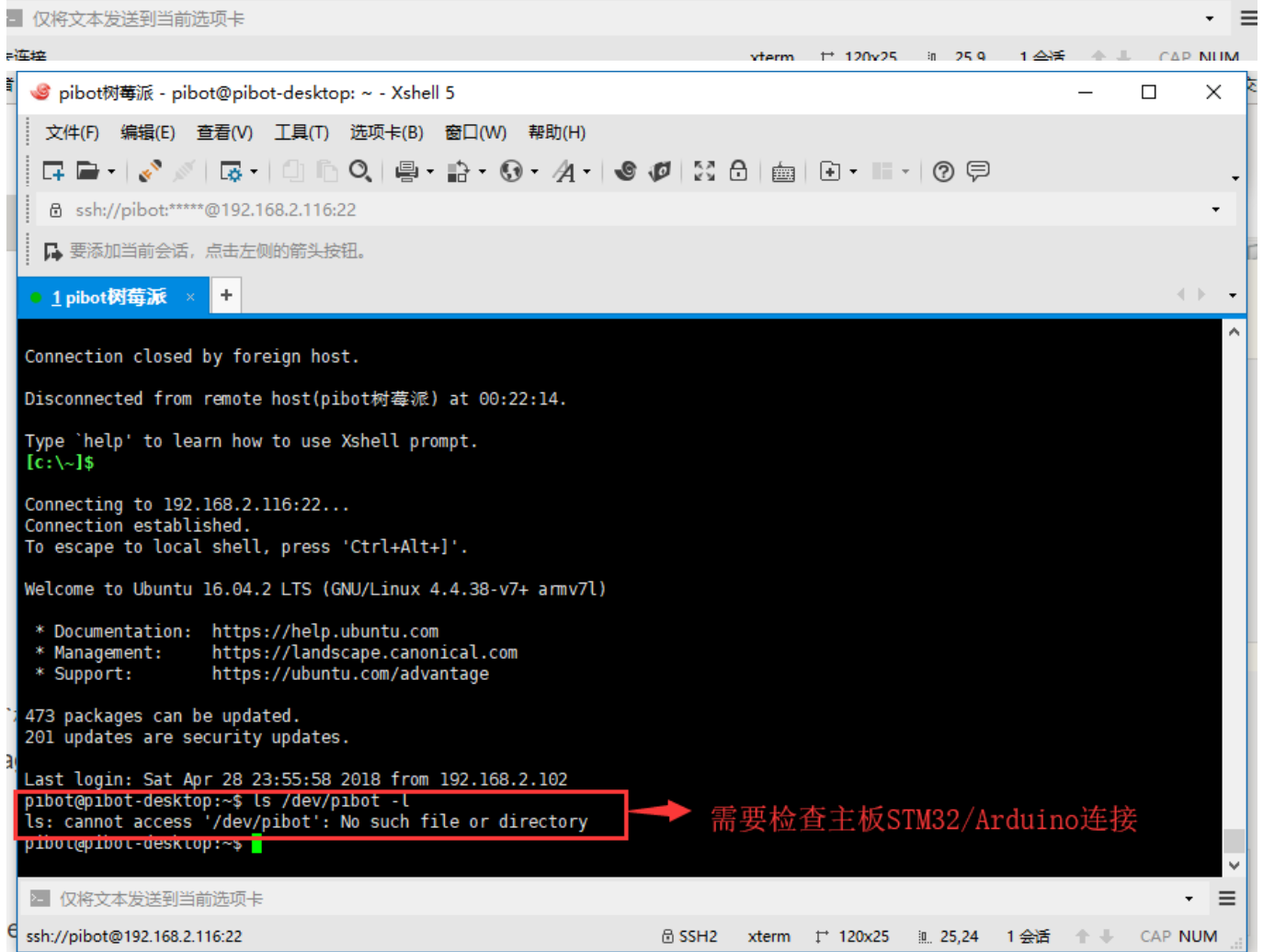
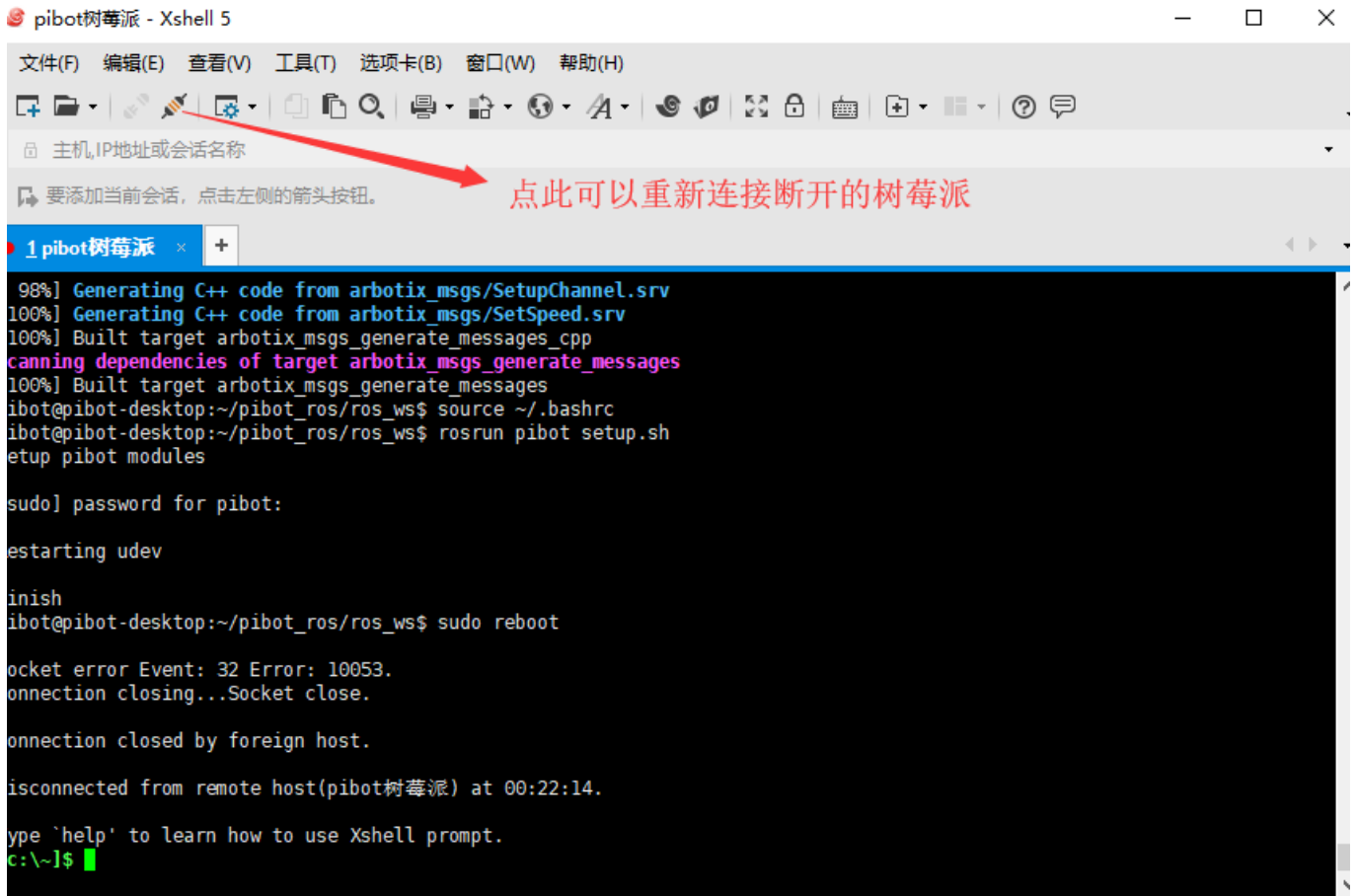
- **PIBOT**下位机 Arduino/STM32F1/F4主板
- **PIBOT**上位机 [树莓派/Nanopi](#)
- 用户主机 [Windows](#)的PC,安装[Vmware](#)虚拟机,和[XShell](#)工具

