Project 1 Report : Toy Car

-Jeffin Johny Kachappilly(118293929)

CAD Part:

- The car was initially drafted in paper in order to meet the specifications provided and also to ensure that links does not collide with each other.
- The car for this project consists of wheel , back axle , chassis and steering mechanism part to be modelled.
- The CAD model file for all these parts were made separately and only a single model was constructed for the wheel and steering link.
- Chassis:(Body frame)
  - A sketch was plotted in the plane with the calculated dimensions.
  - The sketch was extruded and taking the sideview, a portion of the solid formed was cut in order to make space to include the front wheels under the body.
  - Circular cylinder was cut along body to include rear axle and one cylinder was cut and mirrored at the front to include steering links.
- Back axle : It is a circle extruded to the required length.
- Wheel: Extruded circle with a cylindrical hole at the centre to accommodate axle.
  - (For better visualisation purpose in gazebo, a separate wheel model was prepared in solidworks after assembly creation. This wheel model contained spokes where the circular pattern function was utilised and the mesh file was saved .Using this model only the visualisation part in urdf was changed.)
- Steering link:
  - A line was sketched according to specifications and the swept bose function was utilised to the make the link.
- Making of Assembly:
  - The parts were inserted inside an open assembly file of Solidworks.
  - Incase of wheel and steering the same part was inserted 4 and 2 times respectively.
  - The surfaces were then mated using the coincident ,colinear and distance mate features.
- Urdf package creation:
  - After selecting urdf option in tools, parent and child links were named in a tree like structure.
  - All the link and joint names were specified appropriately and then the type of joints were mentioned before exporting to urdf.
  - Continuous joint for back axle, fixed joints were assigned to rear wheels so that it rotates with the axle. And steering links were given revolute joints and front wheels were assigned with continuous joints.

ROS package build:

- The exported urdf was saved to local disk and was transferred to catkin_ws.
- As check_urdf command wasn't found when typed in terminal, had to install it. After that a dummy link was created with the chassis, and then the model was launched in gazebo. It was followed by the editing of urdf file to add transmission

elements for joints subject to motion(back axle and 2 steering links). Position joint interface and velocity joint interface were added in transmission block to provide turning and forward motion, with the actuator having a mechanical reduction of 1.

- Lidar files that were provided were downloaded and analysed. After that the xacro file was downloaded and changes were made which included robot name, file paths and origin of laser frame.
- This was followed by the updating of config files for PID controller and values were changed with P around 100 , and I and D less than 1.
- The template launch file was downloaded along with the new world file. Controller names were modified as well.
- Next the teleop file provided was downloaded to new a source folder in package. Here the topic names were changed and signs of values (+ or -) being published were changed.
- Finally using python, the publisher and subscriber node were coded ,where the values published will change arbitrarily,so that the robot could move in circles.

Contribution:

- I modelled the car with Solidworks and exported the urdf(while my teammate suggested many design aesthetics).
- I also added lidar and transmission files, and the urdf was passed to my teammate for further development.

Problems faced:

- While launching the model for the first time in gazebo, the car was oscillating along its right side.(Solved it by making chassis and assembly origin coincident in Solidworks assembly.)
- After adding Lidar and when launched in gazebo world, robot wasn't spawned.(The Transmission block I typed had wrong indentation)

Result:

- The car was modelled to given specifications .
- The visual representation of the Lidar was successfully achieved in RViz.
- The publisher and subscriber was coded to move the robot in circles and also the robot was able to be controlled using user input for translational and rotational motion.

Video Links:

Teleop in gazebo with Rviz: https://youtu.be/9MUCtm4vwkQ

Publisher-Subscriber: https://youtu.be/ABKqwfLOYEc