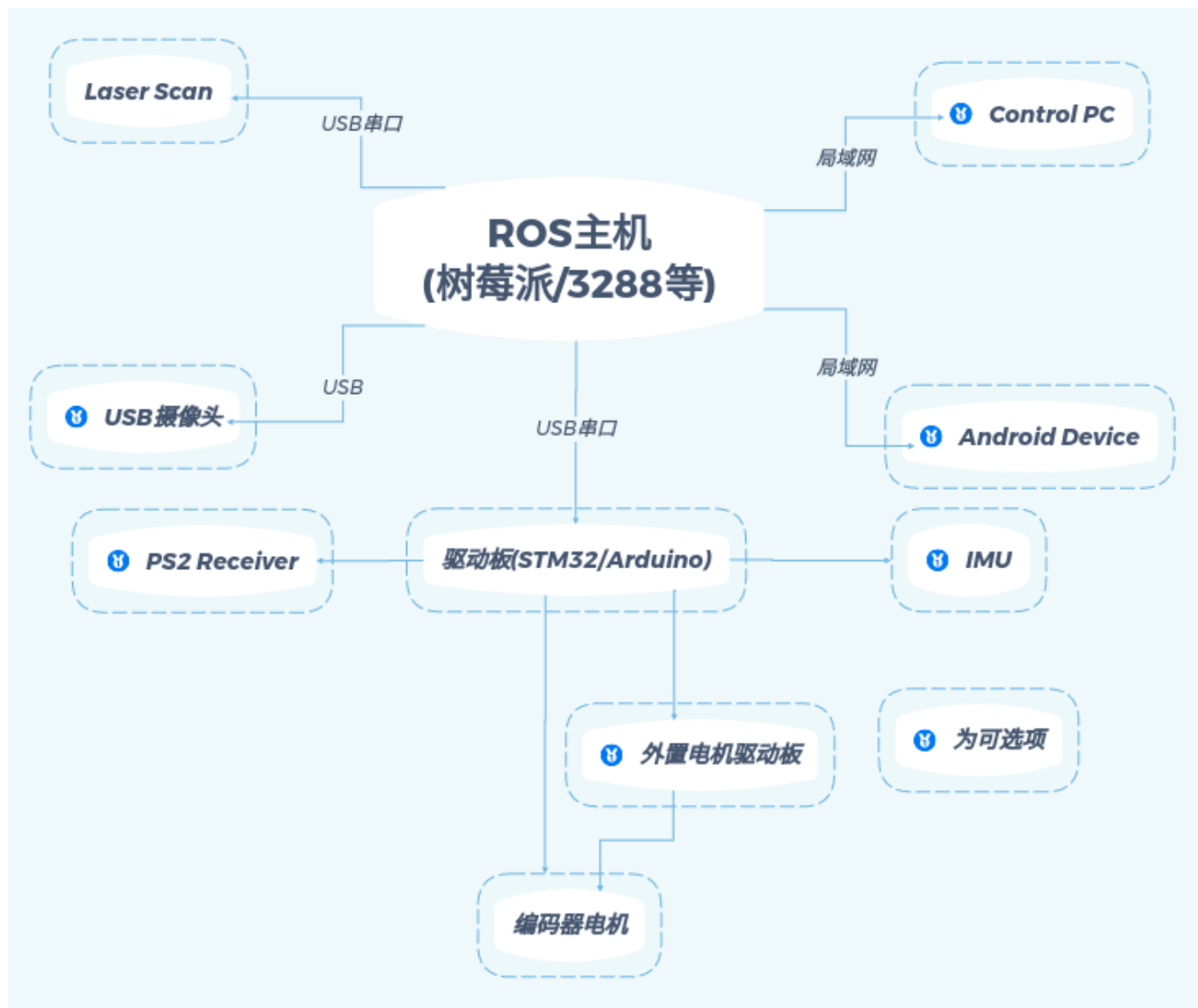


- 1. 硬件连接与安装
  - 1.1 硬件连接示意图
  - 1.2 安装
  - 1.3 接线
- 2. 环境搭建与配置
  - 2.1 联网配置
  - 2.2 配置小车端环境
  - 2.3 配置ubuntu主机环境
  - 2.4. 安装Andriod App至手机
- 3. 建图与导航测试
  - 3.1 测试硬件连接
  - 3.2 建图
  - 3.3 保存地图
  - 3.4 导航
  - 3.5 Android手机APP

