

ENPM662 Project One Report

Objective

- To design a toy car using SolidWorks and export it as a URDF
- Model the toy car in ROS and gazebo and integrate a LIDAR and visualize the sensor output in RVIZ

Goals

- Design a toy car in SolidWorks and export it as URDF
- Integrate LIDAR with chassis of toy car
- Perform necessary changes to URDF to add controllers and transmission
- Spawning and navigating the toy car using TeleOP in a gazebo world
- Code a publisher and subscriber for the toy car to move in a straight line and circle

Project Pipeline

1. Creation of components of toy car and assembling it in SolidWorks
2. Defining axis and coordinate systems and exporting assembled model as a URDF
3. Spawning the Robot in an empty world in Gazebo
4. Integration of Lidar with the model using Xacro
5. Configuring transmission blocks and controllers to joints
6. Spawning the model with lidar in the required simulation world and visualizing the robot and lidar in Gazebo.
7. Controlling toy car in environment using TeleOP.
8. Coding publisher and subscriber for robot motion
9. Visualization and simulation of model in Gazebo and Rviz

Challenges

1. The front wheel while turning had a very limited range of motion.
 - Made cutouts in the chassis to allow for more freedom of motion, increasing the limits of how much the steering can turn.
2. After exporting URDF and spawning it in Gazebo, the toy cart spawned in an undesired manner, resulting it in breaking apart.
 - The origin of the toy car was not properly defined at the plane where the wheels were. A new plane was created at the point of the wheels touching the ground and the origin was redefined on that plane, mirroring the one of the chassis.
3. The rotation of the steering shaft was rotating with respect to the Z-axis of the wheels.
 - The axis of the steering shaft was defined wrongly, it was redefined as along the axis of the point of attachment of the shaft to the chassis and resulting it moving along the Z axis of gazebo.
4. The front shaft and the rear axles moved in a specific commanded direction, but the wheels did not rotate.
 - Whilst exporting the SolidWorks model as a URDF, the wheels were not defined as a child of the respective links. Redefining the wheels as a child of the respective links allowed the wheels to rotate normally.
5. The Lidar visualization in Rviz was showing obstacles detected in the directions not seen in the Gazebo world.
 - The Lidar origin was defined such that it was flipped 180 degrees along the Z axis. Editing the URDF resolved the Lidar rotation.
6. The Wheels moved in the opposite direction when given commands via TeleOP.
 - The Z values were tweaked i.e., the sign of the command given was changed so the toy car moved in the desired direction.

7. The Lidar was not visible in gazebo after integrating the Lidar into the URDF and Xacro files of the package.
 - The XYZ coordinates of the lidar was defined such that it was spawning inside the body of the robot. Editing the X and Z values with decimal increments resolved the improper spawning.
8. Spawn process has died error while running roslaunch of the launch file for gazebo
 - The sim_time value in the competition world flag was made zero as the time it was previously defined was of a very large value.

Screenshot of the Model

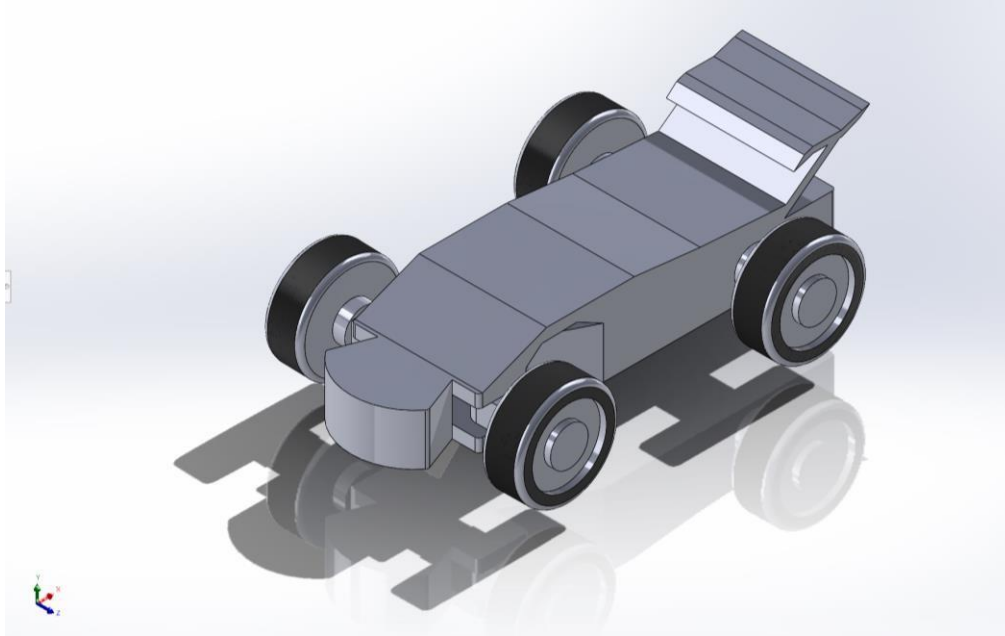


Fig 1.0: Screenshot of Toy Car

Contributions

- Designing the Model in SolidWorks and revising design when issues were faced due to design while toy car was moving.
- Initial visualization of toy car in a empty gazebo world.
- Integrating Lidar into the Model and visualizing it in RViz
- Worked on integration of Transmissions and Controllers with teammate
- Coding TeleOP for movement of toy car.
- Debugging and resolving errors occurring during visualization and simulation of Lidar data and movement of model in environment.

Links

Publisher Subscriber Video (Straight Line) -

https://drive.google.com/file/d/1Ld1JDswyqEj7R7NnYLDLVv2zpj6Z9og5/view?usp=share_link

Publisher Subscriber Video (Circle) –

https://drive.google.com/file/d/16IUa8F2uroO-eTlbjzYaZDocv89UiBfo/view?usp=share_link

TeleOP Video - https://drive.google.com/file/d/1id_xXb2FePQxK20gl3rmNifheOHas6Ea/view?usp=share_link

Rviz Visualization - https://drive.google.com/file/d/1aqRu8Mgc3N6VlvPdY0r-Af7W7tzD-ePK/view?usp=share_link