P-3: Revenge of The Recycling System

Figure 12. Cover Photo. “Zero Waste” FreePik [Online]. Available: https://www.freepik.com/free-vector/vector-doodle-set-zero-waste-goods-hand-drawn-planet-earth-eco-objects-elements-recycle-ec_49501796.htm#query=recycle drawing&position=2&from_view=keyword&track=ais&uuid=cdd05674-32bf-44f2-be72-14ac2a8689b9 [Accessed: April 6, 2024]

Project Narrative

T-08 Thurs-36

Timeline: January 11, 2024 - March 4, 2024

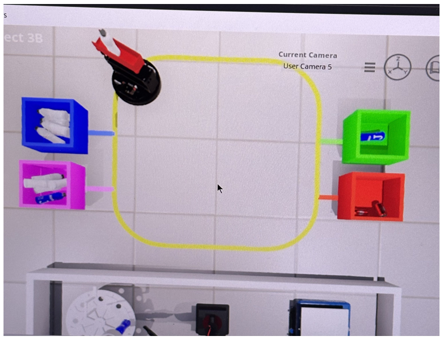

Figure 13. Virtual Environment With 8 Cycles. Photo taken by Ayesha Rashid

https://prod-files-secure.s3.us-west-2.amazonaws.com/89817382-f524-4233-884a-9d6472900626/b248c873-7b30-4976-848f-0630a9318d4a/Untitled_video_-_Made_with_Clipchamp.mp4

Figure 14. Physical Environment: Line follow and deposit. Video Taken by Thurs-36

The Scenario:

This project aimed to design a system for sorting and recycling containers. In the current recycling system model, there is contamination due to items being placed in the wrong bin, and a new sorting algorithm must be created to prevent this problem by utilizing a servo table, a robotic Q-Arm and a Q-Bot.

Objectives:

- Modelling: Create a smooth, and durable mechanism that utilizes a linear or rotary actuator
- Modelling: Low maintenance, simple mechanism
- Computing: Efficient load, transfer, and deposit system
- Computing: Identify the properties of the randomized containers and create an effective sorting system

Constraints:

- Must use a maximum of 2 sensors to detect the type of item to be sorted
- Q-Bot must follow the yellow line to access bins and return to its home position
- Hopper cannot hold more than 3 containers, and the mass inside must be less than 90g

Functions:

Figure 14. Physical Environment. Photo Taken by Thurs-36

- Create a function that deposits a container from a chute, and identifies its bin properties from there
- Create a function that loads the container into a red hopper using a robotic Q-Arm
- Create a function that moves and transfers the Q-Bot into the appropriate bin
- Create a function that deposits the containers using linear or rotary actuator
- Create a function that returns the Q-Bot to its come position to complete one full cycle

Unique Problem Statement:

Design a system for sorting and recycling containers. This system will help sorting facilities reduce the number of non-recyclable items sent to recycling facilities.

Project Objectives:

- Design a system that will increase sorting efficiency in recycling systems to combat recycling contamination
- Create an effective system that can smoothly and precisely transfer collected waste to appropriate bins for recycling using devices such as a servo-controlled turntable, a robotic arm (Q-Arm), and a moving robot (Q-Bot)

- Create an effective mechanism that mounts onto the Q-Bot’s baseplate and utilizes and changes the orientation of the actuator.

Team’s Work and Personal Contributions:

Throughout this project, there were two separate sub-teams, the computing sub-team, and the modelling sub-team who worked closely together to ensure efficiency and effective communication.

Team Contributions:

- Base Mechanism: It was the responsibility of the modelling sub-team to create a mechanism that mounts between a baseplate on top of the Q-Bot and a connecting piece that attaches to a red hopper.
- Determining Type of Actuator: The modelling sub-team was also in charge of determining which type of actuator to use, whether linear or rotary and the orientation of it.
- Weighted Decision Matrix for Mechanism Design: Using all of their concept sketches, the modelling sub-team created a weighted decision matrix, prioritizing key objectives and determining a score for each design.

Personal Contributions:

- Virtual Simulation: It was my responsibility to create a function that successfully loads the containers by orienting the robotic Q-Arm, and moving the grabbed containers into the hopper given its constraints. Additionally, it was also my responsibility, to create a separate function to move the Q-Bot once the loading phase had been completed, and transfer the acquired load to its destination using line following, colour and ultrasonic sensors.
- Hardware/Physical Environment: By using our virtual simulation codes logic, it was my responsibility to create the line-following function that operates the Q-

Arm in real life, similar to the way it does in the virtual environment using line-following and colour sensors to detect when to stop.

- Logbook of Additional Meetings and Discussions: As the coordinator of Thursday 33, it was my role to complete a logbook of additional meetings and discussions which noted in-person and online meetings, and every virtual conversation. This kept us all on track and aligned with project deadlines.

Technical and Soft Skills

Throughout this project, many of my skills were refined:

Technical Applications:

- VNC Viewer: Used for physical control of the Q-Bot in person
- QUANSER: used for a virtual simulation of the scenario, which involved control of the Q-Bot online
- Python: The language used for both physical and virtual environments

Soft Skills:

- Effective Communication: Even though this project was split into sub-teams, as the coordinator, I made the effort to frequently meet with the other sub-team, and update each other with our progress.
- Critical Thinking: A majority of this project involved debugging to create the most efficient algorithm which involved testing my patience, and critical thinking.

Reflection

Throughout this project, my primary focus was on the virtual simulation aspect; honing my coding and algorithm development skills, particularly emphasizing the loading phase, manipulating the position of the robotic Q-Arm, and transferring containers to their desired bin locations using the Q-Bot.

One significant challenge was ensuring a smooth transition between virtual simulation, and the physical environment, which uses the same logic but requires meticulous calibration of sensors and actuators in person. Before coming into the hardware environment, I had an assumption that the same code, and functions would be used in virtual for physical, however, this was not the case. For example, in the physical simulation, I noticed that there was no robotic Q-Arm and containers were loaded manually in the hopper. Given the chance to do things differently, I would have utilized more design studio time to explore the physical environment station and find more creative ways by using a different sensor to return the Q-Bot back to its home position, and ready to deposit.

Moreover, I noticed that each milestone served as a crucial deadline for the work to be well-spaced, and this also helped delegate tasks within the computing sub-team. Reflecting on this, I wonder to what extent our pivotal starting point for choosing our two finalized sensors for the rest of the project played in the virtual simulation code, and what effects this would have on hardware overall? and could we have further optimized and shortened the length of our code using other sensors such as LDR and Active Infrared (IR)?

Furthermore, reflecting on our entire team's progression. I am grateful that as the coordinator, I made the effort to frequently keep both sub-teams aligned with each other progress, and maintain effective communication, in preparation for our in-person interview. For future projects and endeavours, I am definitely going to continue this, as it keeps us organized and aligned with each other and key project objectives.