Jack Beaumont

Design Engineering Student

Hello.

Hi, I'm Jack. I'm currently in third year, studying Design Engineering at Imperial College London. I have a background in **rapid prototyping** and **embedded systems development** for **consumer goods** with an emphasis on creating memorable user experiences.

Technical skills

Hardware engineering
Embedded systems, circuit design, Arduino

Software engineering
Python, C++, Matlab, Linux, JavaScript, HTML, CSS

Product design
Solidworks, Adobe Suite, KeyShot, Final Cut Pro, Design for Manufacture, FEA

Product development
User research, branding, pitching, video production and rendering, laser cutting, 3D printing, rapid prototyping

General skills

Project management
Teamwork and Leadership
Time management

Interests

Theatrical Engineering
Swimming
Road cycling
Sailing

Languages

English - Native
French - Native
Spanish - Certified B2 (DELE)
German - Certified B2 (DSD II)

My experience

Work experience

Dyson School | Undergraduate Research Opportunity Programme
Imperial College London, UK
July 2022 - September 2022

- Chosen to lead individual research in visualisations of time-domain plane wave phenomena in complex optical media, allowing to better model the behaviour of light at boundary conditions

Dyson School | Engineering Mathematics Student Shaper
Imperial College London, UK
July 2021 - June 2022

- Collaborated synchronously alongside 15 other students on an open source GitHub project to revamp the tutorials to an online format
- Conducted weekly tutorial sessions to assist students in the Maths and Computing courses
- Established an interactive online interface to teach Python skills

British Section, Lycée International | Live Events Management and Video Production
Saint-Germain-en-Laye, France
September 2020 - Present

- Employed by the teaching department to organise, film, edit and produce presentation videos for parents
- Organised and moderated livestreams viewed by over 150 people, allowing traditional events to still take place remotely during the pandemic

Ardagh Group | Design Office
Crosmières, France
June 2019

- Designed supply chain parts in SolidWorks for rapid prototyping
- Preformed tensile stress tests on aluminium can samples

CCE | Cost Engineer
Plestan, France
February 2017

- Budgeted the construction cost of residential buildings and produced client offers presenting costing and timeline breakdowns

Education

Imperial College London | MEng Design Engineering
Imperial College London, London, UK
September 2020 - June 2024

- Dean's List Award (top 10% of cohort)
- On target for 1st Class and achieved 1st Class grade in 1st and 2nd years
- Department workshop student expert
- Engineering Mathematics and Computing teaching assistant
- Relevant modules and grades: Computing, Mechanics, Electronics, Materials and Manufacturing, Finite Element Analysis, Industrial Design

Lycée International of Saint-Germain-en-Laye | OIB Bac S
Lycée International of Saint-Germain-en-Laye, France
September 2006 - June 2020

- Followed a bilingual and bicultural qualification taught in French and English at a first language level.
- Studied Maths, Physics, Chemistry and Biology alongside French, English, Spanish, German, Philosophy, History and Geography.

Volunteering

DramSoc | Lighting Director
Imperial College Union, London, UK
March 2022 - August 2023

- Responsible for the maintenance of theatrical lighting equipment - £650k
- Oversaw 40 events including lighting for a £100k event for Imperial College
- Trained students in lighting design, doubling the amount of qualified student crew
- Repaired fixtures with electromechanical faults, increasing functional lights by 30%

MDL | Board Member
Lycée International of Saint-Germain-en-Laye, France
September 2019 - September 2020

- Negotiated a contract for a ball for over 900 students
- Implemented within a 48 hour timeframe a self-hosted video conferencing system essential for lessons throughout the pandemic which 96 students relied on
- Developed a website and app to improve the access to school news for students

Featured projects

04

Tonal GO

A lightweight and **portable battery powered exercise device** for users with neuromuscular disorders.

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Self balancing segway

A robot that **autonomously balances itself** and dances to the beat of a song.

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LightBot

An **interactive light ball** that animates to music and user inputs through computer vision.

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Lighting design

A collection of lighting designs for plays, musicals, concerts and events prdouced in my free time.

01.

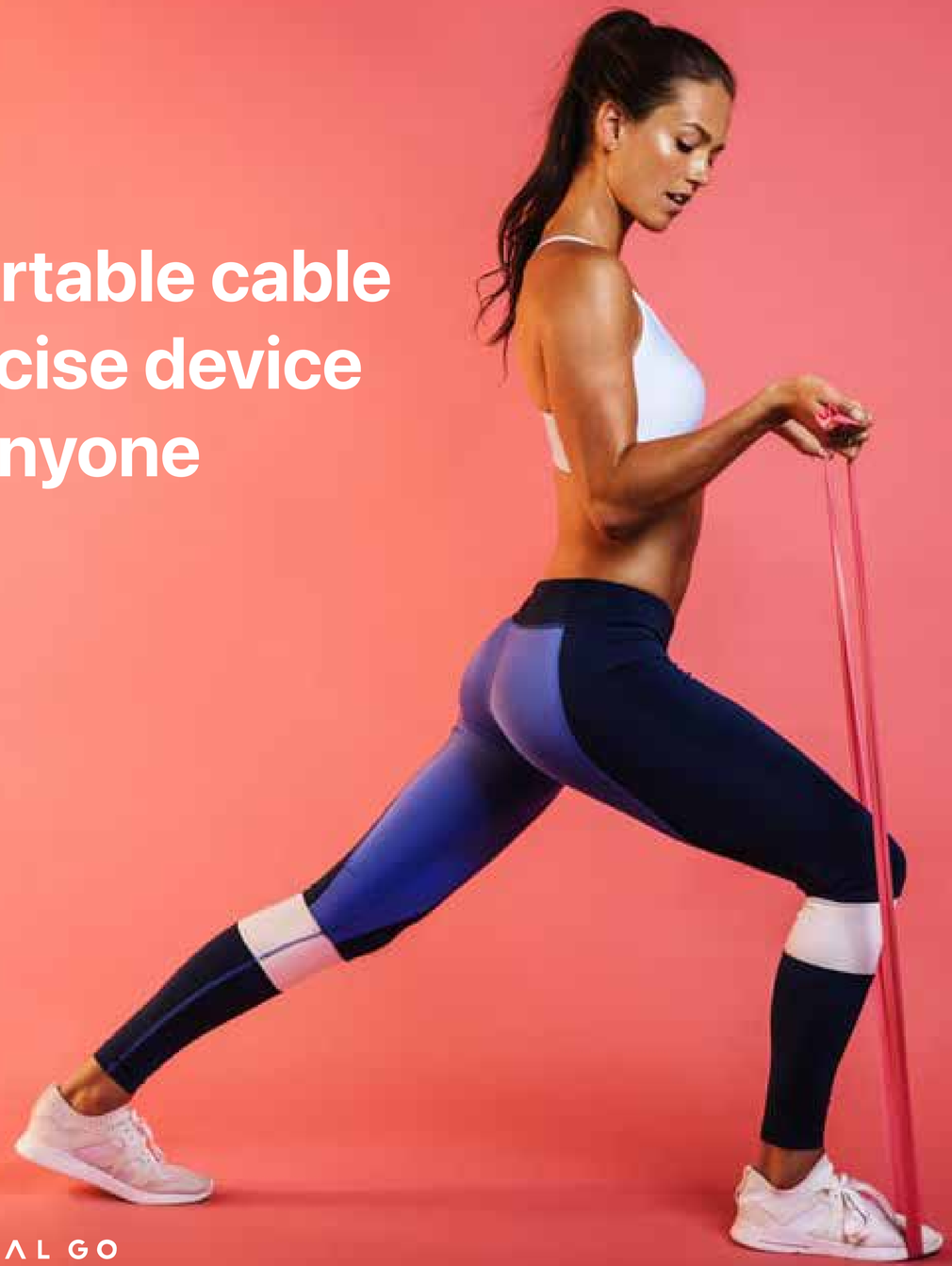
TONAL GO

Brief

Design a battery powered exercise device for users with neuromuscular disorders, whilst ensuring the product is also suitable for the wide public.

