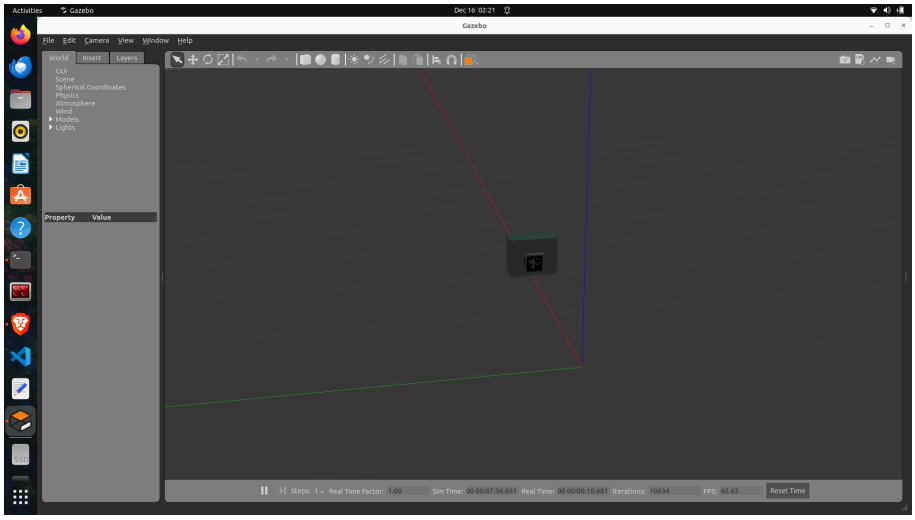
Drobot Submission Report

Goal of the Assignment:

Create a system where a differential-drive robot detects a fiducial marker and navigates to park near it.

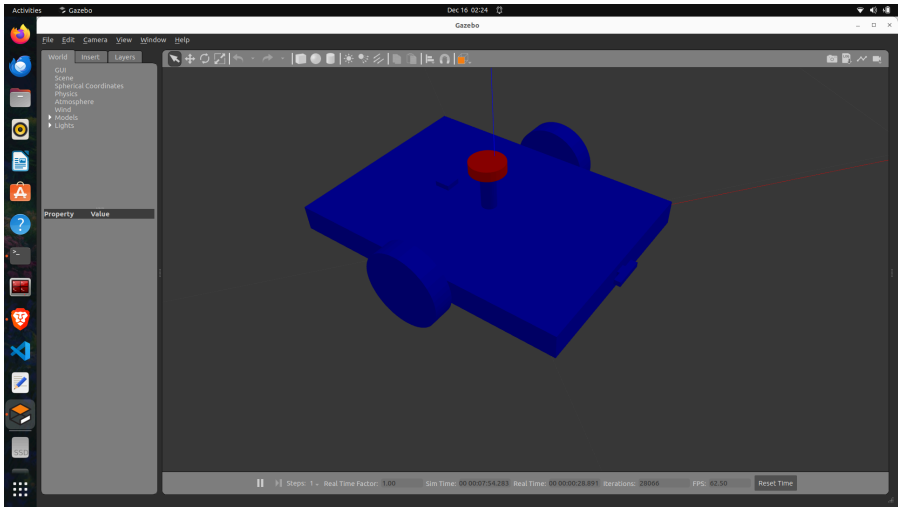
Environment Setup:

Spawned a static cube in the world, with an AprilTag fiducial marker printed on one of its faces. This will serve as the target for the robot.



Robot Setup:

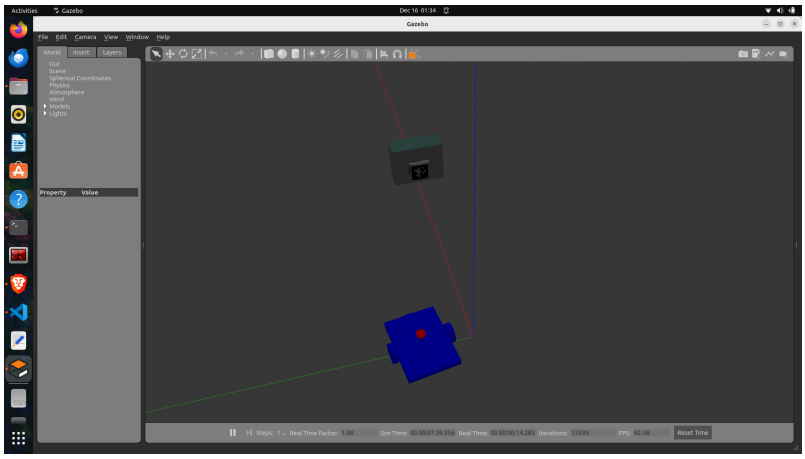
Spawned a differential-drive robot model with a camera mounted behind it.

