Master’s Thesis: Robotic Grasping and Manipulation

Robots have already come out of the industrial settings, and we are gradually spotting them here and there in our daily life. For years, we were simply happy to see that technology is catching up with our fiction. But now, it is time for robots to roll up their sleeves and give us some hand in our daily life. You would not like your robotic assistant to just talk! It would be nice of them to wash a few dishes sometimes, clean the kitchen, or fold the clothes. These tasks might look easy for us, but they are algorithmically incredibly involved tasks for a robot to perform.

Robotic Grasping and Manipulation are among the most exciting fields of robotics for obvious reasons. They are the last stage of a very advanced pipeline of perception, reasoning, planning, and action. It necessitates understanding of the details of the subject in three dimensions, most often than not reasoning based on some partial information about the subject and planning for a precise action.

OCRTOC : Open Cloud Robot Table Organization Challenge

There is a comprehensive body of literature out there about any of these stages of the science of robotics. Each of the methods is claiming to solve some aspects of the problem in hand. However, we are looking for a complete solution. So, we need to benchmark these algorithms against the problem we would like to solve and choose the best of them. Open Cloud Robot Table Organization Challenge (OCRTOC) is one of the benchmarks out there which focuses on object rearrangement scenarios. Object rearrangement is an established and non-trivial task for a robot and puts the capability of our solution for several aspects of robotics into a real test. It includes a complete baseline solution which is improved every year based on the best submissions of that year, and right now it is a comprehensive solution for the problem of Grasping and Manipulation. This to be said, it is still far from perfect, and this competition is about to gradually improve it to have a workable solution at the end.

OCRTOC is organized as a competition between different research groups around the world. Every year lots of prestigious research groups from universities around the world submit their
solution to this competition. Recently it also became part of IEEE International Conference on Robotics and Automation (ICRA), the flagship conference on robotics, which will certainly add to its prestige. As such, we would like to form a team of students from Chalmers, and attract collaboration from other universities, to make our contribution to this scientific and engineering endeavor. You can find a more comprehensive description of the competition in the paper the organizers of the competition update every year: **OCRTOC: A Cloud-Based Competition and Benchmark for Robotic Grasping and Manipulation** (https://arxiv.org/abs/2104.11446), and see the best solution of the last year, which is going to be the base-line solution of this year, in their GitHub repository: https://github.com/OCRTOC/OCRTOC_software_package. We encourage you to study their paper, visit the website of the completion (http://www.ocrtoc.org/#!/), and even listen to the presentation of the authors (OCRTOC: A Cloud Based Competition And Benchmark For Robotic Grasping And Manipulation), and if this was something which excites you, come and join us.

**Suitable background**

This competition is mostly about the development of software and algorithms. It will include dealing with hardware at a high-level. You must exhibit good programming skills, preferably in **Python** and/or **C++**, and good understanding of Robotics concepts like perception, planning and execution. Being familiar with Robot Operating System (ROS: https://www.ros.org/) is a huge plus. If you have not worked with Docker (https://www.docker.com/) I strongly recommend that you make yourself familiar with its concepts (It is easy and should not take more than a week to learn from scratch, if you are already familiar with Linux environment); and keep in mind that we are going to work in Linux, (more specifically, Ubuntu) environment.

Most importantly, this is going to be a TEAMWORK, then you must be comfortable working with others, be dependable, and honor the deadlines.

And, as you may already know, software development is an incredibly involved task, and you may need to make yourself available during the period of this involvement.

**Thesis project tasks**

We will choose one aspect of the solution, like perception, planning, or execution, as your domain, and try to improve the base solution that is available right now. To be able to count the work you will do in your participation in this competition toward your Master’s Thesis, you must produce a novel solution, integrate it into the current base-line pipeline, and exhibit some novelty.

**Methodology**

- Literature Review.
- Implementation of a Software Solution.
Benchmarking Against the Available Datasets.

Running demonstration to validate the results.

Our Commitment To you

We would like to make the project fulfilling for the students. We believe a serious project does not need to be dull. We are committed to creating a collaborative and fun environment which encourages people to reach out, ask questions, and produce innovative ideas.

And a cherry on top, if we produce a decent solution the name of you among our team will go up on the winner's board, and we might even have a chance at winning a prize!

Thesis Level: Master’s

Language: Thesis is to be written in English. All Communications are to be in English too.

Starting date: April 2022, or as soon as possible

Number of students: Two (2)

Tutors:

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