Group project with 4 members. Focused on project management, hardware and software design as well as branding.

A portable cable exercise device for anyone



with features targeted to users with neuromuscular disorders.

User
related goals

An inclusive device. It needs to help users with neuromuscular disorders and able bodied users alike to **maintain and increase their muscle mass**.

Provide **accurate recording of health metrics** for digital health. Users with neuromuscular disorders require particular care to managing their daily energy levels to avoid over exertion.

Increase independency by providing a **wide range of exercices** which anyone can perform at any time, indoors or outdoors, without assistance.

Technical requirements

Adjustable resistance

The device must include a **variety of resistance levels**, for cardio and low strength cable workouts, which can easily be changed during the workout, preferably at the press of a button.

Lightweight

To ensure maximal portability, and allow users with neurouscular disorders, who have strength deficiencies, move the device without assistance, it must be lightweight. Therefore it must preferably **not use any physical weights**.

Heart rate sensing

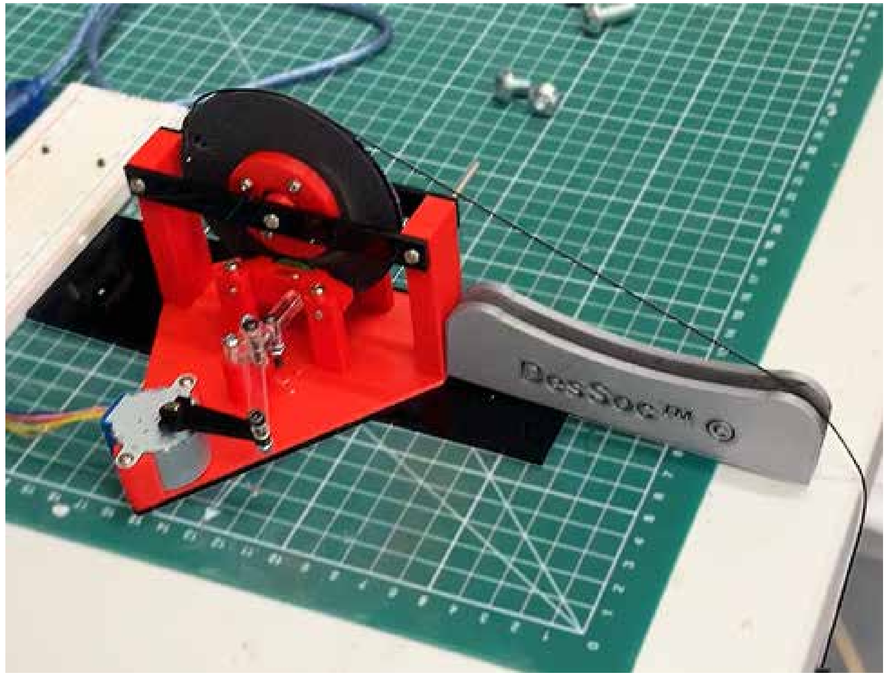
Accurate heart rate sensing must be included to track energy use during the workout. Users with neuromuscular disorders need to carefully manage their daily energy levels. When exessive energy use is detected, the device's **resistance levels can automatically be reduced**.

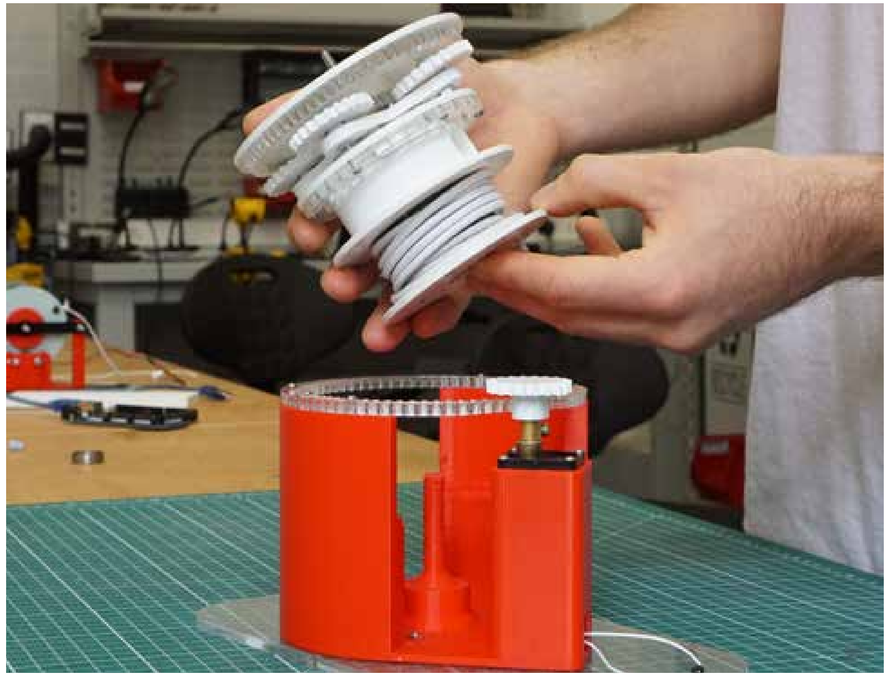
Rapid prototyping

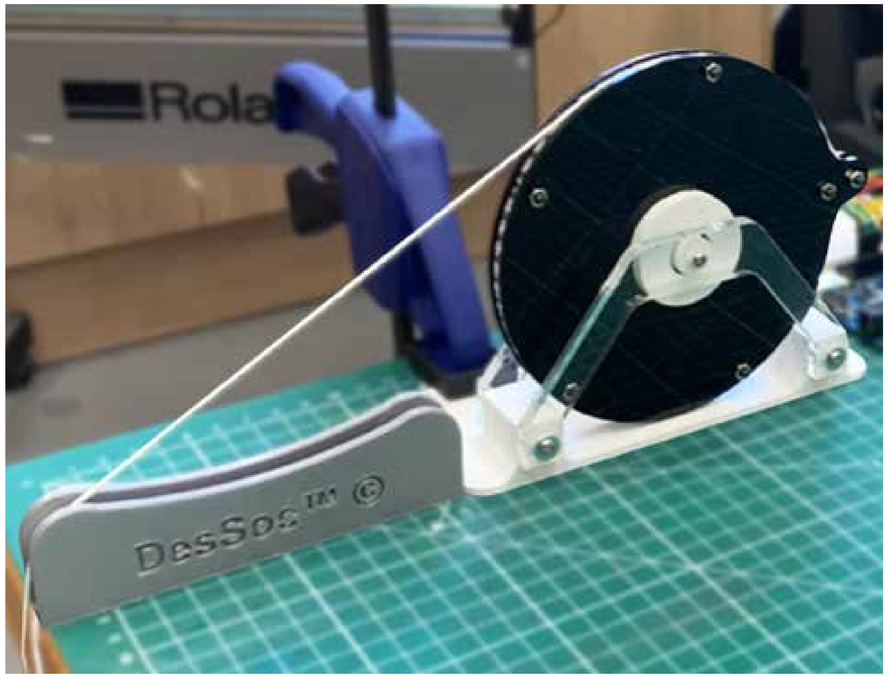
With the context for the project set, various prototypes were developed, to find an appropriate means of creating variable resitance whilst keeping the project lightweight. The embedded electronics and hardware then went through **several iterations** before producing a **functional prototype**.

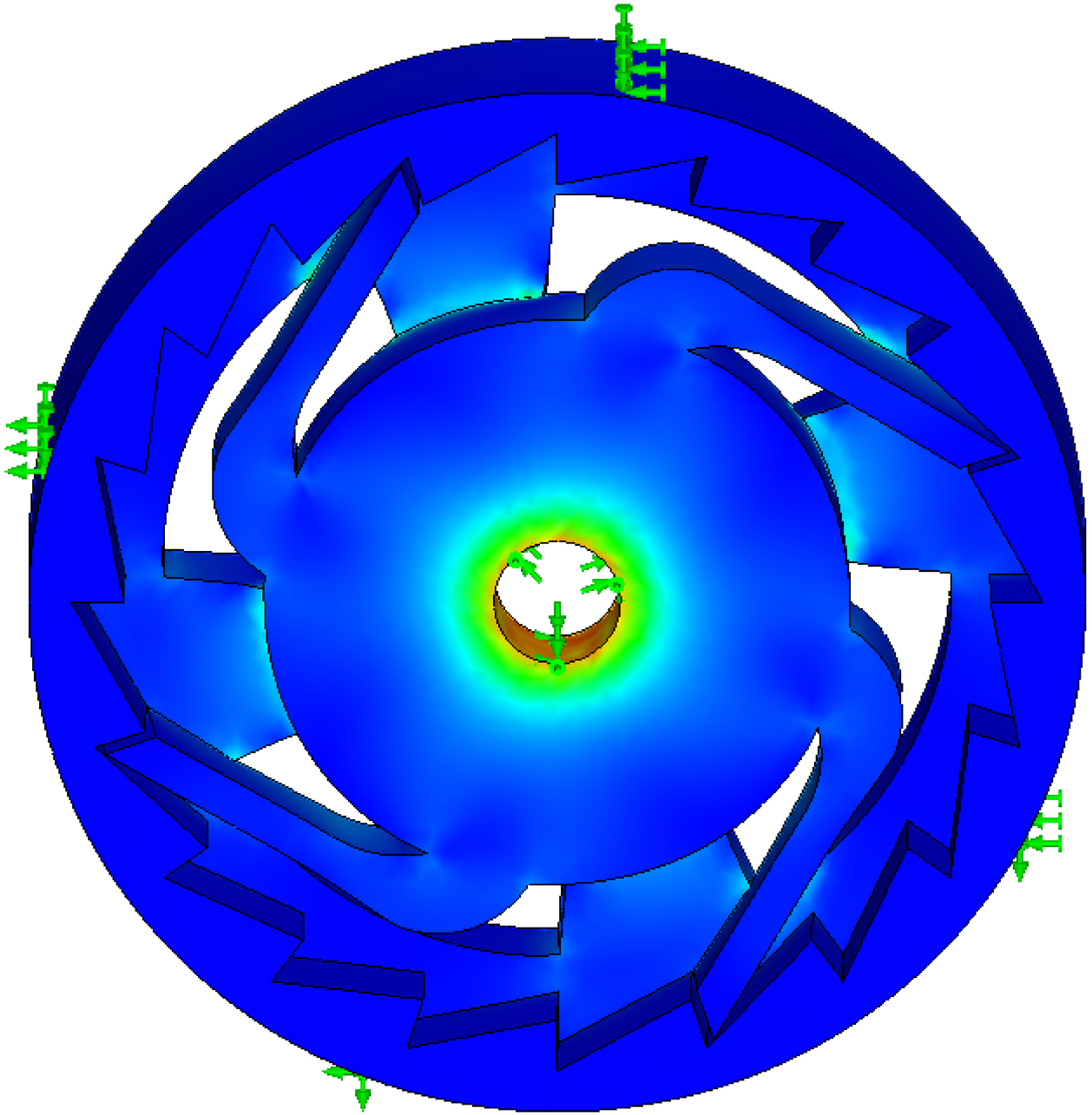
Mechanism prototyping

Four different mechanisms of producing variable resistance were **explored, tested and experimentaly evaluated**. Electromagnetic resistance emerged as the most efficient method for producing variable resistance, by altering the electrical resistance over the motor poles.







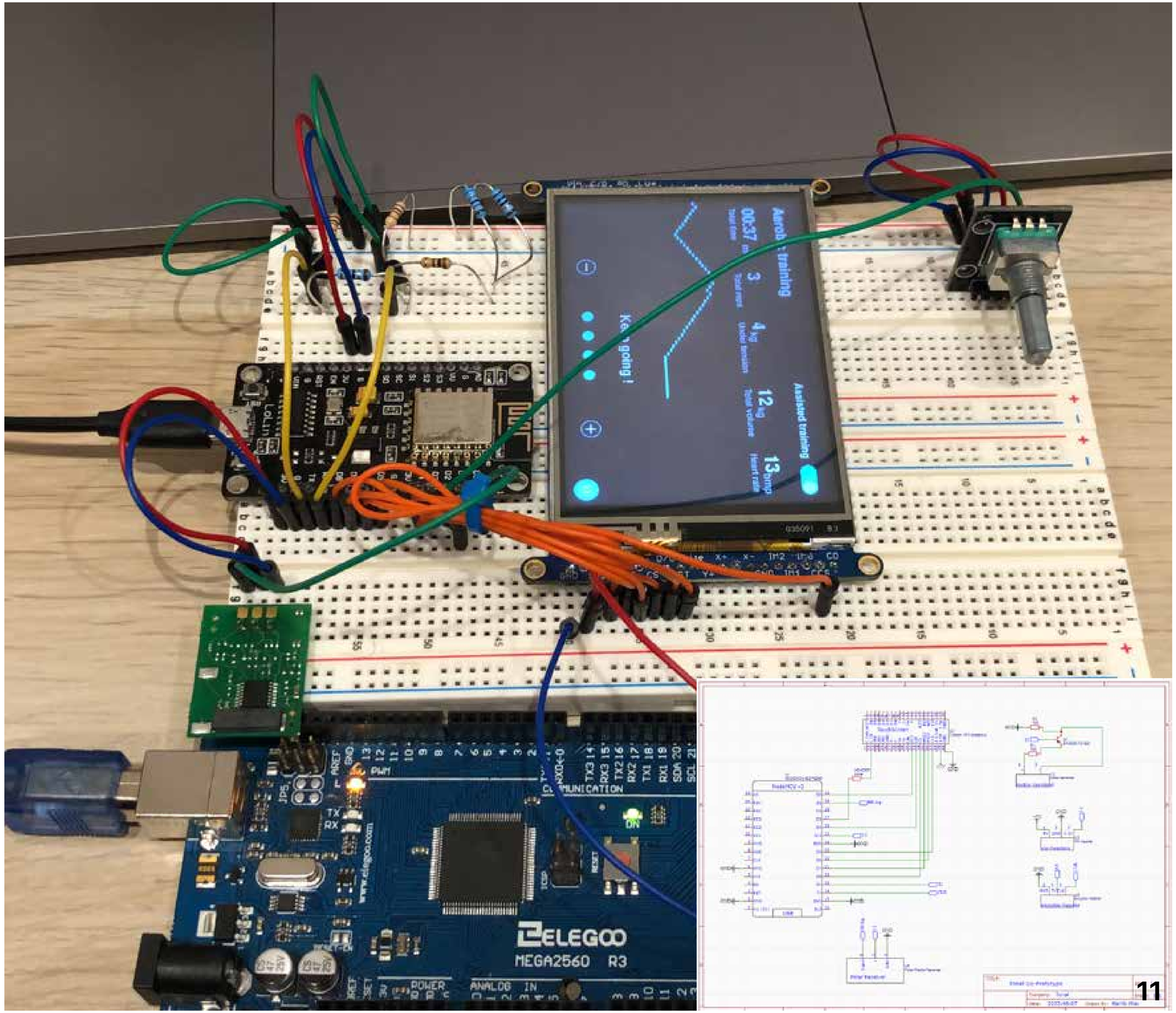


FEA simulations

A ratchet was included in the mechanism to allow the exercise cable to be wound up after each rep. The ratchet was designed as a compliant mechanism to reduce parts and **optimise for DFA**. Therefore **load and fatigue studies** were conducted to ensure the part would not fail under regular use.

Electronics development

The electronics needed to be able to track the status of the current rep, the user's heart rate, as well as providing a user interface to adjust the resistance levels. This was first prototyped on a MEGA2560, before using an ESP8266 in the final prototype. **Custom libraries** were written to calculate the heart rate and display graphs on the **SPI touchscreen**.



User interface development

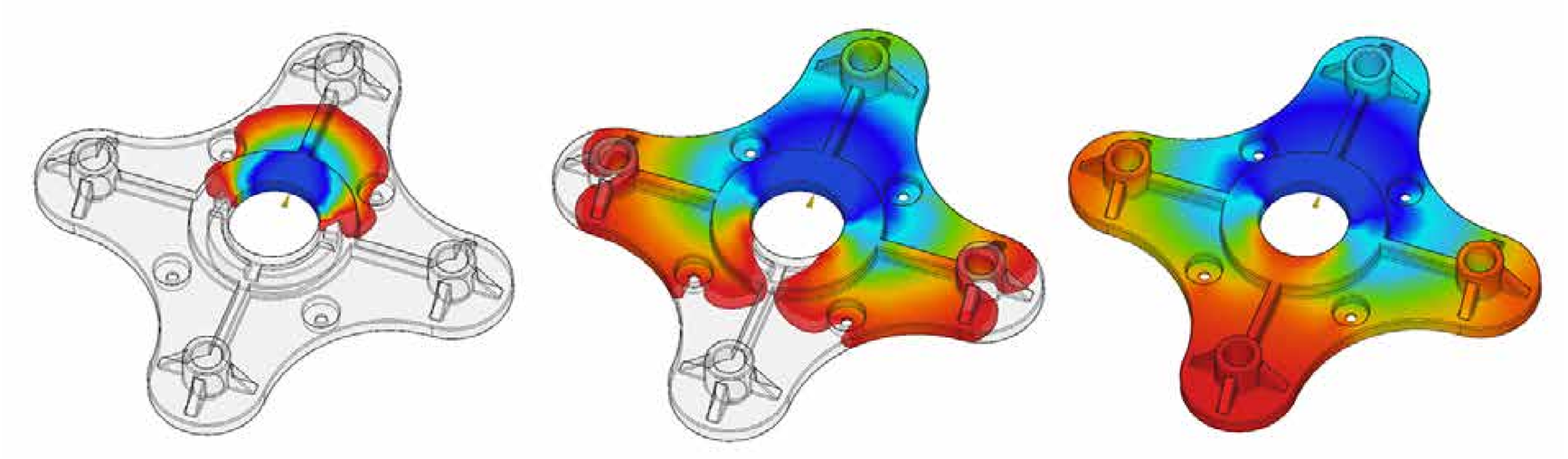
The user interface is one of the main touchpoints of the project, allowing the user to see their activity trends over time, and make decisions to manage their energy levels. The mockup design was iterated through **A/B testing** to optimise the usability of the design.

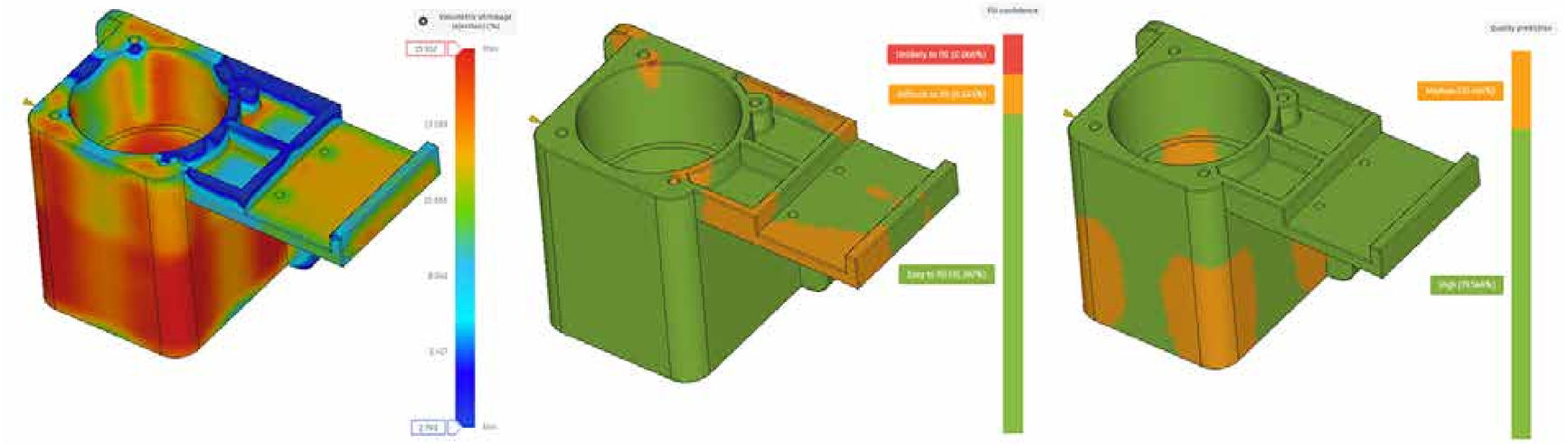
Looks-like prototypes

Foam modelling took place to optimise the **anthropometrics and ergonomics** of the device through user feedback.

Brand development

With the goal of making exercise more accessible to anyone, the product needed a brand whose values and missions fit to our product's value proposition. Tonal was selected due to their bold energetic branding and their mission to make exercise more accessible for anyone. This **branding influence** was seen across all aspects of the design, from the manuals to the packaging.



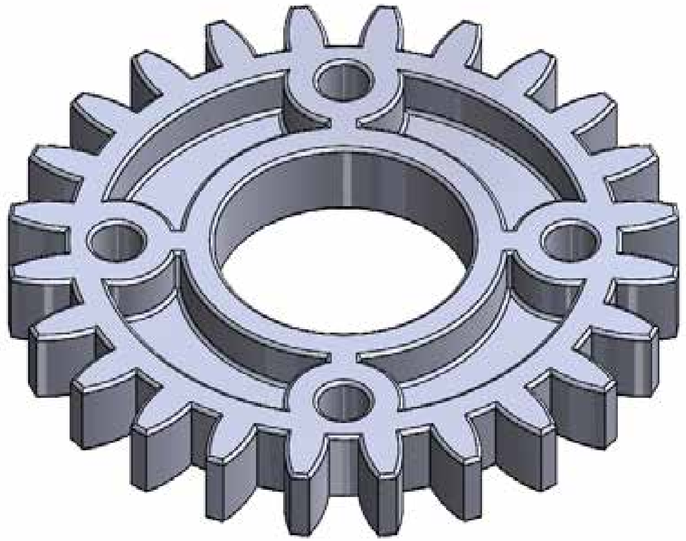


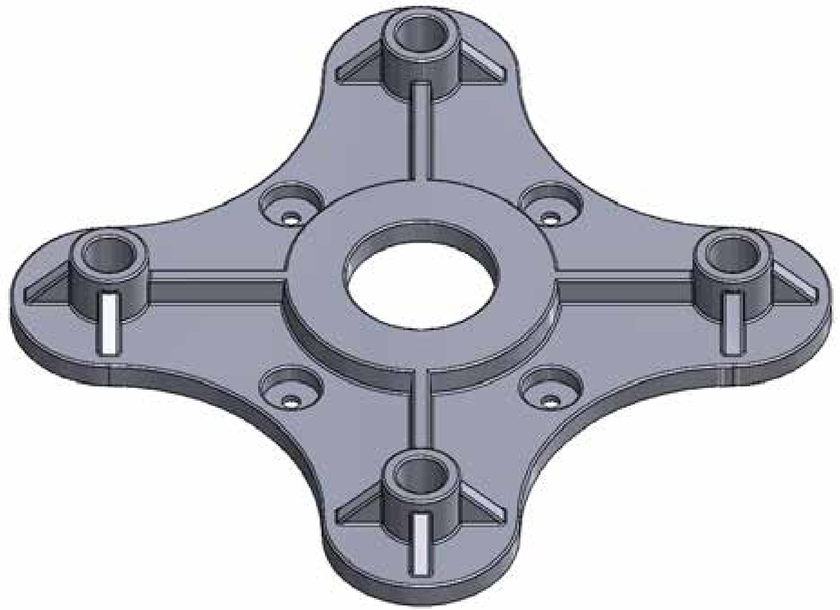
Design for manufacture

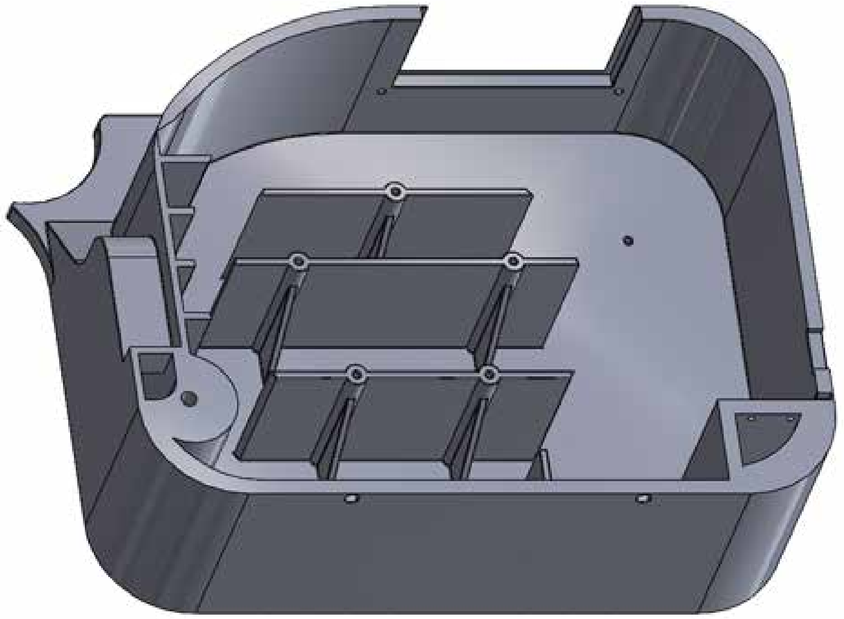
Parts with complex geometries were **simulated and redsigned** if appropriate to ensure all features would fill without shrinkage.

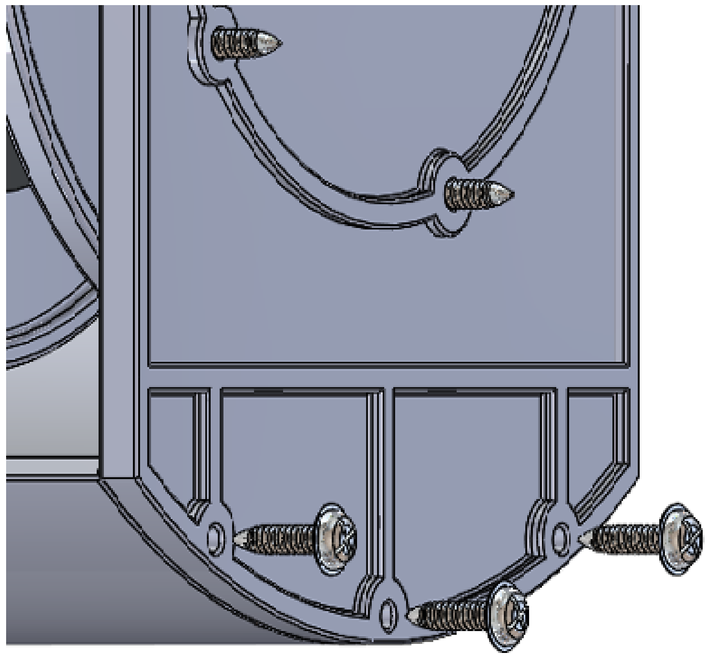
Design for assembly

To optimise the manufacturing time and quality, principles of **design for manufacure and assembly** were kept in mind in the final concept with particular attention to wall thicknesses, ribs, draft angles, bosses, corners and fasteners.







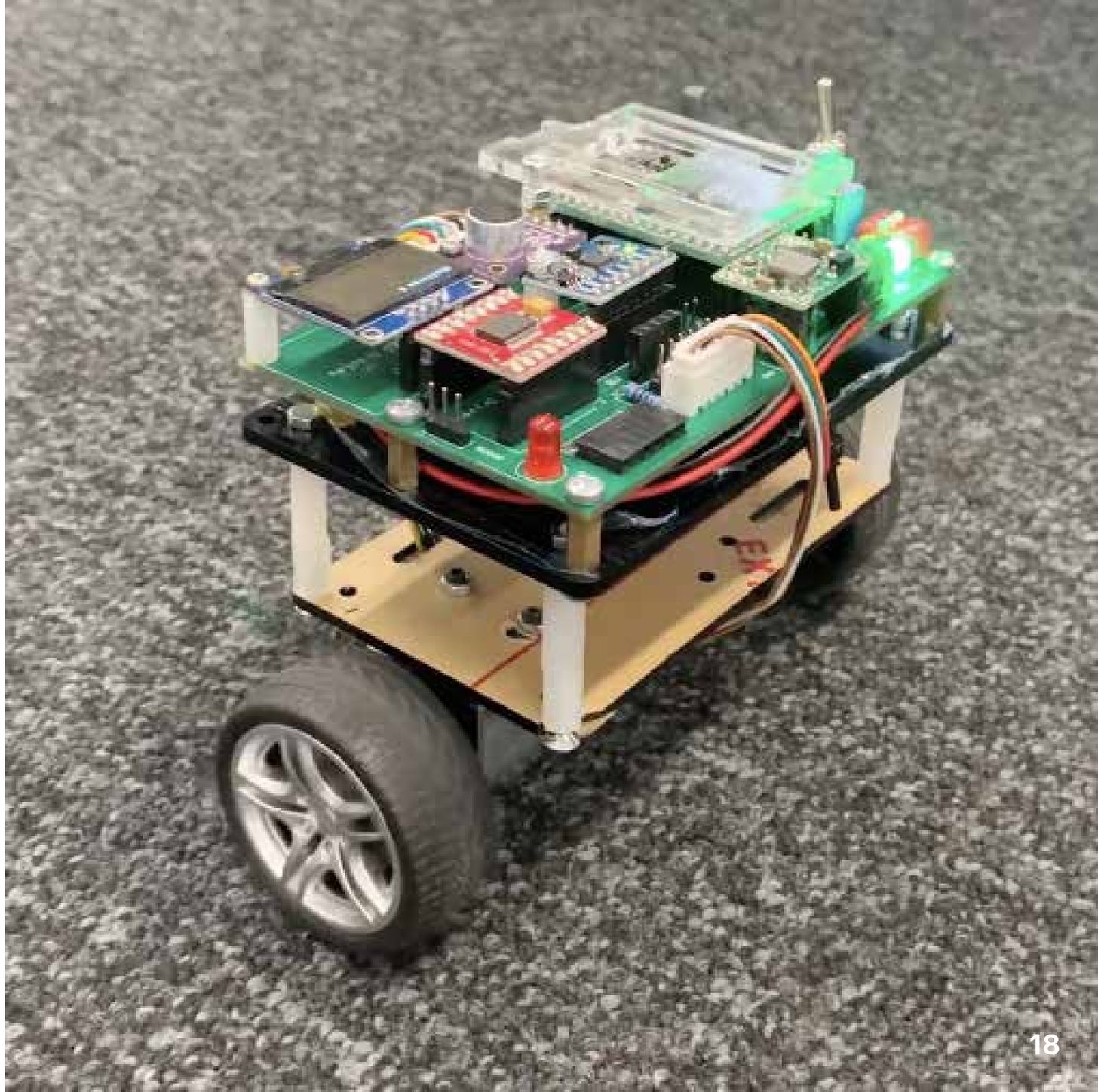


Final prototype

02.

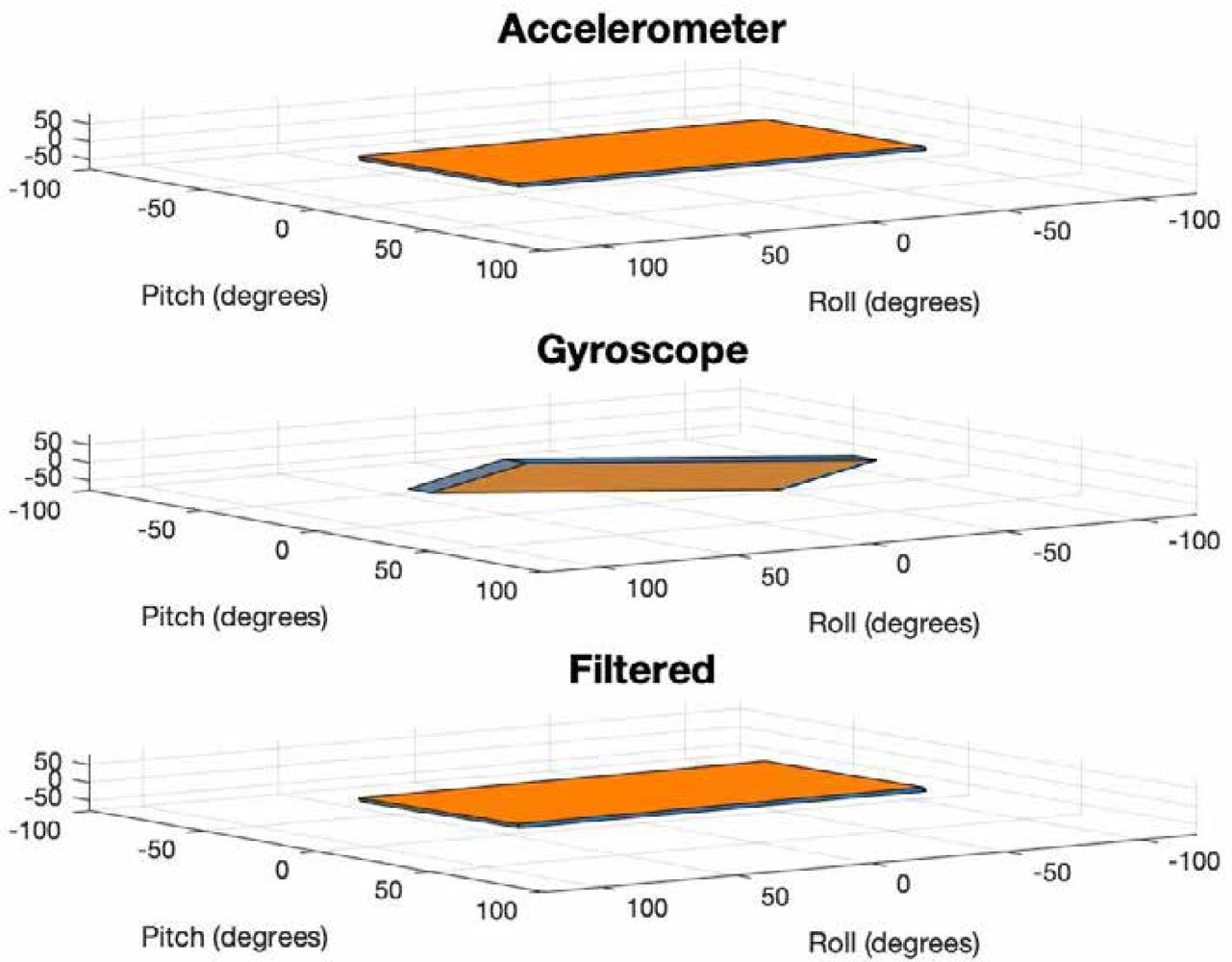
Self balancing segway

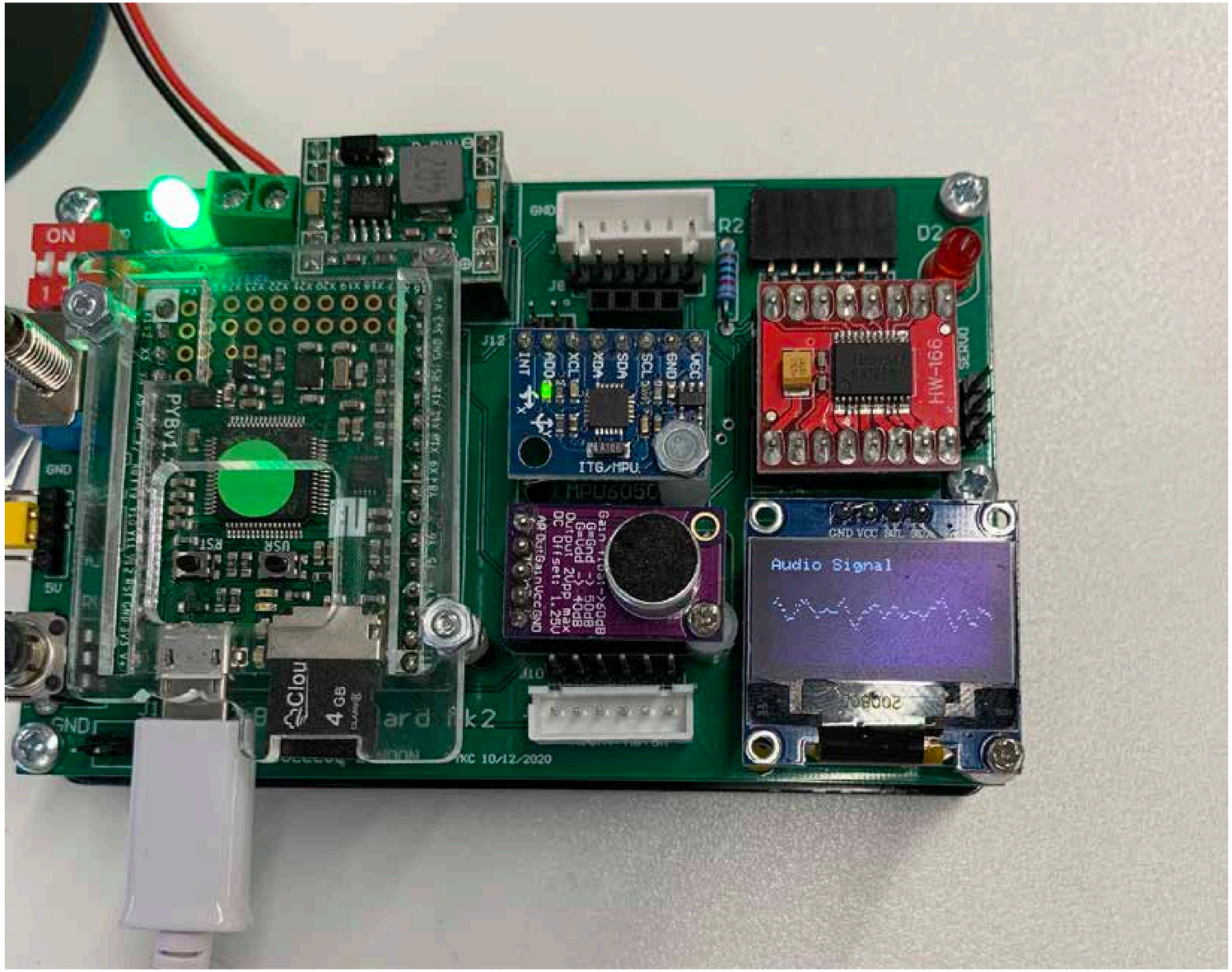
As part of a course challenge, in a team of 2, a self balancing segway was developed using a **PID controller.** The robot was additionally made able to **dance to the beat of a sound track** whilst maintaining its balance.



Electronics

A **complimentary filter** was used to accurately estimate the angle of the segway from the accelerometer and gyroscope readings. Simultaneously a **fast fourier transform** was used to identify the fundamental frequency of the track and instruct the robot to appropriately move to the beat.





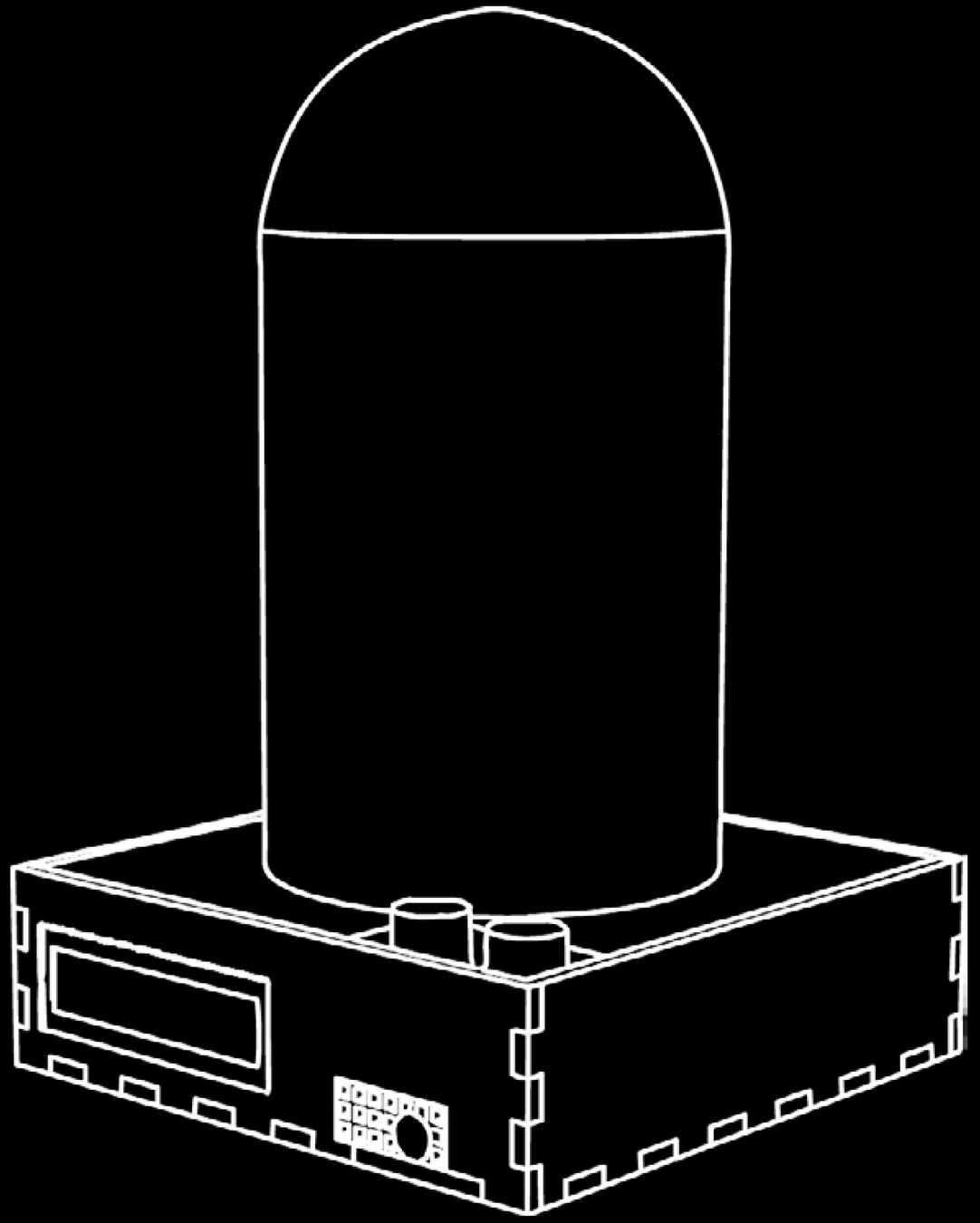
The controller

A PID controller was then tuned to **balance the robot**. By alterating the pitch angle and the PWM ratio between the two motors, the segway could move forwards, backwards and turn.

