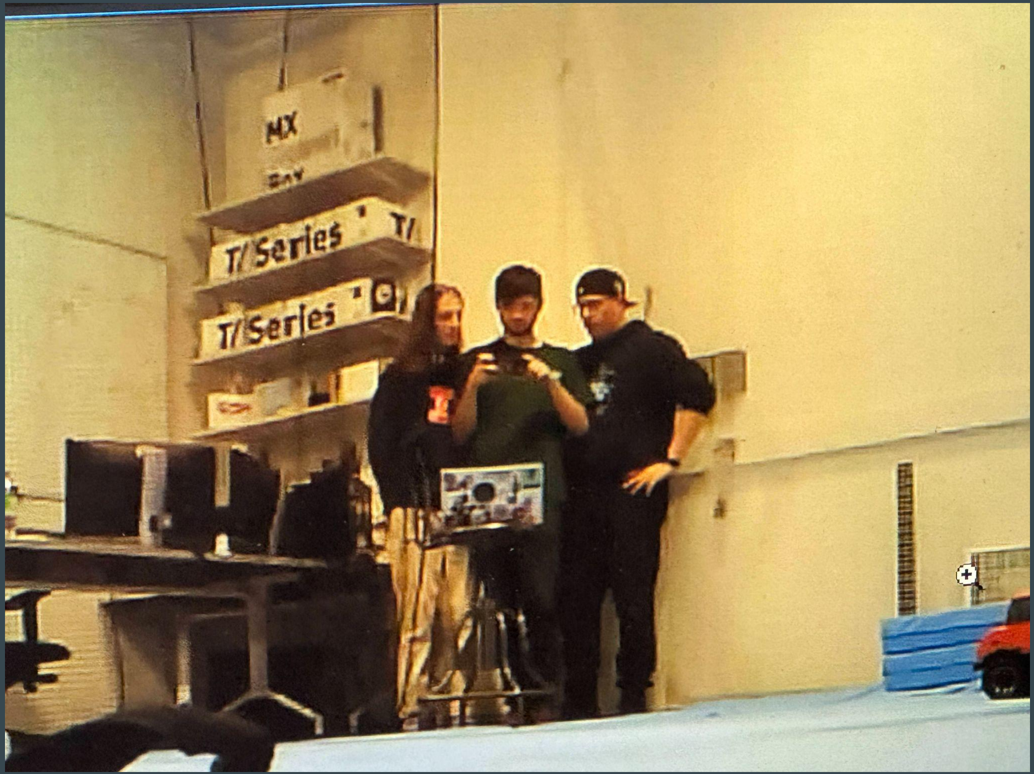
FPV Racing Drone
Team 64

Group 64
Elias O’Malley, Hunter Baisden, Griffin Descant

Who are we?

- Hunter Baisden
- Elias O'Malley
- Griffin Descant



Objective

Our goal is to create a FPV drone that will generate more engagement with drone research by providing students with a unique and exciting flying experience.

The Autonomy Arena

The Crazyflie Drone

The Crazyflie is a lightweight, open source drone used by the lab.

Limitations:

- Size
- Small battery

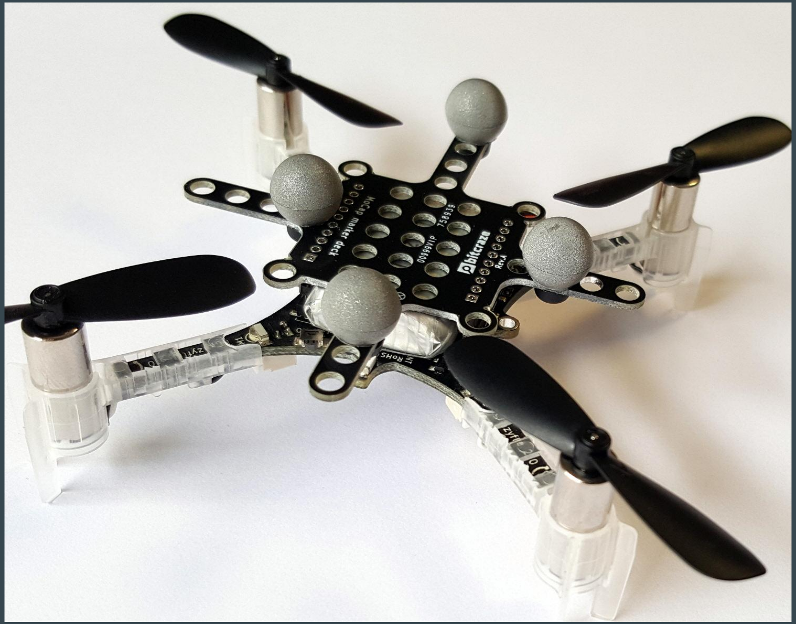
A Crazyflie 2.0 Model

The Vicon Motion Capture System

The flight arena is equipped with a Vicon motion capture system.