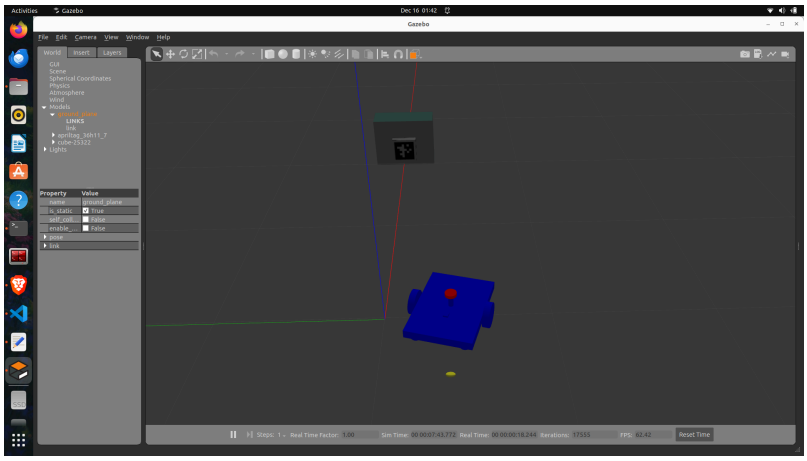


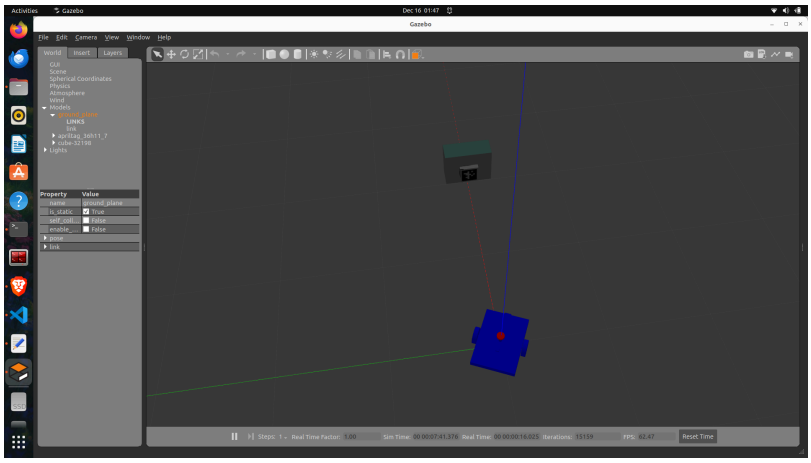
Initial Robot Configuration:

Example cases include starting:

1) 1.5 meters away, with a 40 cm offset to the right and 30° orientation facing away.
2) 1.5 meters away, with a 40 cm offset to the left and 15° orientation facing away
3) Directly in front but oriented 45° off-axis







Approach:

The approach involves using **AprilTag detection** to enable autonomous robot navigation in a simulated Gazebo environment. The system subscribes to camera image data and detects AprilTags using the AprilTag ROS 2 package. Upon detection, the robot dynamically adjusts its behavior, rotating in place to search for a tag if none is detected and moving forward once a tag is located. This approach integrates image processing (using OpenCV) with motion control via velocity commands (`/cmd_vel`), ensuring the robot can navigate and respond to tag locations effectively.

Methodology:

The methodology begins by creating a **ROS 2 node** that subscribes to the AprilTag detection topic (`/detections`) and camera image topic (`/camera/rgb/image_raw`). OpenCV is used to process incoming image frames, while tag detection data (e.g., tag center, size) determines the robot's actions. If no tag is detected, the robot rotates in place (`angular.z`) until a tag appears. Upon detecting a tag that meets a size threshold, the system calculates errors in alignment and commands the robot to move forward linearly (`linear.x`) while stabilizing its orientation. The system is tested in a Gazebo simulation with an empty world containing AprilTag markers, ensuring functionality in a controlled environment.

Video:

You can find the videos of each case mentioned above in the following folder:
~/drobot_ws/src/submission/

Thankyou

If you have any query then feel free to reach out through my mail or number.
Email: makarandmangaonkar@gmail.com
Number +91 7058652984