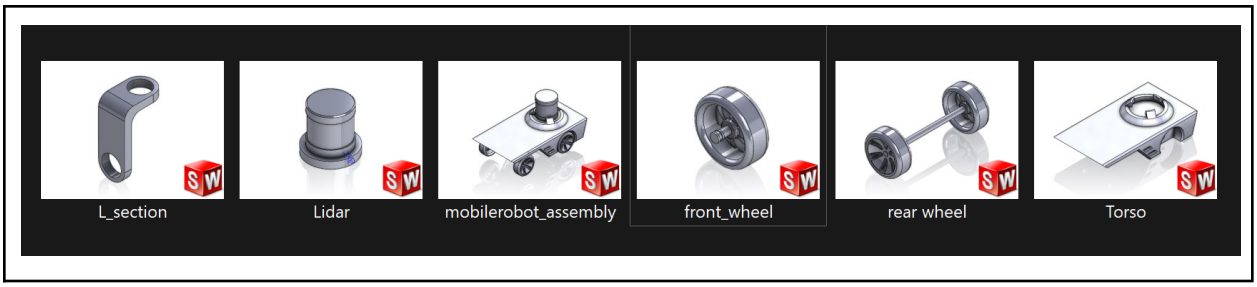
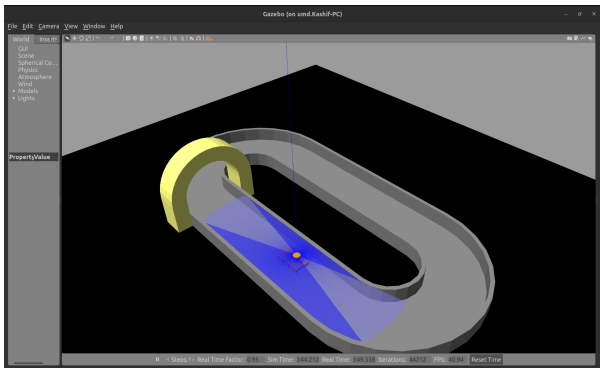
# **ENPM 662 (Project 1 report)** By Kashif Ansari