The lab wants to be able to track and differentiate multiple drones simultaneously.

Currently, the lab uses retroreflective balls, but we tested IR LED on the drone instead.



A Crazyflie with retroreflective balls

FPV Headset

Fat Shark Dominator V2

Composite video or HDMI input

High Level Requirements

Stable Flight

- <5% deviation from normal flight paths
- Balanced
- <15g of weight added

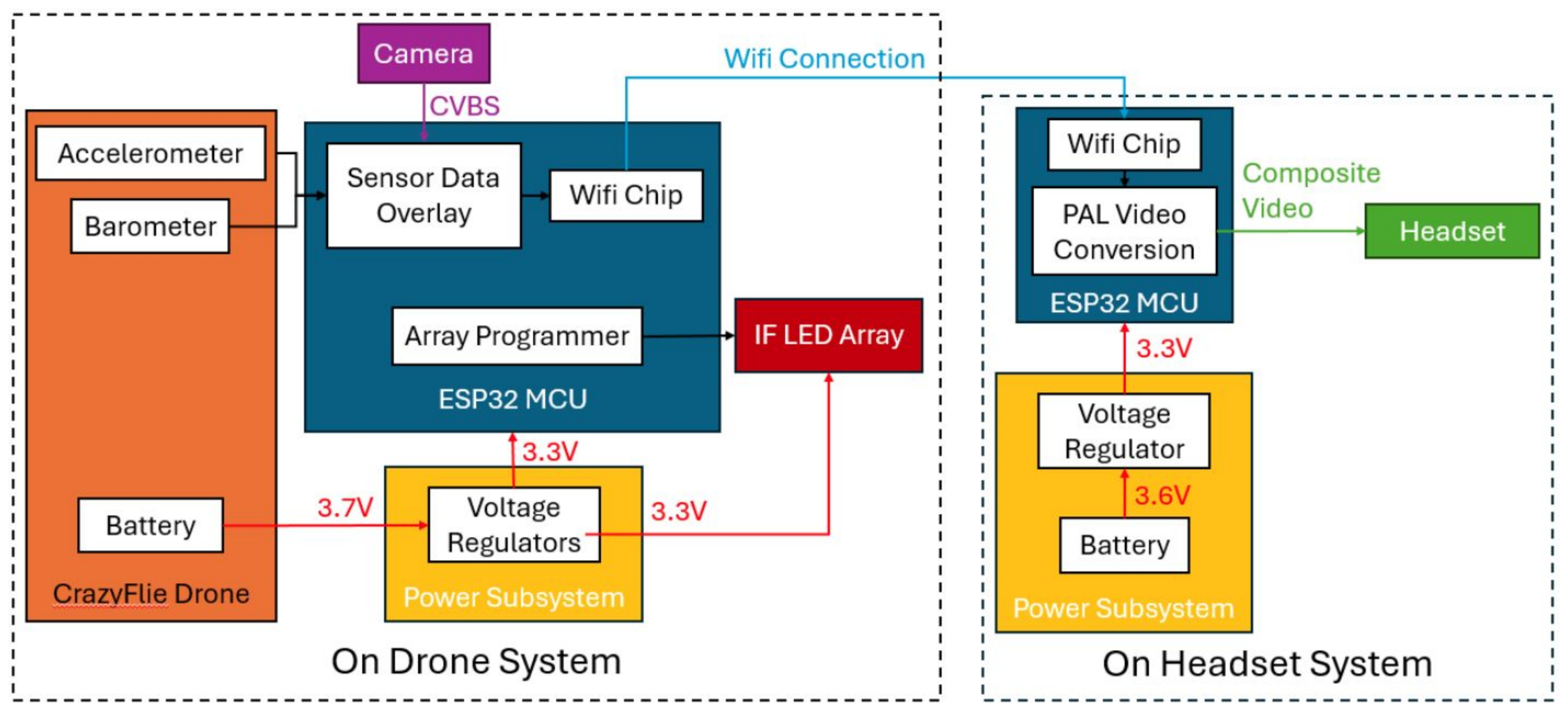
Low Latency Video

- 30 FPS
- Minimal interruptions

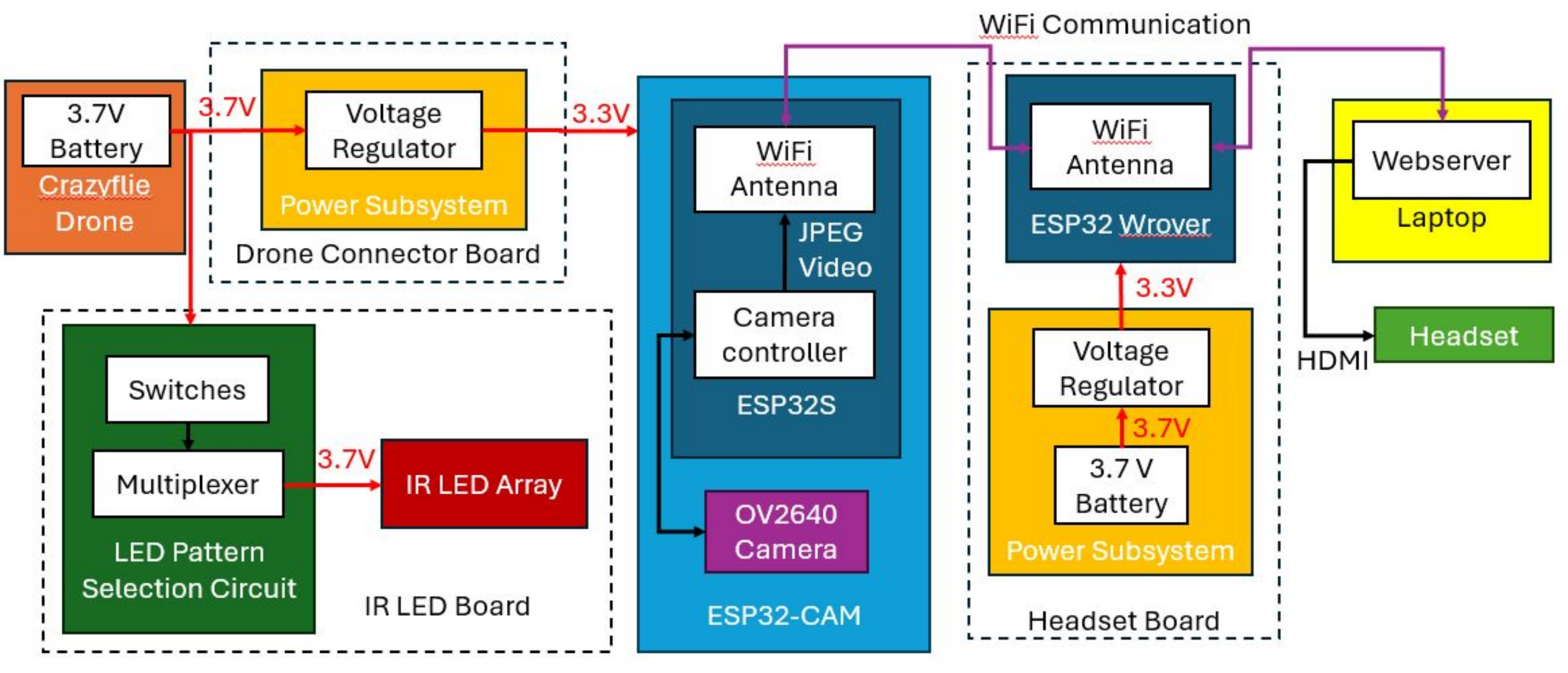
Vicon System

- Track the drone accurately
