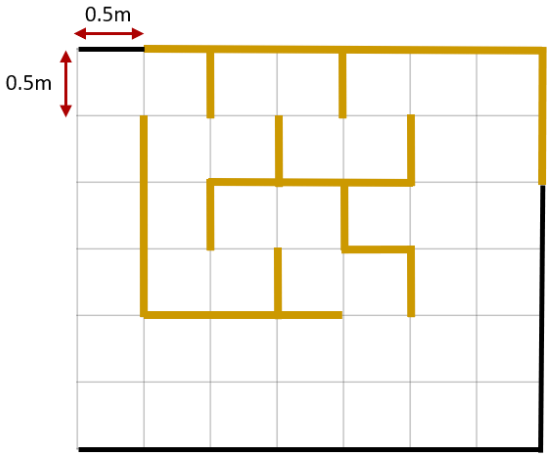
Tutorial 5

Creating a ROS Gazebo maze simulation for Turtlebot3

In this tutorial, you are creating a maze simulation in Gazebo simulator. When this simulator is ready you can test your robot navigation code with the simulator. This will save you a lot of time and resources.

A video showing how to develop the simulation is shared with you. The map of the maze is provided as a .png file. You need a map file (not mandatory but helpful) to create a maze in Gazebo.



maze height - 0.2m
thickness – 0.01m
grid size – 0.5m x 0.5m

Use the existing turtlebo3_empty_world simulation to create your own simulator. First, you have to clone the turtlebo3_empty_world, and then, change it as required.

In this tutorial, you are creating a custom model (maze) and add to an existing world. Model is a keyword used to refer a virtual object in Gazebo. You can add any model from the existing models in Gazebo. Many models are available to be used in simulations. You can experiment with these models, and they will be useful for your project. Some example models are cars, bicycles, trees, houses, walls, person (static and moving), many objects, drones, furniture etc.

These steps are demonstrated in the video.

1. Create a new package called my_simulation.
2. Copy .launch and .world files from turtlebo3_empty_world simulation to my_simulation, and edit them.
3. Create my_maze model using the Building Editor in Gazebo. After you saved the model (in /home/master/.gazebo/models/my_maze) you will see two files inside my_maze folder (.config and .sdf). They are configuration and simulation description format files. Any object in Gazebo is described with these two files. If you want to modify an object you have to edit these files manually or modify the object in a GUI and save it updating these files.
4. For this tutorial, you are creating only four files to complete your maze.
   Your simulation package
   a. /home/catkin_ws/src/my_simulations/worlds/empty_world.world
   b. /home/catkin_ws/src/my_simulations/launch/my_world.launch
   Your maze model
   c. /home/master/.gazebo/models/my_maze/model.config
   d. /home/master/.gazebo/models/my_maze/model.sdf

5. Next, you have to modify your .world file to include my_maze model.

Tips:

- Increase your VirtualBox RAM to a reasonable number (without sacrificing the performance of Windows PC). Close unwanted programs.
- Sometimes, Gazebo does not load due to memory issues. If it crashes or does not load, try to load Gazebo without any worlds (using the command 'gazebo'). If it works, then try the command 'roslaunch turtlebot3_gazebo turtlebot3_empty_world.launch'. If both commands work, it can be a memory issue. Close all terminals (including roscore) and launch again.
- You can watch online tutorials available on the following links for more details.
  https://www.youtube.com/watch?v=qi2A32WgRqI
  https://www.youtube.com/watch?v=tIJRxkaAZtA
  https://www.youtube.com/watch?v=3YhW04wIjEc
  https://www.youtube.com/watch?v=7McYSJFAqlU
- **Creating a simulation needs time and patience.**

Some useful notes about Gazebo are provided here from Practical 1. Go through these notes quickly and then watch the video.

Gazebo simulator

- Goal: Best possible substitute for physical robot
- Architecture

  Physics + Sensors + Interfaces + GUI

- Advantages
  - Design and testing of robot's components and control
  - Software testing and verification (controllers)
  - Save time and money
- Installation: Built-in along with the ROS desktop-full.

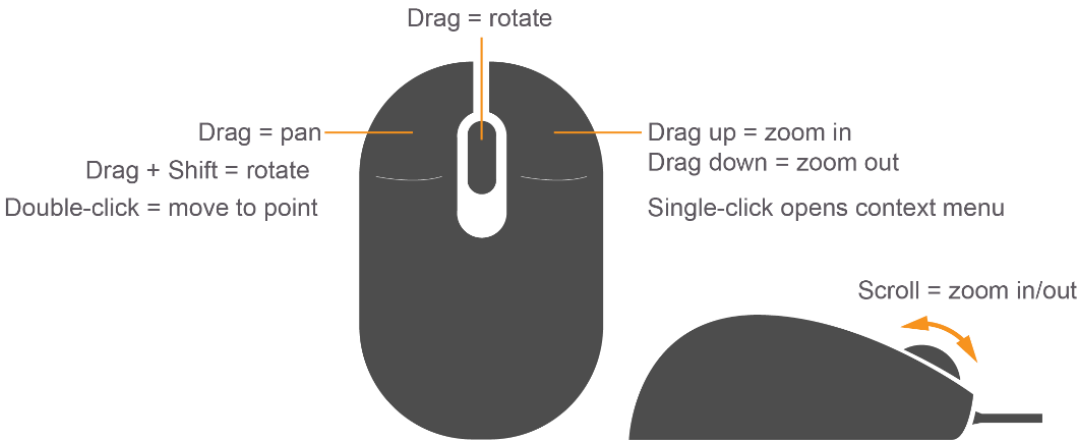
Testing Gazebo

- Gazebo runs two executables: Gazebo server (simulation process) and Gazebo client (Gazebo GUI)

```
gazebo
```

- Add a square block and a sphere using the upper tool bar
- Right click on the sphere
- Select Apply Force/Torque
- Choose a value for the torque and force and select apply.
- Observe kinematics and dynamics simulation

Gazebo mouse controls



References

Introduction to Robotics, The Ohio State University

http://wiki.ros.org/ROS/Tutorials

ROS Robot Programming, Robotis, 2017