## 1. 硬件连接与安装

---

### 1.1 硬件连接示意图

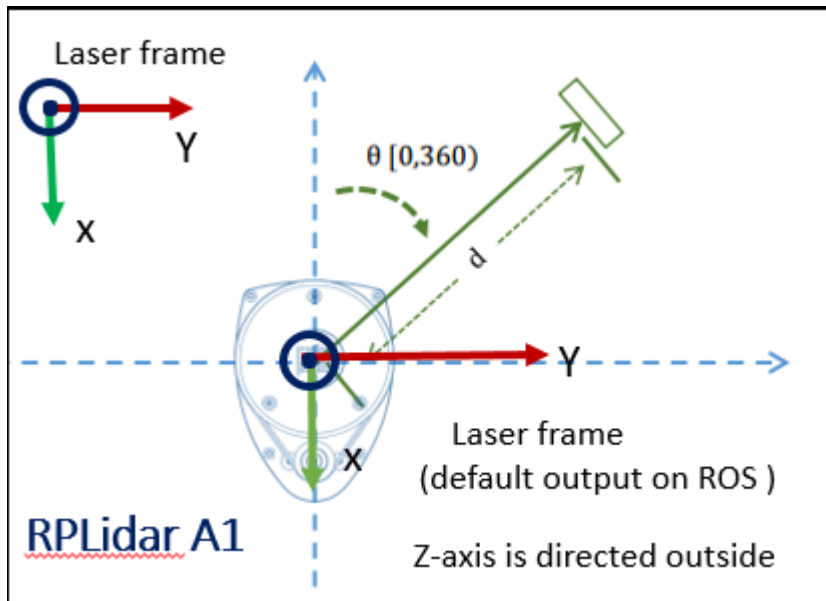


## 1.2 安装

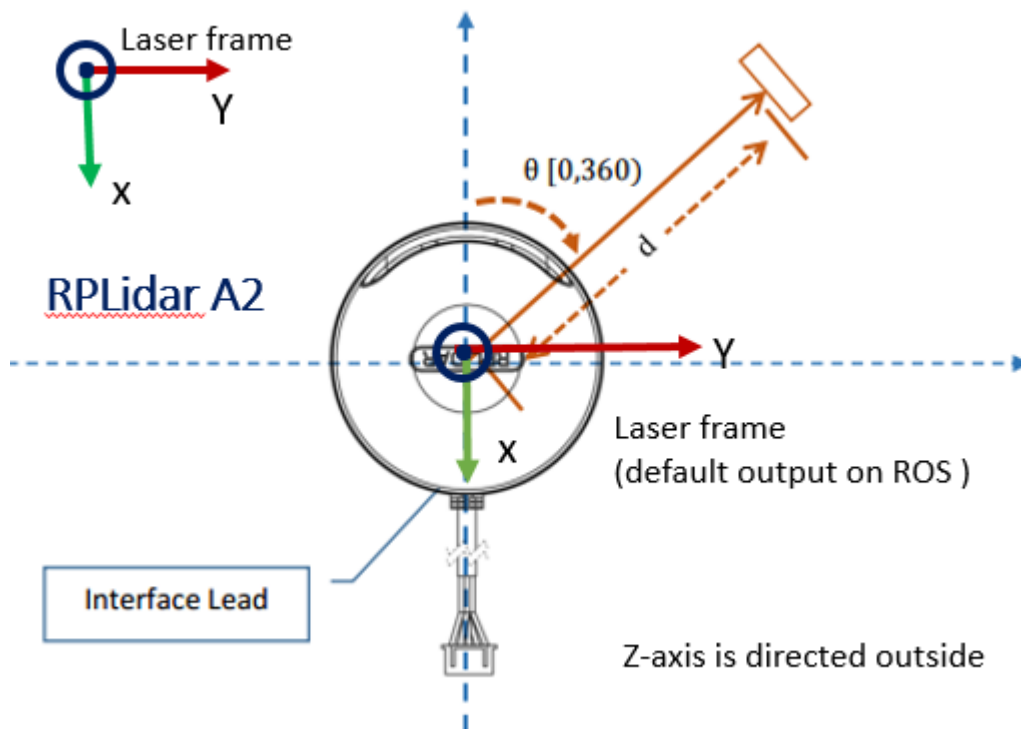
PIBOT调试完成后整体交付，只需要安装雷达或者摄像头支架至顶层板即可

- 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

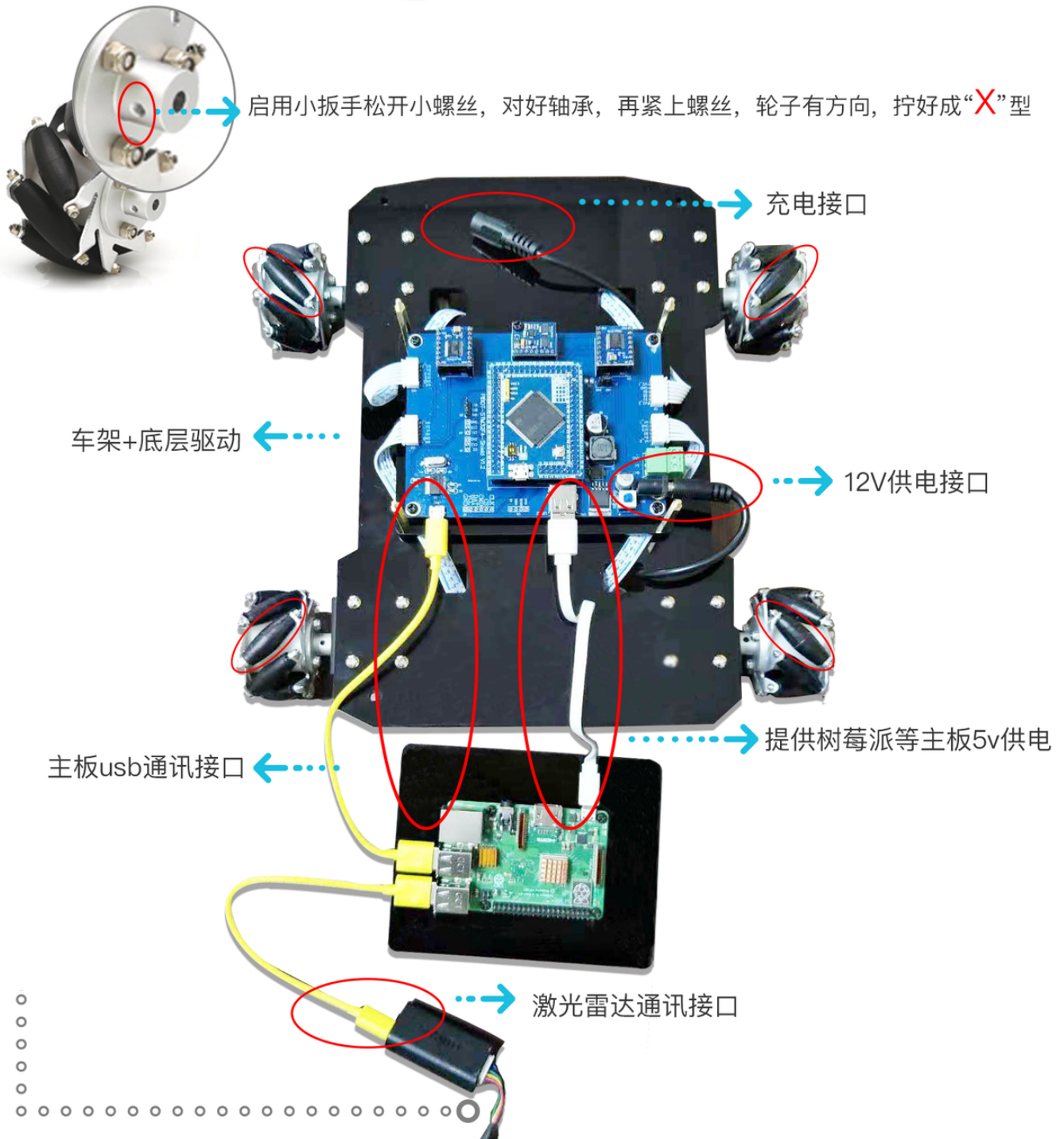
- 电池分别接到电源板和主板给其供电
- 上位机ROS主板/主机供电，主板分2种，一种为5V供电，另一种为12V的
  - 5V供电，通过底板的USB母座提供输出，包括树莓派3b/3b+, nanopi(RK3399)，可参考下面图 [hades 树莓派 rplidar-A2](#)
  - 12V供电，通过底板的USB母座提供输出，包括Firefly(RK3399),X86工控机，可参考下面图 [apollo rk3399 rplidar-A1](#)
- 通讯端口
  - 下位机的通讯口，主板通过usb micro口连接至主机(树莓派/RK3288/RK3399/TK1/TX1/TX2/X86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