- Test IR LEDs with the system

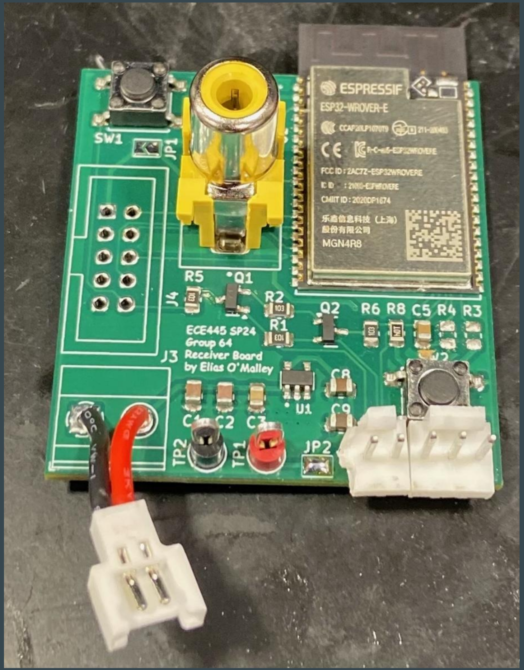
Original Design



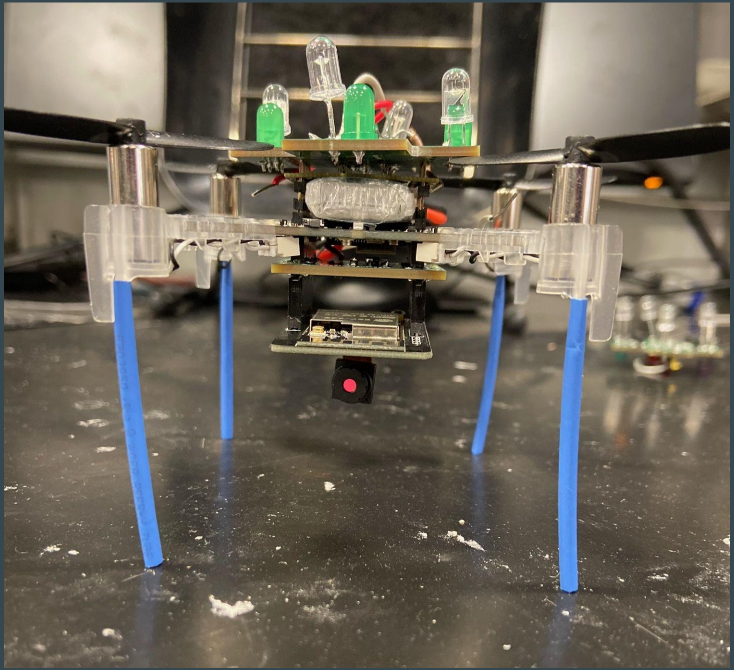
Final Design



Final Design



Receiver Board



Fully Assembled Drone

Final Result

Final Result With Headset

Drone Flight Verification

Has decent controllability and motion.

Flight Issues:

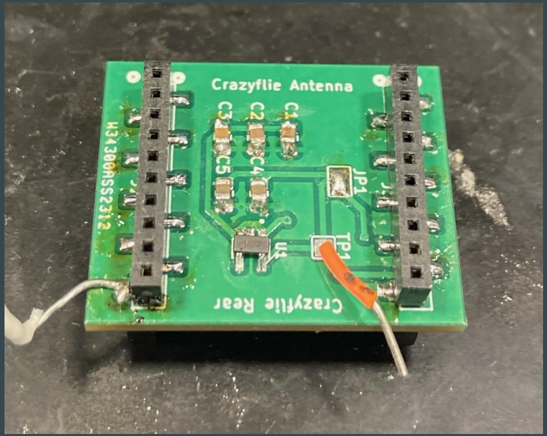
- Slightly lopsided and unstable
- A bit slower

These combined to a flight deviation of well over 5%

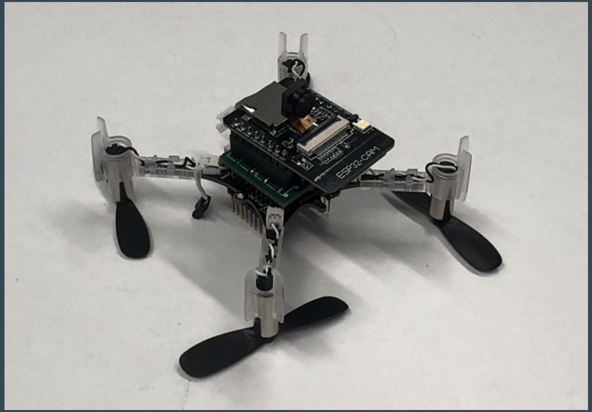
Additionally, the flight time is ~1 min before the ESP32 CAM browns out