**The components and assembly, required for the robot in this project, are provided in the appropriate file format.**

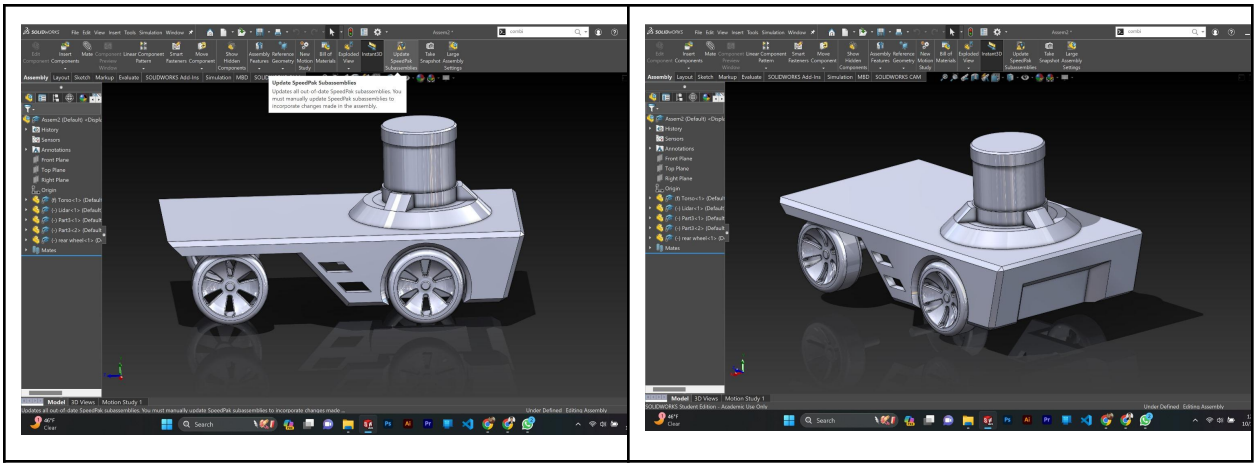



## Robot GuideLines followed

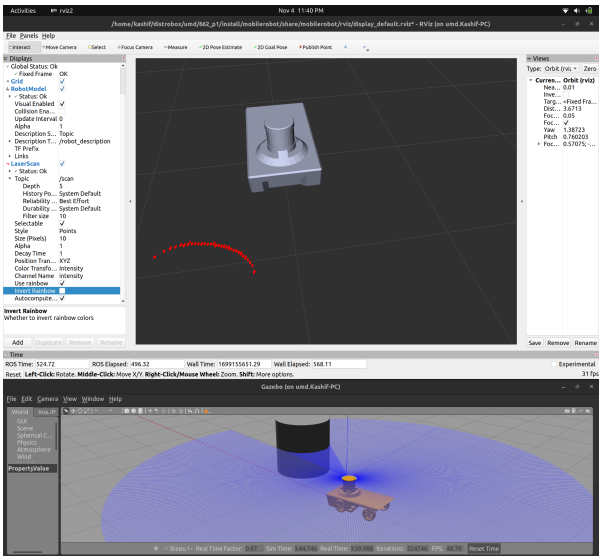


## Robot Aesthetics and description

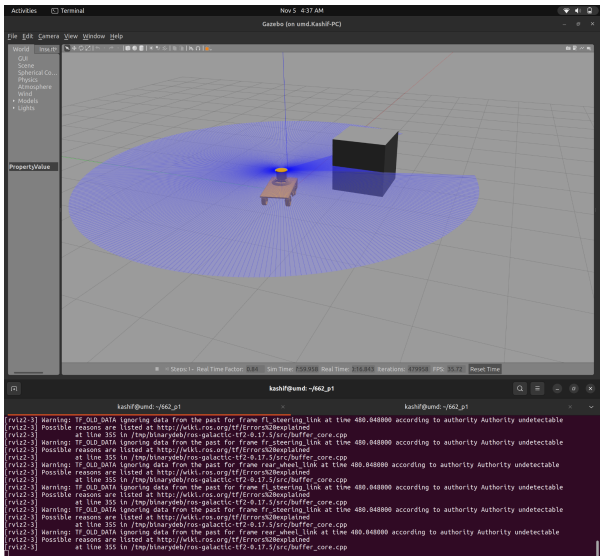
The mobile robot that has been showcased was created with careful attention to its bounding box and dimensions. The structural design has been tailored to suit the robot's intended speed and its role as a warehouse robot, aiming for a balance of practicality and aesthetic appeal.



**Debug.launch**
Both the Gazebo and RVIZ windows are currently open, displaying the robot.
The image illustrates the robot's capability to perceive and recognize the 3D shapes within its surrounding environment.

