Experiment No: 7

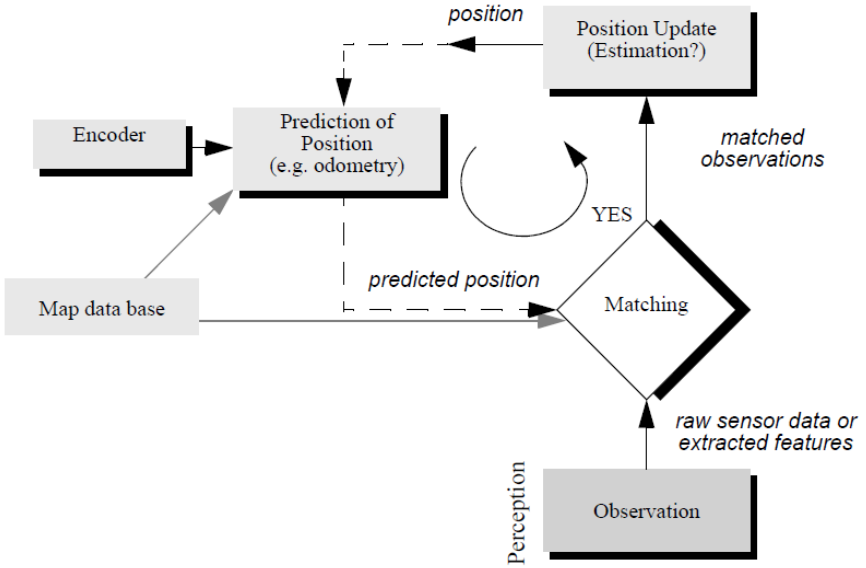
Experiment Name: Localization of a mobile robot using LIDAR

Objective:

Understand how a mobile robot can perform localization. Perform SLAM (Simultaneous Localization And Mapping) operation, save the map and navigate through the map.

Theory:

Localization means the process of a robot identifying its position in the environment.



The SLAMis done using a LIDAR in the turtlebot to understand the operation of Localization. Here the map creation job is also performed along with localization.

LIDAR

LIDAR, which stands for Light Detection and Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the obstacle. These light pulses—generate precise, three-dimensional information about the shape of the obstacle and its surface characteristics

Procedure:

Use ROS, Gazebo and Rviz for this experiment.

Procedure for SLAM

1. Open terminal in ubuntu
   >> cd catkin_ws
   >> TURTLEBOT3_MODEL=burger
   >> roslaunch turtlebot3_gazebo turtlebot3_world.launch
2. New terminal window at catkin_ws
   >> export TURTLEBOT3_MODEL=burger
   >> roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch

3. New terminal window at catkin_ws
   >> export TURTLEBOT3_MODEL=burger
   >> roslaunch turtlebot3_slam turtlebot3_slam.launch slam_methods:=gmapping
4. Now move the turtlebot in the world using control keys in the keyboard allotted by teleop. Once the entire area is scanned; proceed to save the map by following below mentioned steps.
5. New terminal window at catkin_ws
   >>export TURTLEBOT3_MODEL=burger
   >>rosrun map_server map_saver -f ~/map