Drone Transmitter Subsystem

ESP32 CAM

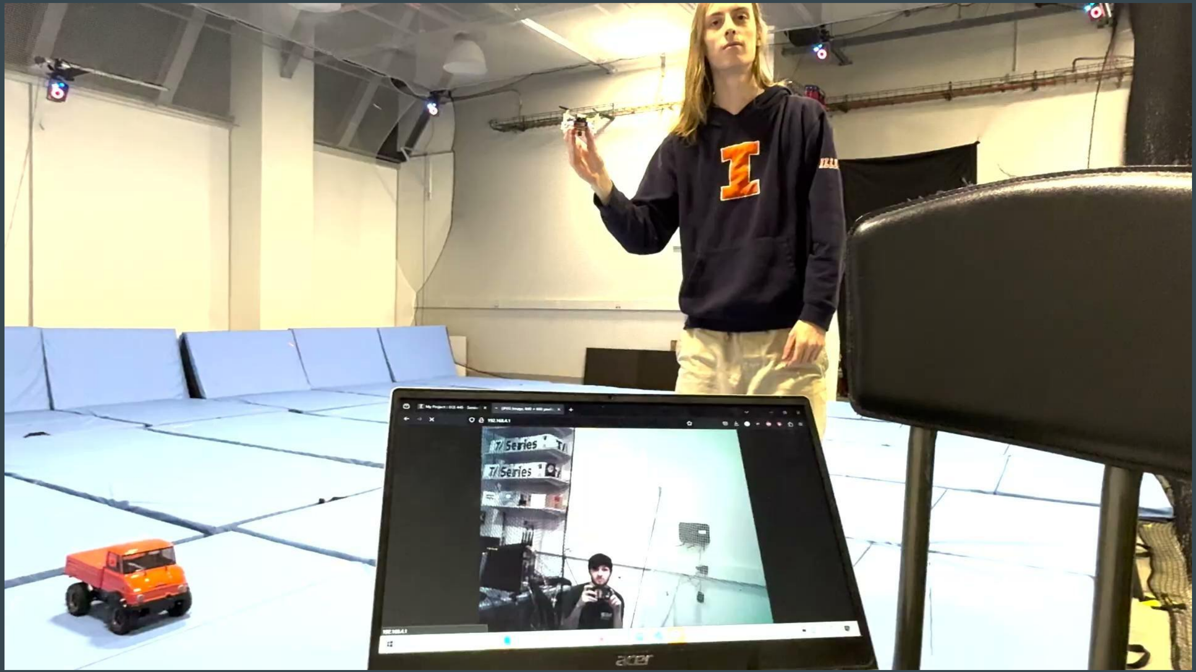


Drone Connector Board



Equipped Crazyflie

Drone Transmitter Verification



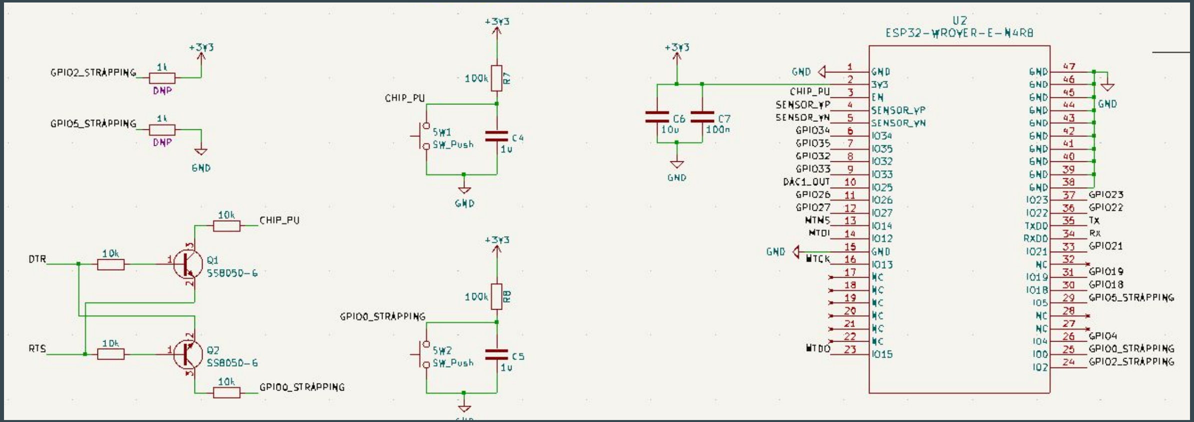
