Birla Institute of Technology and Science, K.K. Birla Goa Campus
Electronics and Robotics Club
First Semester - 2021-2022
Quark Summer Technical Project - 2022
Course Title: Robot Automation and Maze Solving using ROS

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Course Description and Outcome:

Autonomous robots, just like humans, also have the ability to make their own decisions and then perform an action accordingly. A truly autonomous robot is one that can perceive its environment, make decisions based on what it perceives and/or has been programmed to recognize conditions, and then actuate a movement or manipulation within that environment. In this workshop, we will go over some important concepts like planning, controls, and computer vision required to create a fully autonomous stack for robot navigation. We will cover some important skills like ROS and OpenCV. At the end of the course, students will create a simulation of a fully autonomous robot navigating through a maze.

Course Plan:

Week	Topic	Subtopic
1	ROS	● Basic of ROS like Publisher, Subscriber, and messages ● Services and TF
2	Planning and Control	● The basic idea behind motion planning ● Planning algorithms like RRT and A* ● Basics of Control and PID and Pure Pursuit ● Implementation in ROS and python
3	OpenCV	● Different types of filters ● Edge detection and colour detection ● Implementation using ROS and OpenCV

4	Autonomous maze solving	• Using concepts of first 3 weeks to create an autonomous stack for maze solving • Trying different algorithms to compare the performance

Description of Projects / Hands-on activities on the Course:

Students will get hands-on experience in creating software stack and simulations for autonomous robots. They will also get experience with frameworks like OpenCV and ROS. The final project will involve using all the gained knowledge to create a maze-solving robot of your own which has a lot of applications in the field of robotics and can be extended to have deeper knowledge about autonomous robots.

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.

Resources

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

1. ERC Handout
2. 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)
3. 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 set up 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.

Contact Information:

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