ENPM 662

Project 1

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Objective: CAD Modeling and Simulation using Gazebo

Project Understanding:

- The robot car was designed using SolidWorks, assembled, and then exported to a URDF file.
- Controller information for joint positions and velocities, along with LIDAR and IMU data, was integrated into the file.
- A .yaml file was created to contain the controller details, which were added to the project.
- Utilizing provided launch files, the robot was simulated in Gazebo and Rviz.
- The LIDAR data was incorporated and visualized within the simulation.
- Using a teleoperation script, the car was maneuvered within the competition environment.
- Subsequently, a proportional controller was applied to guide the car from coordinates [0,0] to [10,10].

Problems faced:

- The automatically generated axes and coordinate frames for the joints and wheels in the URDF export were inaccurate, leading to incorrect spawning of the car in Gazebo.
  Action taken: All the necessary joints and coordinates frames are defined manually.
- After exporting to gazebo, we noticed that the car is tracing a curve instead of a straight line while using teleop.
  Action taken: Noticed that one of the wheel joints is not straight but at an angle to the global origin, hence taking an curved path and it was resolved
- The robot's wheels ae not spawning in Rviz environment.
  Action taken: Added the velocity controller to missing wheels and respawn.

Contribution:

- Using SolidWorks, the robot car was designed according to the project design specifications.

- Using the SW2URDF Exporter program, the robot's design was exported to URDF format to ensure compatibility with ROS 2.
- Added a LiDAR sensor to the robot's design to enhance its perception.
- Completed a full lap by successfully navigating the robot through a competition scenario using a teleoperation script.
- Controller part was done by both

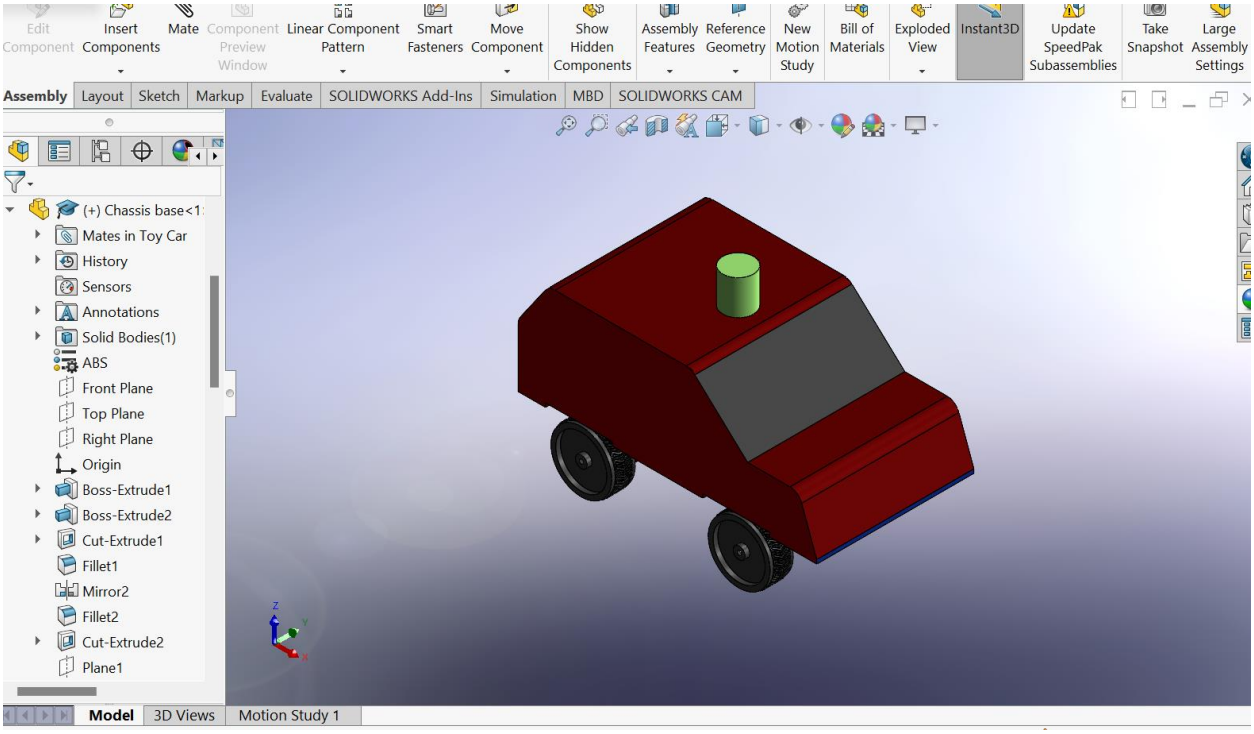
Improvements:

- It would be great if some details about the use of proportional controllers were included.