## 2.1 联网配置

- [树莓派](#)上电后会释放名字为**pibot\_ap**的无线网,该无线网密码也为**pibot\_ap**, 树莓派IP固定为**192.168.12.1**
- [Windows](#)主机连接到**pibot\_ap**无线网
- [Vmware](#)虚拟机桥接到无线网卡,具体虚拟机网络配置请参考[Windows下安装Ubuntu虚拟机及ROS](#),配置完成后打开终端输入**ifconfig**查看**ip**,可以得到**192.168.12.xx**即可

## 2.2 配置小车端环境

[Windows](#)下通过[XShell](#)工具远程登入[ROS](#)上位机, 请参考[XShell怎么登陆linux](#)



PIBOT上位机	登入用户名	登入密码	IP
树莓派3B/3B+	pibot	pibot	192.168.12.1
Nanopi RK3399	pi	pi	192.168.12.1

```
# 在Xshell登入后的终端输入
cd ~/pibot_ros

# 同步最新代码 需要使用用户名密码
git pull

#这里根据提示输入小车类型, 控制板类型, 雷达类型, Machine类型(选0),如下图
./pibot_init_env.sh
source ~/.bashrc
cd ~/pibot_ros/ros_ws/

# 编译PIBOT
catkin_make
source ~/.bashrc
```

```
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: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

## 2.3. 配置虚拟机环境

复制pibot\_ros.tar.bz2至主目录,打开终端输入

```
# 虚拟机中打开新终端
cd ~

# 解压
tar jxvf pibot_ros.tar.bz2

cd ~/pibot_ros
#这里根据提示输入小车类型, 控制板类型, 雷达类型, Machine类型(选1), 小车IP(192.168.12.1)
如下图
./pibot_init_env.sh

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

# 编译PIBOT
```

```
catkin_make
source ~/.bashrc
```

```
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:astral,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

## 2.4. 安装Android App至手机

# 3. 建图与导航测试

## 3.1 测试硬件连接

- a. Windows下通过XShell工具远程登入PIBOT上位机,输入命令`ls /dev/pibot -l`检查主板是否连接

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

正常连接输出如下图

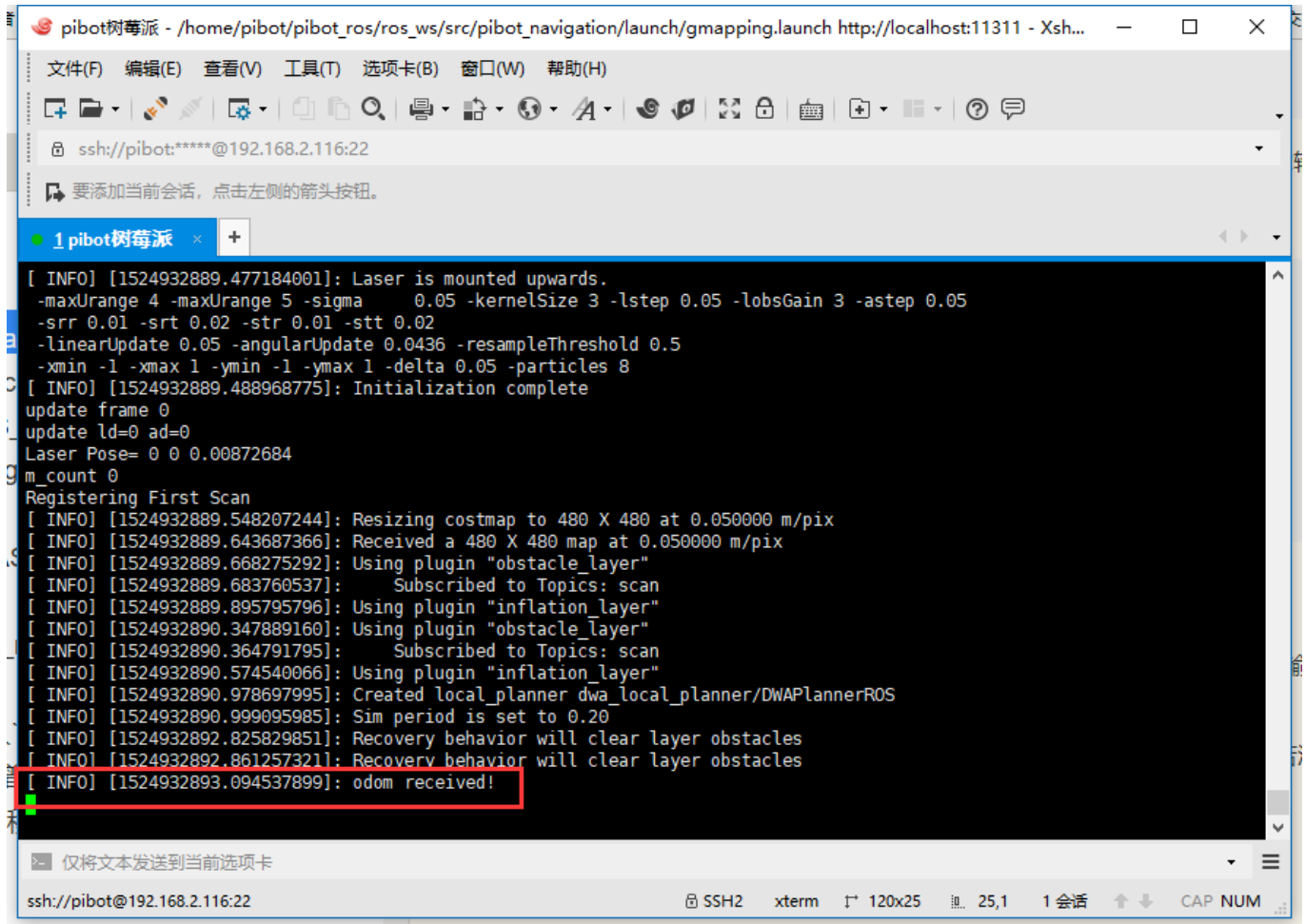
- b.继续输入`ls /dev/ydlidar -l`或者`ls /dev/rplidar -l`(eai x4/g4输入前者, 思岚A1/A2/A3输入后者), 检查激光雷达是否连接

