Robot Automation using ROS

Quark Summer Technical Project - 2021
BITS Pilani, K.K. Birla Goa Campus

Logistics

- Course Instructors : Srujan Deolasee, Suhrudh S and Sushant Swamy
- All resources and assignments will be put up in a github repository
- All work is to be uploaded to a personal github repository for submission

Course Description

Automation and Control in Robotics is a fast growing field with exciting innovations coming out with a rapid pace (check out 1 & 2). In this course we hope to familiarise you with the basic tools and techniques that are at the core of such developments.

The course begins from scratch by covering the basics of **Python** including branching, looping, basic I/O and functions. The key tool you will be learning in the course is the **Robotics Operating System** (ROS) - a software framework designed to make robotics development easier. Along with this you will also be working with **Gazebo** which is a robotics simulator where you can create your own robot models or even test out code on pre-existing Turtlebot.

The **final project** is programming an **autonomous ground robot**, this will involve combining the tasks you will do over the course of the 6 weeks. You will be given a map of an environment with some obstacles. Your task is to help an intelligent robotic spy to spy on an alleged criminal. You will program the robot to follow the suspect in a bounded unknown environment with obstacles. The robot must also avoid the obstacles as it tries to follow the target. The constraint is to stay close to the target but not too close to avoid getting caught. You will be using one of the path planning algorithms you will have learned. You will then need to write a controller for the turtlebot to traverse the path and follow the suspect.

Evaluation

Each week, we will release a few learning oriented assignments. Those who submit all of these to a satisfactory level will get the *Certificate of Completions* and the top 3 participants will get the *Certificate of Excellence*. Participants with great performance and a remarkable show of interest during the QSTP will also be considered for induction into the Electronics and Robotics Club.

Timeline

WEEK	TOPIC	TASK
Week 1	Robotics Development Environment and basics of Python and Git	Installation and setup of Git, ROS (robotics framework) and Gazebo (simulator).
Week 2	Basics of ROS and Gazebo Simulator.	Writing a simple program using ROS to automate Turtlebot.
Week 3	Basic control theory	Developing a PID controller for Turtlebot to move from one point to another within the environment.
Week 4	Path planning algorithms	Implementing a simple path planner in python.
Week 5 and 6	Final Project + ROS and Automation in Real Life	Combining everything done uptill now for a capstone project. You will also learn a bit about what goes into transitioning from simulation into real life implementation.

Resources

Along with these, we shall be putting up further resources on a github repo.

1. Reference book: Programming Robots with ROS by Morgan Quigley, Brian Gerkey, William Smart [Link]. (**Please open the link using BITS ID**, if this is not possible, contact the team)
2. Official ROSwiki tutorials

Software Requirements

We recommend that you try installing ROS before the beginning of the QSTP. We have also dedicated the first week to setup and installation so that we can troubleshoot any issues you may face. We will be putting up detailed instructions for the process on the QSTP repository. For those unable to set up Ubuntu for whatever reason, please put it up on the group or contact one of the team, we will try to work out some alternatives.

1. OS: Ubuntu 16.04 /18.04 /20.04 | Ubuntu on Virtual Machine (for Windows) | ROS Docker Image (for [MacOS](#) or [Windows](#))
2. Software: [ROS Kinetic](#) (for Ubuntu 16.04) or [ROS Melodic](#) (for Ubuntu 18.04) or [ROS Noetic](#) (for Ubuntu 20.04)
3. Python 2.7+ (usually pre-installed with Ubuntu OS)
4. Useful Tools: [Git](#), [Terminator](#)

Notes

- Don't refrain from asking doubts, no matter how silly you think they are. The instructors and mentors are here to help you.
- The skills you learn through the project will be far more valuable than any certificate you get here, so please don't cheat.
- Your feedback is more valuable to us than anything, so please let us know of any thoughts you have or improvements that we can make.