Robotics COMP207

ALGERNON

Project: Micro-Mouse

By Luke Steppens

LIST OF CONTENTS

INTRODUCTION

The goal of this project is to design and manufacture an autonomous micro mouse capable of navigating a pre built maze, following the UKMARS micro mouse contest rules*

Software utilised for this project:

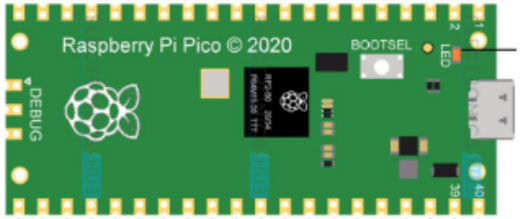
- EasyEda: Printed Circuit Board Design
- Fusion 360: 3D Modelling
- Arduino IDE: Programming

Equipment used for this project

- 3D Printers
- Laser Cutters
- Soldering irons
- General workshop tools

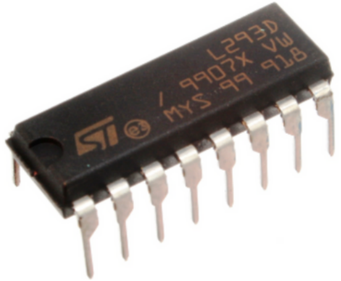
*For micro mouse contest rules visit this link