## 3.2 建图

- a.在Windows通过XShell工具远程登入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

```
# 在Xshell登入后的终端输入
pibot_gmapping # 或者roslaunch pibot_navigation gmapping.launch
```





```

[ 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!

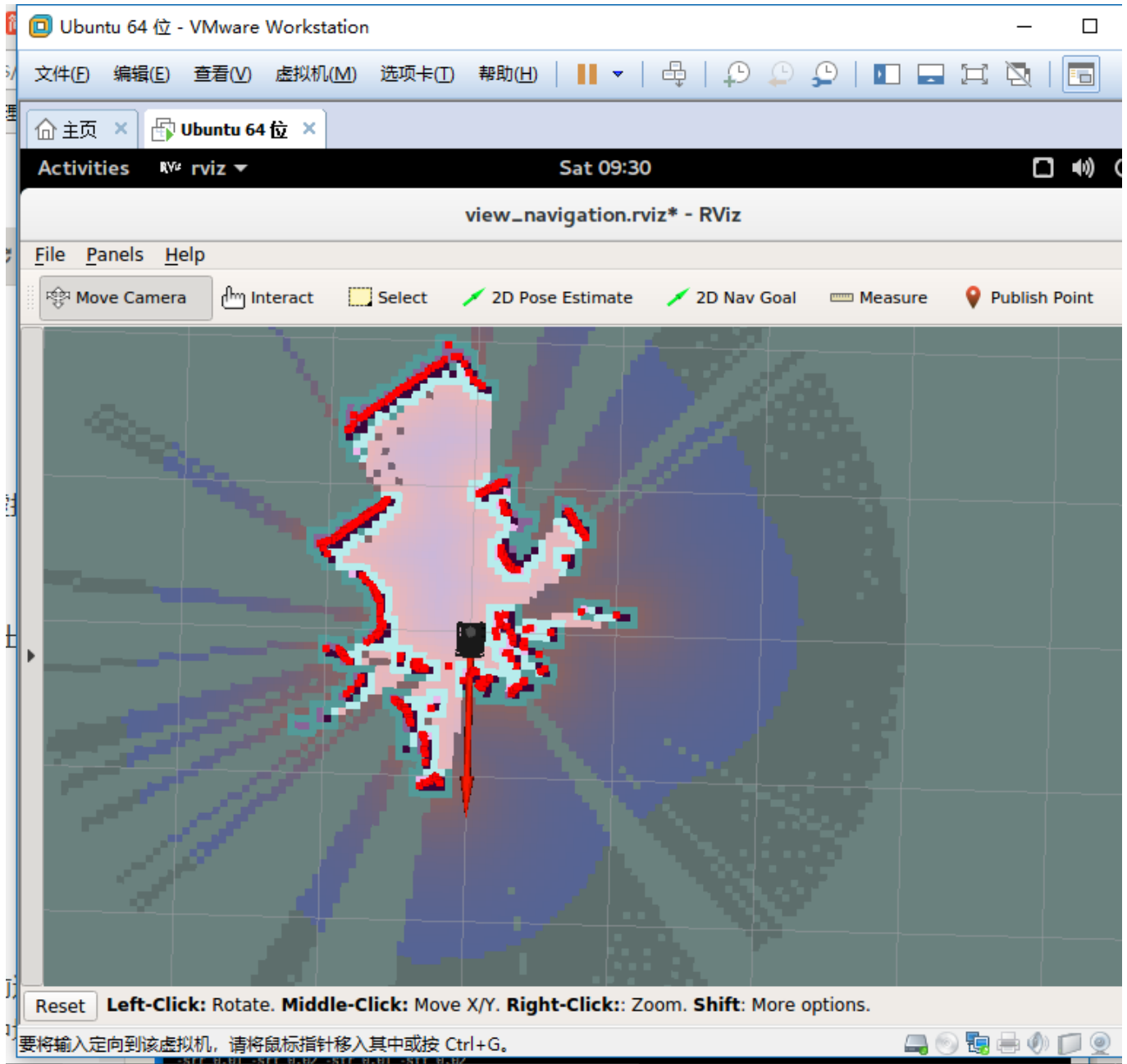
```

