

# ST PAUL'S SCHOOL: CYCLONE

PCBTRAIN

 **HobbyKing**<sup>®</sup>.com

# THE PROPOSAL

## PRIMARY MISSION:

- Air Temperature
- Pressure
- Data transmission to base station

## SECONDARY MISSION:

- Quadcopter:
  - Deploys from launch
  - Within specified CanSat dimensions
  - Ability to explore unknown landscapes
  - Autonomous/Manual Control (GPS, acceleration)
- Agricultural Viability
  - Using predefined algorithm to estimate how suitable a given area would be for crop cultivation (primary obj. +  $R_H$ )

# THE TEAM



**BENJAMIN YASS**  
Head of Structural Design



**NICHOLAS PALMER**  
Material & Construction



**DANIEL HALSTEAD**  
Flight Control



**JAMES CROMPTON**  
Communication Systems

## Structural Design   Software & Electronics

**ASHWIN AHUJA**  
Head of Software/  
Electrical Design



**HUGO AARONSON**  
Data Analysis



**WILLIAM EUSTACE**  
Base Station Software



## Outreach



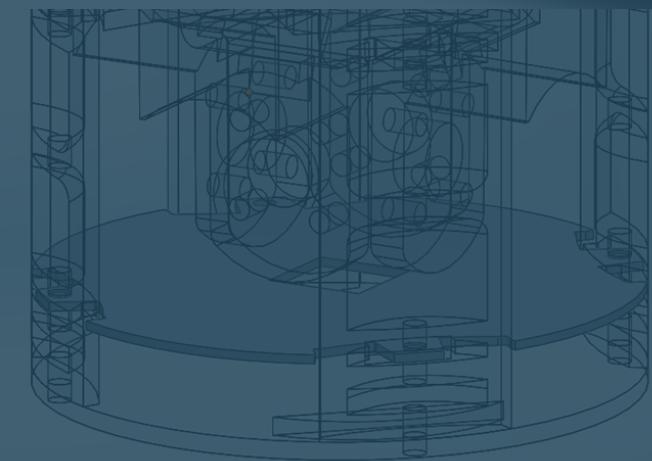
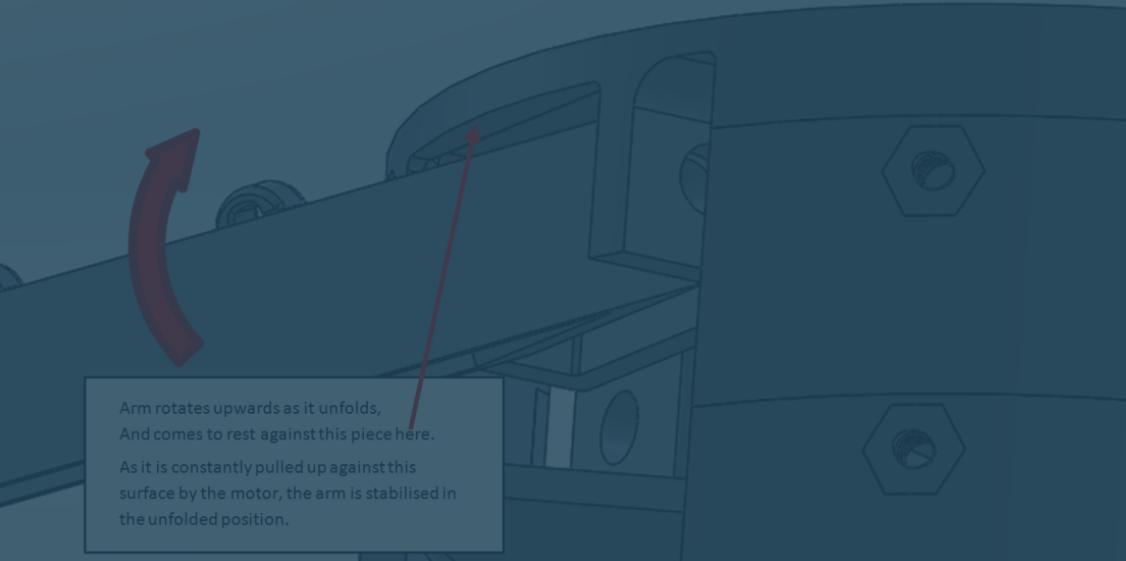
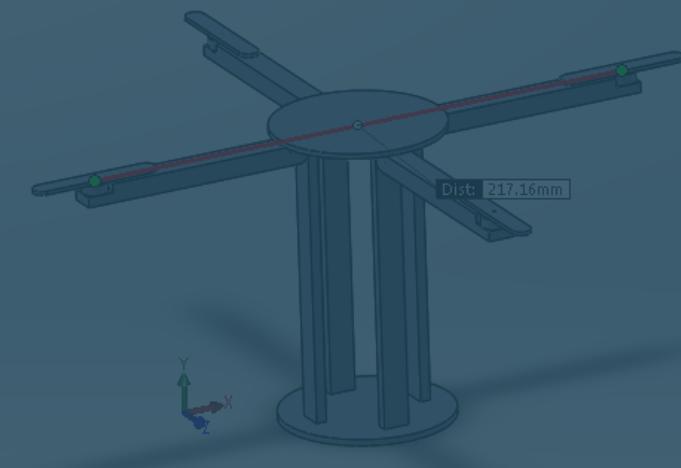
**QUENTIN GUÉROULT**  
Head of Outreach

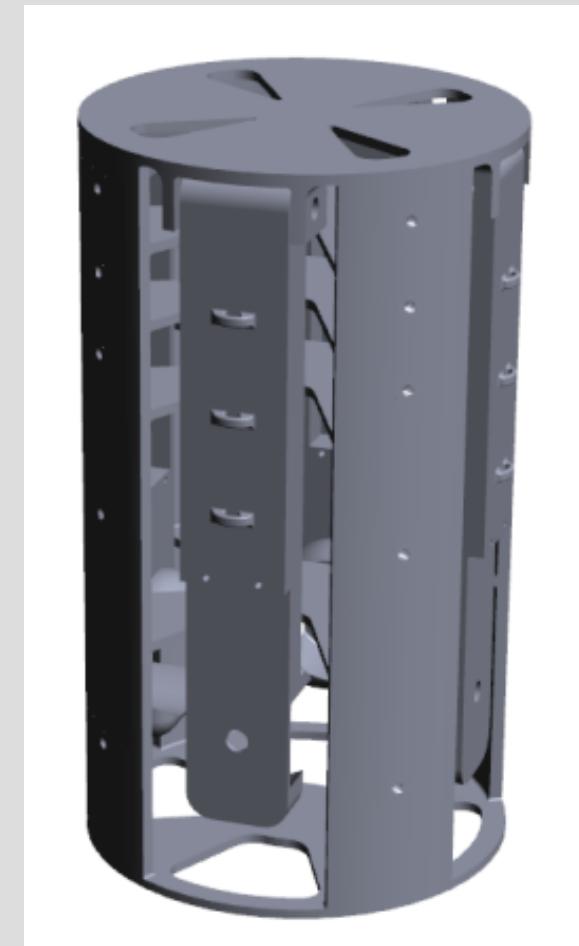
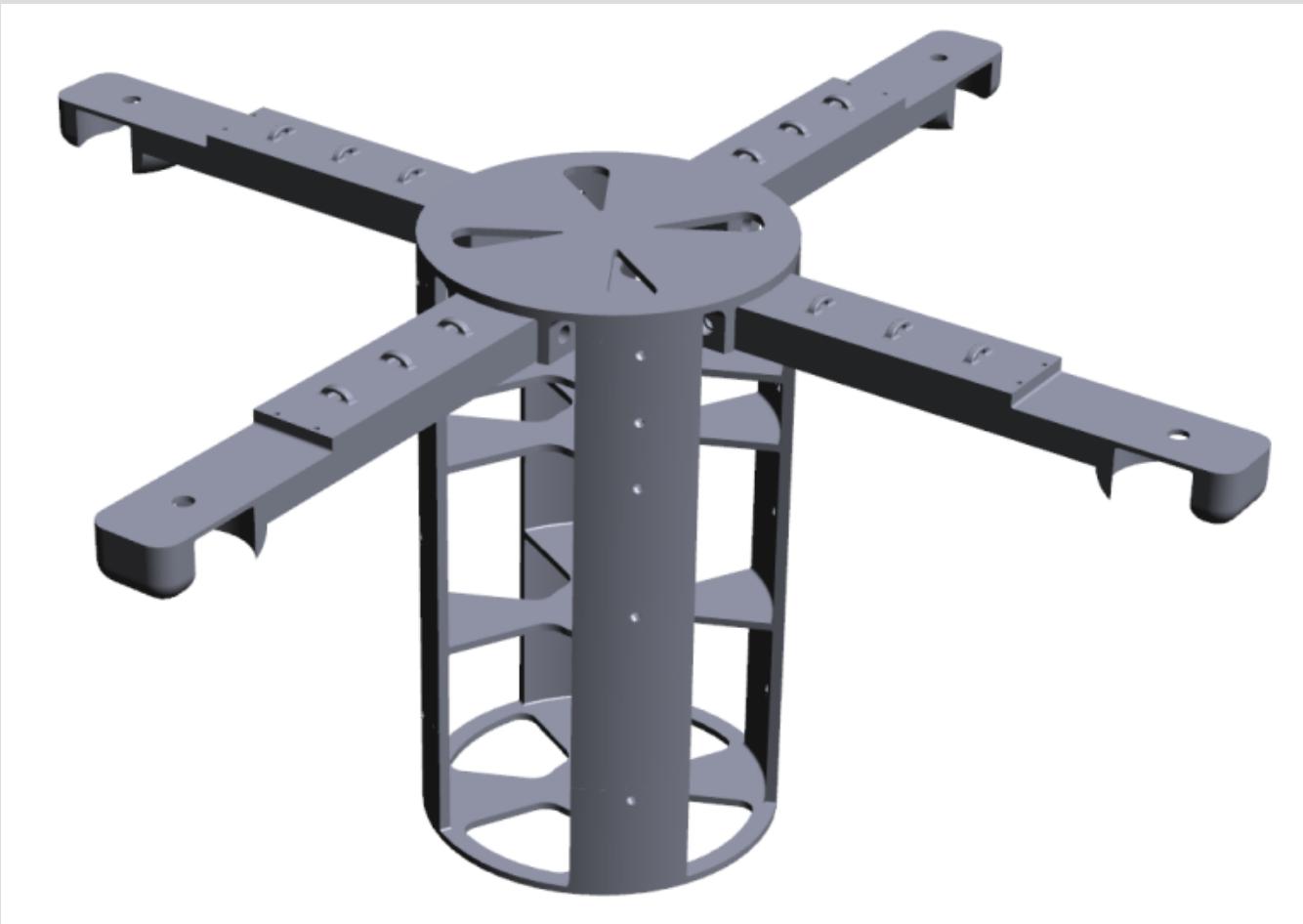


**PHILIP FERNANDES**  
Agricultural Viability

# MECHANICS

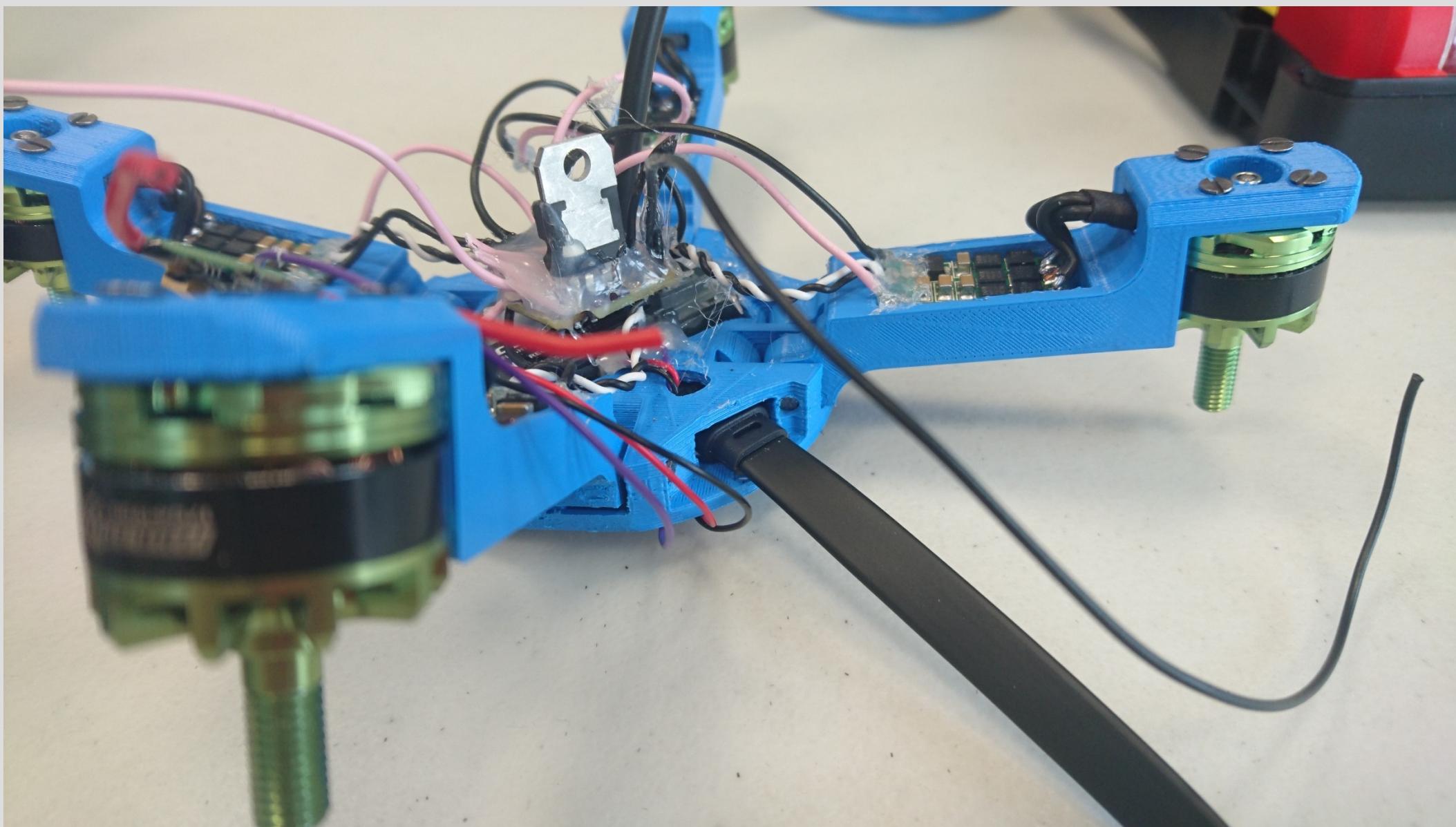
Arm rotates upwards as it unfolds,  
And comes to rest against this piece here.  
As it is constantly pulled up against this  
surface by the motor, the arm is stabilised in  
the unfolded position.



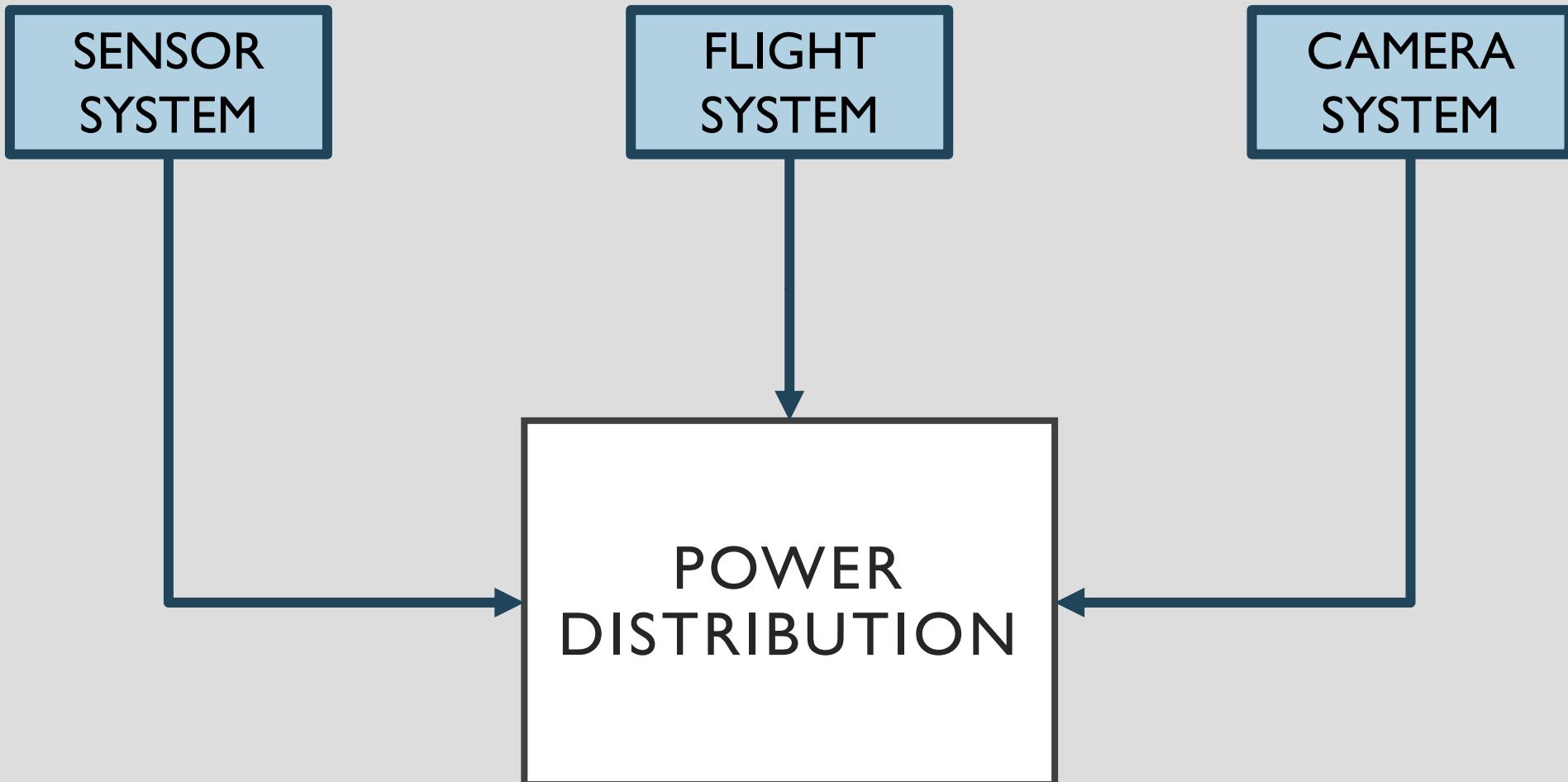


<http://teamcycl.one/finalinterimreport>





# ELECTRONICS



## **SENSOR SYSTEM**

**MCU:** Teensy 3.2

**Pressure + Internal Temperature:** Meas Spec 5637

**Humidity + External Temperature:** HygroChip271

**IMU:** SDLife Augmented LSMDSI

**GPS:** SiRF GP2106

**SD Card:** SparkFun OpenLog

**Transceiver:** Hope RFM98W

## **CAMERA SYSTEM**

**FPV:** TX-SkyZone 200

**Camera:** HobbyKing Mini CMOS520TVL

## **FLIGHT SYSTEM**

**Control Board:** OpenPilot CC3D

**Motors:** Turnigy Outrunner V2 (1704 – 1900KV)

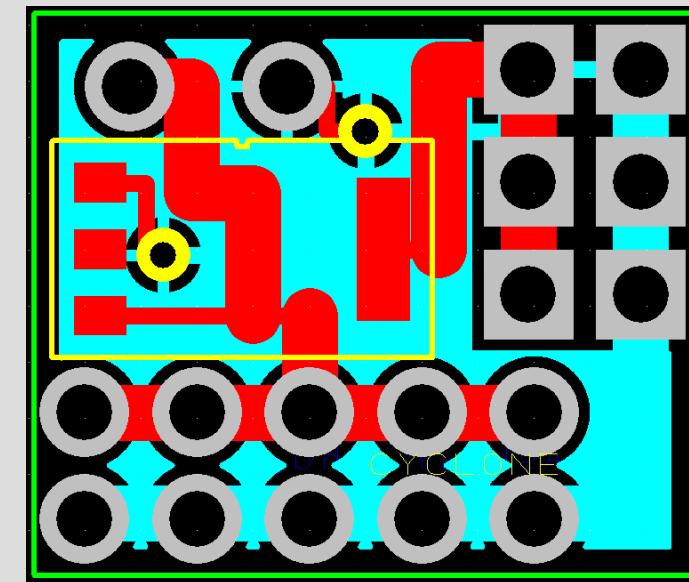
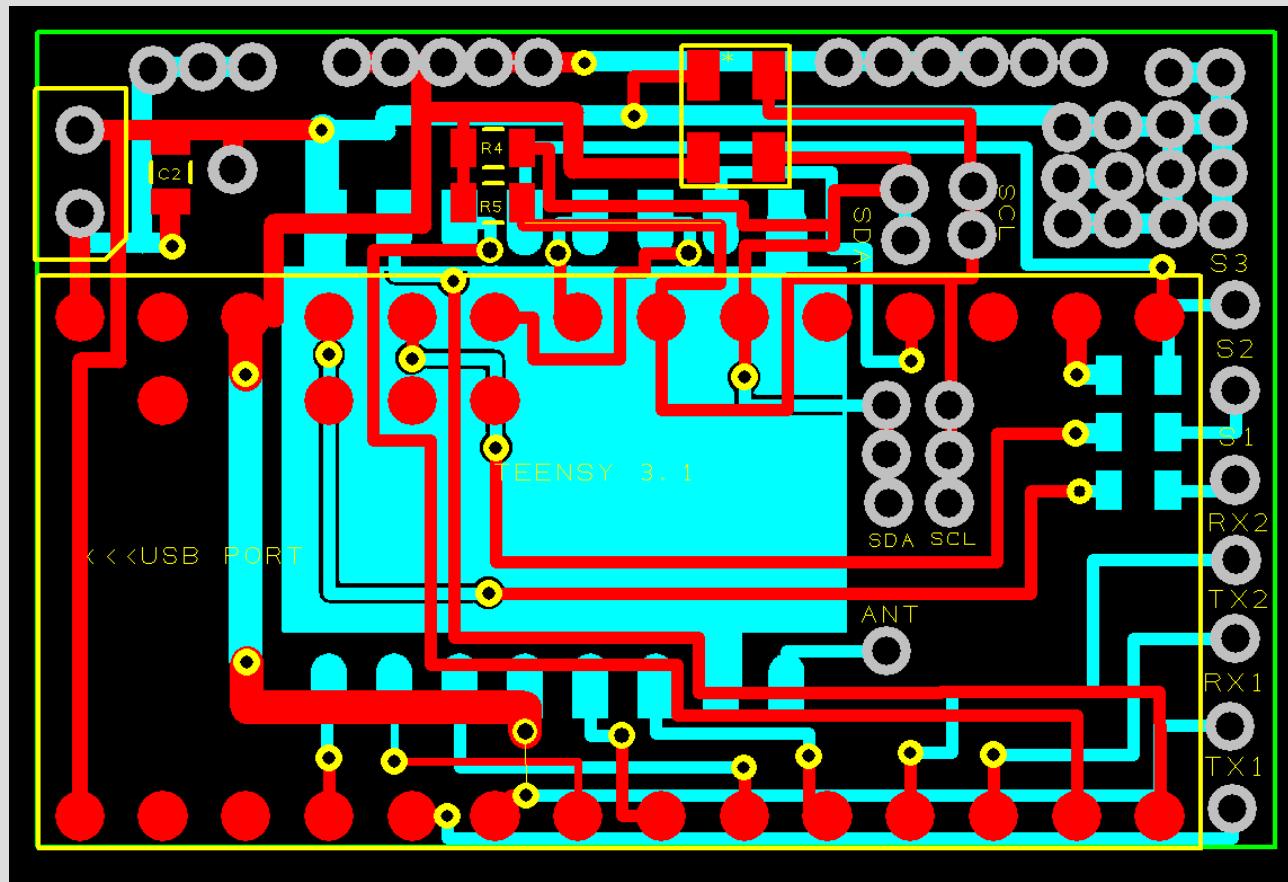
**ESCs:** DYS BLHELI 16A Mini ESC

**Receiver:** Orange 6-Channel RX

## **BATTERY**

Zippy Compact 850mAh 3S 35C LiPo

# PCBs





Internal Temperature / °C	18.78
Barometric Pressure / mBar (hPa)	1025.1
External Temperature / °C	124.98
Relative Humidity / %	99.99
Altitude / m	-135.5992279053
Dew Point / °C	124.9768371582
Relative Agricultural Potential / Arbitrary Units	-8.8754272461

Air Pressure: 1026.27



# SOFTWARE

COM11

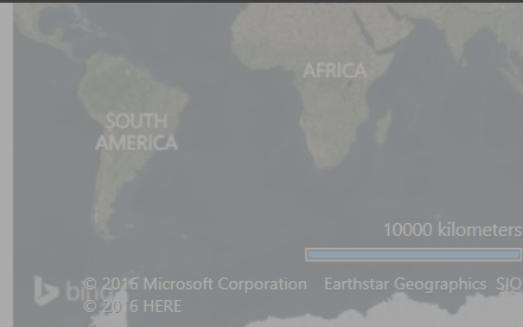
115200

Connect

Disconnect

## RECEIVING DATA

```
2,17.47,0.0000000000,0.0000000000,0.000000
00000
14,-85,344,18.77,1025.10,124.98,99.99,0,0,0
,0,0,0,0,0,0,-8.8754272461,1.01169490
81,-135.5992279053,124.9768371582,1026.2
8,17.46,0.0000000000,0.0000000000,0.000000
00000
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81,-135.5992279053,124.9768371582,1026.2
7,17.45,0.0000000000,0.0000000000,0.000000
00000
```



Samples Received

37

Signal to Noise Ratio

14

RSSI

-84

Start Recording | Stop Recording

Take Snapshot

Longitude: 0.000

0.000

mBars

Set QFE

Set QFE as current

Latitude: 0.000

Set Coordinates

Return to Home

0.000

mBars

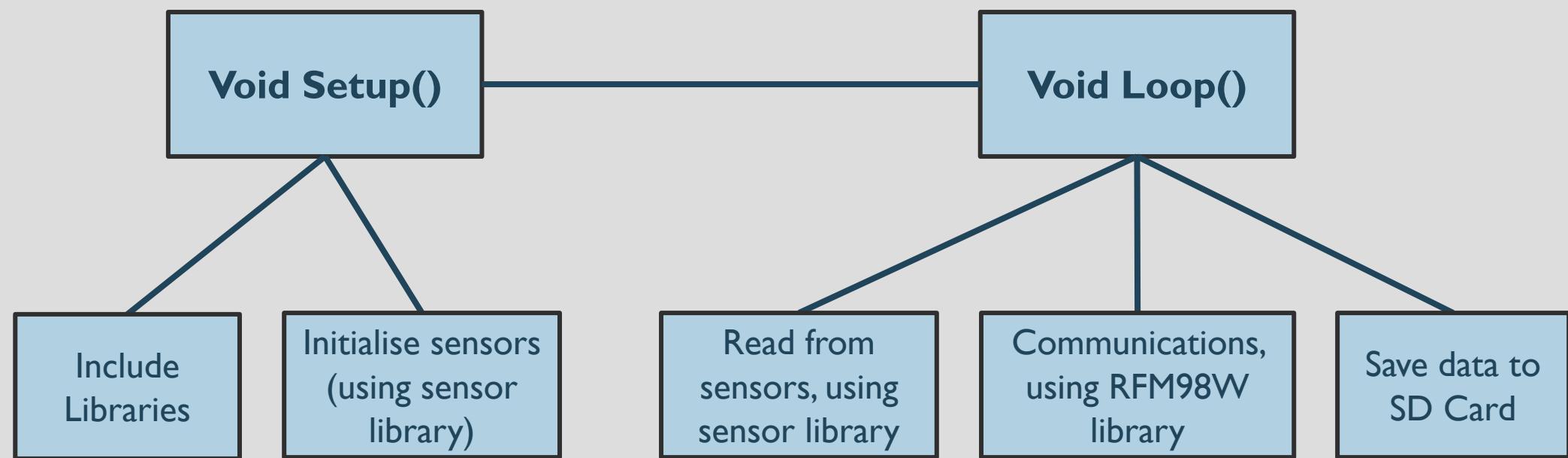
Set QFE

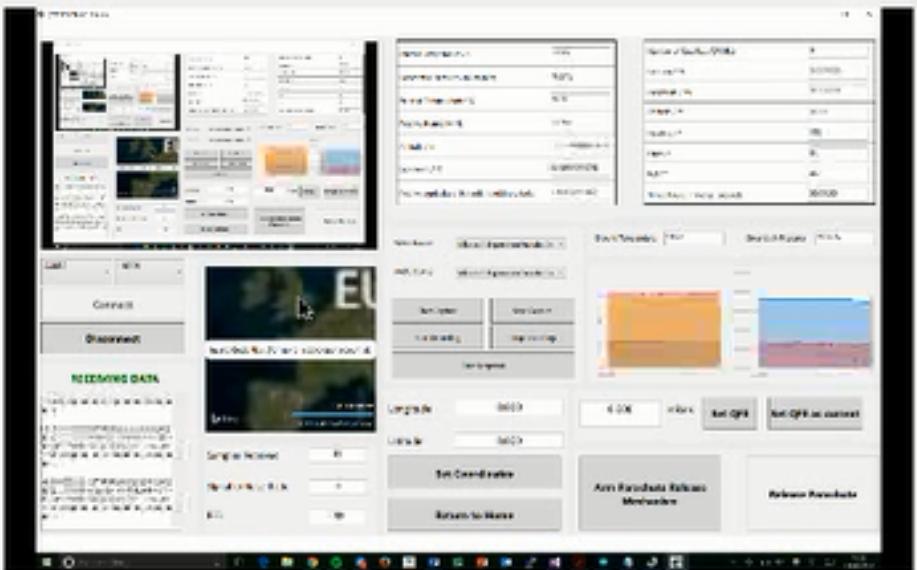
Set QFE as current

Arm Parachute Release Mechanism

Release Parachute

# CAN CODE





COM20	115200
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Connect

## Disconnect

## RECEIVING DATA

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0.0000,0,106.84,0,0.0000,153.80,1.013355/32  
-158603205067.3999774/LB,1026.80,1  
9.20,0.000000000,0.000000000,0.00000000  
000.

### Samples Received

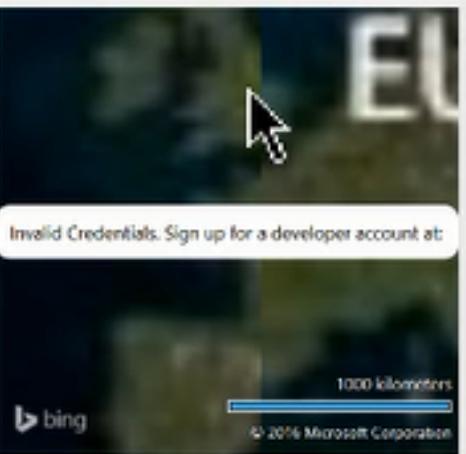
23

## Signal to Noise Ratio

1

RSSI

- 9 -



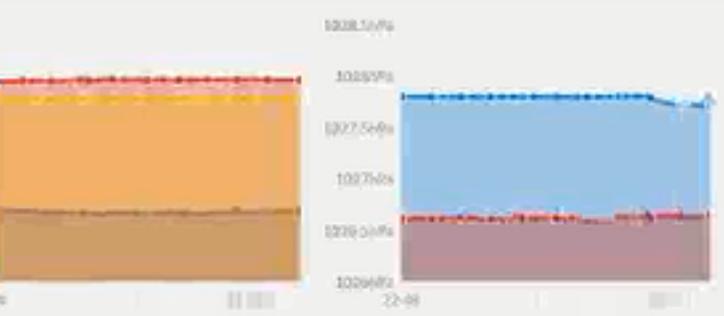
Internal Temperature / °C	20.78
Barometric Pressure / millbar (hPa)	1027.8
External Temperature / °C	10.40
Relative Humidity / %	60.54
Altitude / m	-118.486385898
Dew Point / °C	10.7508895931
Relative Agricultural Potential / Arbitrary Units	0.6082948954

Number of Satellites (GPS Fix)	<input type="text" value="0"/>
Latitude / °N	<input type="text" value="0.000000"/>
Longitude / °N	<input type="text" value="0.000000"/>
Altitude / m	<input type="text" value="0.000"/>
Heading / °	<input type="text" value="306"/>
Pitch / °	<input type="text" value="292"/>
Roll / °	<input type="text" value="71"/>
Time / hours : minutes : seconds	<input type="text" value="00:00:00"/>

Video Device Microsoft.Expression.Encoder.De Ground Temperature: 19.23 Ground Air Pressure: 1026.63

Audio Device Microsoft.Expression.Encoder.Digital - 20% 1000.00/1000

Start Capture	Stop Capture
Start Recording	Stop Recording
Take Snapshot	



longitude 0.000

**Set OFF**      **Set OFF as current**

atitude 0.000

## **Set Coordinates**

[Return to Home](#)

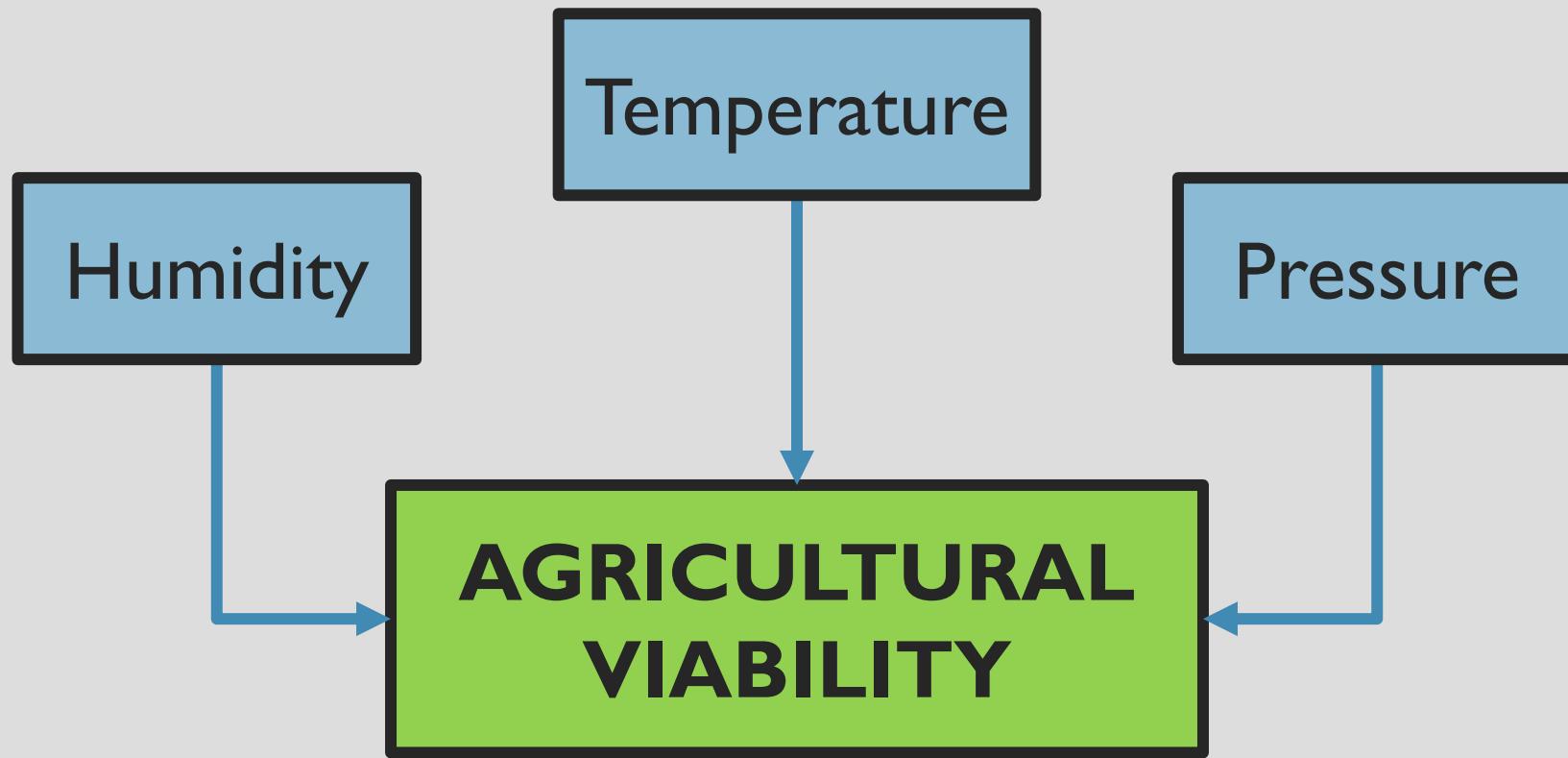
### **Arm Parachute Release Mechanism**

## **Release Parachute**

# AUTONOMOUS MOTION



## DESIGNING THE ALGORITHM

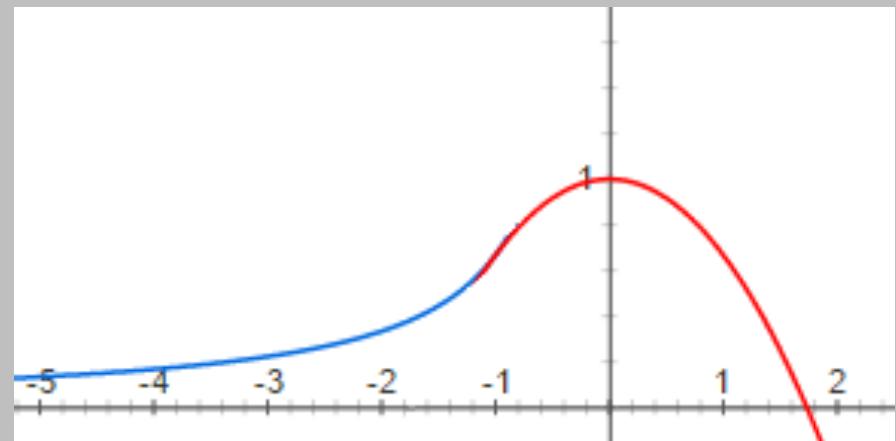


## TEMPERATURE

- Combination of two curves
- Peaks at specific crop's optimal temperature
- Modelled to reflect effect of enzymatic activity within plant cells

$$y = \frac{-2}{3x} \quad y = 1 - \frac{x^2}{3}$$

$$V_T = \frac{-2}{3\left(\frac{T-27}{9}\right)} \quad V_T = 1 - \frac{\left(\frac{T-27}{9}\right)^2}{3}$$

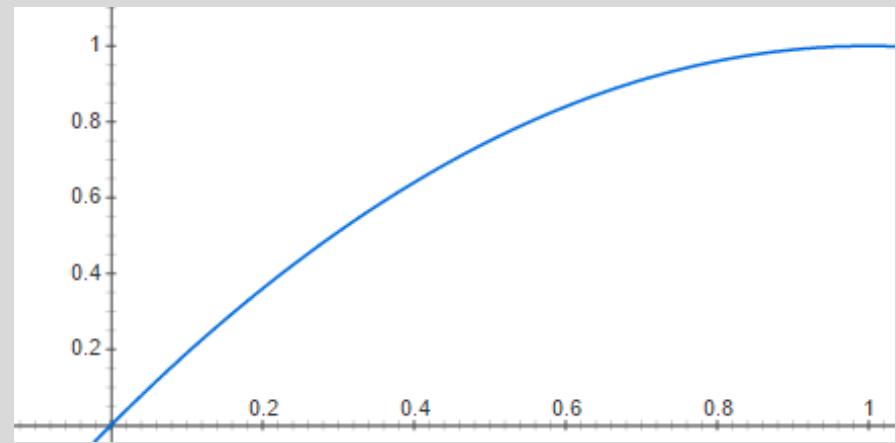


## HUMIDITY

- Uses relative humidity as a proxy for soil water content

$$y = -x^2 + 2x$$

$$V_H = -\frac{H^2}{100} + 2\frac{H}{100}$$

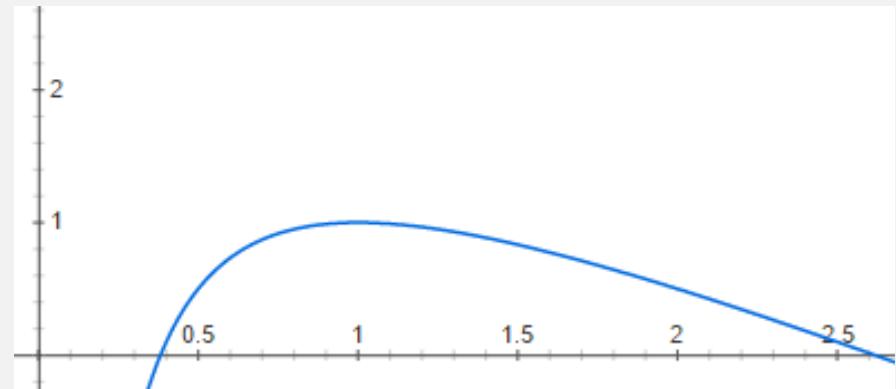


## PRESSURE

- Assumption that pressure of 1 atm is optimal for Earth-based crops
- Assumption that vacuum is more damaging than higher pressures

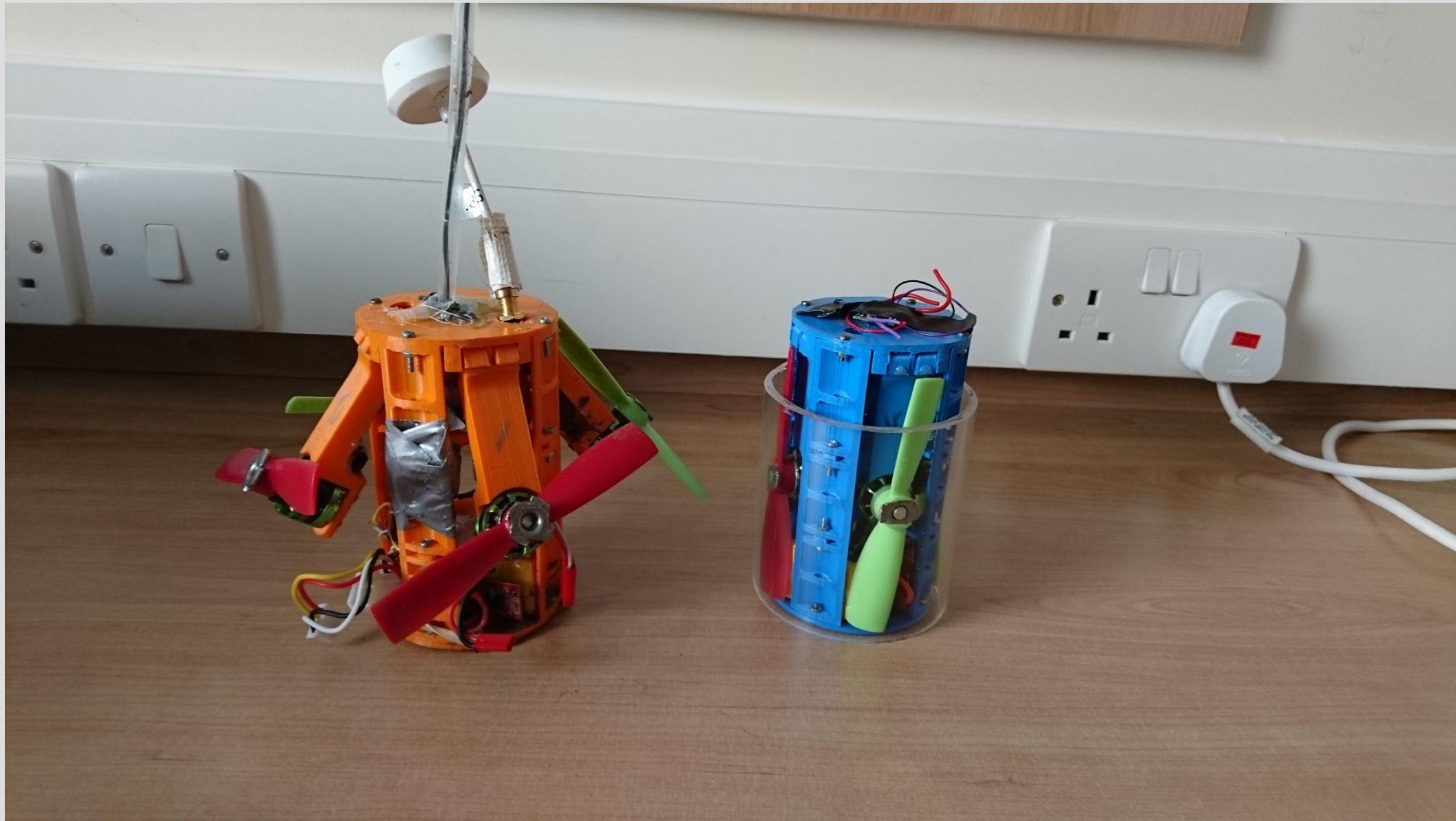
$$\frac{-x^2 + 3x - 1}{x}$$

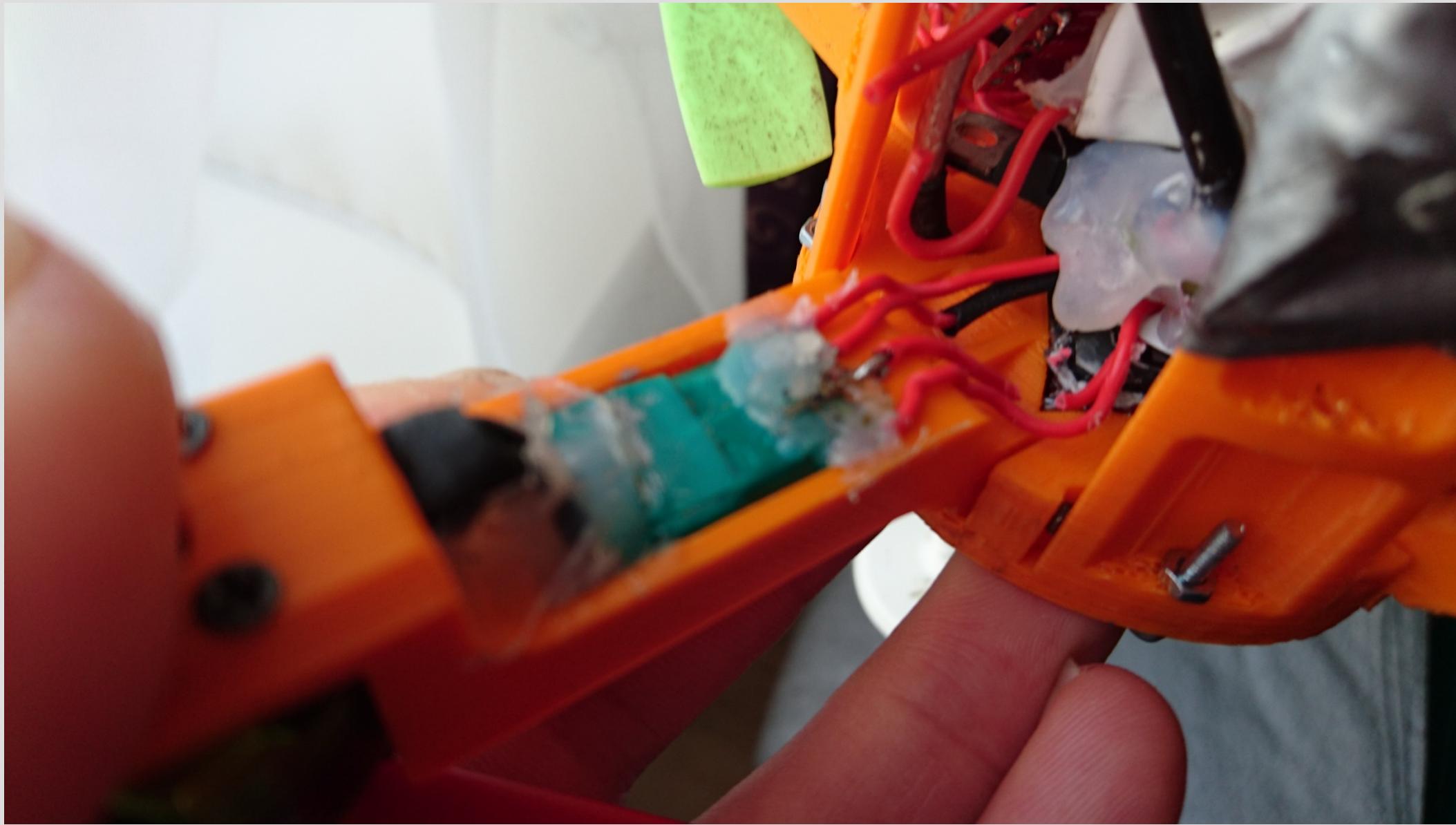
$$V_P = \frac{-P^2 + 3P - 1}{P}$$



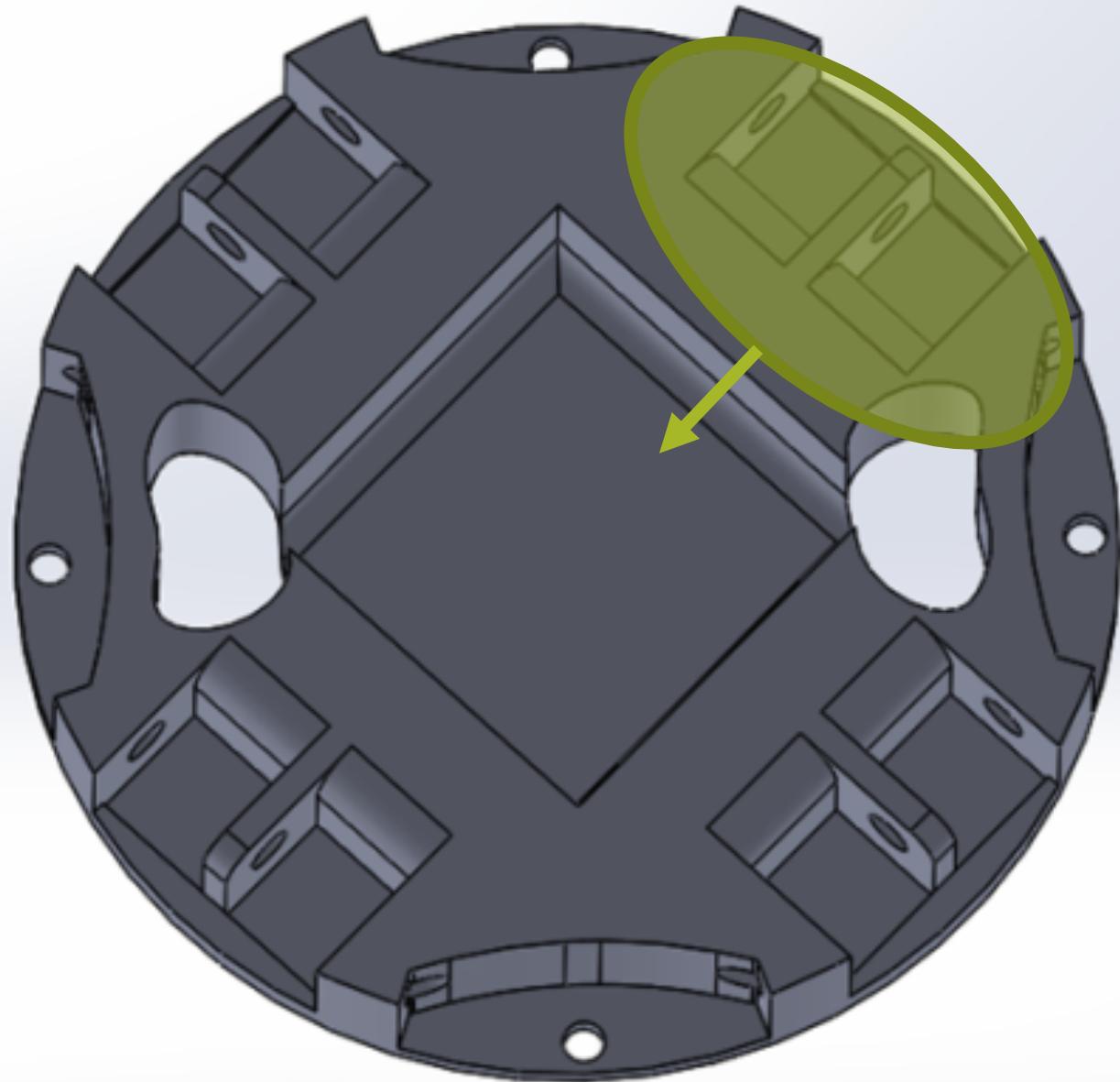
*Agricultural Viability* =  $V_T \times V_H \times V_P$

