6. Pure visual 2D mapping navigation

depthimage_to_laserscan: http://wiki.ros.org/depthimage_to_laserscan

depthimage_to_laserscan source code: https://github.com/ros-perception/depthimage_to_laserscan

6.1. Introduction

depthimage_to_laserscan takes a depth image (float encoded meters or preferably uint16 encoded millimeters for OpenNI devices) and generates a 2D laser scan based on the provided parameters. depthimage_to_laserscan uses delayed subscription, which does not subscribe to image or camera information until a user scans.

The depthimage_to_laserscan function package converts depth images into lidar data, and its mapping and navigation functions are the same as lidar. Note: The scanning range of the depth camera is not 360°.

6.2. Use

Note: Pure depth mapping navigation in this section does not work well and is not recommended.

Note: When building a map, the slower the speed, the better the effect (note that the rotation speed should be slower). If the speed is too fast, the effect will be poor.

According to different models, you only need to set the purchased model in [.bashrc], X1 (normal four-wheel drive) X3 (Mailun) Take X3 as an example

```
#Raspberry Pi 5 master needs to enter docker first, please perform this step
#If running the script into docker fails, please refer to ROS/07, Docker tutorial
~/run_docker.sh
```

Open the [.bashrc] file

```
sudo vim .bashrc
```

Find the [ROBOT_TYPE] parameters and modify the corresponding car model

```
export ROBOT_TYPE=X3 # ROBOT_TYPE: X1 X3 X3plus R2 X7
```

6.2.1. Map construction

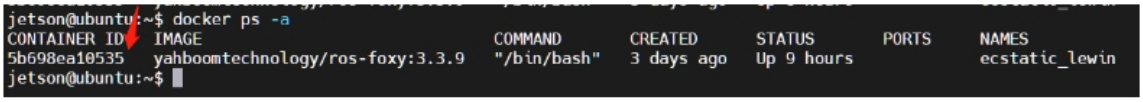
Start command (robot side)

```
roslaunch yahboomcar_nav astrapro_bringup.launch
```

<PI5 needs to open another terminal to enter the same docker container

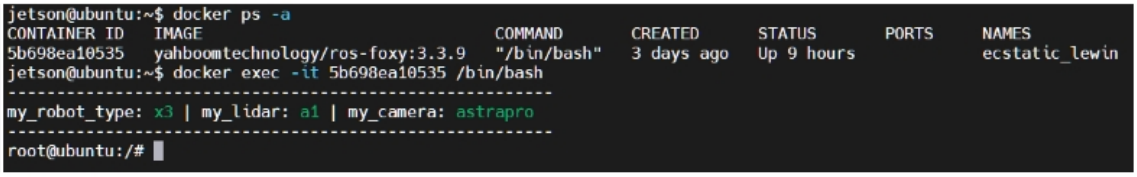
1. In the above steps, a docker container has been opened. You can open another terminal on the host (car) to view:

```
docker ps -a
```



2. Now enter the docker container in the newly opened terminal:

```
docker exec -it 5b698ea10535 /bin/bash
```



After successfully entering the container, you can open countless terminals to enter the container.

