

JAMES DYSON FOUNDATION UNDERGRADUATE BURSARY

Robotics
ACTIVITY REPORT

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1 Introduction

Robotics is an exciting field with rapid technological advancements and its uses can be observed all around. In particular, there have been a large amount of research in robotics for automation. Robots are already widely used in less agile settings, such as in car manufacturing, but in settings with a greater variance, new creative solutions are implemented to overcome each of their inherent disadvantages.

In particular, robots that are used in grocery warehouses are explored. The need to operate in a highly varied setting with manipulation of delicate objects such as soft fruits require the integration of a large number of components to work together. This included areas of artificial intelligence and soft robotics.

2 Activities

To ensure the students take away some of the ideas that make up robotics, the activity was split into two parts.

2.1 Part 1: Introduction to Robotics

The students were introduced to the ideas of robotics through an interactive presentation, where question prompts invites guesses from the students. Firstly, an explanation of what robotics is and a brief history. As robotics is a multi-disciplinary area of engineering, it can be hard to initially see what is involved in the blanket term of robotics.

The students were then shown videos of robots that are currently in operation. A wide range of different application for robotics were selected to demonstrate its versatility in different fields, also highlighting the importance of the field of robotics for the future. The final examples were in the direction of visually guided robots to lead onto the final section of the presentation.

Finally a brief example of how artificial intelligence and machine learning works with a simple example to highlight how robots are able to learn what they see and how this enables operation in agile settings. As the demonstration that follows is on a robot that is made for grocery warehouses and uses soft robotics components, this was also explained. In particular the functions of a suction cup, a soft pneumatic actuator

and particle jamming, concepts that appear regularly in soft robotics literature, are explained briefly to introduce the robotic demonstration.

2.2 Part 2: Demonstration in the Robotics Lab



Figure 1: Novel Soft Gripper holding a 3D printed Mango (in Green)

To demonstrate the particle jamming effects, a particle jamming suction cup was passed around the students, Figure 1. The compressed air valves were manually controlled to turn the vacuum effects on and off. This simulated particle jamming that is similar to the effects observed by a vacuum packaged coffee grounds. Turning off the vacuum allows the grounds inside the suction cup membrane to flow and when turned on, the membrane hardens and the shape is maintained.



Figure 2: Foodly Robot used in Demonstration

Figure 2 shows the robot used for the demonstration. The set up involves the fully integrated system that is used to pick up a piece of fruit, a mango, and then place it in the adjacent tray. Key moments were triggered using timed keystrokes to give time for an explanation of the robot process at each step.

These were:

- Start up and moving the robot to starting position (arm and camera positions)
- Computer vision running to find the location and detect the fruits
- Process the computer vision to calculate where the arm must move
- Move the arm to pick then place the fruit

The robot then demonstrated the fully process without stopping before questions at the end.

3 Outcome and Review

The first part of the activities were relatively successful with some student interaction at later stages. The questions may have been too open ended, as a way to encourage some creative thinking, but this lead to some students exploring answers that were not necessarily relevant. The videos seemed to be engaging but required unplanned pausing of the videos to explain what was happening as some students seemed to be confused. Surprisingly, the later explanations on more advanced concepts seemed to have been of great interests to students with more interaction from them.

The demonstration was successful with students fully engaged in the demonstration. There were plenty of thought provoking questions in the end. After speaking to the students in the direct aftermaths, they seemed to enjoy watching a robot function in real life.

Overall I believe the activity was a success and students seemed to be both interested and entertained. I think it was able to convey the exciting field of robotics to the students.