CYCLONE

Project summary

Cyclone is a **safe and inclusive hair curler** designed towards visually impaired people. Curlers are often a hazard due to high conductive heats.

The idea for this product is to use **airflow and heat convection** to create a vortex to style the user's hair.

Additional visual, tactile and sensory **cues** are used in this **wireless device** to help the user throughout their experience.

To view the full project **click here!**
To view the project's video, **click here!**

AIRFLOW

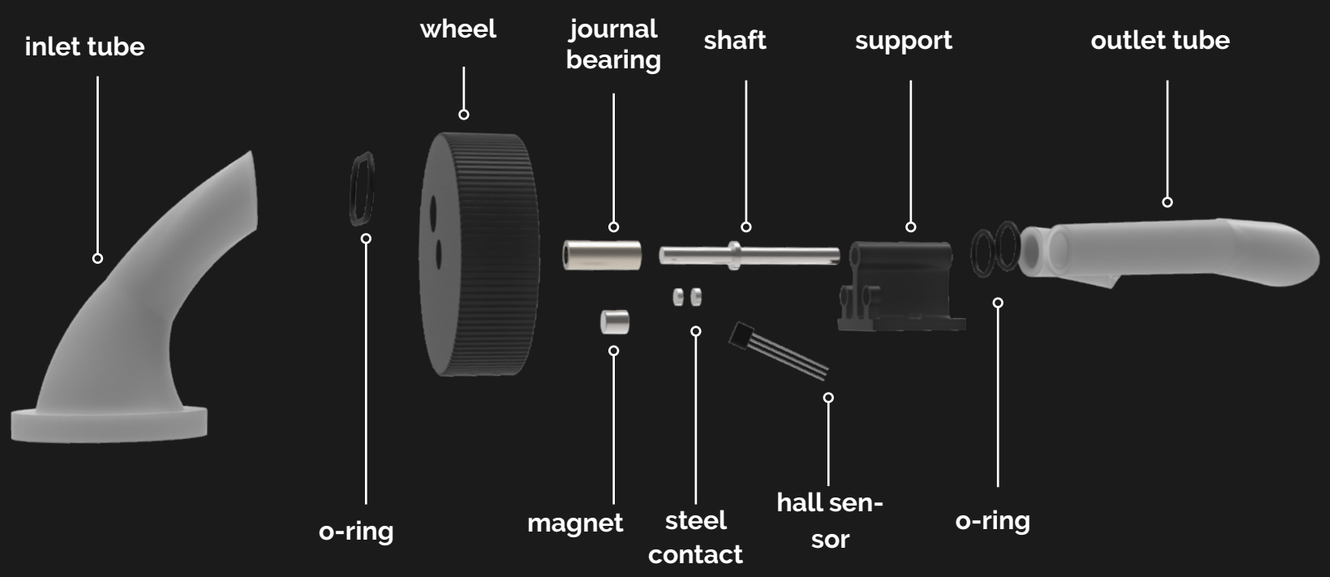
Flow separator: a bifurcation system

An important part of any curler is the ability to **style the hair in both direction** depending on the hairstyle wanted.

The wheel rotates freely around a shaft, and **directs the air** from the **main tube to one of two smaller tubes**. These are the outlet tubes to the inside of the cylinder, **creating a clockwise or counter-clockwise vortex.**

Neodymium magnets are used to **secure the wheel in position** as well as controlling the direction of the lights on the LED strip. To provide an **air tight mechanism**, o-rings are used in the mechanism.

Exploded view of the components in the flow separator

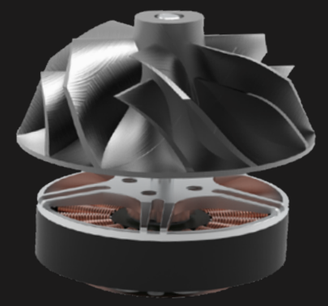


Air flow creator: motor and impeller

Solidworks CAD & Keyshot render of the motor & impeller

By studying the centrifugal compressor maps for the **impeller**, we can determine that to obtain 10L/s of air flow, the impeller needs to rotate at a rate of **8000 revolutions per minute.**

The torque necessary to rotate the impeller from stationary was calculated using D'Alembert's principle at **6mNm**. Hence, the power of the motor is of **5W**.

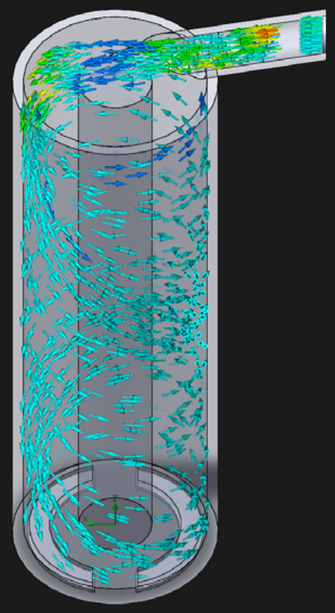


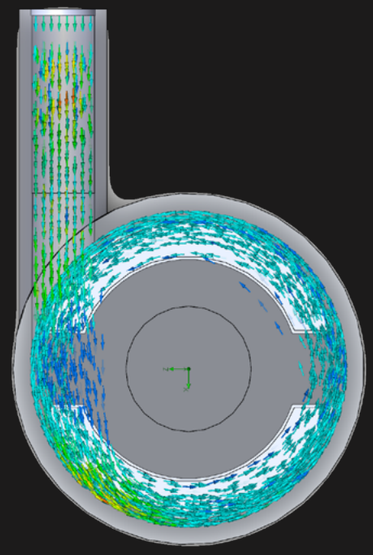
Air flow: vortex analysis

Air flow is the most import aspect of this product. The idea is based on the principle of a **cyclone separator**. Determining the correct **piping** is essential so that output air velocity may create a **vortex**.

