

# Autonomous Navigation of Bot

## Project Description

The Navigation Stack is fairly simple on a conceptual level. For the project we are going to do whole project using ROS (Robot Operating System)

The Robot Operating System (ROS) is an open-source framework that helps researchers and developers build and reuse code between robotics applications. It takes in information from odometry and sensor streams and outputs velocity commands to send to a mobile base. Use of the Navigation Stack on an arbitrary robot, however, is a bit more complicated.

## Approach

- Design and build your customized physical robot with autonomous navigation capability
- Create a map of your house using the lidar scanner of the robot
- Localize the robot in the map
- Navigate the bot in the map between 2 points in rviz

## Tech Stack

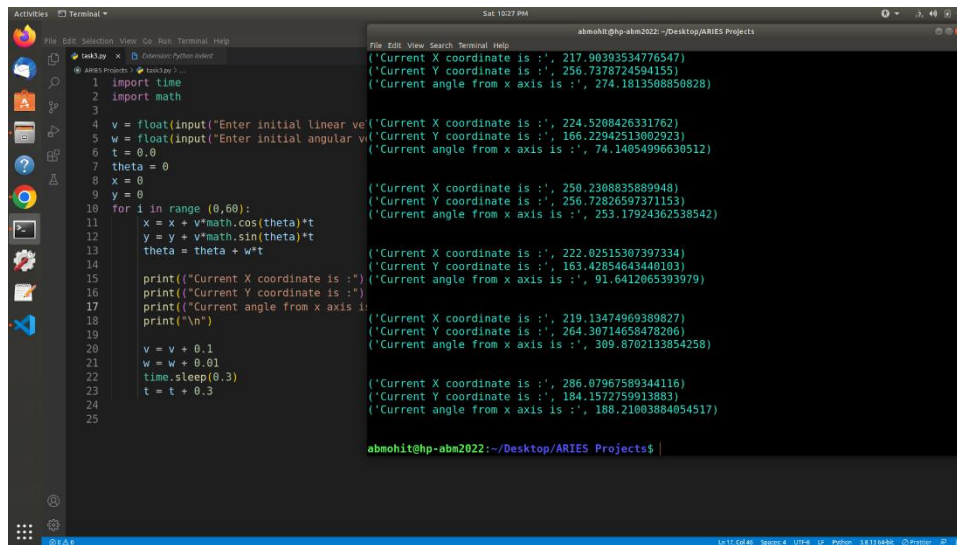
- Google Colab
- Ros-melodic desktop full
- Git and Github
- VS-Code
- Python
- Discord
- Google doc

## TASK

### 1) Turtlebot3 simulation

Create a workspace. Install turtlebot3 packages. Run gazebo simulation. Move the turtlebot using teleop keys.





```
1 import time
2 import math
3
4 v = float(input("Enter initial linear velocity: "))
5 w = float(input("Enter initial angular velocity: "))
6 t = 0.0
7 theta = 0
8 x = 0
9 y = 0
10 for i in range(0,60):
11     x = x + v*math.cos(theta)*t
12     y = y + v*math.sin(theta)*t
13     theta = theta + w*t
14
15     print("Current X coordinate is :", x)
16     print("Current Y coordinate is :", y)
17     print("Current angle from x axis is :", theta)
18     print("\n")
19
20     v = v + 0.1
21     w = w + 0.01
22     time.sleep(0.3)
23     t = t + 0.3
24
25
```

```
(*Current X coordinate is :, 217.90393534776547)
(*Current Y coordinate is :, 256.7378724594155)
(*Current angle from x axis is :, 274.1813598859828)

(*Current X coordinate is :, 224.5208426331762)
(*Current Y coordinate is :, 166.22942513802923)
(*Current angle from x axis is :, 74.14054996530512)

(*Current X coordinate is :, 250.238835889948)
(*Current Y coordinate is :, 256.72826597371153)
(*Current angle from x axis is :, 253.17924362538542)

(*Current X coordinate is :, 222.02515307397334)
(*Current Y coordinate is :, 163.42854643440103)
(*Current angle from x axis is :, 91.6412065393979)

(*Current X coordinate is :, 219.13474969389827)
(*Current Y coordinate is :, 264.30714658478206)
(*Current angle from x axis is :, 309.8702133854258)

(*Current X coordinate is :, 286.07967589344116)
(*Current Y coordinate is :, 184.1572759913883)
(*Current angle from x axis is :, 188.21003884054517)

abnohit@hp-abm2022:~/Desktop/ARIES Projects$
```