ELECTRONIC COMPONENTS



Microcontroller:
Pi Pico

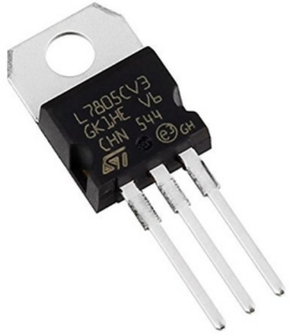
DC Motors:
12V N20



Motor Driver:
L293D

Proximity Sensor:
TCRT5000

Magnetometer:
GY-271 HMC5883L



Voltage Regulator:
L7805

Light Emitting Diodes:
White, Blue ,Red

These are the premade electronic components used in this project

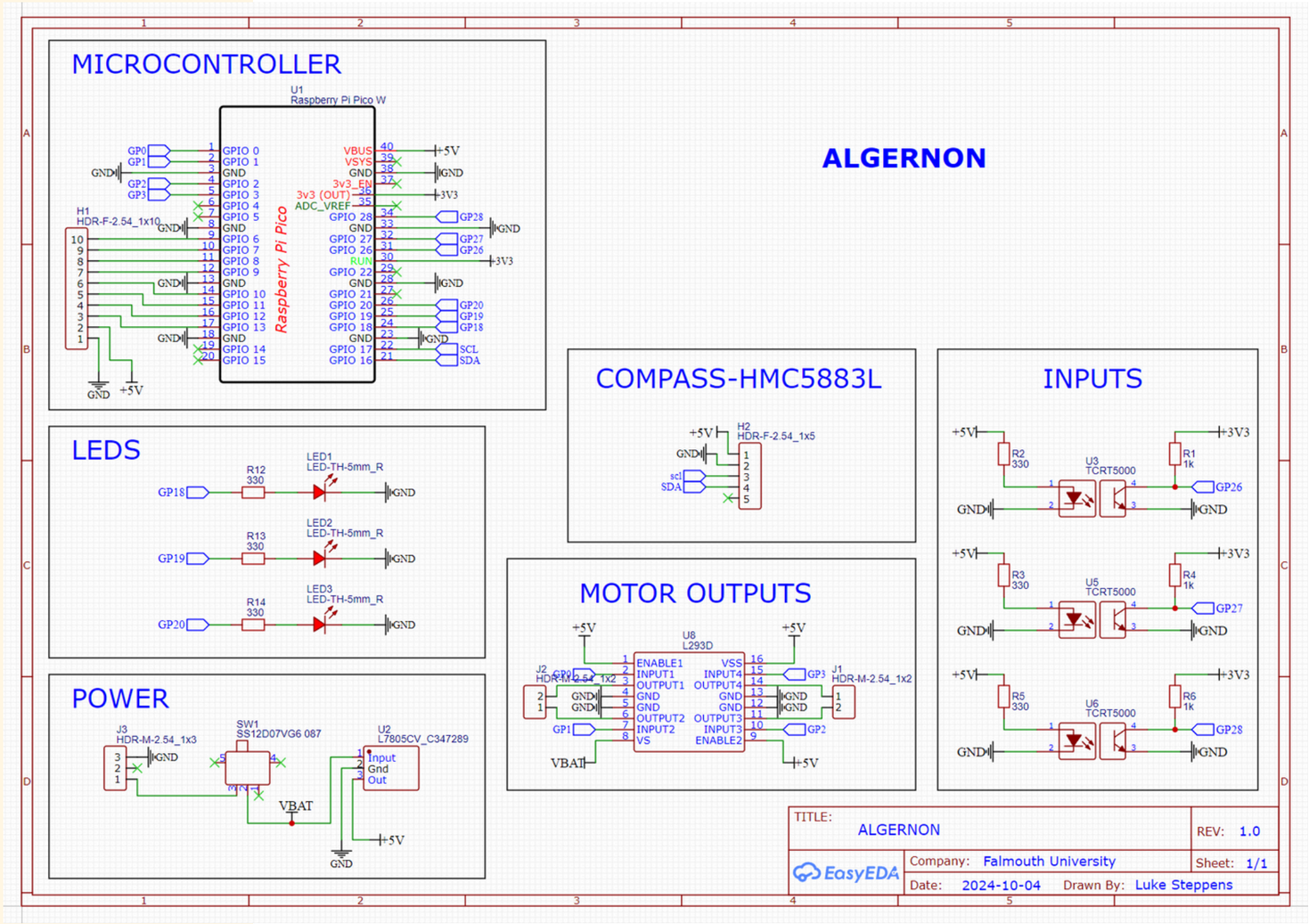
PRINTED CIRCUIT BOARDS AND ASSEMBLY

The first stop on the micro mouse journey was designing the schematic for all the components.

- Connect all components to correct pins
- Components in series are correct, such as LEDs and resisitors
- Consult your datasheet for correct values

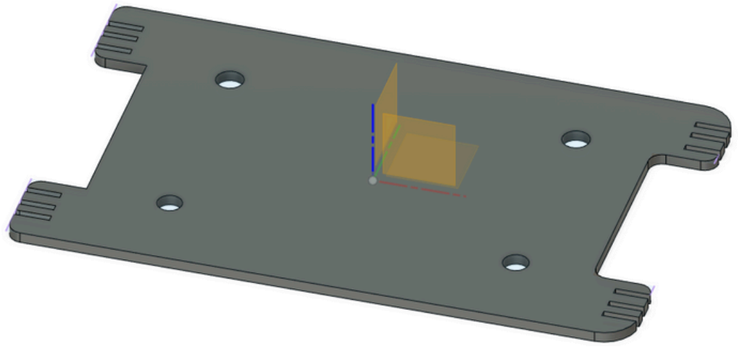
The distributor of the Compass had incorrect values on the website and because of this the final PCB was soldered incorrectly. Checking the datasheet would have taken moments and saved a lot of time that had to be spent debugging and testing.