## 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
- Ubuntu主机连接到pibot\_ap无线网,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

```
# 打开新终端, 远程登入小车 根据提示输入密码pibot
ssh pibot@192.168.12.1 # nanopi则为ssh pi@192.168.12.1 密码为pi
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:astral,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
*****
```

## 2.3 配置ubuntu主机环境

复制pibot\_ros.tar.bz2至主目录,打开终端输入

```
# 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 communication:
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Andriod App至手机

# 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

```
# 打开新终端, 远程登入小车
ssh pibot@192.168.12.1 # 根据提示输入密码`pibot`
ls /dev/pibot -l
```

```
Last login: Sat Apr 28 23:55:58 2018 from 192.168.2.102
pibot@pibot-desktop:~$ ls /dev/pibot -l
ls: cannot access '/dev/pibot': No such file or directory
pibot@pibot-desktop:~$
```

需要检查主板STM32/Arduino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

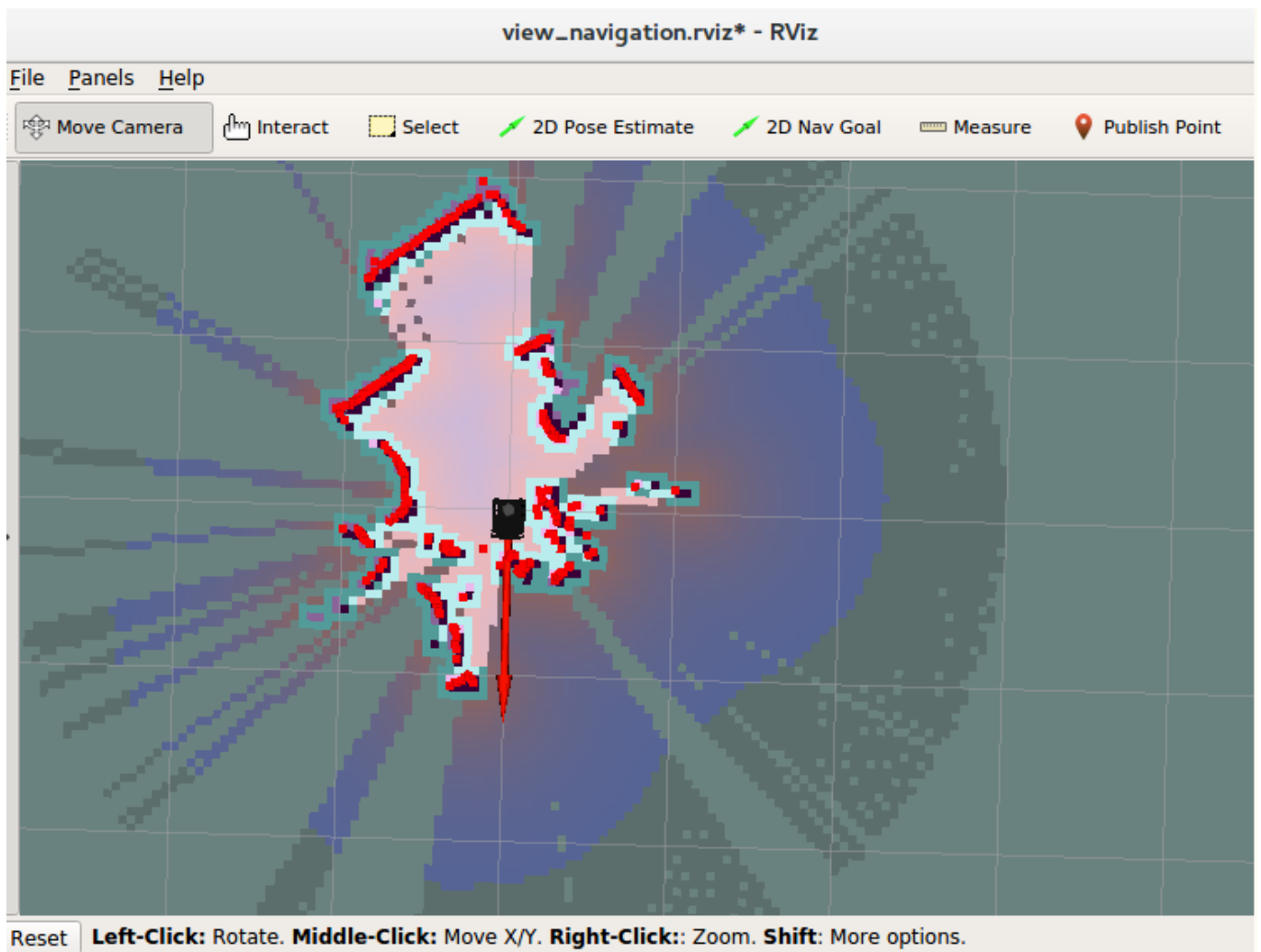
- a.在用户主机通过ssh连接PIBOT上位机, 输入运行`pibot_gmapping`或者`roslaunch pibot_navigation gmapping.launch`启动建图节点, 收到最后输出`odom received`表示正常