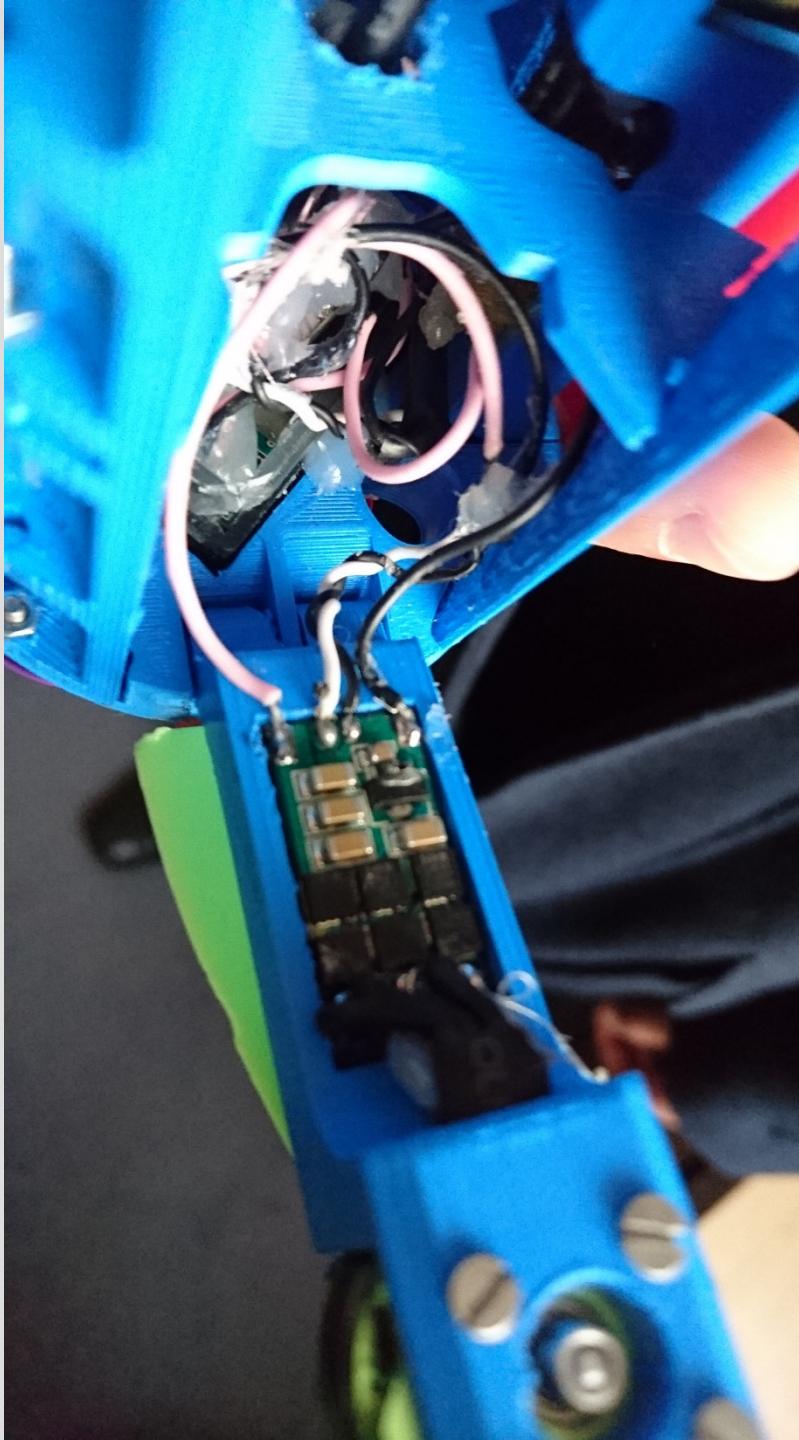
## FURTHER IMPROVEMENTS





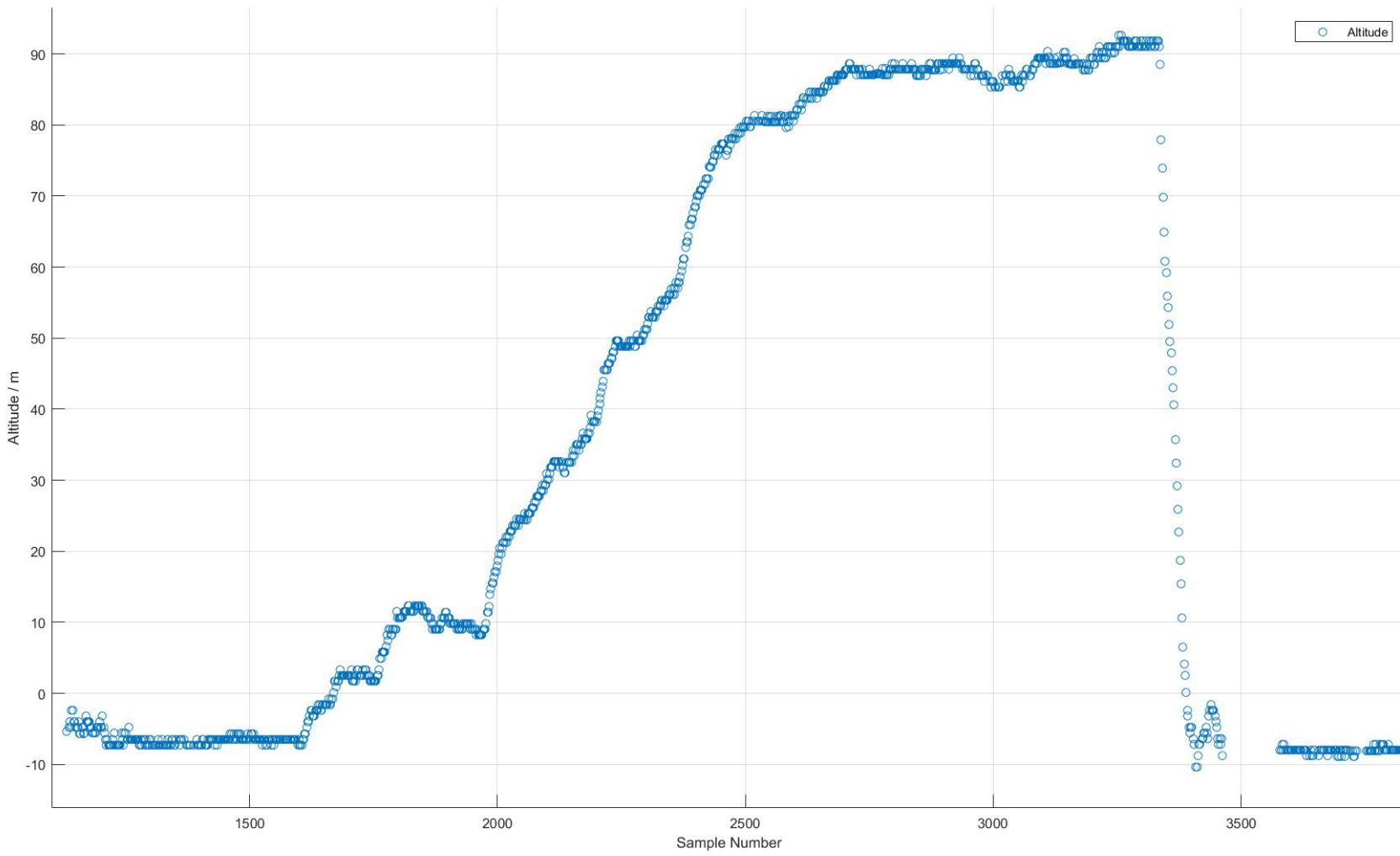


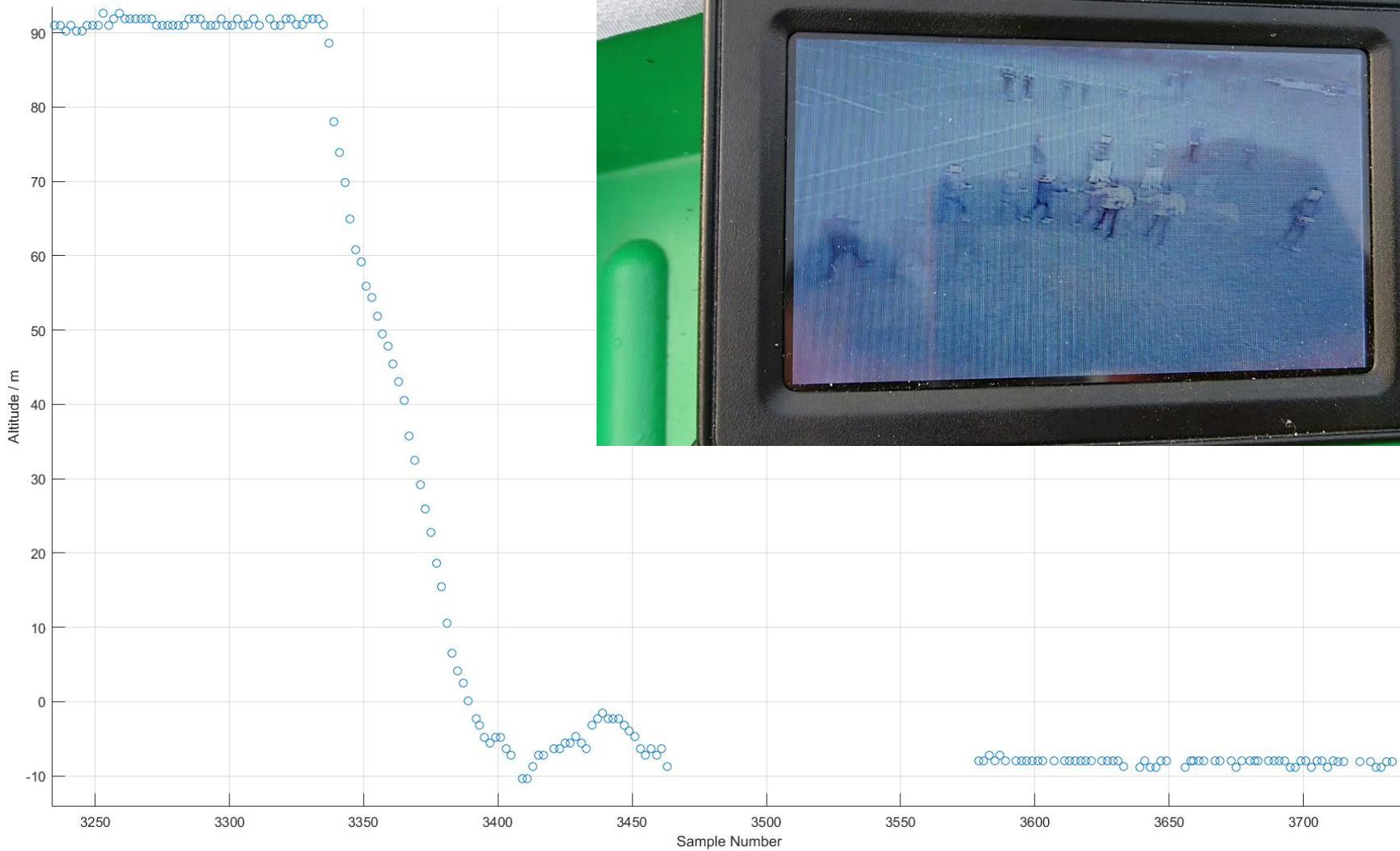


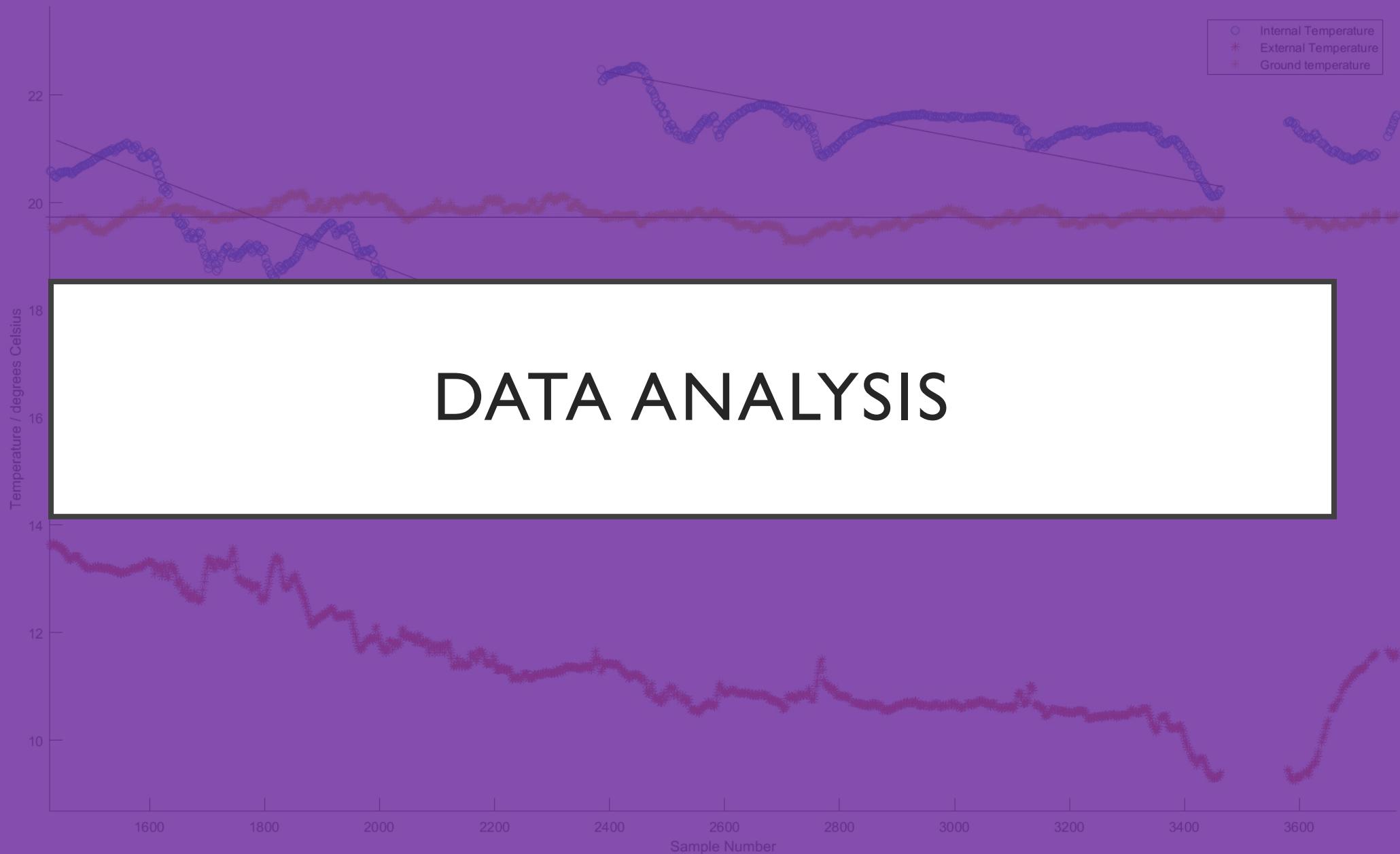


# THE LAUNCH

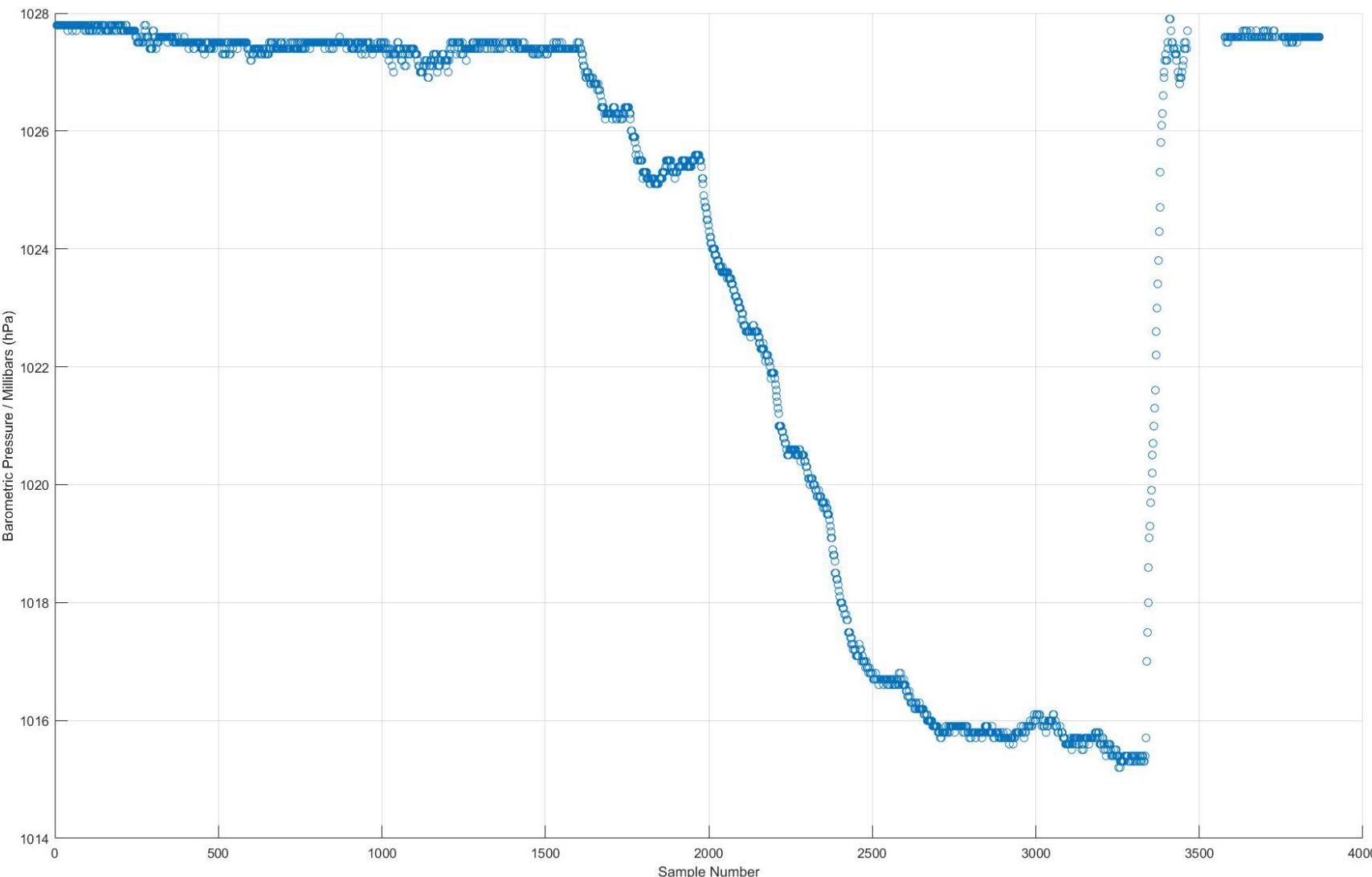




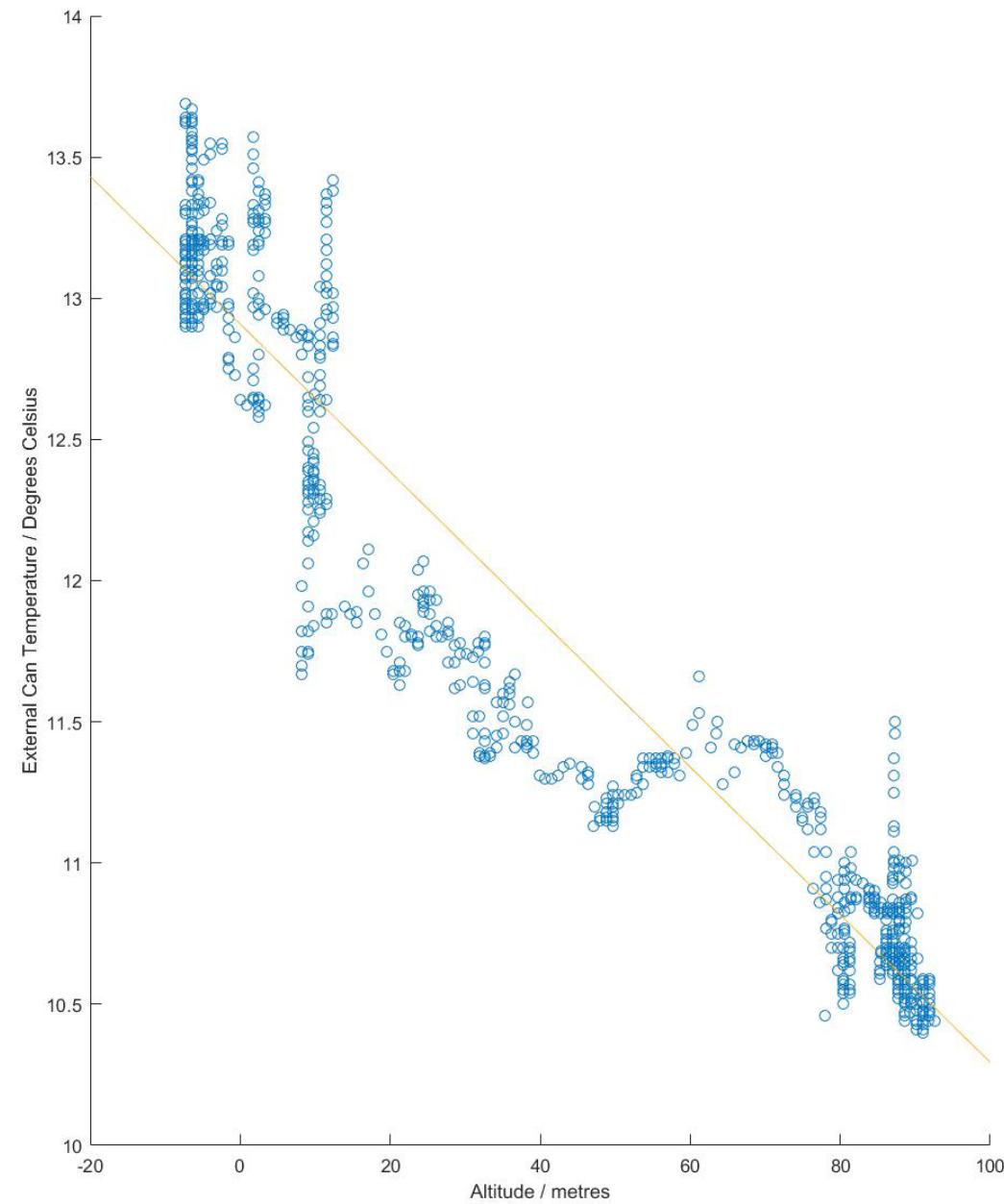




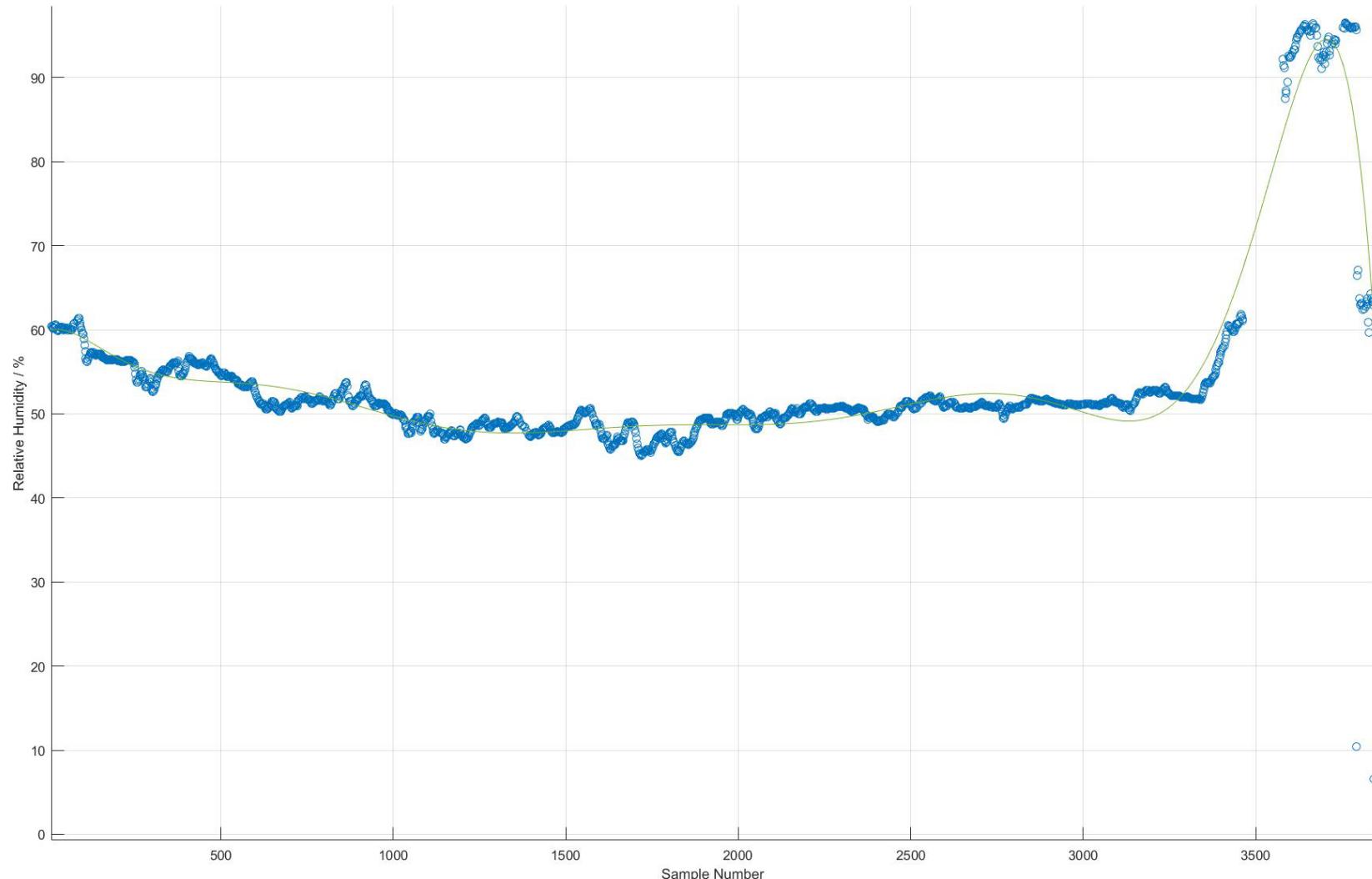
# PRESSURE



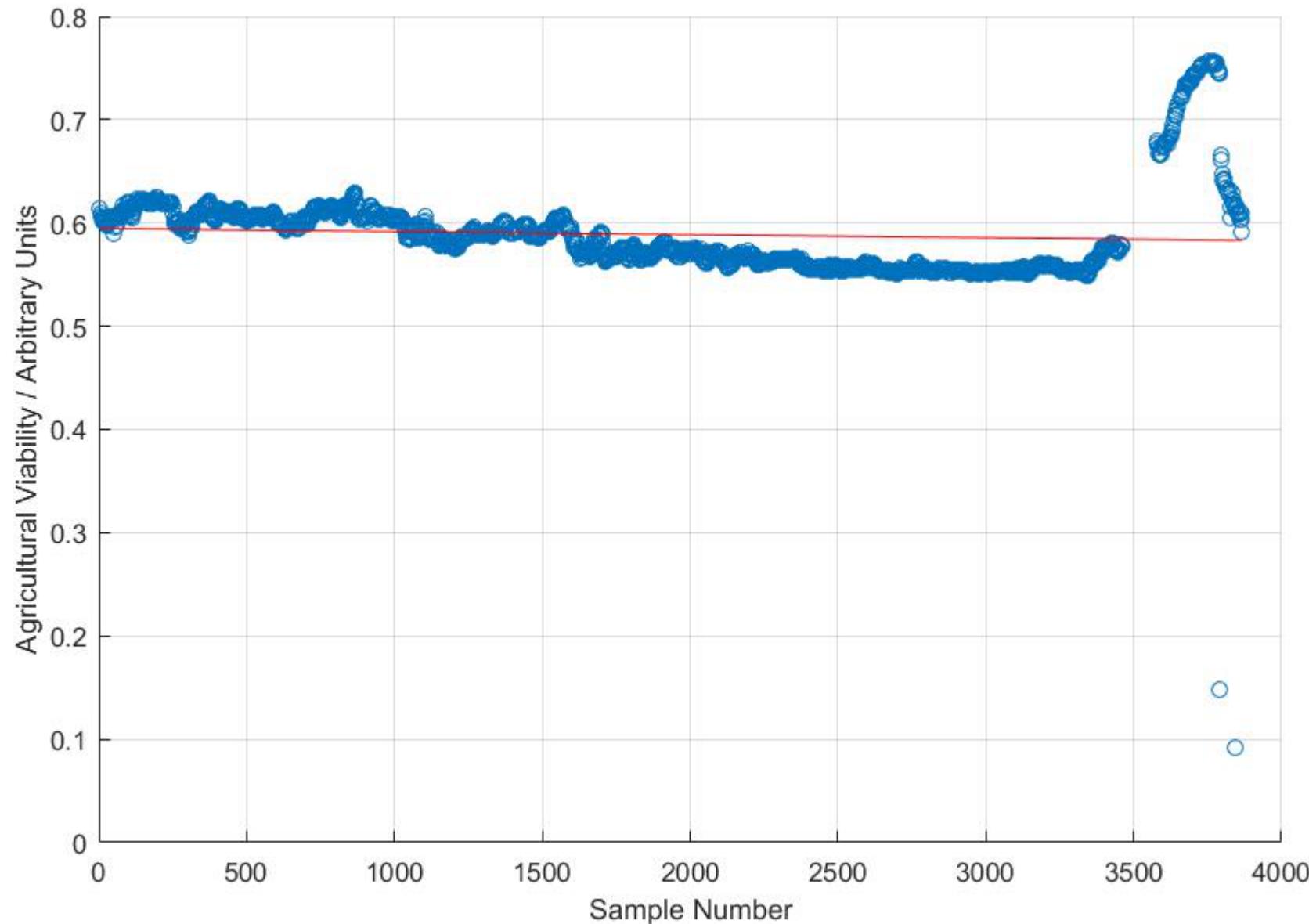
# EXTERNAL TEMPERATURE & ALTITUDE



# HUMIDITY



# AGRICULTURAL VIABILITY





# OUTREACH



## SCHOOL

- Talks at internal societies