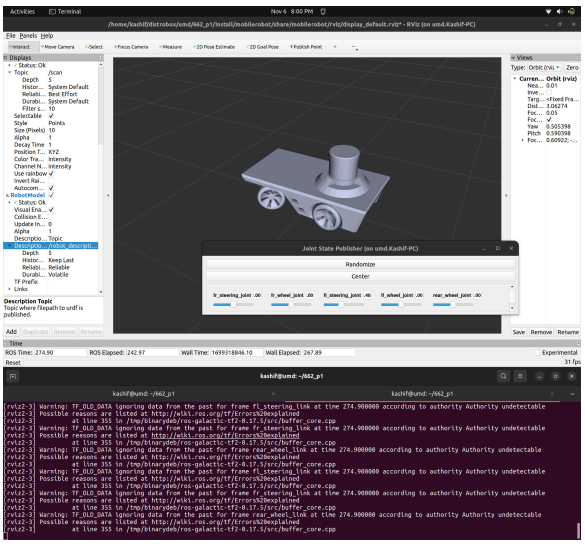


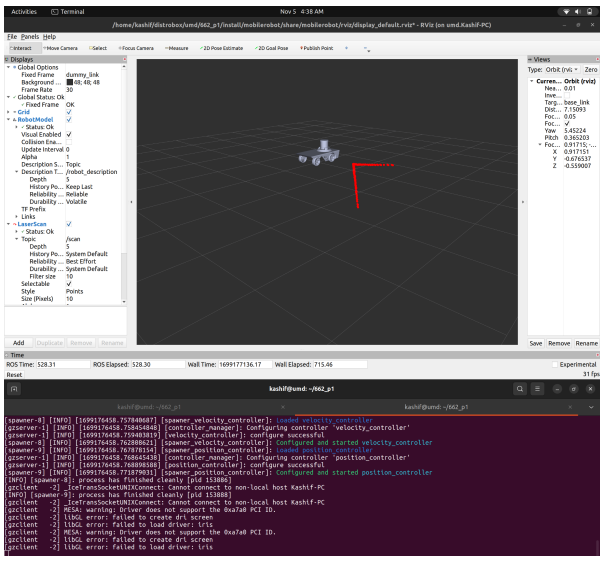
**Gazebo.launch**
Robot should be visible in Empty World



**Display.launch**
The image demonstrates the robot's visibility alongside the joint controller slider GUI within RVIZ. As depicted in the image below, sliders are employed to control the steering and rolling of the robot's wheels.

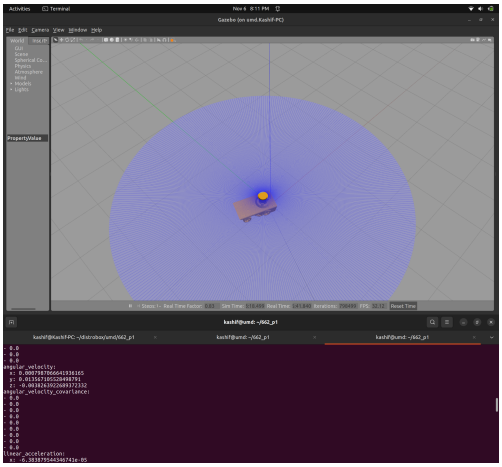
**RVIZ LiDAR Visualization**
The red dots depicted in the image serve as a visual representation of the 3D shapes in RVIZ, which correspond to the physical objects within the Gazebo environment.