```
# 打开新终端, 远程登入小车 根据提示输入密码pibot
ssh pibot@192.168.12.1 # nanopi则为ssh pi@192.168.12.1 密码为pi
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.在用户主机的UBUNTU虚拟机终端, 输入`pibot_view`或者`roslaunch pibot_navigation view_nav.launch`启动RViz节点,查看地图

```
# 打开新终端
pibot_view # 或者roslaunch pibot_navigation view_nav.launch
```



- 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

```
# 打开新终端，远程登入小车
pibot_control # 或者roslaunch pibot keyboard_teleop.launch
```



```

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

- 在用户主机通过ssh连接PIBOT上位机，输入

```

# 打开新终端，远程登入小车 根据提示输入密码pibot
ssh pibot@192.168.12.1 # nanopi则为ssh pi@192.168.12.1 密码为pi
roscd pibot_navigation/maps

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

```

```

pibot@pibot-desktop:~$ clear
pibot@pibot-desktop:~$ rosvun 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

```

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.在用户主机通过ssh连接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)

```

# 打开新终端，远程登入小车 根据提示输入密码pibot
ssh pibot@192.168.12.1 # nanopi则为ssh pi@192.168.12.1 密码为pi

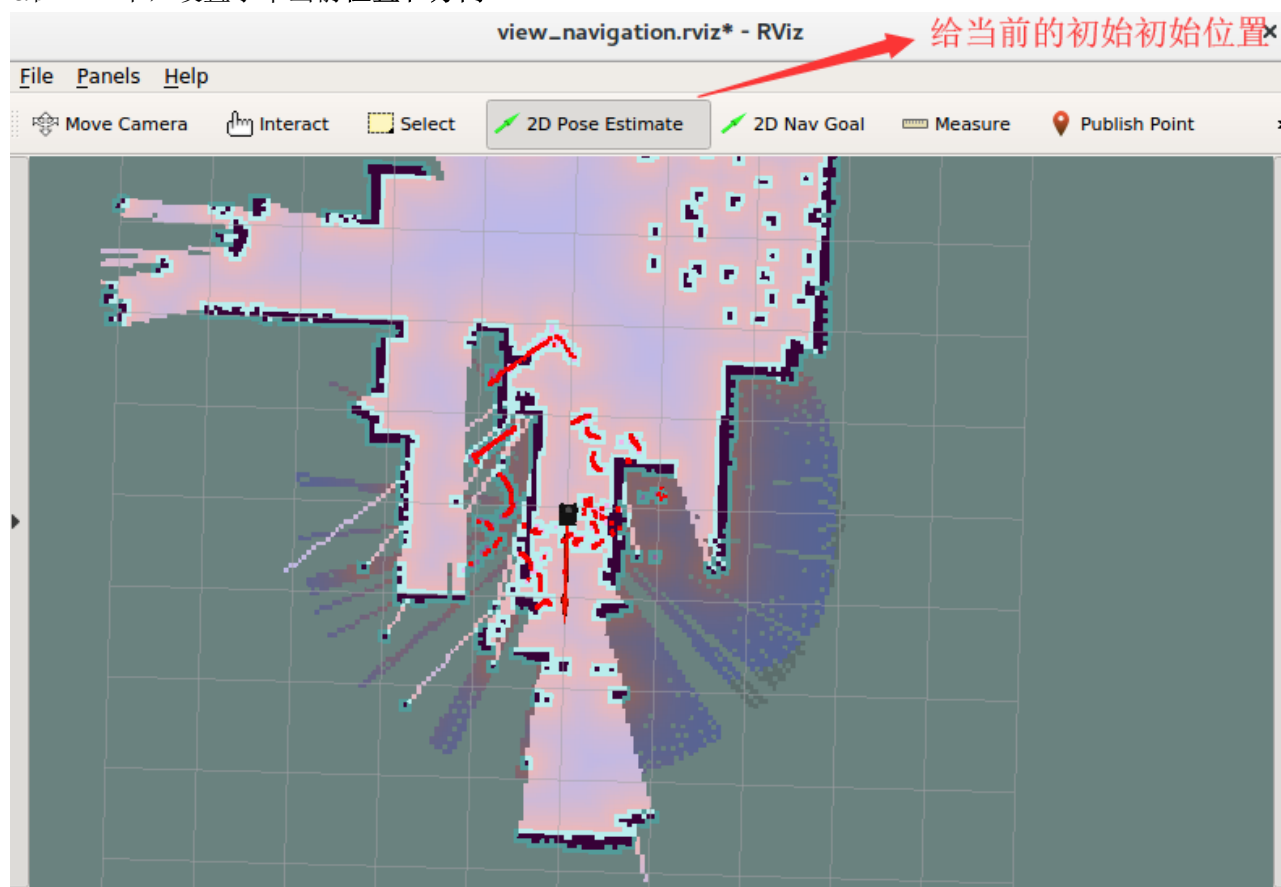
```

```
# `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
```

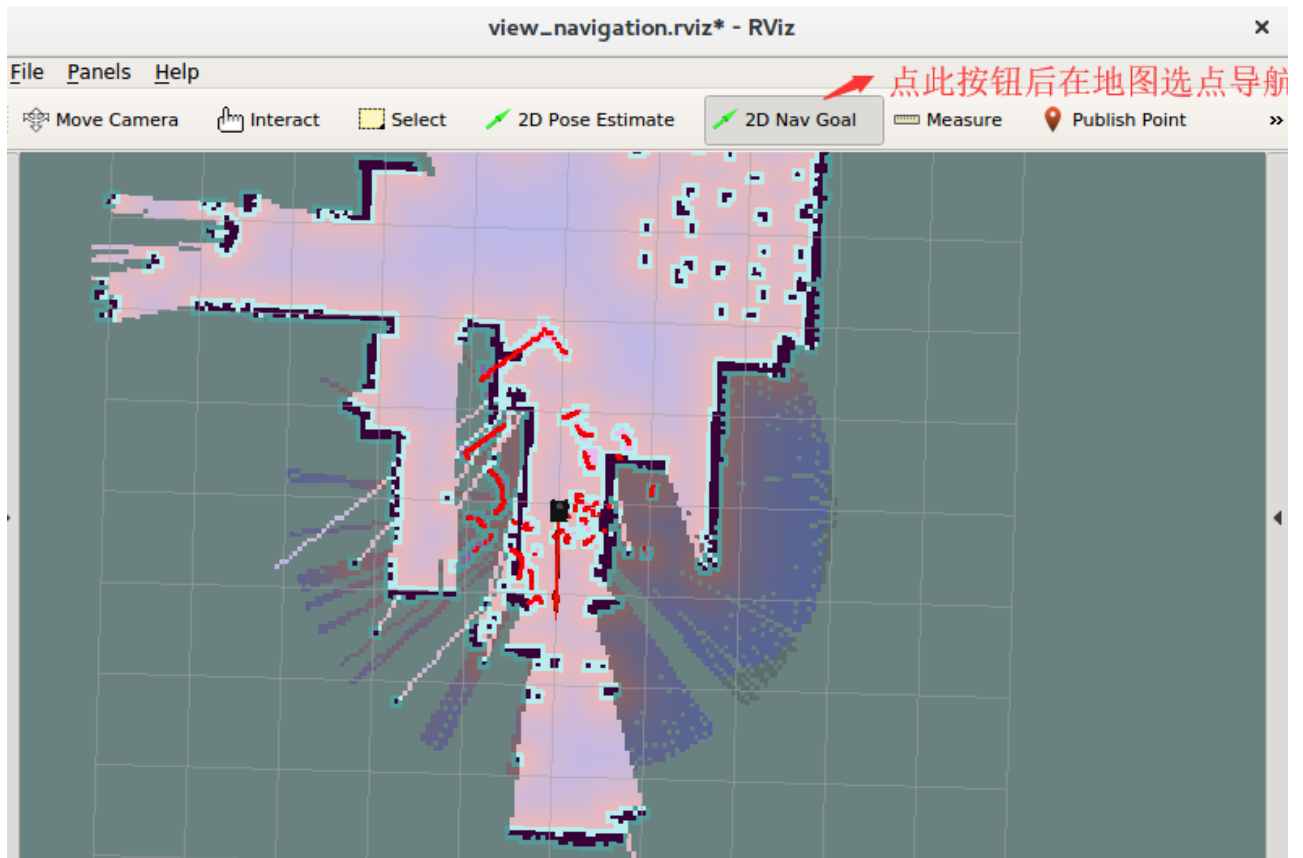
- b.在用户主机中, 输入`piBOT_view`或者`roslaunch piBOT_navigation view_nav.launch`启动RViz节点,查看地图