After Frame Analysis in Premiere Pro:

- Achieves 30 FPS
- Delay of about 160ms

Headset Receiver Subsystem

ESP32 WROVER Chip

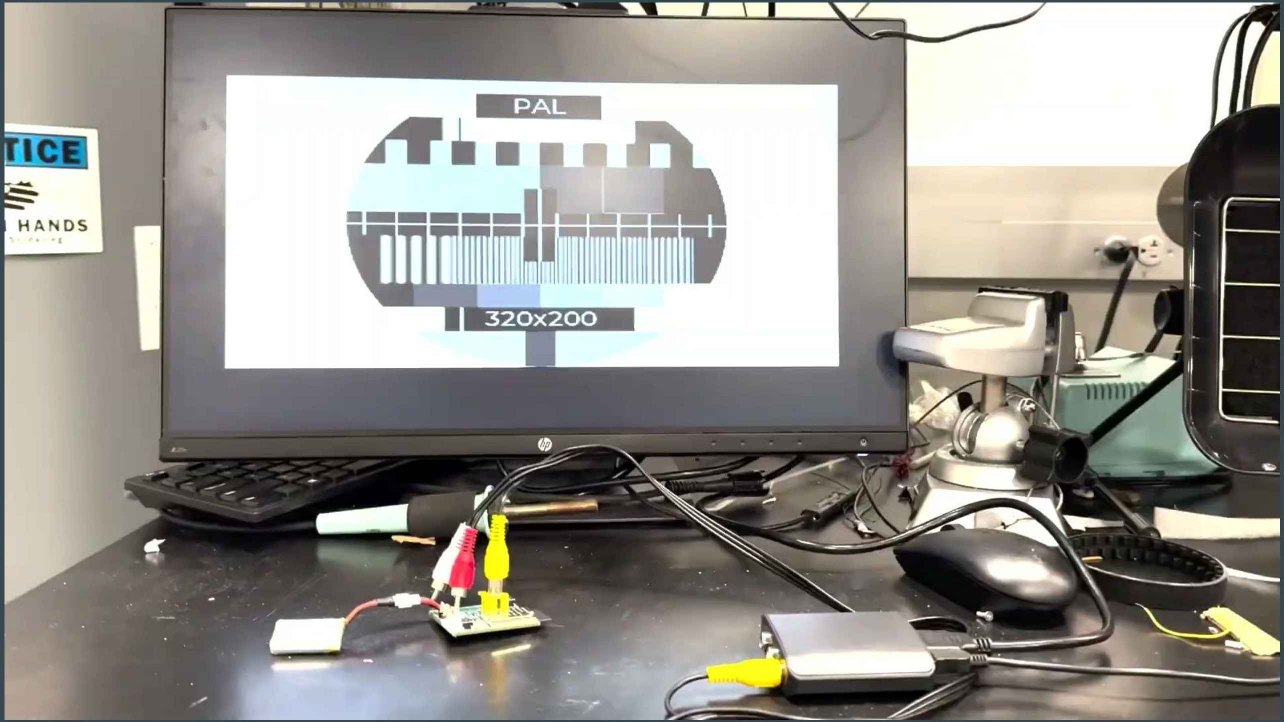
- Different package
- Different GPIO strapping pins
- Has two DACs