#### 4) Reading git repo file of odometry calculation

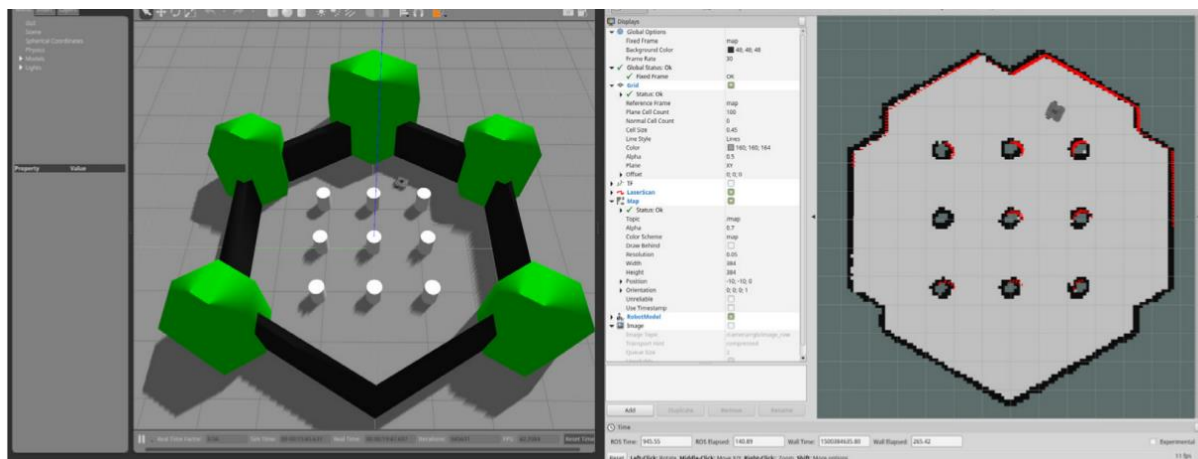
Understanding the concepts involved in publishing of odometry information in ROS.

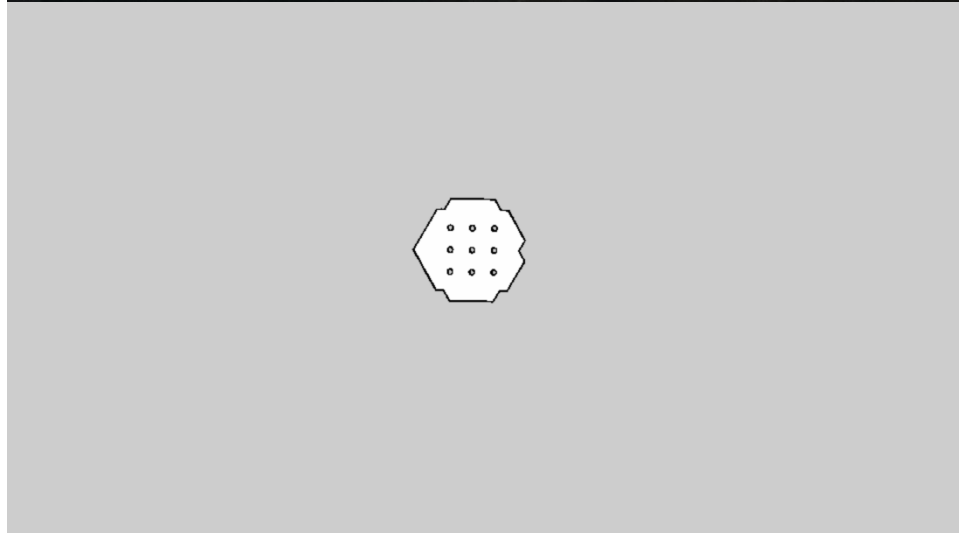
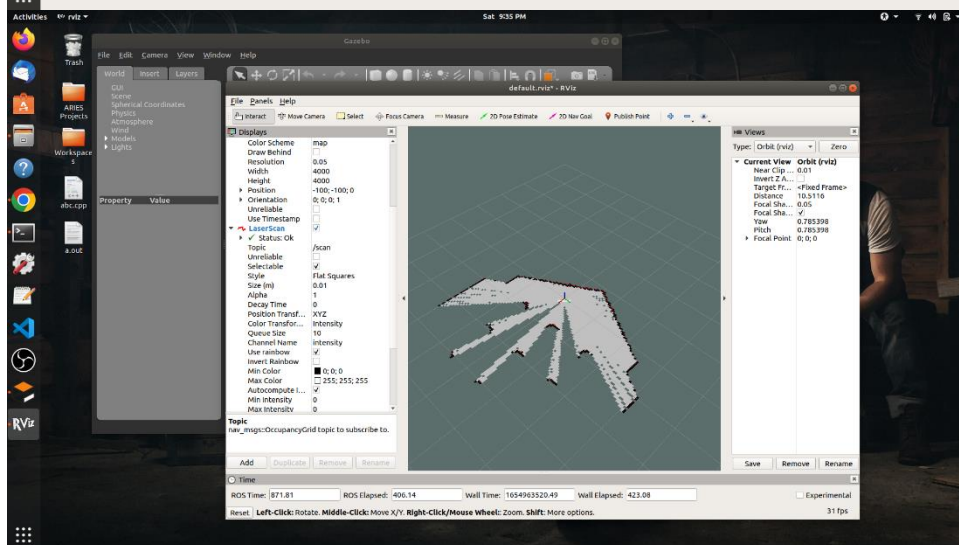
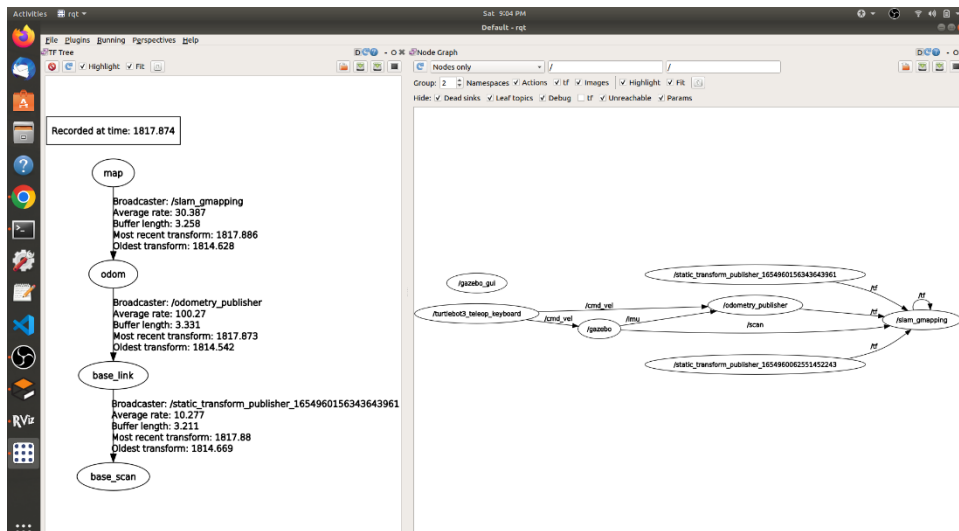
<https://gist.github.com/atotto/f2754f75bedb6ea56e3e0264ec405dcf>

#### 5) Writing custom odometry node

An incomplete python file was to be edited and run. File was written using class. Input is taken from subscribing to relevant topics(cmd\_vel, imu).