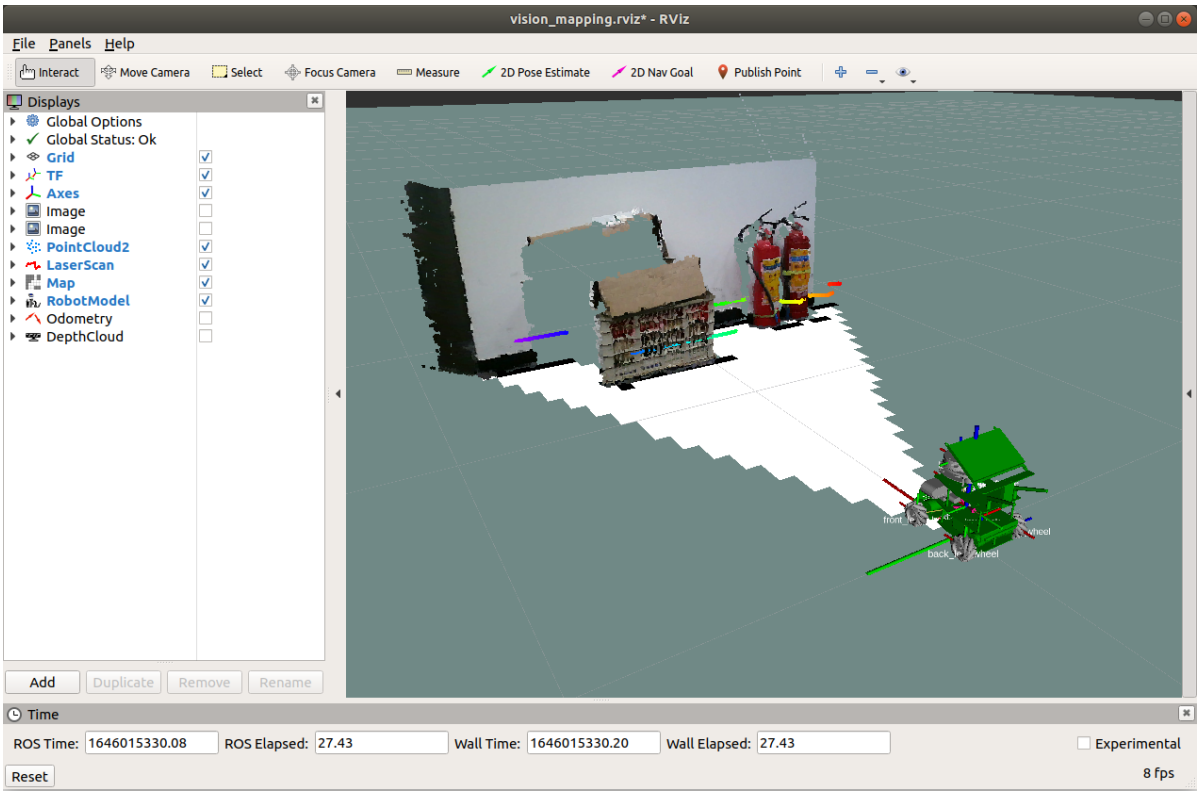
Mapping command (robot side)

```
roslaunch yahboomcar_nav yahboomcar_map.launch use_rviz:=false map_type:=gmapping
```

- [use_rviz] parameter: whether to enable rviz visualization.
- [map_type] parameter: Set the mapping algorithm [gmapping].

Turn on the visual interface (virtual machine side)

```
roslaunch yahboomcar_nav view_vision_mapping.launch
```



6.2.2. Controlling the robot

- Keyboard controls robot movement

```
rosrun teleop_twist_keyboard teleop_twist_keyboard.py # System integration
roslaunch yahboomcar_ctrl yahboom_keyboard.launch # Custom
```

- Control the robot movement with the handle

There may be some scattered points during the mapping process. If the mapping environment is well closed, relatively regular, and the movement is slow, the scattering phenomenon will be much smaller.

6.2.3. Map saving

```
rosrun map_server map_saver -f ~/yahboomcar_ws/src/yahboomcar_nav/maps/my_map #
The first way
bash ~/yahboomcar_ws/src/yahboomcar_nav/maps/map.sh # The second way
```

The map will be saved to the ~/yahboomcar_ws/src/yahboomcar_nav/maps/ folder, a pgm image and a yaml file.

map.yaml

```
image: map.pgm
resolution: 0.05
origin: [-15.4,-12.2,0.0]
Negate: 0
occupied_thresh: 0.65
free_thresh: 0.196
```

Parameter analysis:

- image: The path of the map file, which can be an absolute path or a relative path.
- resolution: resolution of the map, meters/pixel
- Origin: 2D pose (x, y, yaw) in the lower left corner of the map. The yaw here is rotated counterclockwise (yaw=0 means no rotation). Many parts of the current system ignore the yaw value.
- negate: whether to reverse the meaning of white/black and free/occupied (the interpretation of the threshold is not affected)
- occupied_thresh: Pixels with an occupation probability greater than this threshold will be considered fully occupied.
- free_thresh: Pixels with occupancy probability less than this threshold will be considered completely free.

