

Faculty of Engineering

Summer Research Program 2022-2023

Project Title: Programming robot trajectories in VR

Supervisor(s): Dr Juxi Leitner, Dr Akansel Cosgun

Department: Department of Electrical and Computer Systems Engineering

Email: akansel.cosgun@monash.edu

Website profile of project supervisor: <https://www.linkedin.com/in/akansel-cosgun-02608847/>

<https://scholar.google.com/citations?user=HPPx6F8AAAAJ&hl=en&oi=ao>

Objective

In our [previous work](#), we developed a new paradigm to program robots intuitively: by selecting the robot's waypoints by hand gestures in Augmented Reality. Even though this was an innovative way to program the robot path, it is a tedious process to select each individual waypoint via a hand gesture. Furthermore, it only allows us to encode the 3D position and not the orientation of the robot end-effector. In this project, we explore the use of VR to overcome these difficulties. The idea is to create a replica of the real robot and the objects in the workspace in VR. The user would then be able to select and move a virtual object. The robot's configuration/trajectory will then be computed from the object's position at each timestep. The trajectory then can be executed on the real robot.



Project Details

The hardware that will be used for this project is a robotic manipulator (Franka Panda) and a Virtual Reality Headset (Meta Oculus Quest 2). The project would consist of the following stages:

- 1) Visualize the robot's raw sensor (from RGB-D cameras) in VR
- 2) Detect objects in real-world using RGB-D cameras, and create virtual replicas of them in VR
- 3) Creating the user interface that will let users move the objects freely in VR.
- 4) From the virtual object's movements, solve how the robot arm should move. If the actions are infeasible, show to user which trajectories are feasible (staying as close to the user's movements as possible)
- 5) Executing the programmed trajectory on the real robot
- 6) Conduct user studies to evaluate the effectiveness of the user interface.

Prerequisites

- Strong programming skills in Python, C++, C# or another programming language