  - Engineering / Physics Society
  - Project discussed at Societies Fair
- School open day
- Article in school magazine

## THE LOCAL COMMUNITY

- Presentation at Colet Court
- Talk to Surrey Explorer's Club
- SPS Summer Festival

# THE WIDER PUBLIC



## OUR WEBSITE

**teamcycl.one**

Primary platform for learning about the team, linking to all other platforms



## FACEBOOK

**Cyclone CanSat**

Sharing updates on the team's progress



## TWITTER

**@spscyclone**

Brief updates of progress



## VIMEO

**Team Cyclone**

Video sharing platform



## GITHUB

**github.com/cyclonecansat**

Making source code, designs and plans available to the public



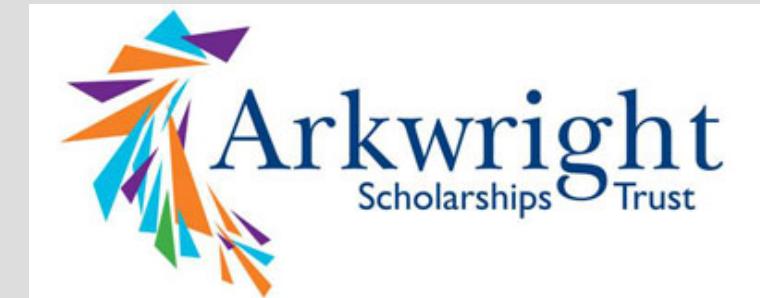
## WORDPRESS

**cyclonecansat.wordpress.com**

Blog posts by each team member

# FUNDING

- Sponsorships:
  - Newbury Electronics
  - HobbyKing
- Arkwright Scholarships
- School's engineering budget
- Cake sale



# CONCLUSION