6.2.4. Navigation

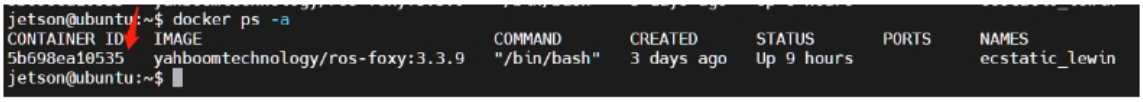
Start command (robot side)

```
roslaunch yahboomcar_nav astrapro_bringup.launch
```

<PI5 needs to open another terminal to enter the same docker container

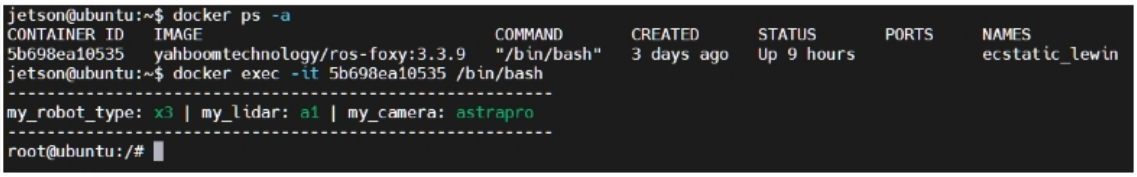
1. In the above steps, a docker container has been opened. You can open another terminal on the host (car) to view:

```
docker ps -a
```



2. Now enter the docker container in the newly opened terminal:

```
docker exec -it 5b698ea10535 /bin/bash
```



After successfully entering the container, you can open countless terminals to enter the container.

Navigation commands (robot side)

```
roslaunch yahboomcar_nav yahboomcar_navigation.launch use_rviz:=false map:=house
```

- [use_rviz] parameter: whether to enable rviz visualization.
- [map_type] parameter: Set the mapping algorithm [gmapping].

Turn on the visual interface (virtual machine side)

```
roslaunch yahboomcar_nav view_navigate.launch
```

1. Single point navigation

- Use the [2D Pose Estimate] of the [rviz] tool to set the initial pose until the position of the car in the simulation is consistent with the position of the actual car.
- Click [2D Nav Goal] of the [rviz] tool, and then select a target point on the map where there are no obstacles. Release the mouse to start navigation. Only one target point can be selected, and it will stop when it is reached.