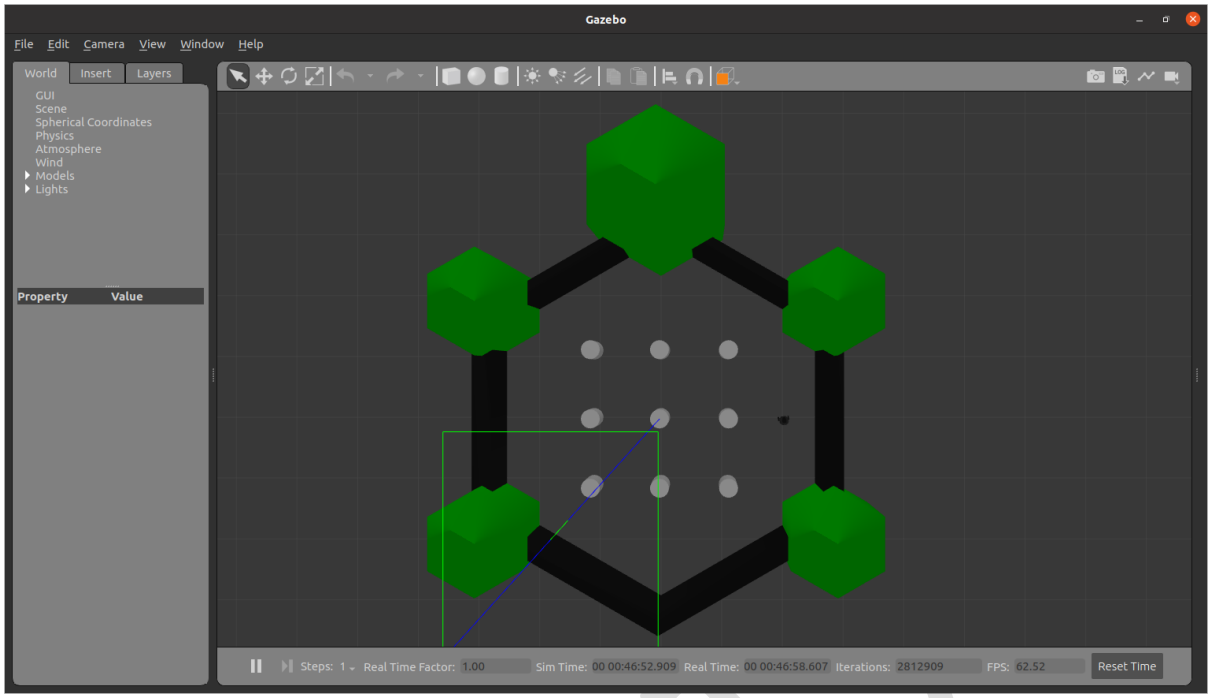
Procedure for Navigation

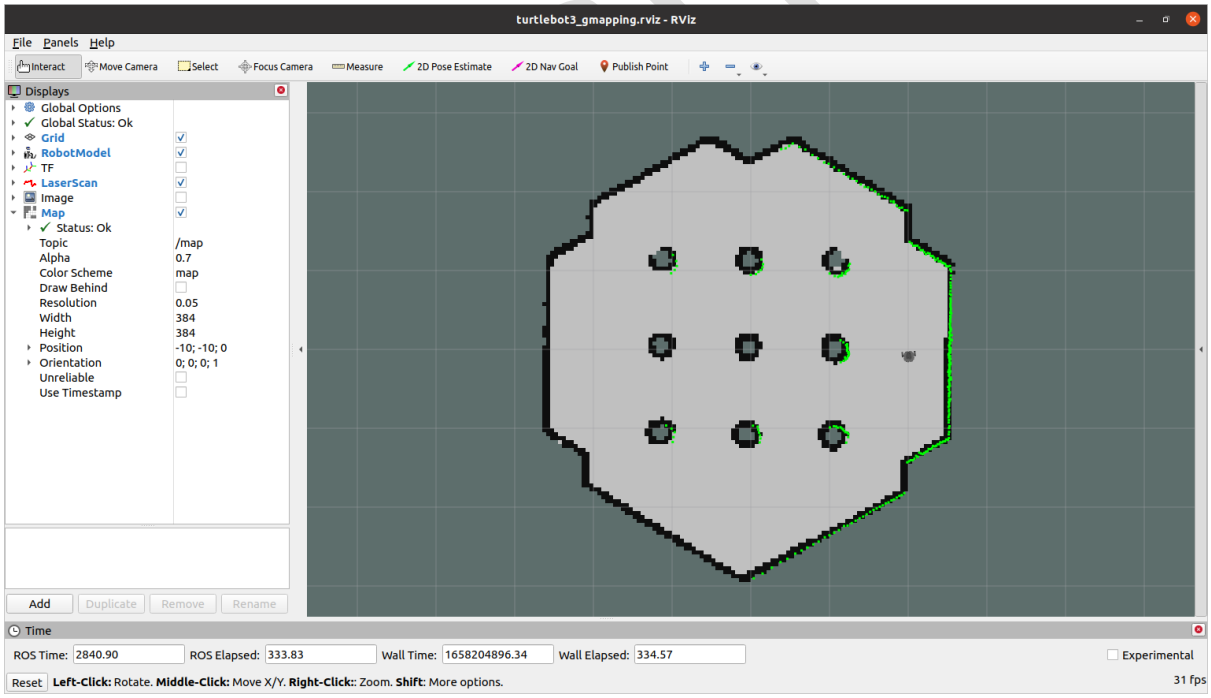
1. Terminate all applications with Ctrl + C that were launched in the previous sections. Type in new terminal
   >> cd catkin_ws
   >> export TURTLEBOT3_MODEL=burger
   >> roslaunch turtlebot3_gazebo turtlebot3_world.launch
2. Run Navigation Node:
3. Open new terminal window at catkin_ws
   >> export TURTLEBOT3_MODEL=burger
   >>roslaunch turtlebot3_navigation turtlebot3_navigation.launch map_file:=$HOME/map.yaml
4. Estimate Initial Pose: Initial Pose Estimation must be performed before running the Navigation. TurtleBot3 has to be correctly located on the map with the LDS sensor data that neatly overlaps the displayed map.
5. Click the 2D Pose Estimate button in the RViz menu.
6. Click on the map where the actual robot is located and drag the large green arrow toward the direction where the robot is facing.
7. Repeat step 1 and 2 until the LDS sensor data is overlaid on the saved map.
8. Launch keyboard teleoperation node to precisely locate the robot on the map.
   >> roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch

Move the robot back and forth a bit to collect the surrounding environment information and narrow down the estimated location of the TurtleBot3 on the map which is displayed with tiny green arrows.
Terminate the keyboard teleoperation node by entering Ctrl + C to the teleop node terminal in order to prevent different cmd_vel values from being published from multiple nodes during Navigation.

Calculation:

Observation:





Result: