

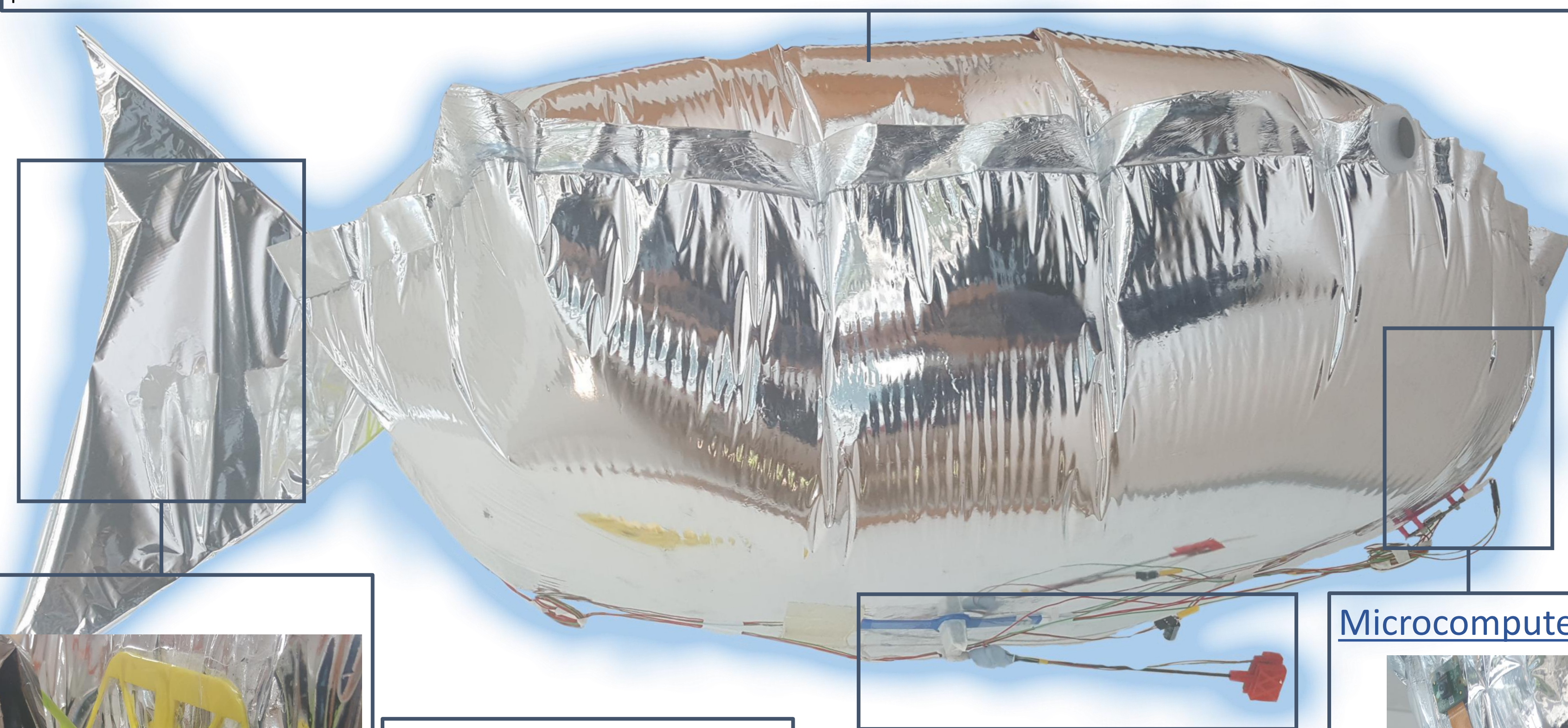
## Introduction

The Hoverfish is designed as a cute and kid friendly toy, yet it is able to capture the attention of adults. As the body of the HoverFish is a helium balloon, it is collision safe, suitable for children who may not be old enough to fly a drone safely. Its propulsion is dependent on a flapping tail and its lift is provided by the helium in the balloon, compared to spinning blades found in conventional drones which are far more dangerous elements. As a bonus, the HoverFish swims through the air much more quietly than the typical drone. In the HoverFish, we have packaged an assortment of functions such as Wi-Fi communications, live video streaming capabilities and altitude control, despite the HoverFish being a relatively small balloon. The HoverFish is designed and created entirely from scratch, as we created the 3D balloon from flat 2D sheets of Mylar and used 3D printing for the various servo supports. Through the HoverFish, we deliver the freedom of flight to everyone, even the most inexperienced of pilots.

## Design Specifications

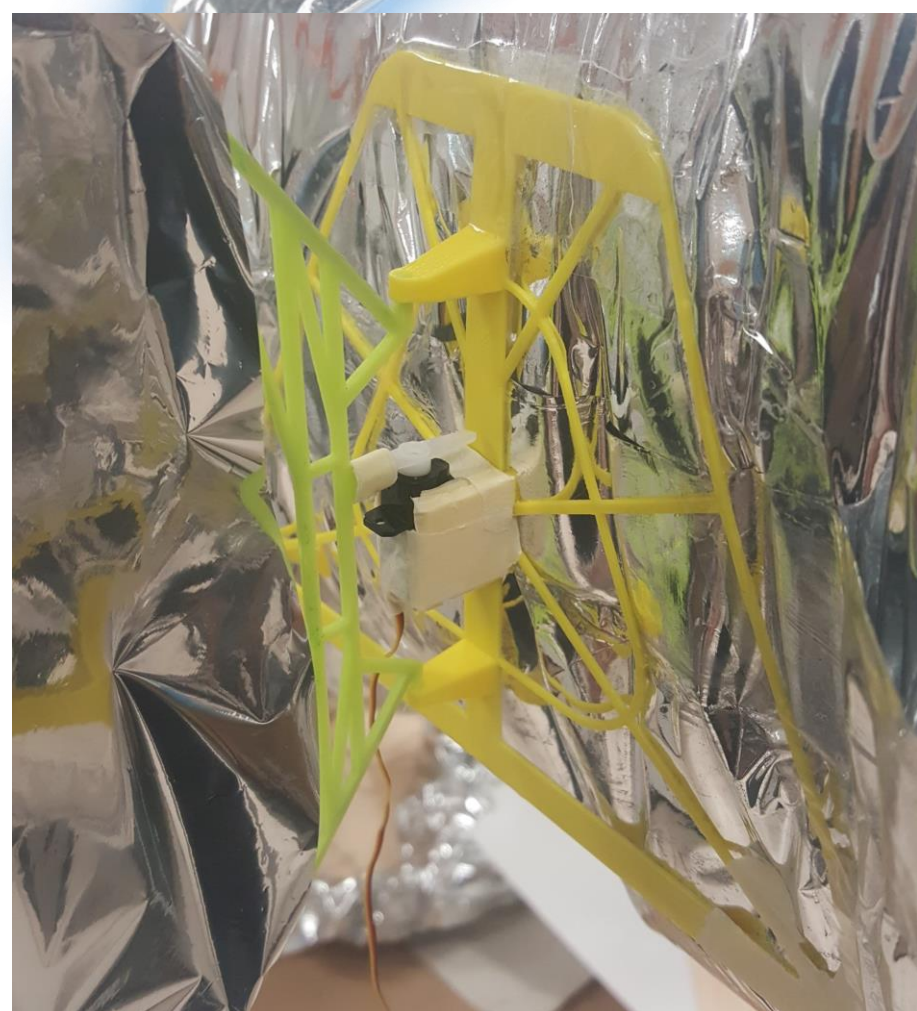
### Balloon

Made from .48 mil metalized biax nylon .65 mil LLDPE to reduce leakage and increase durability. The balloon is responsible for providing the lift and to support the working parts of the Hoverfish.



The code, structures and circuit comprising the Hoverfish were designed and built for the purposes of this project, allowing them to be tuned as needed to refine the performance and feel of the final product.