Biot-Savart law which is simplified by Localized Induction Approximation results in finding a **velocity of 32 m/s**. Using **Poiseuilles's** law, this gives an output radius of about 5mm.

FEA validation of the theoretical results





HEATING AND DFMA

Design for Manufacturing & Assembly

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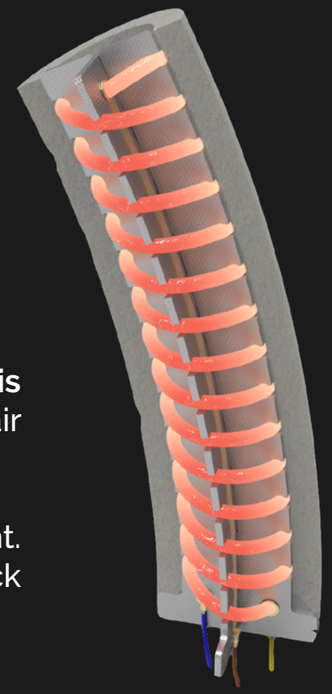
CAD & render of the heating element

Heating element

CAD & render of the heating element

The target temperature for a successful **hair treatment is 60°C**. 422W of power are needed to heat up the 10L/s air flow from an ambient temperature (25°C) to 60°C.

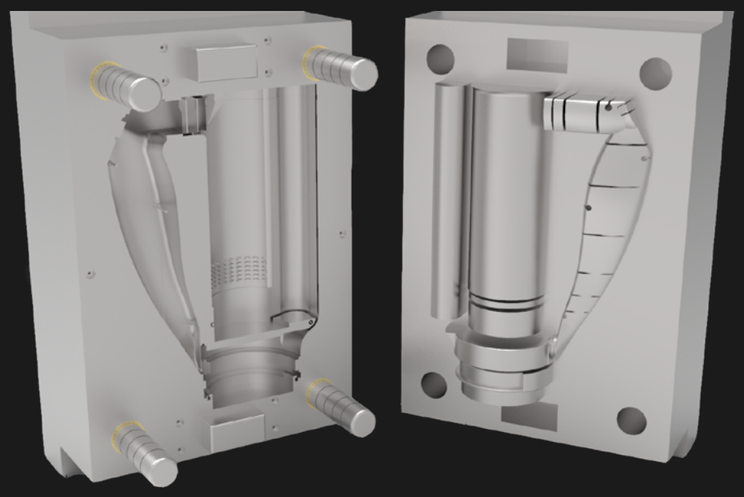
A 2 mm thick **Nichrome wire** was used as heating element. To ensure that the handle did get too hot, a 4 mm thick **fiberglass shell** was added.

