e-Yantra Robotics Competition

eYRC-EB#201

Team leader name	**Aditya Gaddipati**
College	**Dwarkadas J. Sanghvi College of Engineering**
e-mail	**adityagaddipati@gmail.com**
Date	**20 December 2016**

Think and Answer

****

Instructions:

- Maximum **30 marks** will be awarded
- There are no negative marks
- Write your answer in given space only. Suggested n**umber of lines** will be taken seriously at the time of evaluation
- **Unnecessary explanation** will lead to less marks even if answer is correct
- Use the same **font and font size** for writing your answer
- After completing this document upload the document on portal. Instruction for uploading the document is provided on the portal.

****

Q1:

What is Odom frame? How is it important while navigation and who publishes it?

(3+3 lines: 2 + 2 marks)

Answer:

There is Map frame and Odom frame. Odom frame is the frame in which the odometry data is published. Odom frame tells us the position of robot according to the odometry data. But the actual position of robot is relative to the Map frame. If Odom data is accurate then the Map and Odom frame will overlap. While navigation the robot should know where it is in the world. Therefore odom frame and map frame are used to calculate the actual position of robot. In Gazebo, libgazebo_ros_diff_drive plugin publishes odom topic. In a real robot the microcontroller will publish the odom topic.

Q2: What are the necessary requirements (packages and settings) to navigate in a map and why they are necessary? Can navigation be done without gazebo simulator?

(5+5 lines: 5 + 5 marks)

Answer:

The necessary packages are: Global planner package plans the path from current position to goal position. Local planner makes plans to navigate small sections of the global plan and it sends velocity commands to robot. Costmap_2d package provides global and local costmap (maps containing information about obstacles) to global and local planner respectively. Move Base package is required to link all the above packages. base_local_planner and base_global_planner are move_base parameters that must be set to specify which planner we are using. Gazebo simulator is the place from where our robot publishes the sensor data, odometry data, etc. Using this data path planning is done in Rviz. Gazebo is used to realize these plans. Hence navigation cannot be done without gazebo simulator. But if we have a real robot in a real world that publishes the sensor data, odometry, etc then we do not need the gazebo simulator for navigation.

Q3:

Is it possible to define the starting position of robot in RViz? Justify your answer with example.

(2+5 lines: 2 + 5 marks)

Answer:

It is not possible to define the starting position of robot in Rviz. Rviz visualizes the robot present in Gazebo. Therefore robot's position in Gazebo will be the starting position of robot in Rviz. Suppose we want the starting position to be (x,y,z) in Rviz. Then we can spawn the robot in Gazebo at (x,y,z) then we will see the robot at (x,y,z) in Rviz. But we cannot directly define starting position in Rviz. We have to first change the position of robot in Gazebo. In amcl package by setting initial_pose_x , initial_pose_y and initial_pose_a parameters we can change the starting position of robot in Rviz. But that will not change the robot's position in Gazebo.

Q4:

How can you calculate the linear and angular velocity using encoder ticks? Justify your answer and write mathematical expressions?

(10 line: 5 marks)

Answer:

Encoder ticks is a square waveform received by the encoder when the robot is moving. Pulse count of the square wave indicates the position and the time period indicates the velocity.
Lets say the circumference of the wheel is 'x' (meters) and 'n' is the number of slots present on the encoder disc, then the linear distance travelled in each pulse is x/n (meters per pulse). Hence, linear velocity can be calculated by knowing the distance and time it took. For angular velocity let's consider the distance between the wheels of the robot to be 'r' which is the radius of the curve path is takes to turn. Therefore for 360^0 rotation it will cover the distance of 2*3.14*r = 'm' (say). We can get the number of rotations of wheel for 360^0 by m/x = 'R' (say). Therefore total number of pulse in 360^0 can be calculated by multiplying R*n ='t' (say). Finally, the encoder resolution for each degree is given as 360/t (degree per pulse). Hence by knowing the pulse count, we can calculate the degree of rotation and hence the angular velocity.

Q5:

Explain accelerometer and gyroscope in brief (No marks for definition)

(5 lines: 3 marks)

Answer:

Accelerometer measures force and thus acceleration in a particular direction. It can measure static as well as dynamic accelerations. Single accelerometer can measure acceleration in one direction and hence we can use three accelerometers to measure tilt in 3D. However accelerometer cannot measure rotation about any axis, this is done by gyroscope. Gyroscope measures change in the angular position thus giving the angular velocity about a particular axis. We use angular velocity to find out angle.