- b.在虚拟机终端，输入`piobot_view`或者`roslaunch piobot_navigation view_nav.launch`启动RViz节点,查看地图

```

# 虚拟机中打开新终端
piobot_view # 或者roslaunch piobot_navigation view_nav.launch

```



- c. Windows下通过XShell工具远程登入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/j`控制前进后退，输入`l/r`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

```
# 在Xshell登入后的终端输入
piBOT_control # 或者roslaunch piBOT keyboard_teleop.launch
```

终端窗口标题: `piBOT树莓派 - /home/piBOT/piBOT_ros/ros_ws/src/piBOT_navigation/launch/gmapping.launch http://localhost:11311 - Xsh...`

```

[ 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/DWAPlannerROS
[ 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!

```

任务栏提示: 双击这里可以打开了一个终端

终端窗口标题: `piBOT树莓派 - /home/piBOT/piBOT_ros/ros_ws/src/piBOT/launch/keyboard_teleop.launch http://localhost:11311 - Xshell 5`

```

ROS_MASTER_URI=http://localhost:11311
process[teleop_twist_keyboard-1]: started with pid [2851]
Reading from the keyboard and Publishing to Twist!
-----
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 0.2    turn 1.0

```

### 3.3 保存地图

- Windows下通过XShell工具远程登入PIBOT上位机, 输入

```
# 在Xshell登入后的终端输入
roscd pibot_navigation/maps

#(xxx)为设置新建好的地图名称
roslaunch map_server map_saver -f xxx #或者roslaunch pibot_navigation save_map.launch
map_name:=xxx
```

```
pibot树莓派 - pibot@pibot-desktop: ~ - Xshell 5
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

Ctrl+C退出所有的程序和终端

- a.Windows下通过XShell工具远程登入PIBOT上位机, 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)

```
# 在Xshell登入后的终端输入

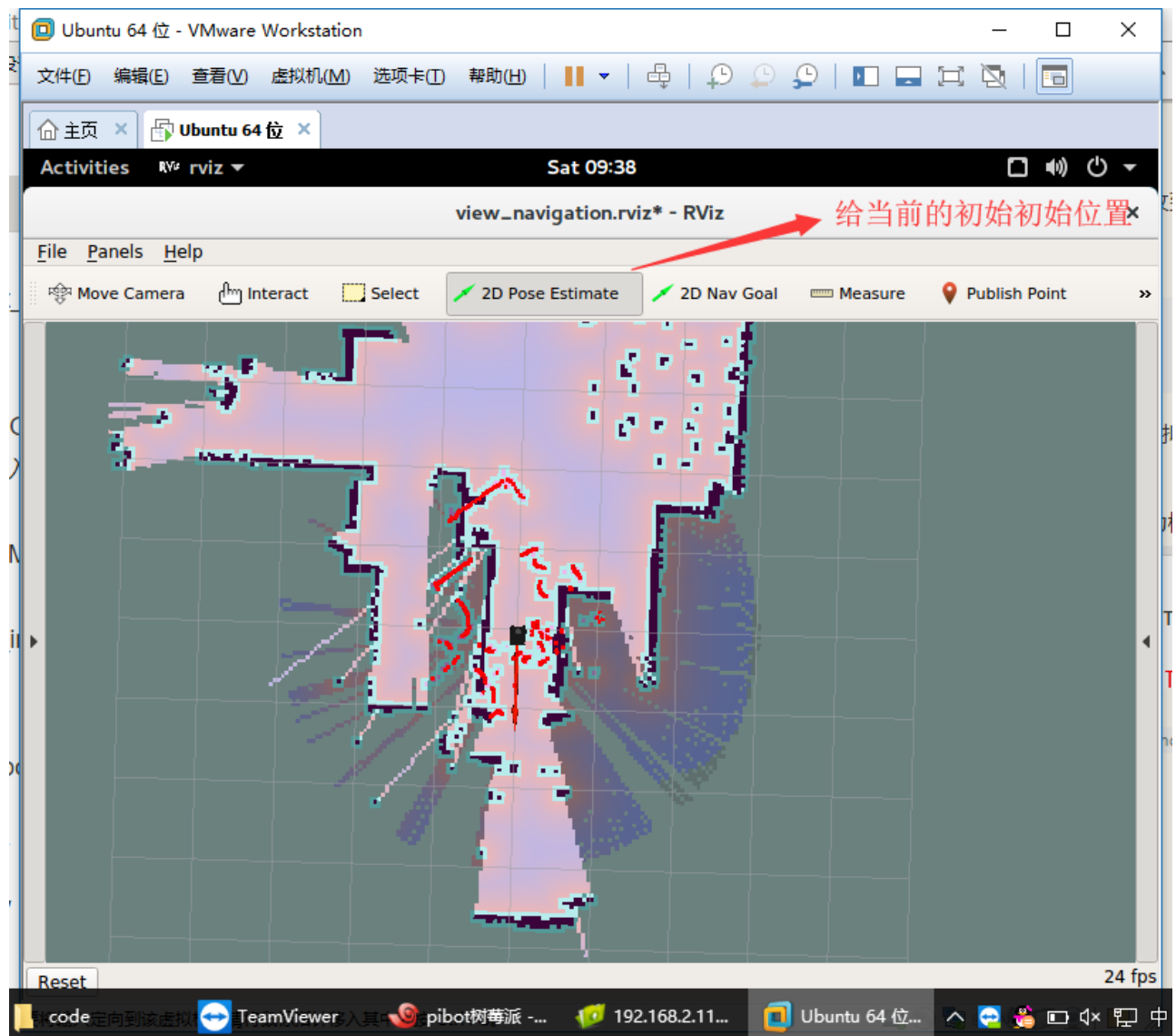
#`xxx`为之前新建好的地图名称
pibot_navigation # 或者roslaunch pibot_navigation nav.launch map_name:=xxx.yaml