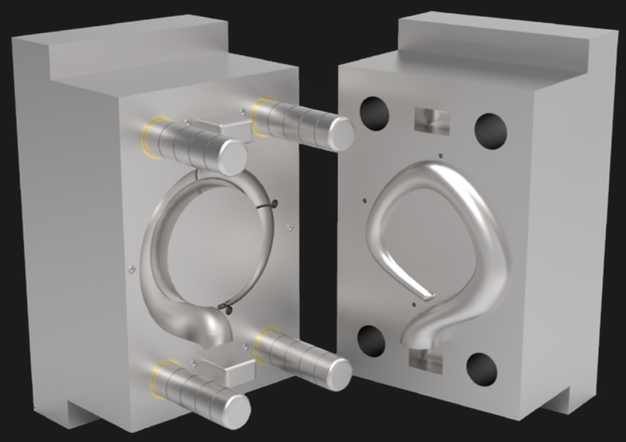


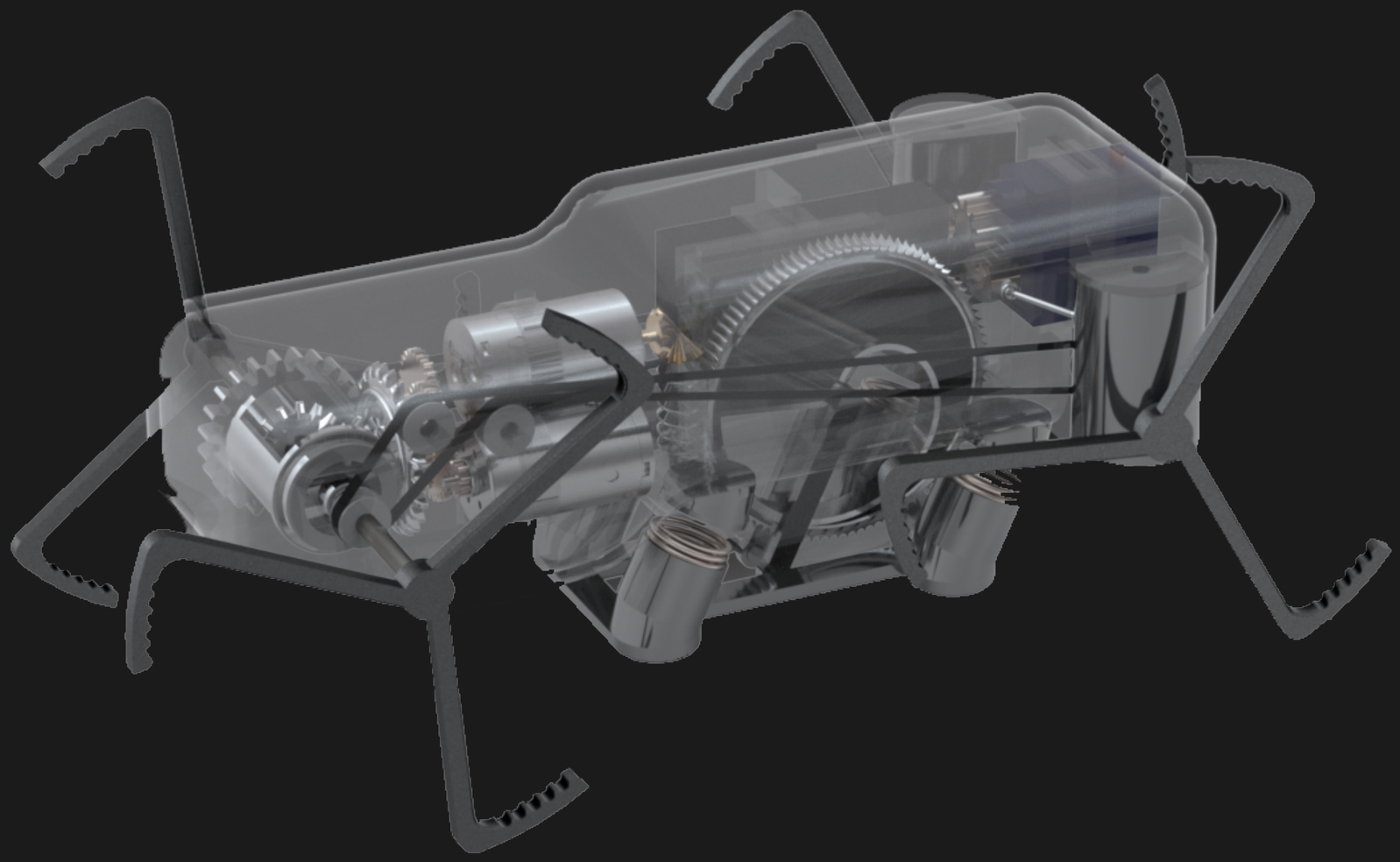
Manufacturing: injection moulding

The entire product is designed for **injection moulding** for a total of **6 different moulds**. By using **ABS,** and concering estimated sales projections and mould price, a estimated retail price would be of **£129.99**.

CAD & render of the casing's and volute chamber's moulds







GIZMOSITY

Project summary

This project's goal was to construct a rendition of the MiniWheg. Gizmosity is a highly functional mini rover which is 4500 times lighter than Curiosity and could cover the 21.9km it has travelled in just 10 h 40 min.

This iPhone sized robot can go at speeds of 0.5 m/s and it's jumping mechanism would allow it to lunge over 1.8m horizontally and 17 cm vertically considering Mars's gravity.

To view the full project, **click here!**

BREAKDOWN

The idea behind this project's rendition of the mini-wheg is to make it a **highly manoeuvrable robot** on such a difficult terrain as the one on **Mars.**

It needs an efficient **climbing and jumping mechanism** to clear vertical and horizontal obstacles. Having the robot **transition smoothly** between 'walking' and jumping was deemed necessary.

Conventional jumping system

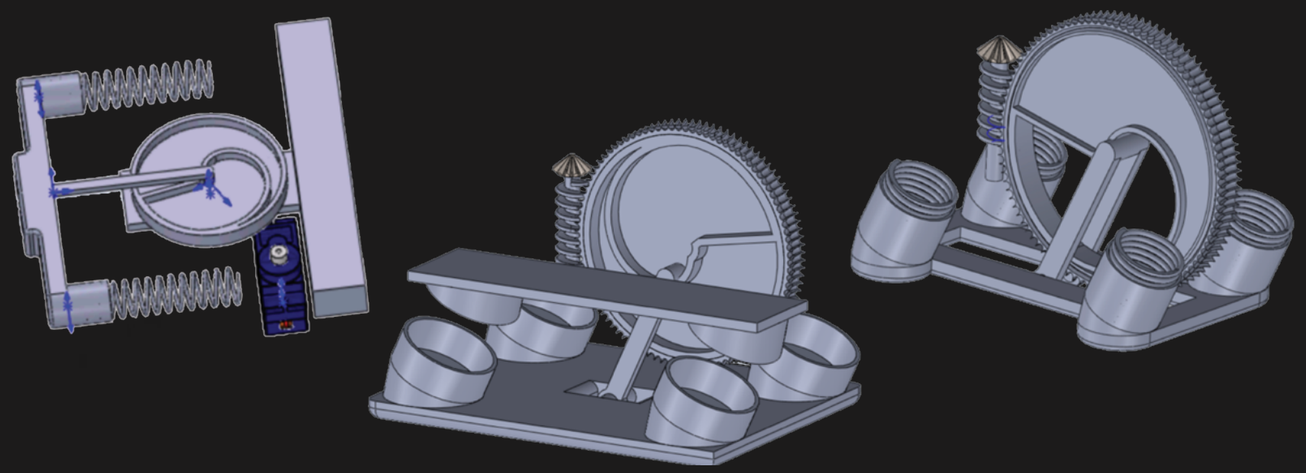
Proposed jumping system

Iterative development for the jumping mechanism

Initially, a turning wheel with an integrated cam would compress two springs in parallel. The design of the mechanism (small trough in the spiral) allows it not to disengage until needed.

A first iteration of this mechanism was put in place in which the wheel is turned by a worm gear which is connected to a motor by a bevel. Four springs in parallel were incorporated to a lower platform and are supposed to compress under an upper platform. The lower platform was optimized whilst the upper platform was discarded to be directly integrated to the chassis.

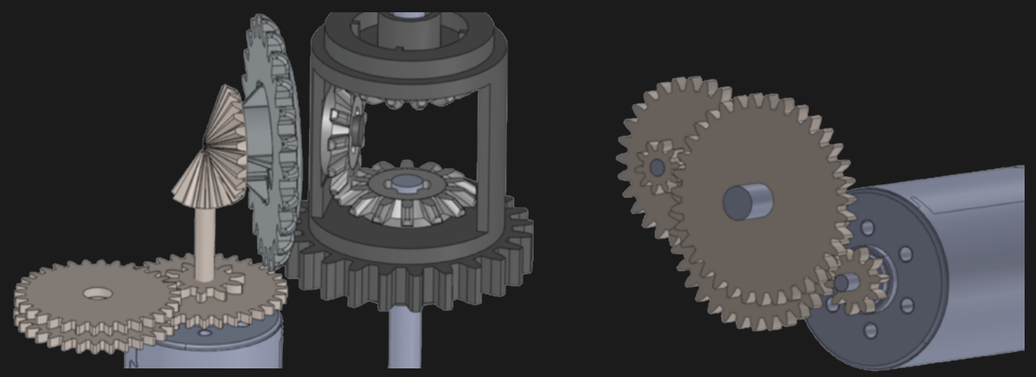
Iterations of the jumping mechanism from prototype 1 to 3



Iterative development of the gears

Gear optimisation was done to obtain a ratio 32.5 for the driving motor. Iterations enabled to grandly reduce size of the gear box.

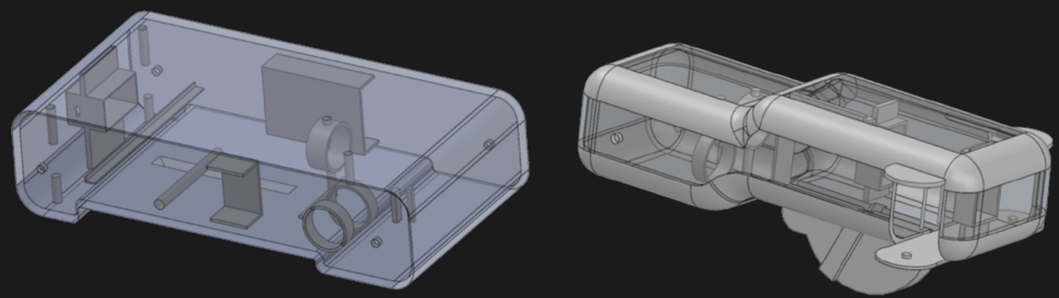
First and final iteration of the gear box for the driving motor



Iterative development of the chassis

LMDPE was used as a material for the chassis. By iterating around the design, mass was reduced by 55% (from87.1g to 39.5g)

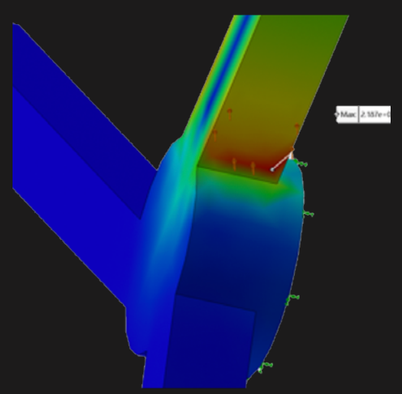
First and final iteration of the chassis

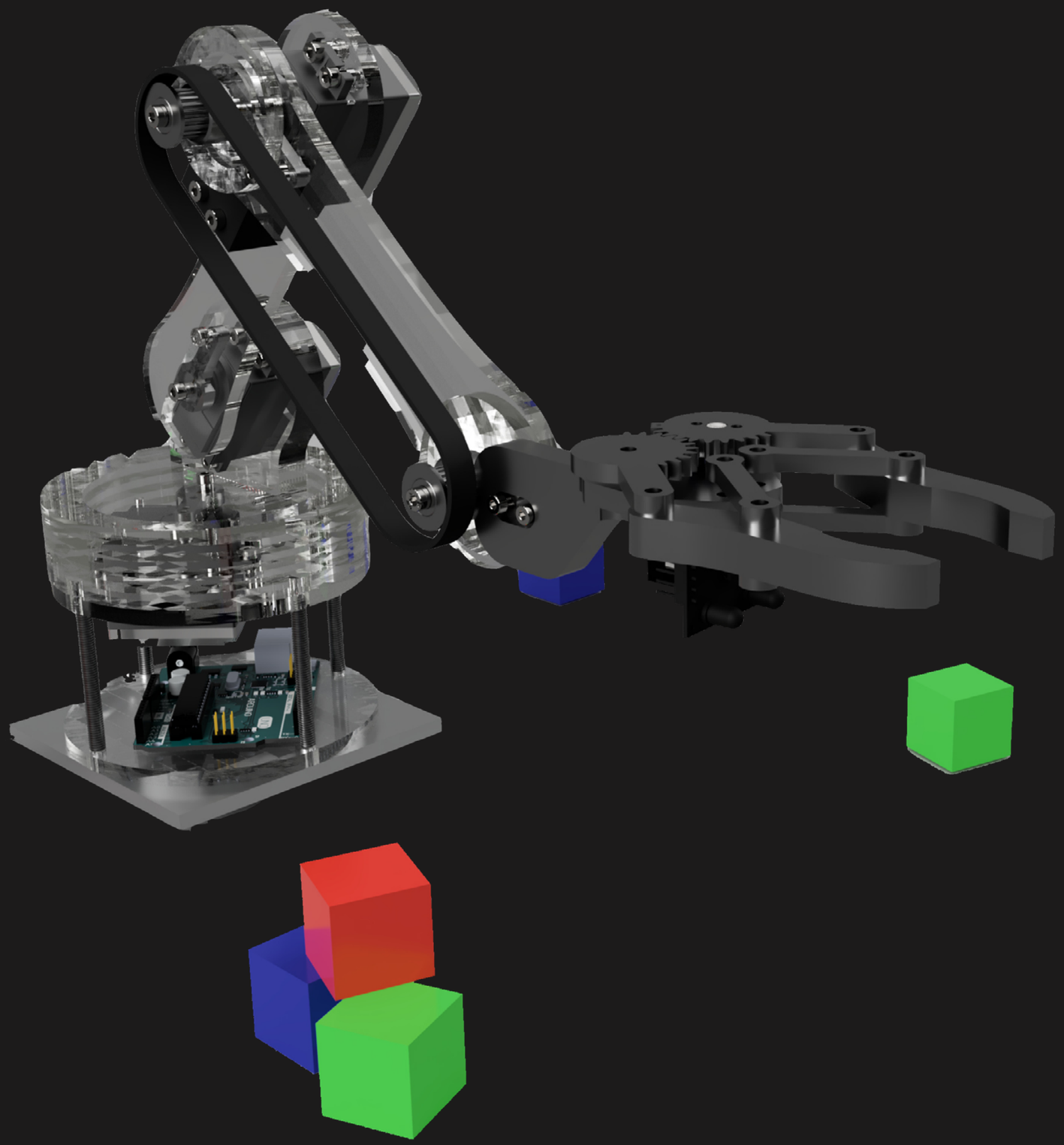


Validation

FEA stress plot of the wheg

Considering the wheg itself, three main causes can lead to **failure**: fracture during a **large drop**, when **climbing an obstacle** or **fatigue**. Considering the obstacle, Von Mises stress is of 22 MPa and maximum displacement is 2.4 mm. Hence, **Delrin** is used to make the whegs.





COLORIZMO

Project summary

Robo Colorizmo is a **user-controlled robotic arm**. Its rotating base combined with two actionable joints allow for swift and precise motion. This **3 dimensional arm** has an integrated **sorting system**.

It can pick up cubes and sort them depending on their colour. The components are controlled by an **Arduino Uno**. All in all, 4 servos, 4 potentiometers, 1 LED, 1 RGB sensor and 1 push button were used.

To view full project **click here!**
To view project's video **click here!**

OVERVIEW

Servo attachment

3D printed fitted part attached to the servo and to screw in the reference point of belt system.

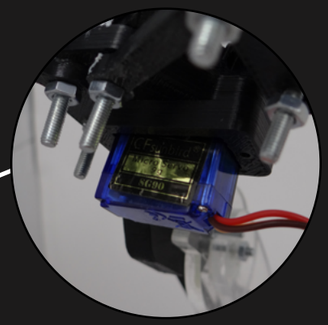
Belt clamp

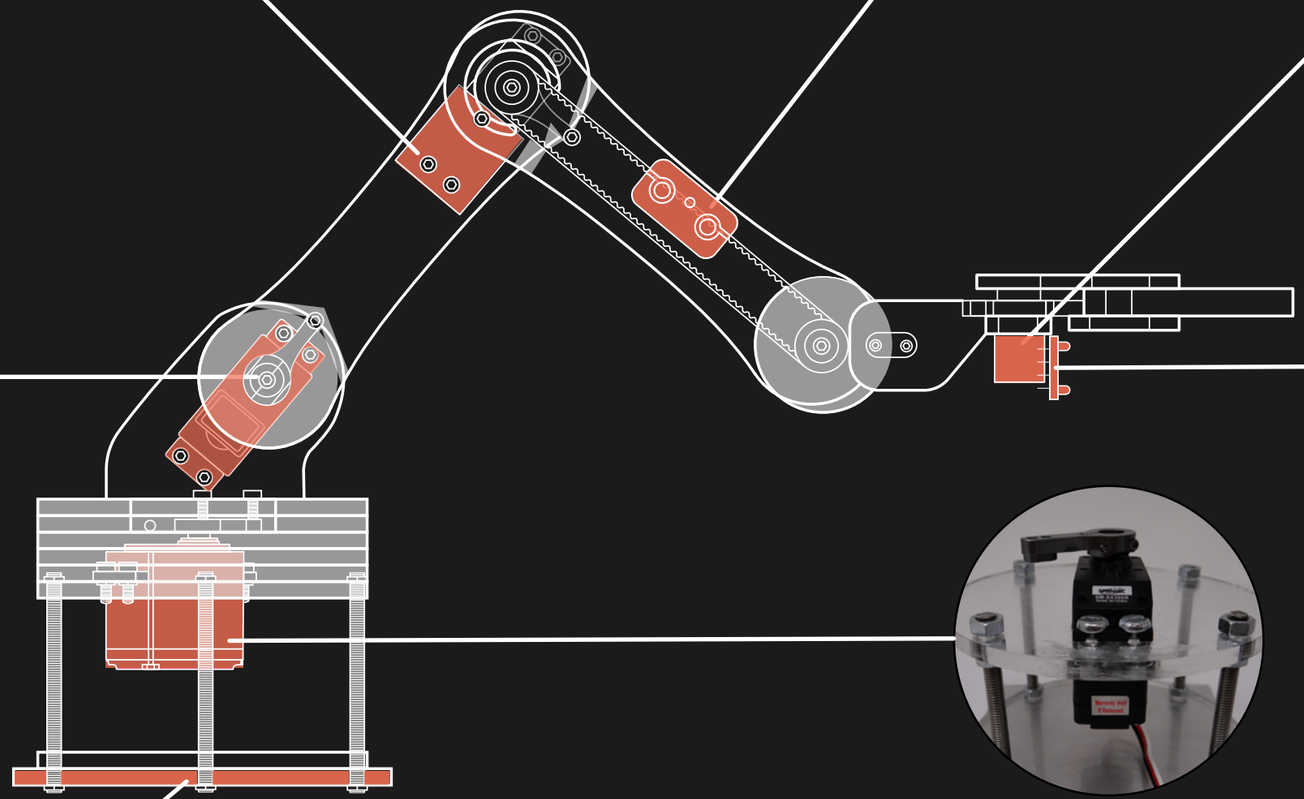
Specially designed belt clamp to ensure rotational energy transfered from one wheel to the other.

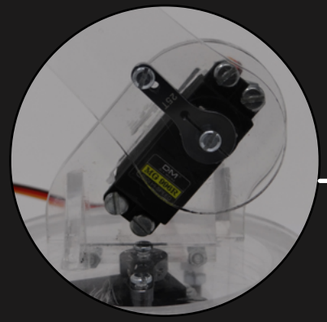
SG 90 Servo

Small 9g servo to make the gear turn to open and close the gripper.

1.2 kg/cm stall torque.



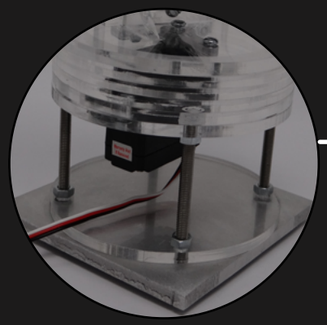




MG 996R servos

Positioned at the ‘shoulder’ and ‘elbow’ of the robotic arm.

13 kg/cm stall torque.



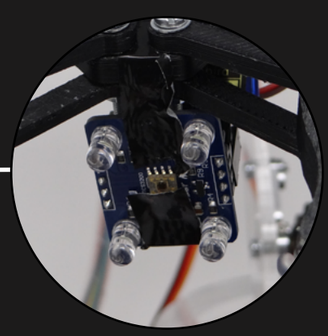
Metal base plate

Base plate to weigh down the arm.

SM-S4306R continuous servo

Rotates the base 360˚ to allow the arm to reach objects around it.

8 kg/cm stall torque.



Sunfounder TCS 3200

Color sensor placed near gripper to measure object when held.

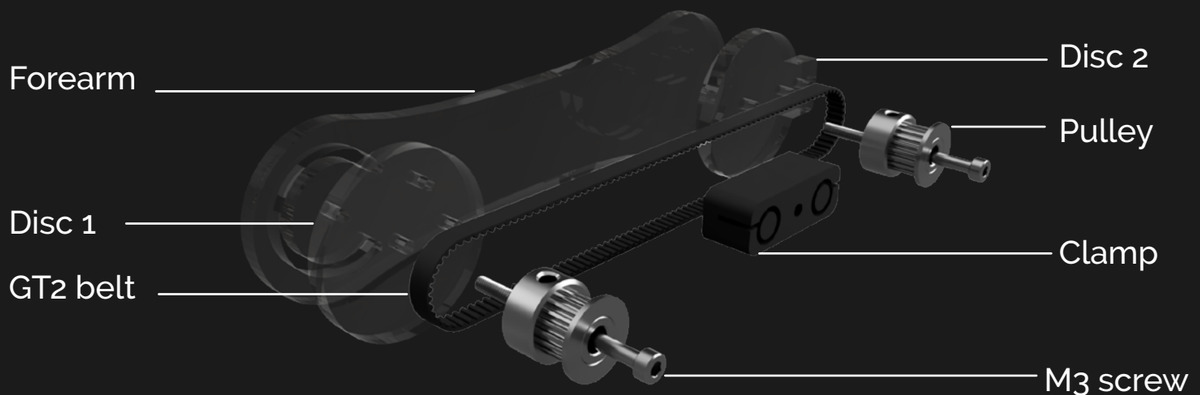
6x6 RGB photodiode.