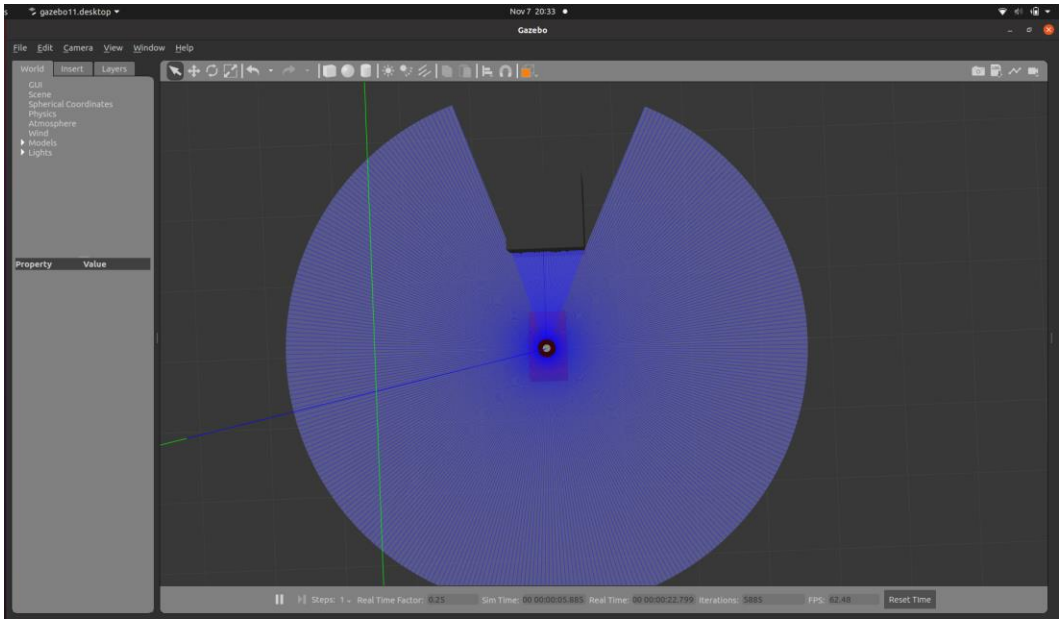
Results:

SolidWorks model:

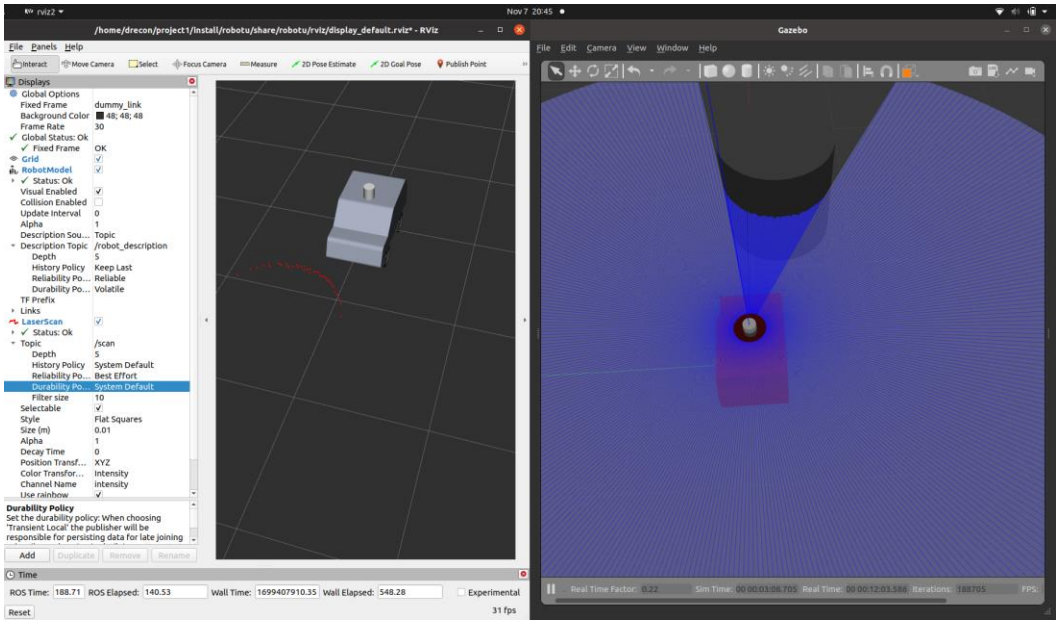
Both the front wheels can be individually steered, and top link is the Lidar