Was able to create CSV Video

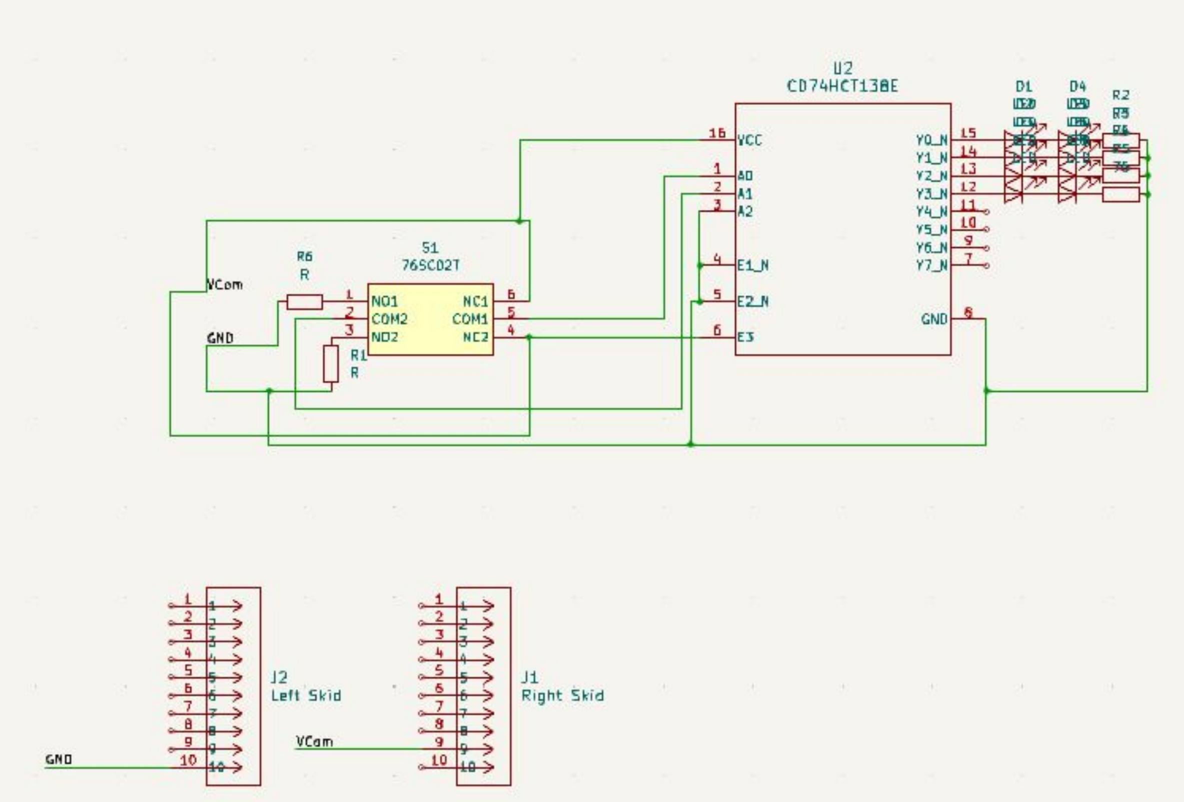
Was not able to convert JPEG Video to CSV

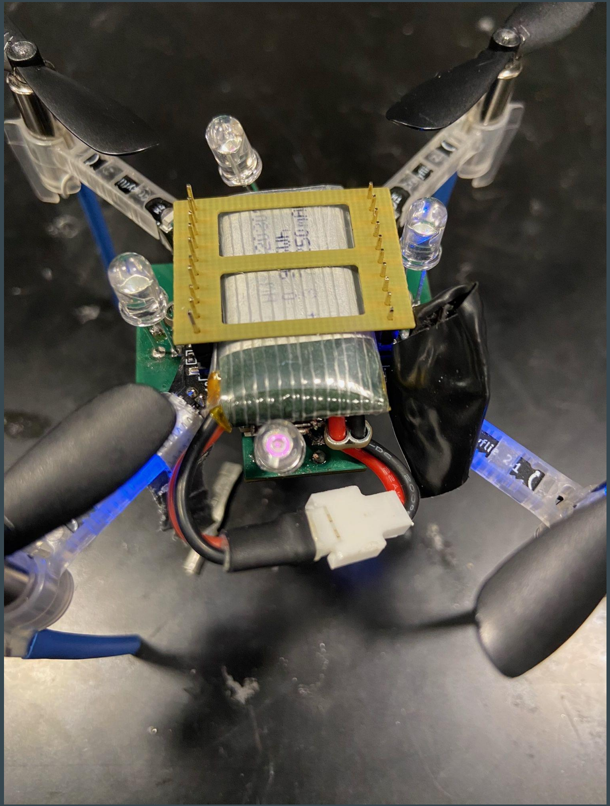
Headset Receiver Verification



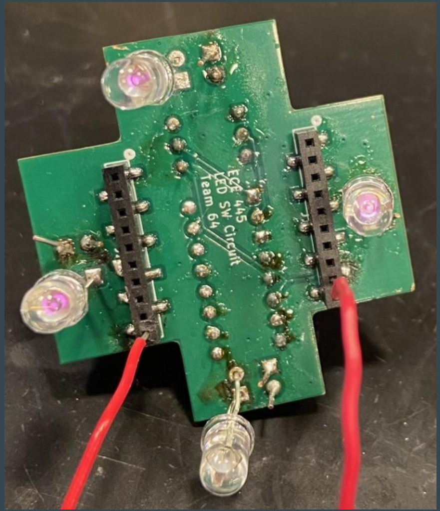
CSV output with preloaded video

LED and Vicon Subsystem

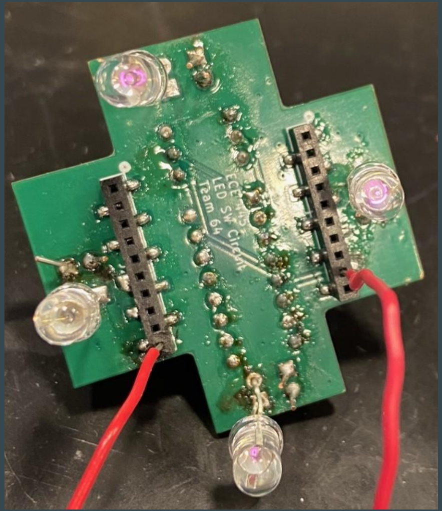




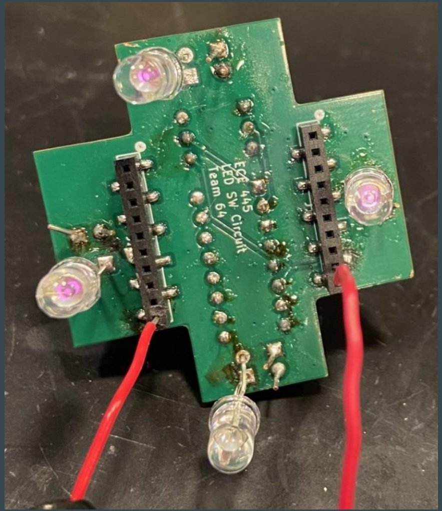
