Task 1.2 – Moving robotic model in Gazebo and RViz

The objective of this task is to make you familiar with the frequently used simulators in Robotic Operating System namely Gazebo and visualization tool RViz. In addition, you are supposed to learn the concepts of launch files, creating maps, creating the world enviornment, and an autonomous navigation in the map.

The world, map and model are already given, created as templates to help you understand the concepts. Now, you are expected to learn these concepts and **design models on your own**.

Given:
Please find the following folder within the folder that contains this file.

- First Folder is ***Designing Requirement***
  - Please find the following files in this folder:
    - Final_Task_World_Dimension
    - Final_Task_World-Image-1
    - Final_Task_World-Image-2
    - Final_Task_World-Image-3
    - Robot_Dimension_Parameters,pdf
  - Open the file Final_Task_World_Dimensions and note down the dimensions given in image. Your final world in gazebo must be of the same dimensions as mentioned in this image. Final_Task_world-image-1, Final_Task_world-image-2 and Final_Task_world-image-3 are the sample images of different views of the world. Your final world should be similar to these images.
  - Open the file ***Robot_Dimension_Parameters.pdf*** and note down the parameters given in this file. These parameters are related to your robot model (URDF model). Your final robot model must be of exactly the same dimensions as mentioned in this file. You can edit the Firebird urdf model to fulfill this requirement. The sample images of robot model are shown in *robot_model_image-1* and *robot_model_image-2*.

NOTE: Gazebo is the actual real world physics **simulator.** In this you can set up a world and simulate your robot moving around world . Rviz is the **visualization software** that is used for **path planning and localization** of your robot inside gazebo.

Problem Statement:

1. You are expected to navigate your robot model in gazebo and RViz by avoiding obstacles. Initially, the robot has to be at origin having **coordinates (0,0,0)**. Then it has to traverse in such a way that it connects vertex1, vertex2, vertex3, vertex4, vertex1 and back to origin sequentially.

NOTE: To extract coordinate from the map use Publish point feature of RViz. After clicking on "Publish Point", **hovering the cursor over the map gives the corresponding coordinates (shown at the left bottom corner) in the (x,y,z) form**. Note that the z coordinates for all the points are almost zero as you are dealing with a 2D plane.

2. It can be inferred that your total path can be divided into **6 parts**. They are:
    a. Origin to Vertex1
    b. Vertex1 to Vertex2
    c. Vertex2 to Vertex3
    d. Vertex3 to Vertex4
    e. Vertex4 to Vertex1
    f. Vertex1 to Origin.

Make sure that the coordinates of the **all vertices fall within the green boxes** shown in Figure 1. The path on which the robot traverses can be similar to the path shown in Figure 1. Note that the path may vary according to the parameters you have set.

Task Requirement:

1. To move from **current coordinate** to **destination coordinate**, you should specify the destination coordinate. Initially, the current coordinate would be origin and the destination coordinate would be that of Vertex1.

2. You have to pass destination coordinate to the **"move_base/goal"** topic for path planning between the robot's current coordinate to destination coordinate in map.

3. For path planning using **move_base**, all the **parameters** have to be set beforehand. You can find move_base parameters in the ***"param"*** folder of ***"task_1"*** package.