Video link :

[https://drive.google.com/file/d/1wilrebbXFib1g707sQ6bZWtSgFik7\\_uS/view?usp=drivesdk](https://drive.google.com/file/d/1wilrebbXFib1g707sQ6bZWtSgFik7_uS/view?usp=drivesdk)

## 7) Localization of bot in map using amcl package

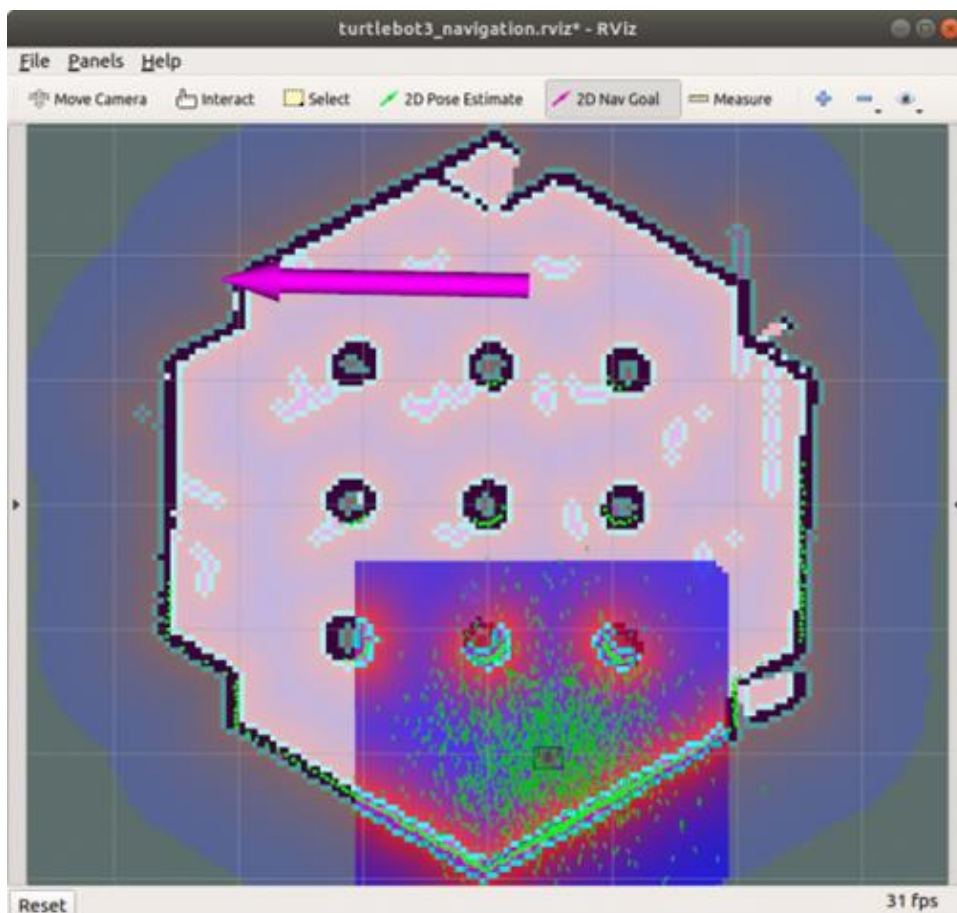
Clone navigation package from git repo in workspace. Move the bot using teleop and compare the coordinates calculated and in gazebo(real world).

Video Link :

<https://drive.google.com/file/d/1O0l1ZoAuxByhk6PiZm1r8EU9cTNCinP4/view?usp=drivesdk>

## 8) Navigation in map using move base

Set initial and final pose in map in Rviz. The bot will now navigate from initial and final pose choosing the shortest path. Instead of calculating Odometry on our own, odometry estimate is taken from turtlebot3 package.



Video Link : <https://drive.google.com/file/d/12U-ZFdfukMCP64UI8YYy5Yr2LTFvG-g/view?usp=sharing>

# References/Resources

- <https://emanual.robotis.com/docs/en/platform/turtlebot3/simulation/>
- <https://gist.github.com/atotto/f2754f75bedb6ea56e3e0264ec405dcf>