```

- b.在虚拟机中, 输入pibot\_view或者roslaunch pibot\_navigation view\_nav.launch启动RViz节点,查看地图

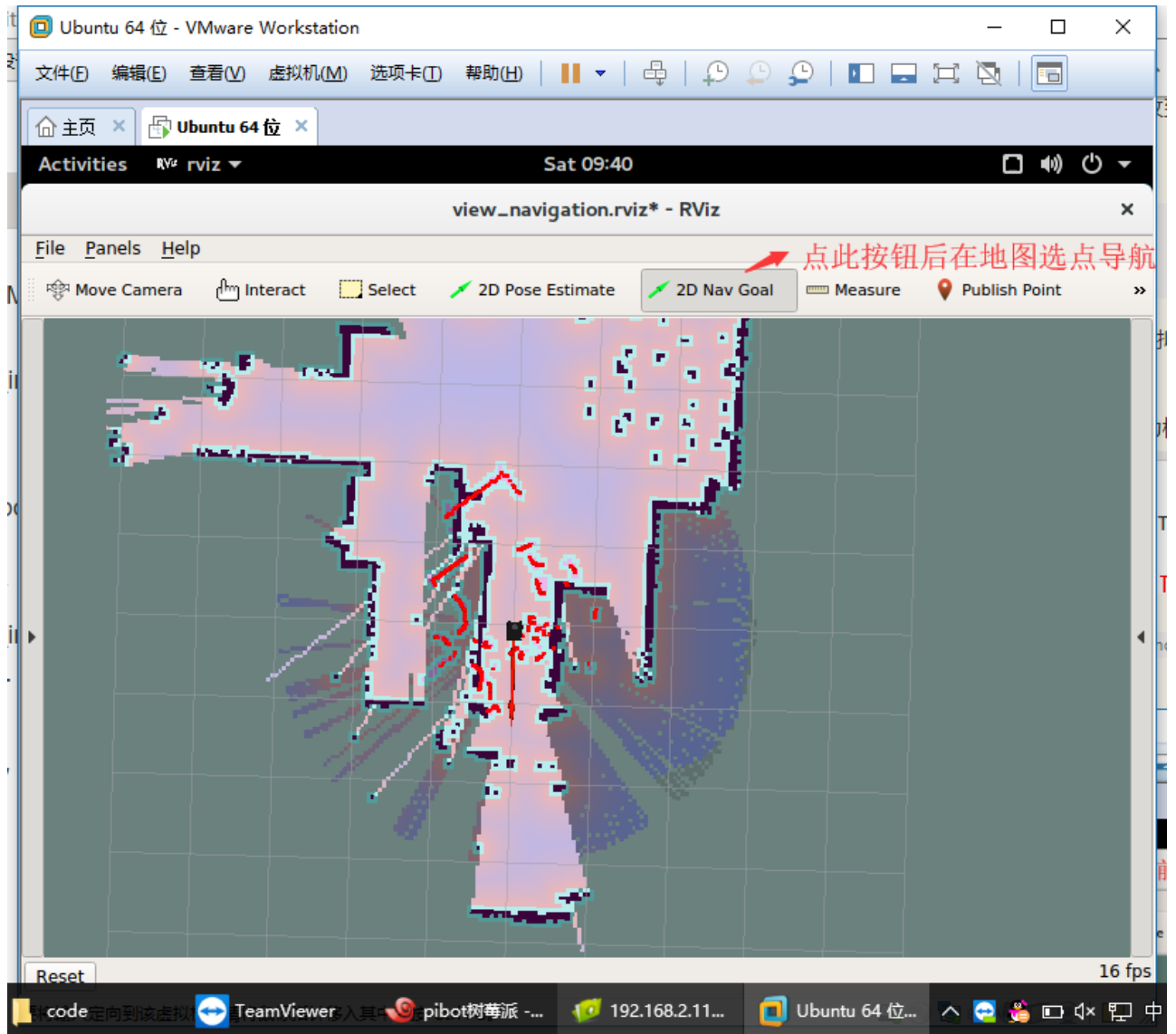
```
# 虚拟机中打开新终端
```