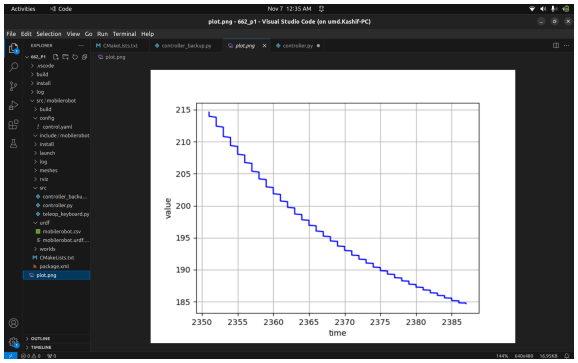


## IMU

The image below displays the visualization of the IMU Plugin Topic in terminal



## Error and Control vs Time Graph of the Proportional Controller.

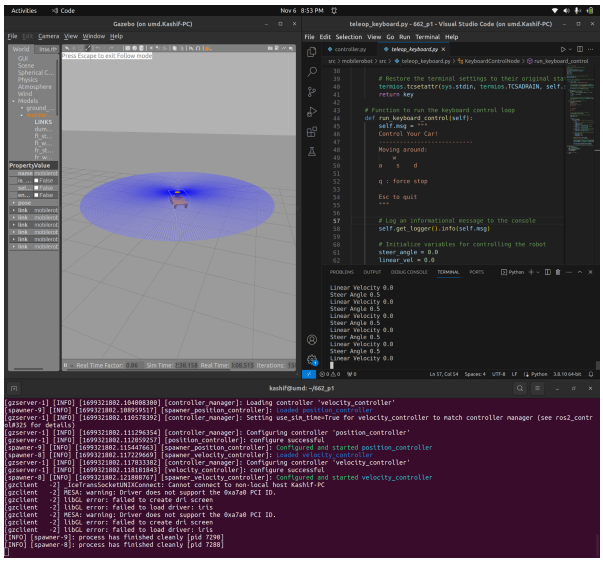


**Project Process in Brief 1 line about all the steps taken to complete the project.**
1. The setup of the workspace was executed in accordance with the ROS2 guidelines, ensuring successful building and sourcing.
2. A package was created, built, and sourced with the following directories: CMakeLists.txt, Include, Car, Package.xml, and src.
3. The robot was designed and assembled using Solidworks.
4. The URDF was adapted to function seamlessly with ROS2, employing a series of xacro commands within the URDF.
5. Subsequently, modifications were made to the launch file and CMakeLists to facilitate the loading of the robot in Gazebo.
6. To integrate controllers, dependencies were added to the CMakeLists, and a yaml file was generated and populated.
7. An RVIZ template was incorporated into the URDF file, defining the parameters within the RVIZ workspace.
8. Moving forward, LIDAR and IMU plugins were integrated into the URDF file, with corresponding updates in the CMakeLists.
9. The competition setup was imported into Gazebo.
10. A script for teleoperation was developed and tested within the Gazebo environment.
11. The generation of a graph to verify the functionality of teleoperation is pending.
12. Finally, the teleoperation and proportional controller script underwent testing.

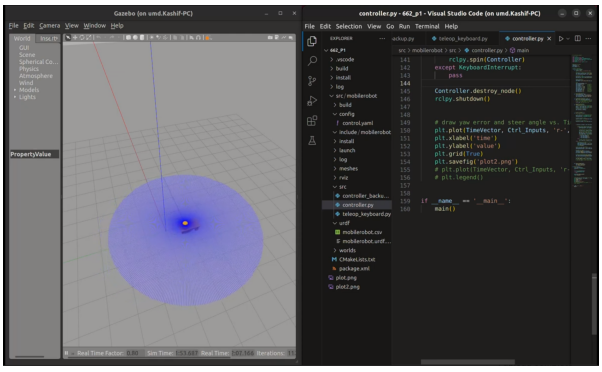
**Any problems faced during the process and how they were solved.**
The project completion process was full of challenges. When converting the mobilerobot package to make it ROS2 compatible, we faced an error due to the absence of certain xacro packages for ROS Galactic. To resolve this issue, we had to perform the necessary installations.
While attempting to incorporate colors into the URDF.XACRO file of the mobilerobot, we had to determine the correct pattern to follow in order to apply colors to the links. Additionally, indentation problems in the URDF.XACRO file were causing issues, necessitating the correction of indentation errors to ensure the proper import of all components.

| **Personal contribution towards the project.** | **Teleop of Robot Moving around the track** |
|---|---|
| 1. Design and assembly of the robot using Solidworks.<br>2. Exporting the robot design into URDF format. | Video link:<br>https://drive.google.com/drive/folders/1Gou1acRFPSj0_7HtIBBf5YRUmQ8JtIPQ?usp=drive_link<br><br>Screenshot: |

3. Making the URDF file compatible with ROS2.
4. Integrating controllers, LIDAR, and IMU into the robot model.
5. Testing the functionality of the LIDAR and IMU sensors.
6. Modifying and testing the teleoperation control for the robot.
7. Providing assistance to my partner in implementing proportional control for the robot.



**Proportional Controller to Move the robot in a straight line.**
**It should move from point (0,0) to (10,10).**
Video link:
https://drive.google.com/drive/folders/1Gou1acRFPSj0_7HtIBBf5YRUmQ8JtIPQ?usp=drive_link



**Any improvements that can be made in the documentation for the Project.**

1. The process for the development of the project can be made clearer and more streamlined.

2. There are certain challenges that are faced during the development that remain unaddressed for which clear hints and help should be provided (including video clips of some crucial steps)

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