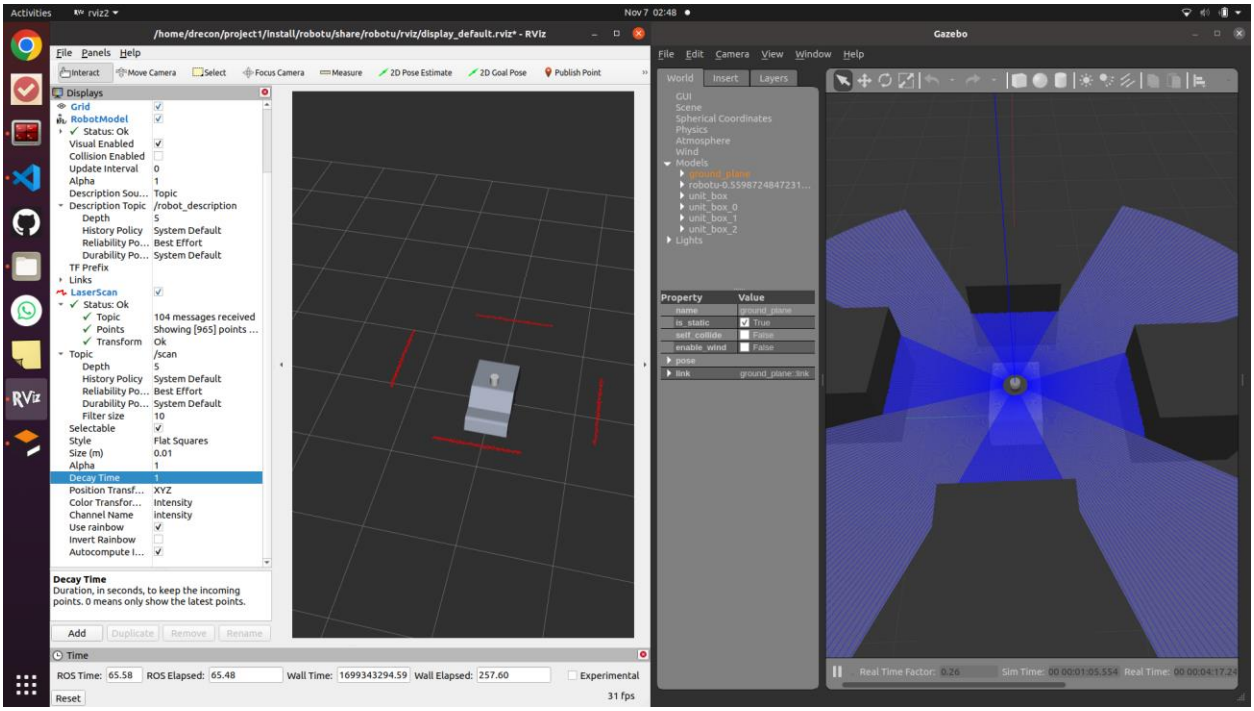
Gazebo Launch:



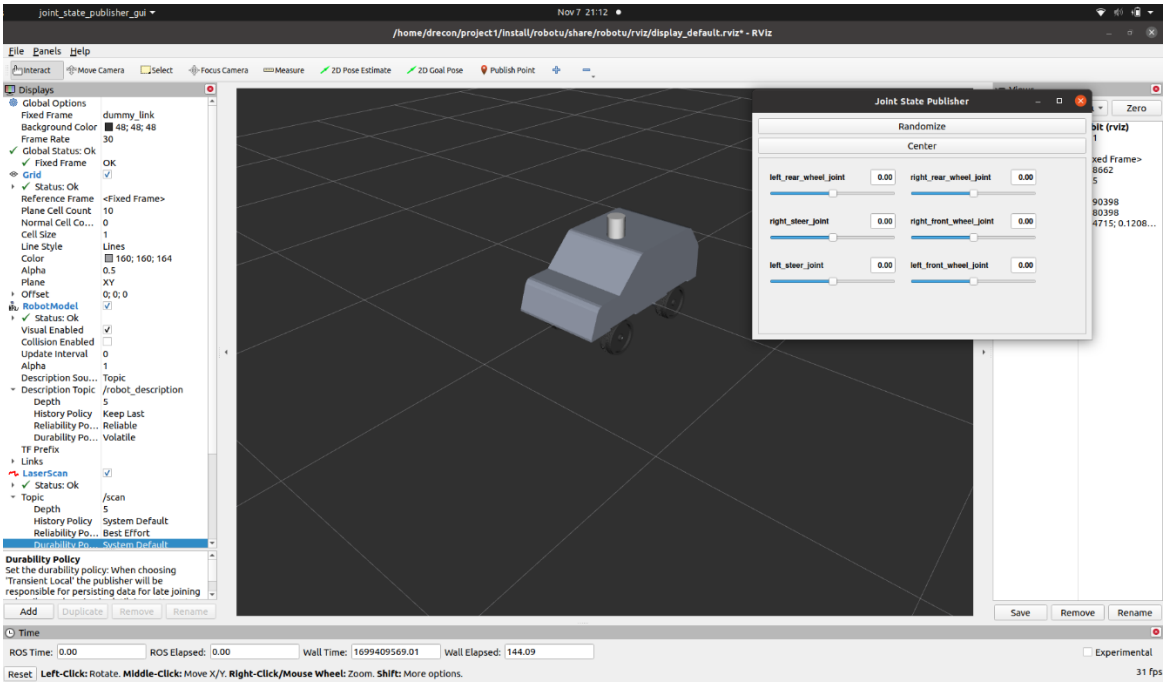
Gazebo and RviZ:



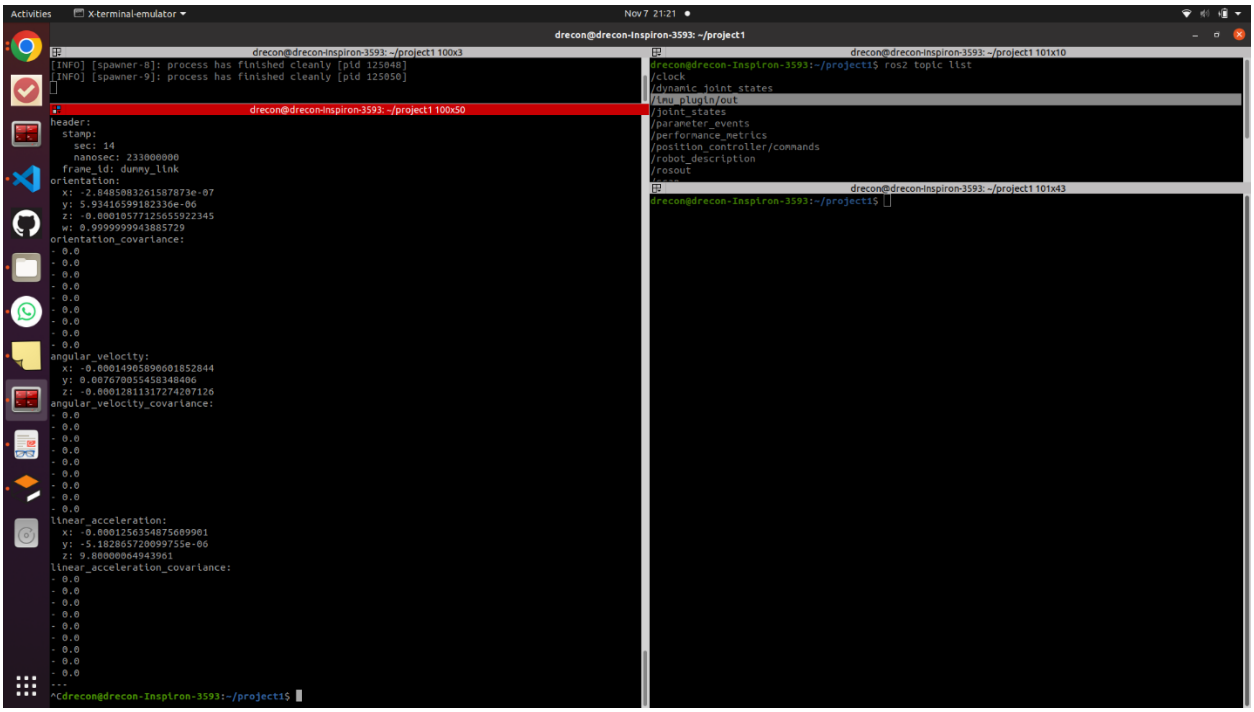
Lidar visualization:



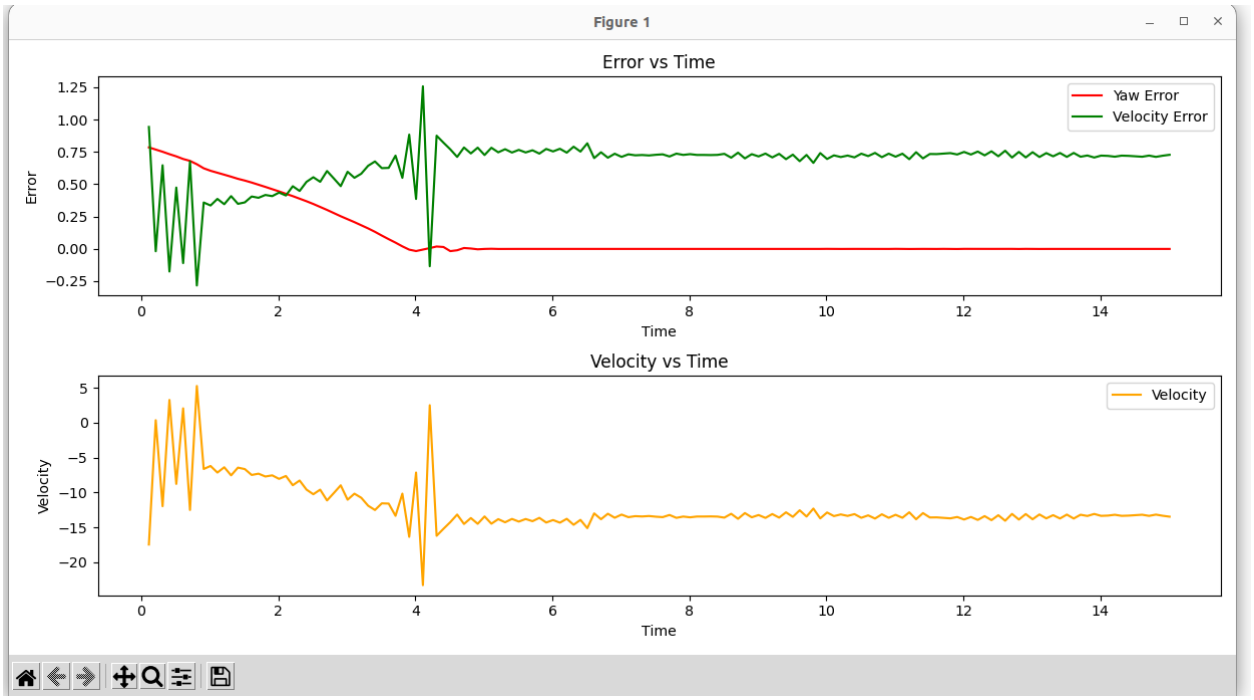
Rviz with joint state publisher:



IMU topic visualization:



Error and Control vs Time Graphs:



Teleop operations:

Video link: https://drive.google.com/file/d/1Y-P311eL-4n64vUKXOKZ4EmCd-KmDKi6/view?usp=sharing

PD controller:

Video link:
https://drive.google.com/file/d/1xuxxebWyATNuIR7whLErxf4eKjiYw9K-/view?usp=sharing