Robotics 2018 Project 1

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In this project, real robot is simulated and moved with given command using `ROS` and `Gazebo` softwares. To simulate the real robot effectively, the heaviest parts of the robot are selected after extracting and sorting the mass information of individual parts. These part are drawn using simple shapes and their physical properties such as center of gravity and inertia matrices are calculated and implemented in the simulation. In addition to that, rotational encoder sensors are simulated in the environment.

1 Measurements

Measurements that are taken from `Autodesk Viewer` program using given `Assemble5.obj` file. Measurements units are based on millimeters.

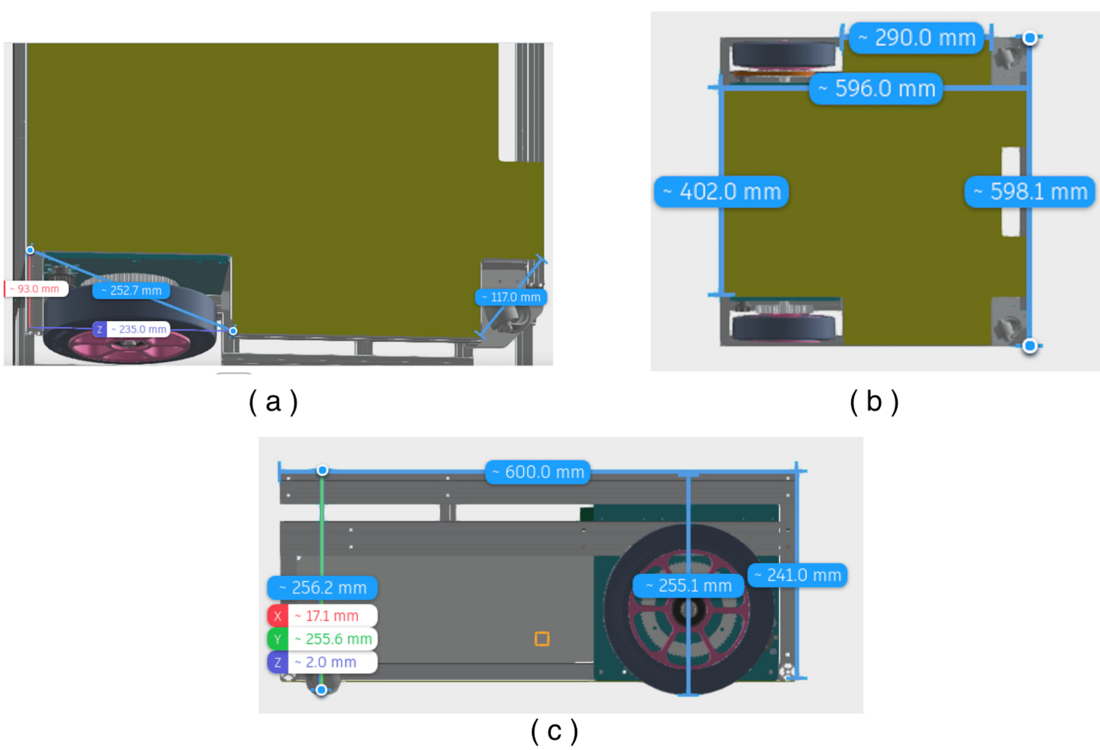

Figure 1: (a) is angled view for wheels, (b) is the top view and the (c) is side view

2 Calculations

Calculation steps start with converting the coordinate systems from `Autodesk Viewer` to `Gazebo`. We prepared a table for calculations for gravity and the inertia properties.

	Inventor X (mm)	Inventor Y(mm)	Inventor Z(mm)	Gazebo X(m)	Gazebo Y(m)	Gazebo Z(m)	Mass(kg)
right wheel	262	82	-125	0.175	0.262	0.082	2.325
left wheel	-262	82	-125	0.175	-0.262	0.082	2.325
right motor	102	50	-43	0.257	0.102	0.05	0.8041
left motor	-102	50	-43	0.257	-0.102	0.05	0.8041
right caster	260	0	-549	-0.249	0.26	0	0.101553
left caster	-260	0	-549	-0.249	-0.26	0	0.101553
chassis	0	146	-309	-0.009	0	0.146	7.8612
right motor	207	117	-121	0.179	0.207	0.117	0.41504
left motor	-207	117	-121	0.179	-0.207	0.117	0.41504
base plate	0	-1	-306	-0.006	0	-0.001	1.551
rod	0	82	-125	0.175	0	0.082	0.82663
side plate	-207	83	-414	-0.114	-0.207	0.083	0.31054

Figure 2: Selected components of the real robot

Total Mass	17.840756			
		609.15	190.65	-290.625
		-609.15	190.65	-290.625
		82.0182	40.205	-34.5763
		-82.0182	40.205	-34.5763
		26.40378	0	-55.752597
		-26.40378	0	-55.752597
		0	1147.7352	-2429.1108
		85.91328	48.55968	-50.21984
		-85.91328	48.55968	-50.21984
		0	-1.551	-474.606
		0	67.78366	-103.32875
		-64.28178	25.77482	-128.56356
	CoG in Inventor	-3.603086102	100.8125463	-224.0912091
	CoG in Gazebo	0.07590879086	-0.00360308610	0.1008125463
	Calculated CoG in the plugin	0.076643	0.003597	0.100316

Figure 3: Calculated mass information

3 Simulation

The simulation is based on `Gazebo` and `ROS`. Provided `.zip` file contains necessary files and folders for model and the plug-in that is created for simulation of the encoder.

To run the simulation: (Assuming the `ROS` and `Gazebo` softwares are installed and running correctly)

1. Open a new terminal (T1) and `unzip` the project folder.

```
unzip yusuf_pilavci_892973_refik_malli_883509.zip
cd yusuf_pilavci_892973_refik_malli_883509
```

2. Start `ROS` in the terminal (T1)

```
roscore
```

3. Open a new terminal (T2) and run `Gazebo`. Sensor plugin should also start printing out the values.

```
export GAZEBO_PLUGIN_PATH=${GAZEBO_PLUGIN_PATH}:${PWD}/encoder/build
cd encoder
rosrun gazebo_ros gazebo -file encoder.world
```

4. Open a new terminal (T3) and publish a speed command. The robot will start to do circular movement.

```
rostopic pub -1 /ProjectRobot/cmd_vel geometry_msgs/Twist
'{linear: {x: -1, y: 0.0, z: 0.0}, angular: {x: 0.0, y: 0.0, z: 1.0}}'
```

5. (Optional) Sensor plug-in can also reachable from separately for both encoders `rostopic`.

```
rostopic echo /right_encoder
rostopic echo /left_encoder
```