BREAKDOWN

Mechanical system

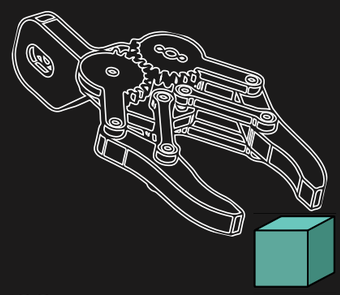
4 servos are used in this **serial manipulator with open loop chain**. A **mechanical system** was implemented for the wrist instead of an electronic one. A **belt** system was set up so that the gripper would always stay parallel to the ground. 2 **pulleys** are attached to rotating discs on the forearm and are connected by a timing belt and **clamp** ensures constant tension in the belt.

Exploded view of the mechanical system done on Fusion 360



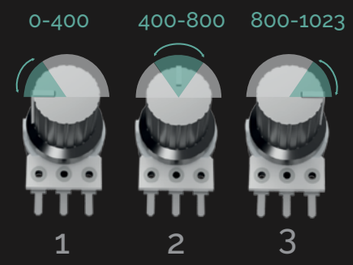
Electronics

Inputs: potentiometers, switches and sensors

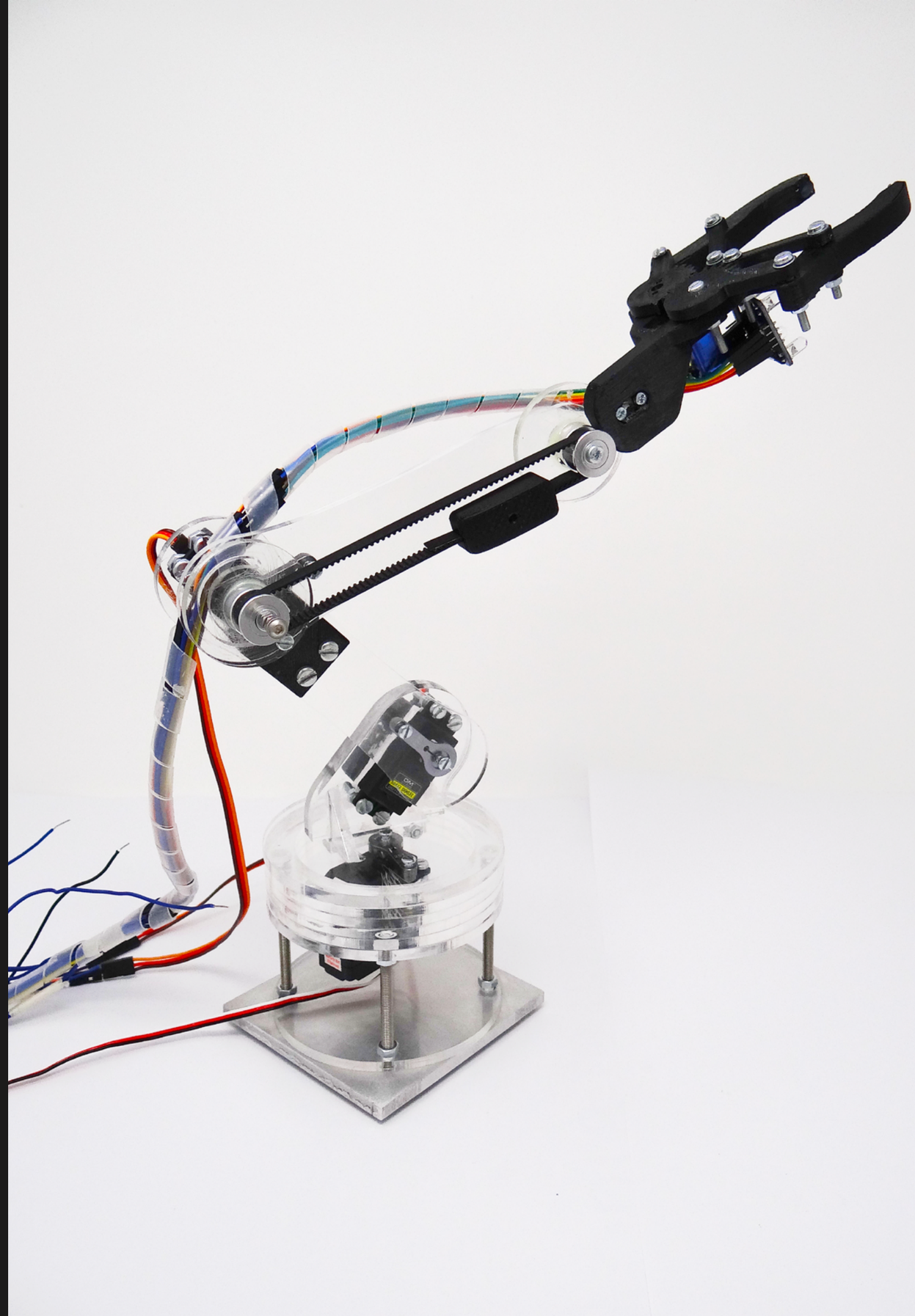


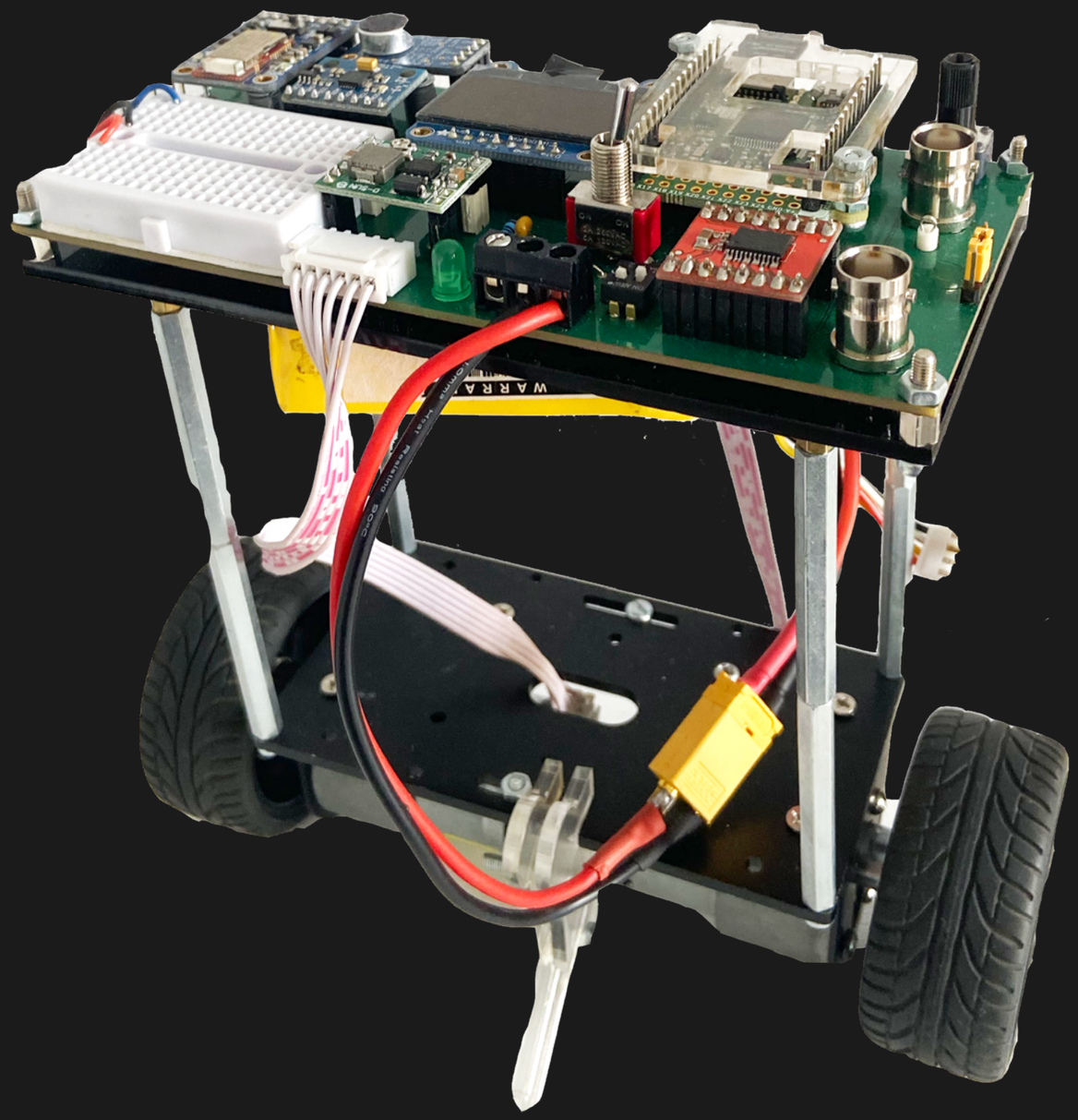
Potentiometers are inputs of a variable resistance in the circuit. The switch is linked to an RGB sensor. When pressed, it inputs a 1 into the code that activates the **sensor which 'scans' a surface** and inputs back into the code its RGB values.

Outputs: LEDs, continous & non-continous servos



Once the colour of the scanned object is determined, an **LED lights up**. The values of the potentiometers are mapped between 0 and 180 which allows the user to **control the angle of non-continuous servos**. The continous one acts like a DC motor. Three areas of the potentiometer (0-400, 400-800, 800-1023) represent **anti-clockwise, no motion, clockwise** (figures 1,2,3).





DANCER

Project summary

Dancer is a robot that dances to the beat of *Uptown Funk* and stabilizes itself whilst doing so.

This robot uses signal processing to recognize the song it has to dance to. Once the song is recognized, it starts dancing to it. It self-balances thanks to a PID controller in which constants were modified for better control.

Dancer is remotely controllable through an integrated UART system. A 3D printed batter holder was designed to keep the centre of gravity stable and avoid additional tuning.

To view the robot being driven, **click here!**
To view the robot dancing, **click here!**
To view the robot stabilizing itself, **click here!**