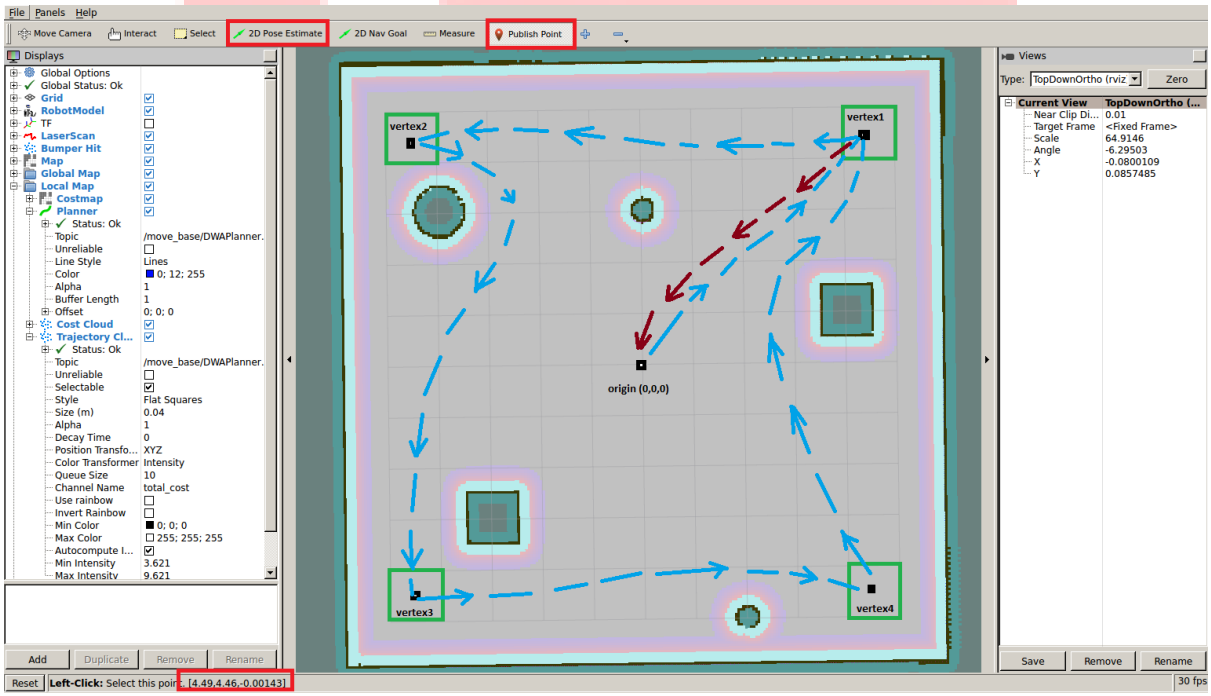

Figure 1: view of RViz Simulator

4. To automate this, you have to write a python script that will publish coordinates of the vertices sequentially over the "move_base/goal" topic**.**

Note: The path followed in RViz directly gets reflected in gazebo. In short, RViz is planning path to move robot inside gazebo.

Procedure to complete task:

1. Create robot model and gazebo world for this Task. Refer to tutorial *1.2.1 URDF Model Understanding* and *1.2.3 Editing Simulator Enviornment*.

After creating robot model and gazebo world, launch gazebo world and robot model created by you inside gazebo and RViz. You can edit the following launch files to launch your model:

- **simple_robot_gazebo.launch:** This file launches gazebo simulator with the world and robot model which are already created by you. Open this launch file in editor and change file accordingly to launch your world file in gazebo with your robot model.

- **gmapping**: Create a map of gazebo world by gmapping for autonomous navigation. "gmapping" is only used to **create a map from gazebo environment**. After creating map you can terminate this node.

- **rviz_navigation.launch:** This launches the rviz simulator with the robotic model which was created by you (all the parameters are expected to be set beforehand).

- **move_base.launch:** Using this launch file you can load the map to RViz. Open this launch file in editor and change accordingly to open your map. Make sure that you have set all the move_base parameters beforehand.

2. You have to write a python script that will publish the coordinates of the vertices sequentially over the "move_base/goal" topic**.** Find the **"move.py"** in **"scripts"** folder of package.

Use 2D navigation in RViz before writing the scripts.

Sample Video of autonomous navigation using 2D navigation is given here

You can run your ***move.py*** using the following command alongside with all launch files mentioned above:

rosrun task_1 move.py

Expected output:

The **video** of the robotic model **moving in both RViz and gazebo simulator traversing through the given vertices, avoiding obstacles**. The video should be made in such a way that **Rviz and gazebo simulator windows are placed side by side**.

- **Submission Instructions:**

1. **Video Link:**
   Upon verifying that your task is complete, record a **maximum 5 minute** video using a screen recorder. The video must be as follows:

   - Team Slide –All members detail in the given slide.
   - Any One member of the team, running the scripts and launch files in terminal.
   - Show output of RViz and Gazebo on the PC screen.

   Upload the video link as per instruction given on portal.

2. **ROS Package:**

   After completing the given task store your whole package into Task-1 folder with name <team_id>task1.2. Instructions for uploading your task will be provided on the portal.