```
piBOT_view # 或者roslaunch piBOT_navigation view_nav.launch
```

- c. 在b中虚拟机打开的RViz中, 设置小车当前位置和方向



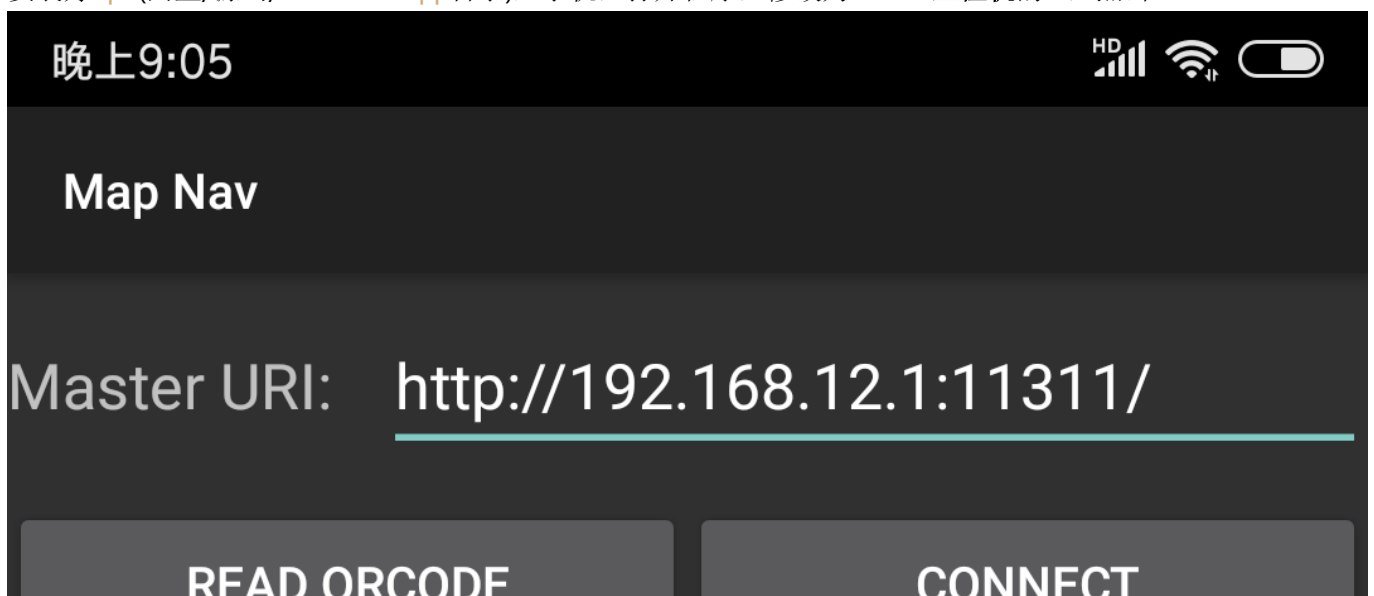
- d.在b中虚拟机打开的RViz中，设置小车目标位置和方向，即可开始导航



### 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piobot\_ap)，开启建图或者导航程序

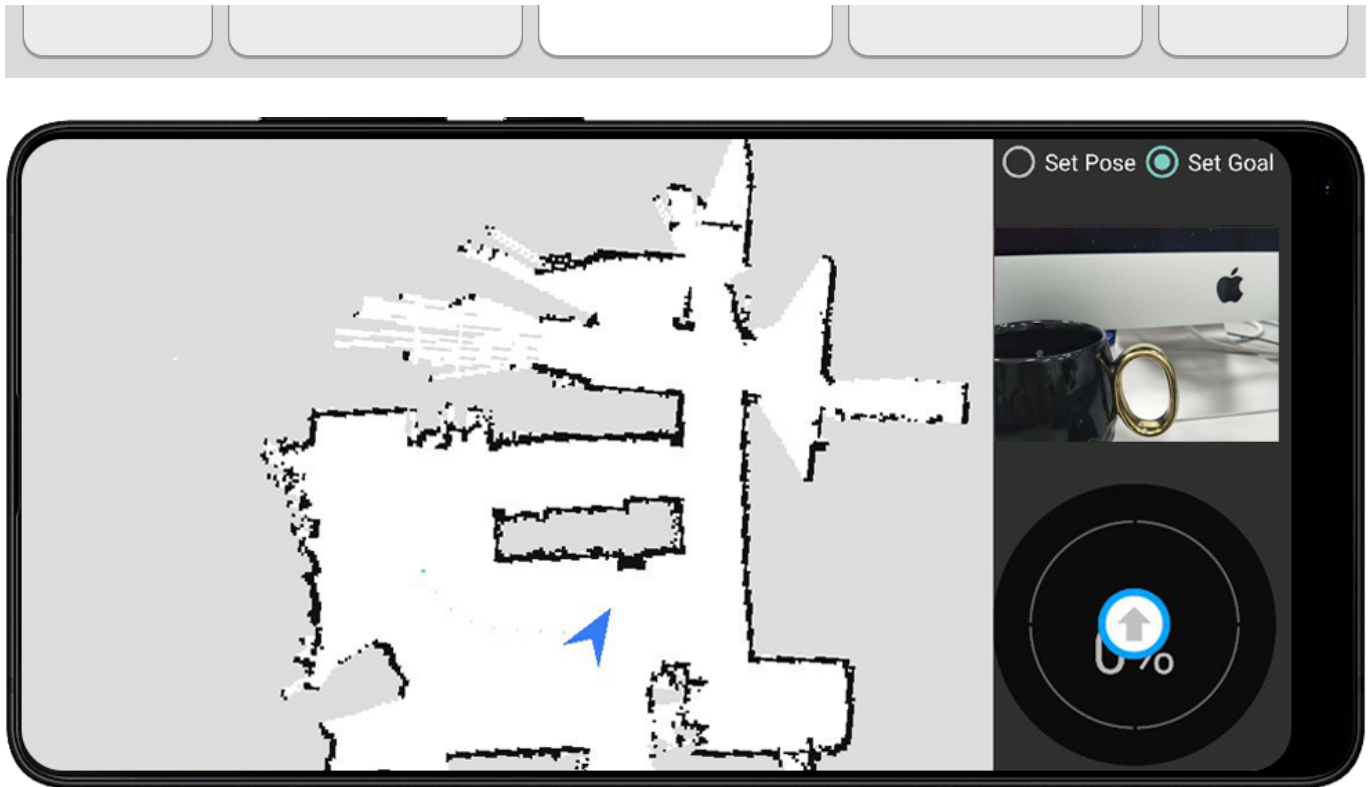
安装好apk(网盘/源码/Android App目录)至手机，打开程序，修改为PIBOT上位机的IP，点击CONNECT



Show advanced options

CANCEL





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(不包括kinect等深度摄像头)

```
# 在Xshell登入后的终端输入  
roslaunch pibot usb_camera.launch
```