EasyEda Design



PCB EVOLUTION

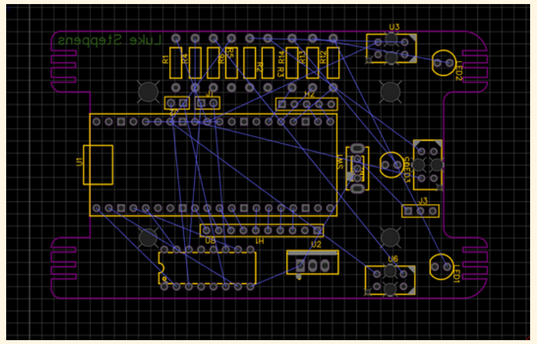
Fusion 360 **EasyEDA**



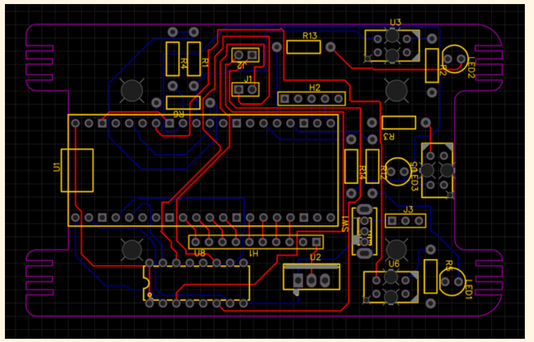
Issue encountered:

I adjusted the track width to simplify the design, but this caused significant issues. I decided to reset the PCB layout, allowing me to start fresh and reorganize the tracks effectively.

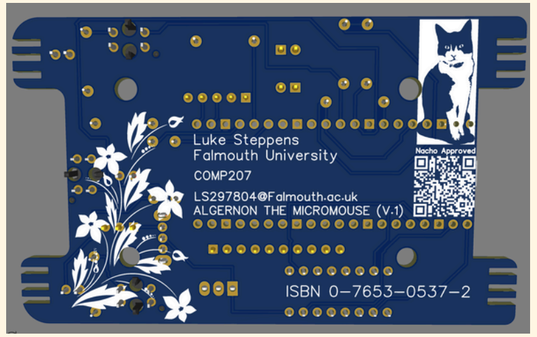
Check your schematics before soldering!
I didnt do this and soldered the Pi Pico headers on the wrong side



