

IM3080 Design and Innovation Project (AY22/23 Semester 1)

Individual Report

Name: Ryan Gan

Group No: 3

Project Title: Tubes

Contributions to the Project (1 page)

I was part of the hardware team for the project. After researching, 4 assembly attempts and plenty of trial and error, I completed assembly with the help of project mate Bing Hong.

Ideation:

Coming up with sketches for design

Created a 3D model, followed by a cardboard prototype

Exploration:

Research and wiring for 12V LED strip using makeshift external 12V power source

Wiring for interactive components (Button, PIR, Ultrasonic Sensor, ...)

Research and wiring to use interactive components in conjunction with LED strips

Execution:

Purchased 3 rolls of 12V LED strips and 120 Screw Terminal Wire Connectors

Integrated the PSU (Power Supply Unit) into the circuit by cutting a computer charger

Soldered multiple junction boards for the GND, 5V and 12V wires

Coiled wires and placed junctions and wire connectors for wire management

Soldered data lines onto a header pin strip and placed rubber tubing to ensure that the data pin is secure on the Arduino

Modularised tubes for easy assembly and maintenance

With research from project mate Bing Hong, I integrated capacitors and resistors into the circuit to take power spikes into account.

Beautifying:

Pasted new tracing paper, LED strips and wiring onto all 25 tubes.

Maintenance:

Assisted with maintenance of the structure post assembly, solving any hardware issue to keep the project functional while the Arduino team test their code.

Reflection on Learning Outcome Attainment

Reflect on your experience during your project and the achievements you have relating to at least two of the points below:

- (a) Engineering knowledge
- (b) Problem Analysis
- (c) Investigation
- (d) Design/development of Solutions
- (e) Modern Tool Usage
- (f) The Engineer and Society
- (g) Environment and Sustainability
- (h) Ethics
- (i) Individual and Team Work
- (j) Communication
- (k) Project Management and Finance
- (l) Lifelong Learning

Point 1: Development of Solutions

As working with hardware was a new experience for me, I had to do plenty of research and learn by doing. There are many problems that arose, which needed to be analysed and resolved. Below are the main problems faced.

1. Wire Management

This issue was identified during the first out of the four assembly phases where we attempted straight-line connections for all wires. This limited the future development of our project as it would not be possible to amend the connections to each component due to the mess created by poor wire management. I analysed this problem and came up with appropriate solutions such as coiling the wires from each tube together and creating a path to lay the wires with several junctions. This planned solution made it easy to identify and troubleshoot problems with the hardware.

2. Controlling the LED Strip and Ultrasonic Sensor with the Arduino

This problem arose after we laid the wire, coiled it, and placed junctions. To keep the wires neat, some wires became extremely long as they circled around the edges of the structure. This caused problems in controlling the LED strips and sensors with the Arduino. After researching and analysing what could be the cause of the problem, it was identified to be signal attenuation of the wire. This factor was identified by changing 1 variable in the testing phase at any point in time to pinpoint the variable causing the problem. As the cables were very long and bunched up together, interference and noise from surrounding electric signals and the length of the cable were prominent factors that could have been causing this signal loss. The solution to this problem was to create space between cables and reduce the length of the cables when possible.

3. Problems with Assembly

During assembly, it was difficult to lift the lid of the structure to work on the circuitry in the base. I also had to ensure each tube was stable upon connecting it to the structure such that more tubes can be added. Initially, I tried putting the lid sideways while using the poles to rest it perpendicular to the ground. This was not ideal as the wire lengths of each tube had to cater to the placement of the tube, whether it was further away from the base or not. The final solution was to put the sides of the lid on 2 tables and ensure the lid is suspended over the base.

From these 3 problems, it is safe to say that throughout the project there were many problems identified that required analysis, research as well as trial and error. Developing solutions does not come in an instant but it comes from experience.

Point 2: Lifelong Learning

As mentioned in my previous point, using an Arduino was something new to me. Through this experience, I have learnt many things, some of which are below.

1. Soldering
As the project requires a large amount of soldering, I had to learn from Youtube videos and my project mates how to properly solder. Despite picking up this skill relatively late in my university life, I was very keen on doing a good job while soldering as I felt that this is a relevant skill that could aid me in my future projects or tinkering in general.
2. Wire Management
As my project mate Bing Hong was extremely experienced with soldering and tinkering. He often gave input and suggestions in terms of how to organise the components and the wiring which came in very useful. From watching him work, I was able to learn how to properly wire a large-scale Arduino project.
3. Possibilities of Arduino
Through this project, I learnt about the many capabilities of Arduino and would continue exploring various use cases for Arduinos using my experience gained from this module as well as conducting my own research to improve the quality of my projects.