03.

LightBot

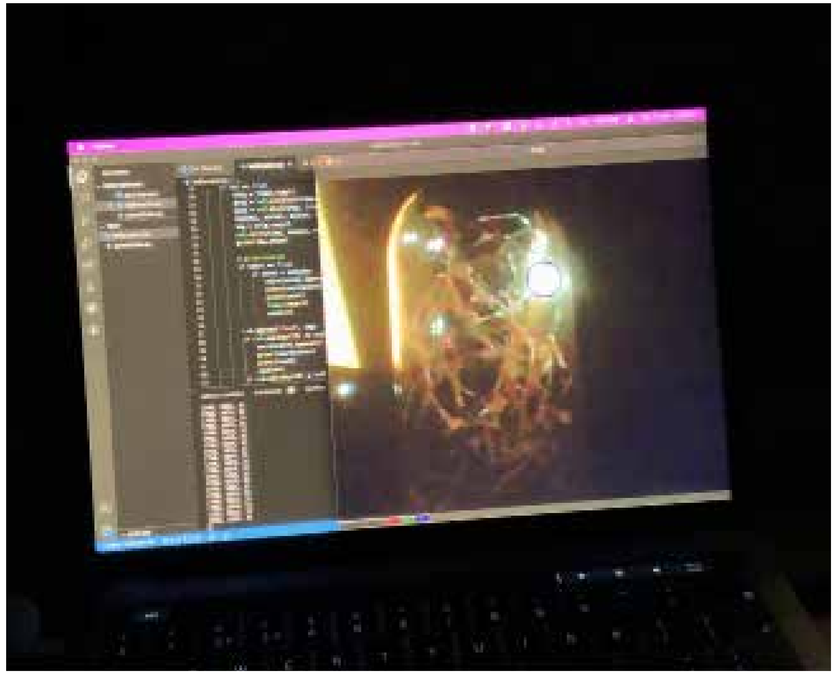
As part of the physical computing module, an Arduino powered machine that would lead to a fun user experience had to be created. An interactive pixel mapped ball of LEDs was designed for this. It would either **play repeated animation loops** and **interact** with the user as they waved their hand over it, or **animate to music** being played.



All the electronics were contained inside of a laser cut and engraved plywood box. A remote control was provided to change light modes and brightness levels.

Computer vision

As the led strip was tangled together inside the dome, a method to find the coordinates of each LED to run animations in space was needed. **OpenCV** was used to calibrate this by iterating through each LED and storing its coordinates to be later used by the animation functions.



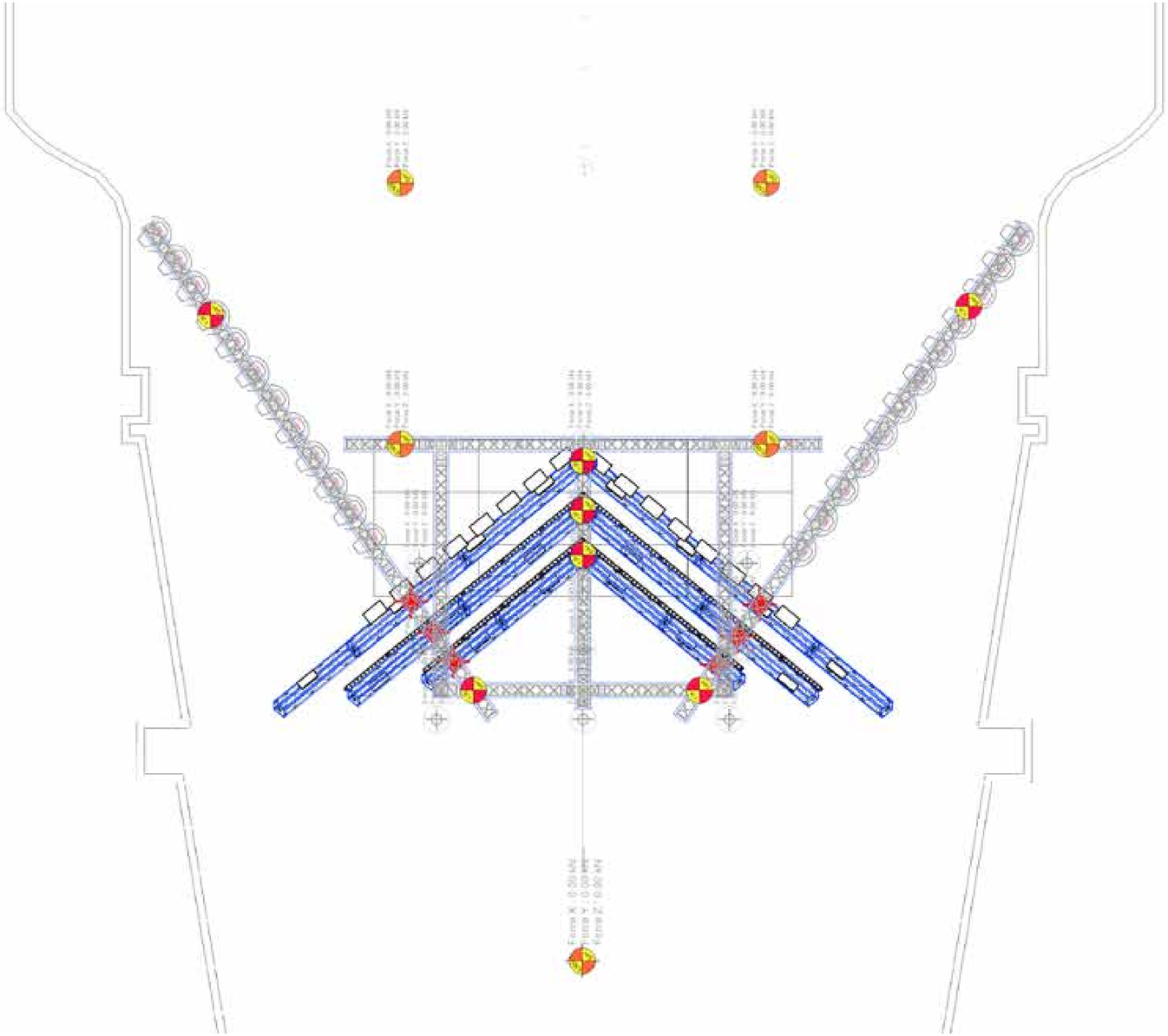
04.

Lighting design

Aside from my degree, I spend my free time designing lighting rigs for plays, live events and concerts. Recent productions include Grease, Family Room and Imperial College London's Summer Ball attended by over 3,000 people. These projects put to test my **teamwork and leadership skills, weaving together tight deadlines and high quality productions**.

Engineering analysis

These events additionally allow me to fully put my engineering skills to test in **real world applications**. Vectorworks **truss simulations** were used to double check mathematical estimations to ensure all the structures would be safely loaded.



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