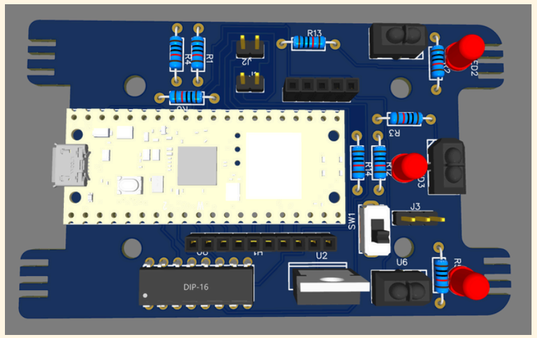
Before Track Layout



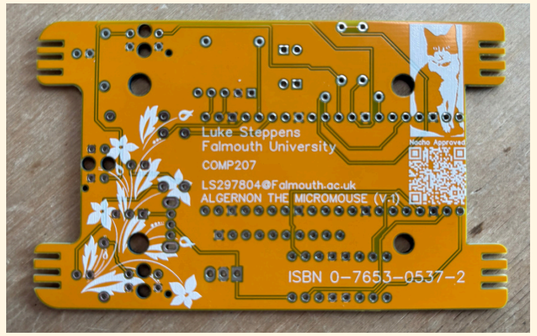
After Track layout



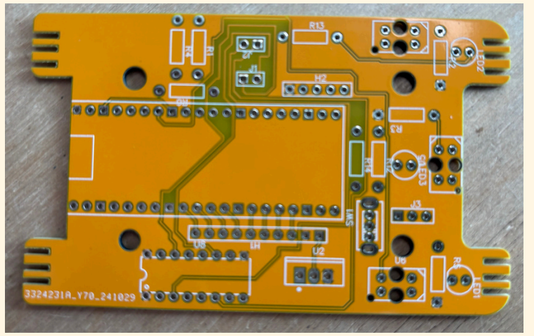
3D Render Underside



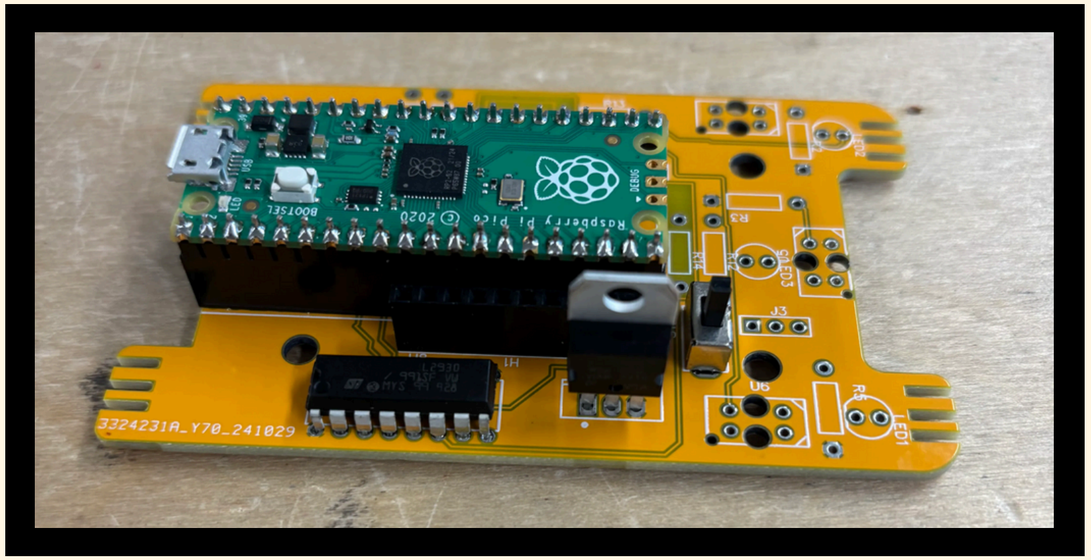
3D Render Top Side



Final Product Under side



Final Product Top Side

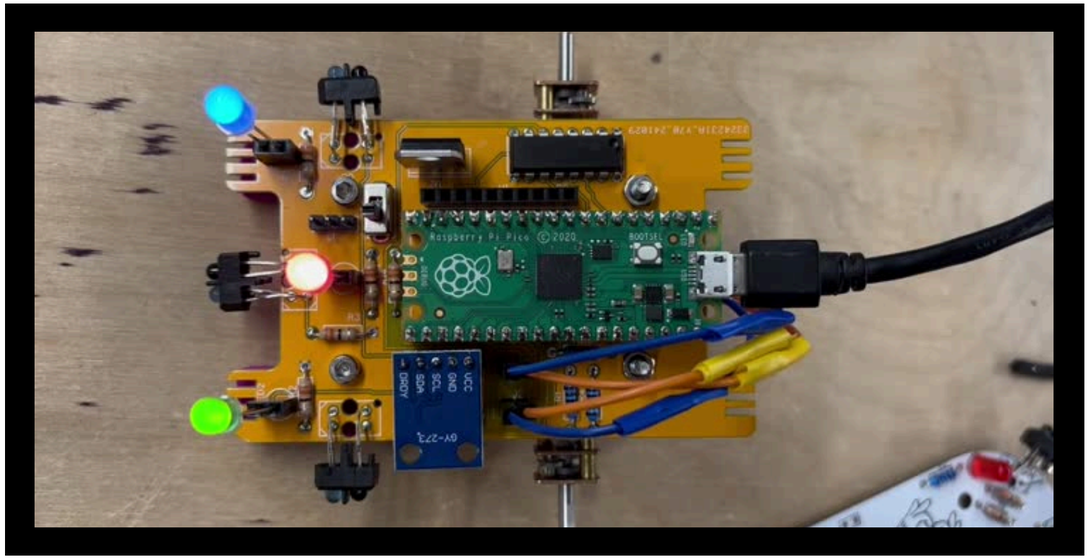


PCB ASSEMBLY

Attaching the components to the board was straightforward soldering. However, ensuring the resistors had the correct resistances and were properly positioned was crucial to prevent future issues.

```
int ledR = 20;
int ledG = 19;
int ledB = 18;

void setup() {
  pinMode(ledR, OUTPUT);
  pinMode(ledG, OUTPUT);
  pinMode(ledB, OUTPUT);
}

void loop() {
  digitalWrite(ledR, HIGH);
  digitalWrite(ledG, HIGH);
  analogWrite(ledB, 30);    //lower the Blue LED to match intensity of Green and Red
  delay(200);
  digitalWrite(ledR, LOW);
  digitalWrite(ledG, LOW);
  digitalWrite(ledB, LOW);
  delay(200);
}
```

Basic LED Code written in Arduino IDE



DESIGNED COMPONENTS

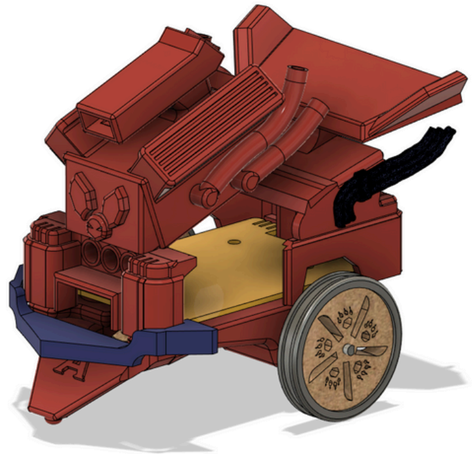
"The freedom to create our own parts comes with a major caveat: it also means creating more problems for ourselves—problems we then have the opportunity to solve."
— Luke Steppens, The Book of Pretentious Self-Quoting

Designed and fabricated Pieces:

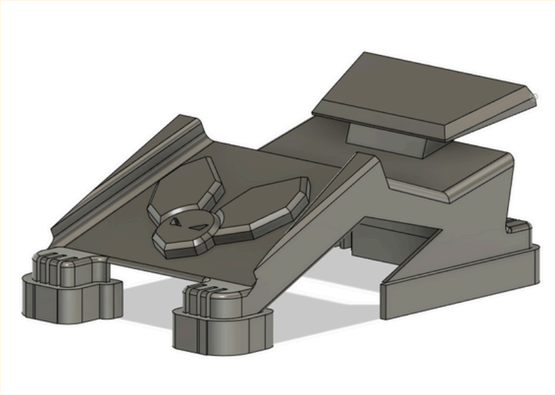
- Basic Chassis
- Motor Mounts
- Battery Holder
- Bumper
- Tires
- Final Chassis
- Wheels

CHASSIS EVOLUTION

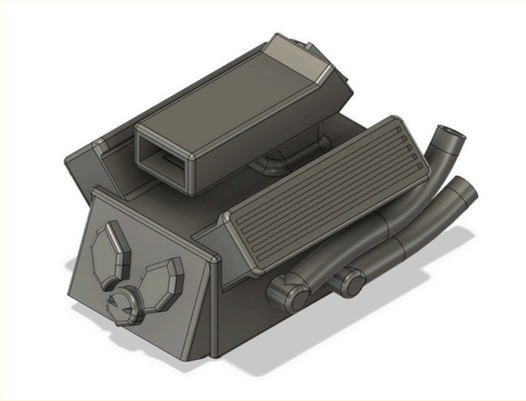
From the relatively simple to overly engineered



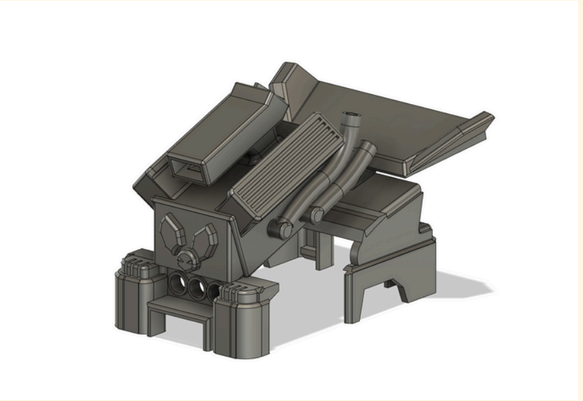
Overall fun design but very visually noisy and needlessly overcomplicated.



Mostly simple design with the mouse logo flourish and some geometry showing signs of complexity at the front.



Obvious inspiration from V8 engines as a battery holder. A fun learning experience



Due to meeting of seperate complex geometries combining the two bodies was very difficult.

Fusion 360 TECHNIQUES

These are a selection of the tools used to create the Chassis, Wheels, Tires, Battery Holder and Bumper.

Extrusion

Rectangular Pattern

Circular Pattern

Pipe

Mirror

Fillet

Chamfer

Combine

Offset

Scale

Shell

Joint

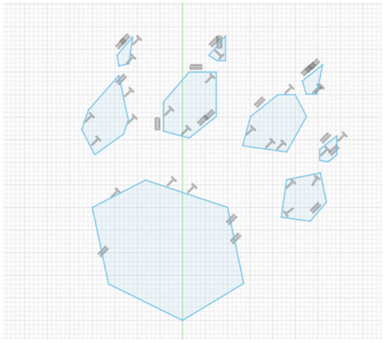
Offset Plane

Appearance

LASER CUTTING

A quick line-based design combined with the circular pattern tool allowed for a paw design to be laser cut. The paw design, along with the wheel, was laser cut in the same process. Laser cutting offers several advantages over 3D printing:

- It is significantly faster, enabling quicker iterations.
- It uses more sustainable resources.
- It provides greater precision for finer details compared to 3D printers.



3D SCANNING

First I made an exhaust from clay and scanned it with the Polycam app, using all 150 shots for the greatest detail.

The GLTB file was then converted into an STL file and imported into fusion where all the background was cut away leaving just the exhaust.

The GLTB file was then converted into an STL file and imported into fusion where all the background was cut away leaving just the exhaust.

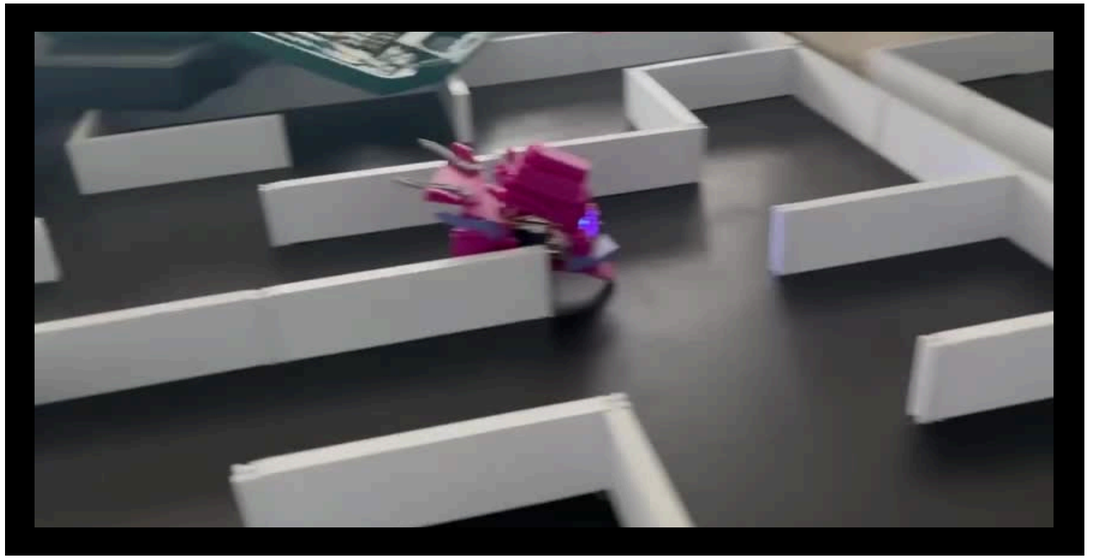
PROGRAMMING

Shorter more succinct code
while having trouble traversing
the maze it still navigated sections.

```
if (!Front){
    motorsForward();
  }

  else if (!Left){
    turnLeft();
  }

  else{
    turnRight();
  }

}
```

Longer more complicated code
while looking like it should have dealt
with problems actual created more.

```
if (Front && Left && Right){
    motorsBackward();
  }

  else if (Front && Left){
    turnRight();
  }

  else if (Front && Right){
    turnLeft();
  }

  else if (Left){
    turnRight();
  }

  else if (Right){
    turnLeft();
  }

  else if (Front){
    turnLeft();
  }

  else {
    motorsForward();
  }
}
```



COMPOSITE COMPONENT

An ongoing challenge was dealing with the wheels gripping the maze's surface. Wood was easier to laser cut but didnt allow for a groove to fit an elastic band in, so I decided to use both PLA and MDF.

I created a tire within Fusion 360 that would sit ontop of the wooden wheel. This tire had an indentation allowing for the elastic band.

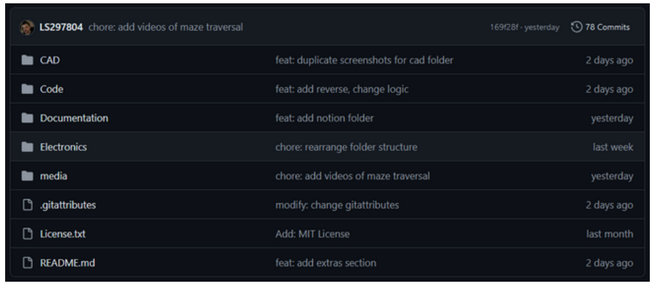
Polylactic Acid Tire

PLA Tire + MDF Wheel

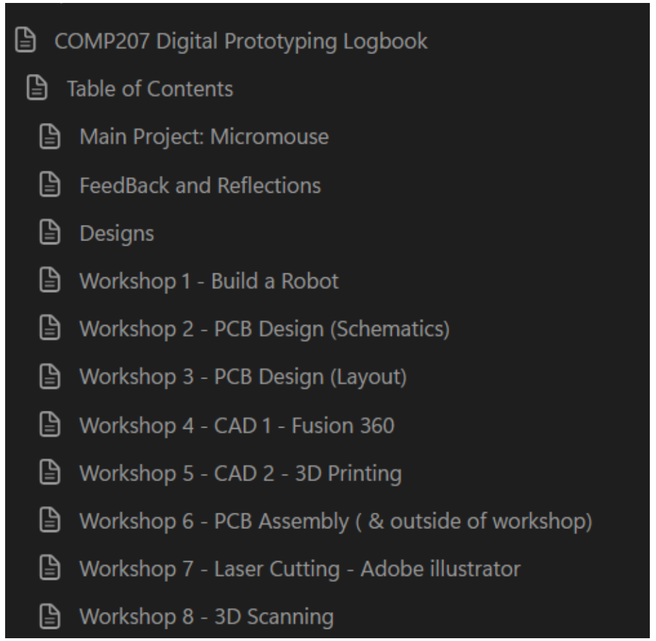
VERSION CONTROL AND DEVLOG

Both of these used in tandem ensured that firstly the project can be reproduced in its entirety and secondly the process of writing the devlog and readme reinforces the concepts and helps commit them to memory.

Github organised in a way to make information easily retrievable by myself and others in the future.



Notion arranged in a way so that I can see previous mistakes. The timeline of the project and see reasoning behind decisions made.



RECOMMENDATIONS

Spend more time refining code whilst looking for ways to keep complexity low.

Always refer to datasheets when creating schematics, do not rely on other sources. Minutes spent at the start will save hours later on.

Save visual flourishes in 3D designs until the item meets its functional requirements. Then go wild!

Recognising and understanding mistakes made often yields new ideas. Starting from the beginning allows the fresh implementation of them.

Ask for feedback at intervals that allow time for changes to be made.