```
# 打开新终端  
piBOT_view # 或者roslaunch piBOT_navigation view_nav.launch
```

- c.在RViz中, 设置小车当前位置和方向



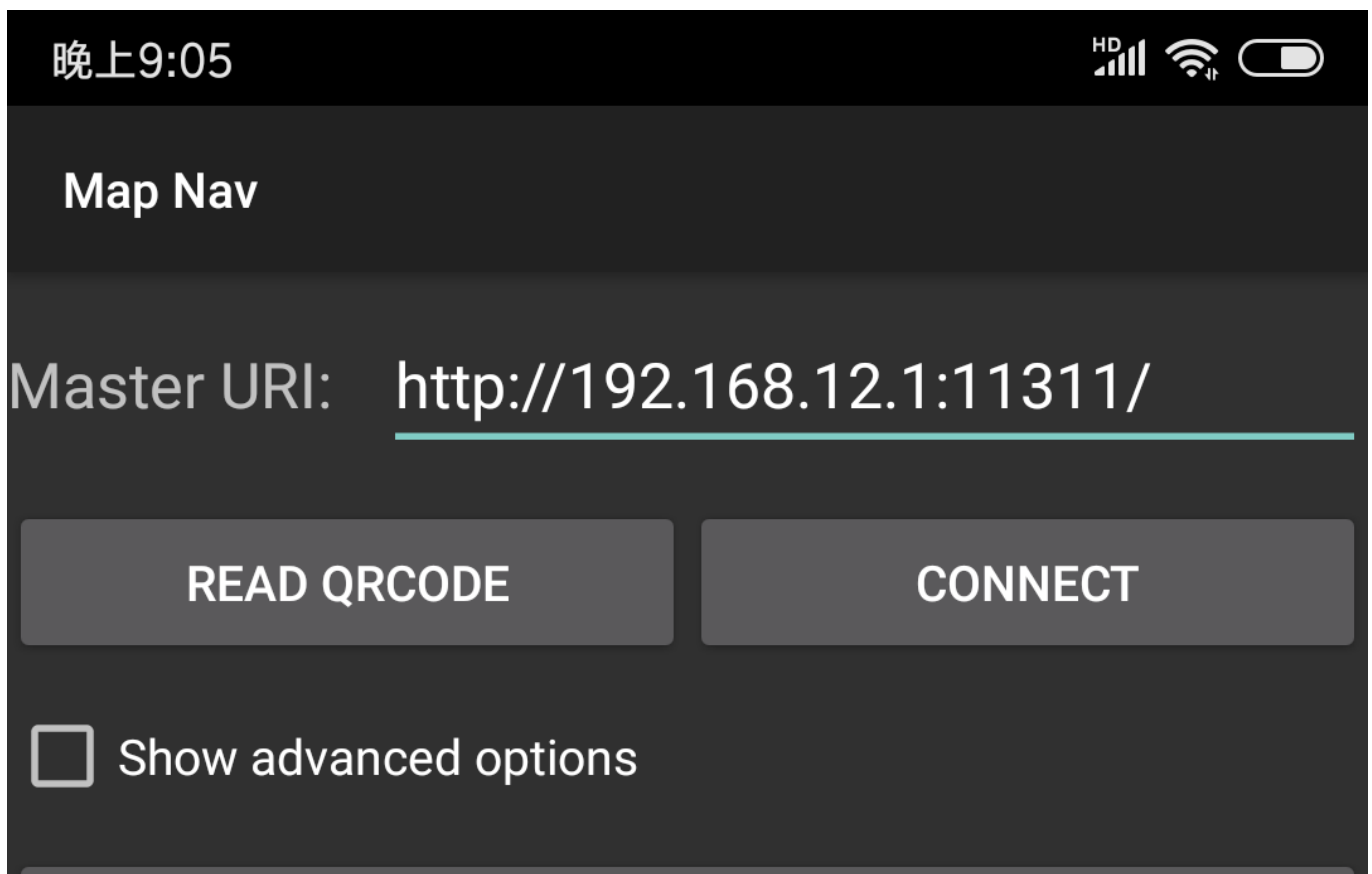
- d.在RViz中，设置小车目标位置和方向，即可开始导航

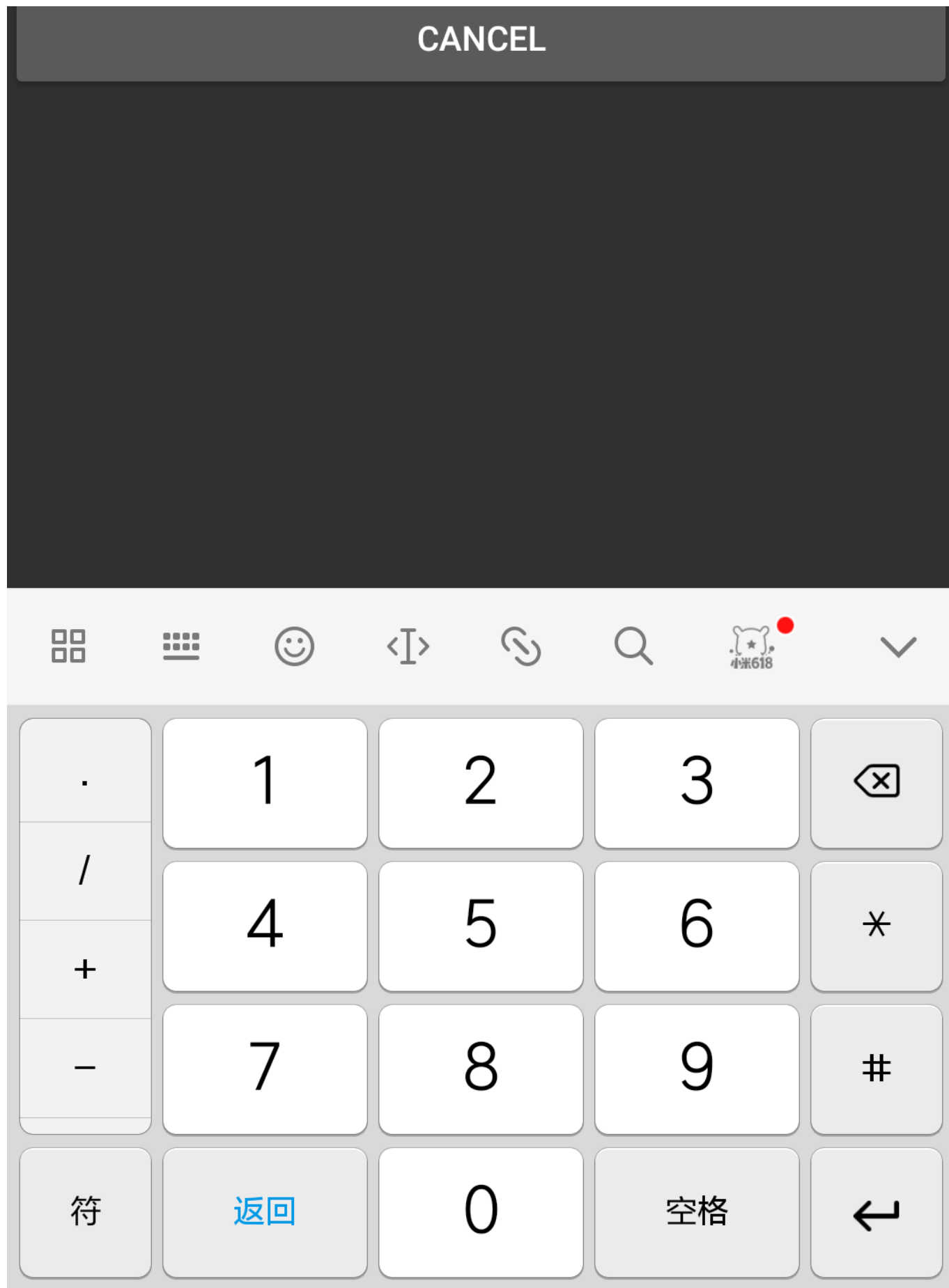


### 3.5 Android手机APP

手机连接无线网pibot\_ap,密码也为pibot\_ap, 执行上面 3.2 建图或者3.4 导航

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(192.168.12.1)，点击CONNECT







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)

```
# 打开新终端, 远程登入小车 根据提示输入密码pibot  
ssh pibot@192.168.12.1 # nanopi则为ssh pi@192.168.12.1 密码为pi  
  
roslaunch pibot usb_camera.launch
```