2. Multi-point navigation

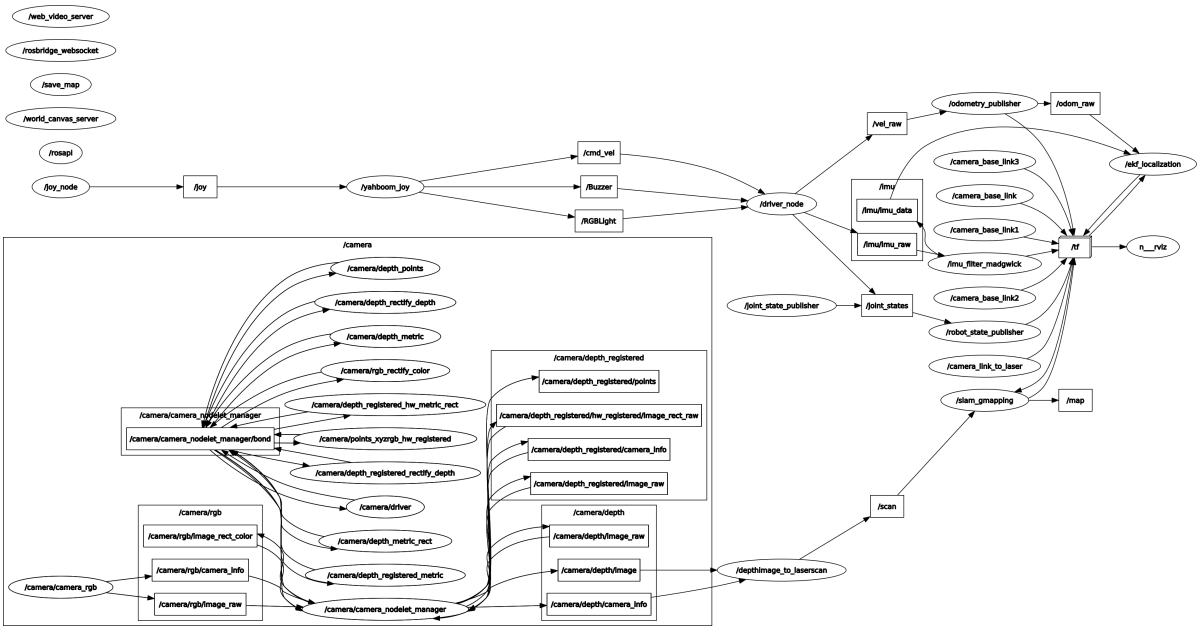
- Same as the first step of single-point navigation, first set the initial pose of the car.
- Click [Publish Point] of the [rviz] tool, and then select the target point on the map where there are no obstacles. Release the mouse to start navigation. You can click [Publish Point] again, and then select the point, and the robot will click on it. Cruising between points.
- When using the [2D Pose Estimate] tool of the [rviz] tool to set the initial pose of the car, the multi-point navigation function is automatically canceled.

6.3. Topics and services

Subscription topic	**Type**	**Description**
image	sensor_msgs/Image	Input image. This can be in floating point or raw uint16 format. For OpenNI devices, uint16 is the native representation and is more efficient to handle. This is usually /camera/depth/image_raw. If your image is distorted, you should remap this theme to image_rect. OpenNI cameras typically have very little distortion, so correction can be skipped for this application.
camera_info	sensor_msgs/CameraInfo	Camera information for the associated image.
Post Topic	**Type**	**Description**
scan	sensor_msgs/LaserScan	Output laser scan. and will output a range array containing NAN and +-INF.

Node view

```
rqt_graph
```



6.4. Configuration parameters

Parameters	Type	Default value	Description
scan_height	int	1 pixel	Number of rows of pixels used to generate the laser scan. For each column, the scan returns the minimum value of the vertically centered pixel in the image.
scan_time	double	1/30.0Hz (0.033s)	Scan interval time (seconds). Typically, a rate of 1.0/frame. This value is not easily calculated from consecutive messages and is therefore set correctly by the user.
range_min	double	0.45m	The minimum range returned in meters. Ranges smaller than this value will be output as -Inf.
range_max	double	10.0m	The maximum range returned in meters. Ranges larger than this value will be output as +Inf.
output_frame_id	str	camera_depth_frame	Laser scanning frame id. For point clouds from Z-forward "optical" frames, this value should be set to the corresponding frames in X-forward and Z-up

6.5, TF transformation

Required TF transformation	Description
laser-->base_link	The transformation between the laser radar coordinate system and the base coordinate system is generally published by robot_state_publisher or static_transform_publisher
base_link-->odom	Transformation between the map coordinate system and the robot odometer coordinate system, estimating the robot's pose in the map
Released TF Transform	**Description**
map-->odom	Transformation between the map coordinate system and the robot's odometry coordinate system, estimating the robot's pose in the map

View tf tree

```
rosrun rqt_tf_tree rqt_tf_tree
```