### Tail



The continuous back and forth rotation of the servo drives the flapping of the tail. When the tail is pushing against the air, the force is transferred to the balloon through the tail platform, propelling the HoverFish forward. Steering is done by favouring the flapping of the tail more towards one side, causing asymmetrical forward forces that produces a rotation for it to achieve horizontal mobility.

### UI Layout



Optimised to run on touchscreen devices, the UI offers a largely unobstructed view of the camera feed while providing useful information for piloting the Hoverfish. The joysticks are configured for ease of use, taking reference to the user's initial touch and reflecting accurately how their actions correspond to different command inputs. The controls also snap to various CG positions and straight-ahead, to improve steering performance.

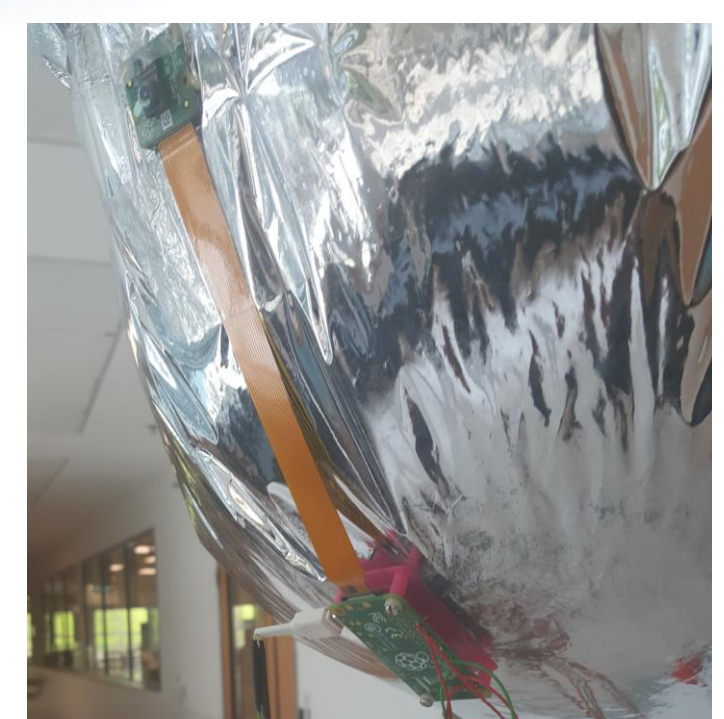
### Centre of Gravity (CG) Adjuster



By changing the location of a mass comprising the LiPo battery powering the HoverFish and accompanying DC/DC boost, the CG adjuster is able to significantly change the location of the centre of mass for the HoverFish.

The misalignment of the centre of buoyancy and the centre of mass results a tilt of the line of action of tail, resulting in the thrust of the tail being vectored up and down. This system provides the HoverFish with its vertical mobility.

### Microcomputer



The microcomputer chosen for this project was the Raspberry Pi Zero W. Small and feature rich, the Raspberry Pi Zero W comes with an in-built Wi-Fi module for wireless communications and supported 8-megapixel camera. The role of the microcontroller was to act as the bridge between the user and the actuators on board the HoverFish. It serves as the connection point for the user interface, interpreting user commands as signals to the servos, as well as providing power and these signals to the servos.

## Optimization Results

Speed: 10m in 40s from a stationary start  
Turning: Able to turn on the spot  
Safety: Collision safe  
Connectivity: Connect via a Wi-Fi network or directly as a wi-fi router  
User interface: Informative and intuitive  
Customisability: Balloon size, shape, component choice, UI layout

## Future Works

In the future, we want to add more capabilities onto the HoverFish, and also increase the quality of components such as the video camera.

## Acknowledgements

We would like to thank Dr Ho Shen Yong for the advice and the MnT lab for providing the resources for us to finish our project.

## Various QR Codes

1<sup>st</sup> HoverFish  
Wi-Fi



2<sup>nd</sup> HoverFish  
Wi-Fi



HoverFish  
IP Address



Video



Blog