LED and Vicon Verification



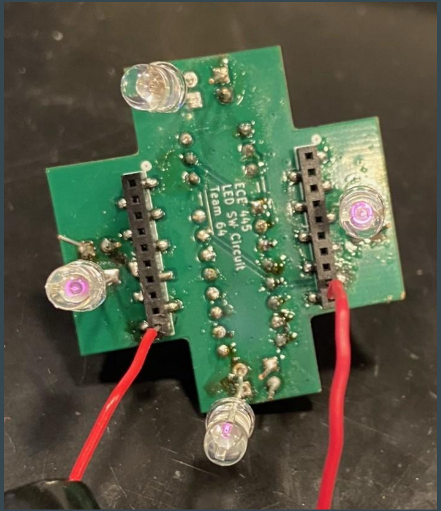
Configuration 1



Configuration 2

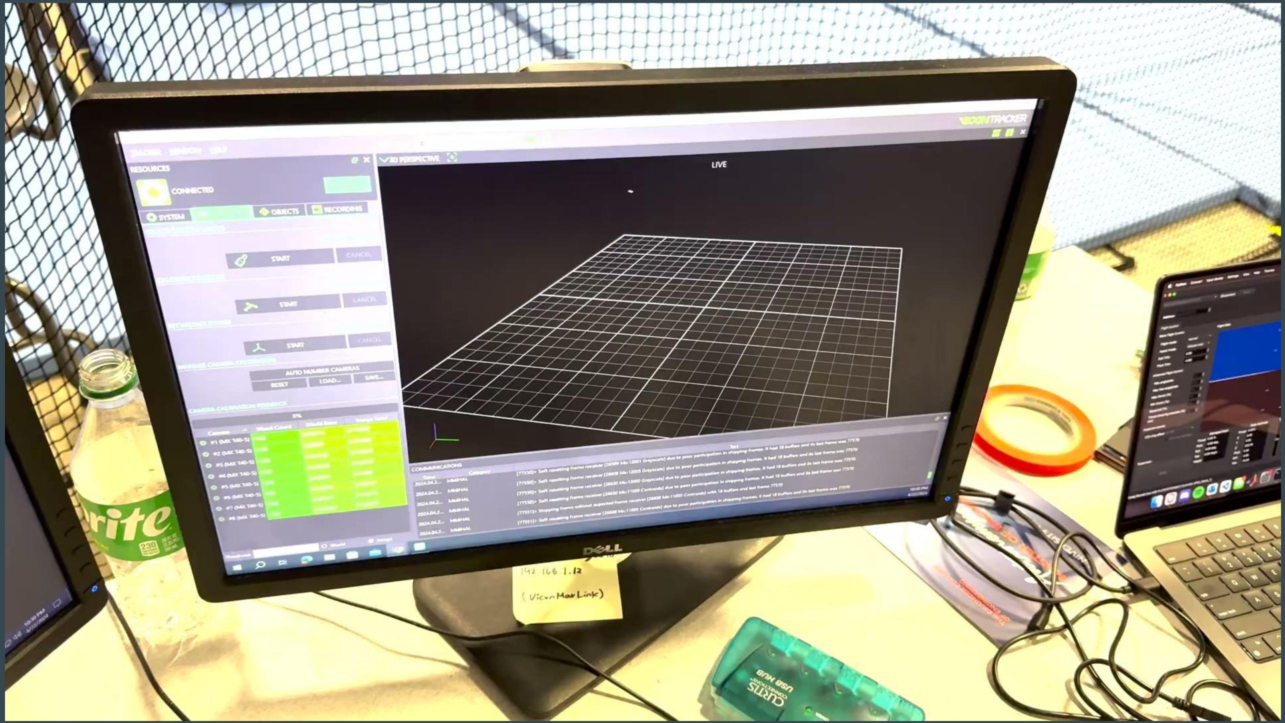


Configuration 3



Configuration 4

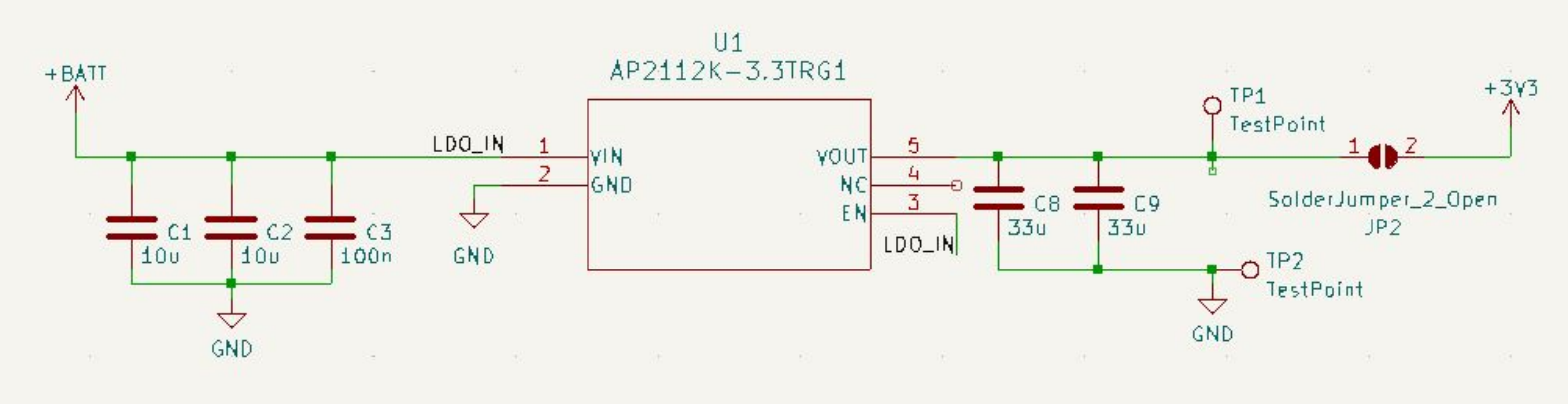
Vicon Verification With Reflective Balls



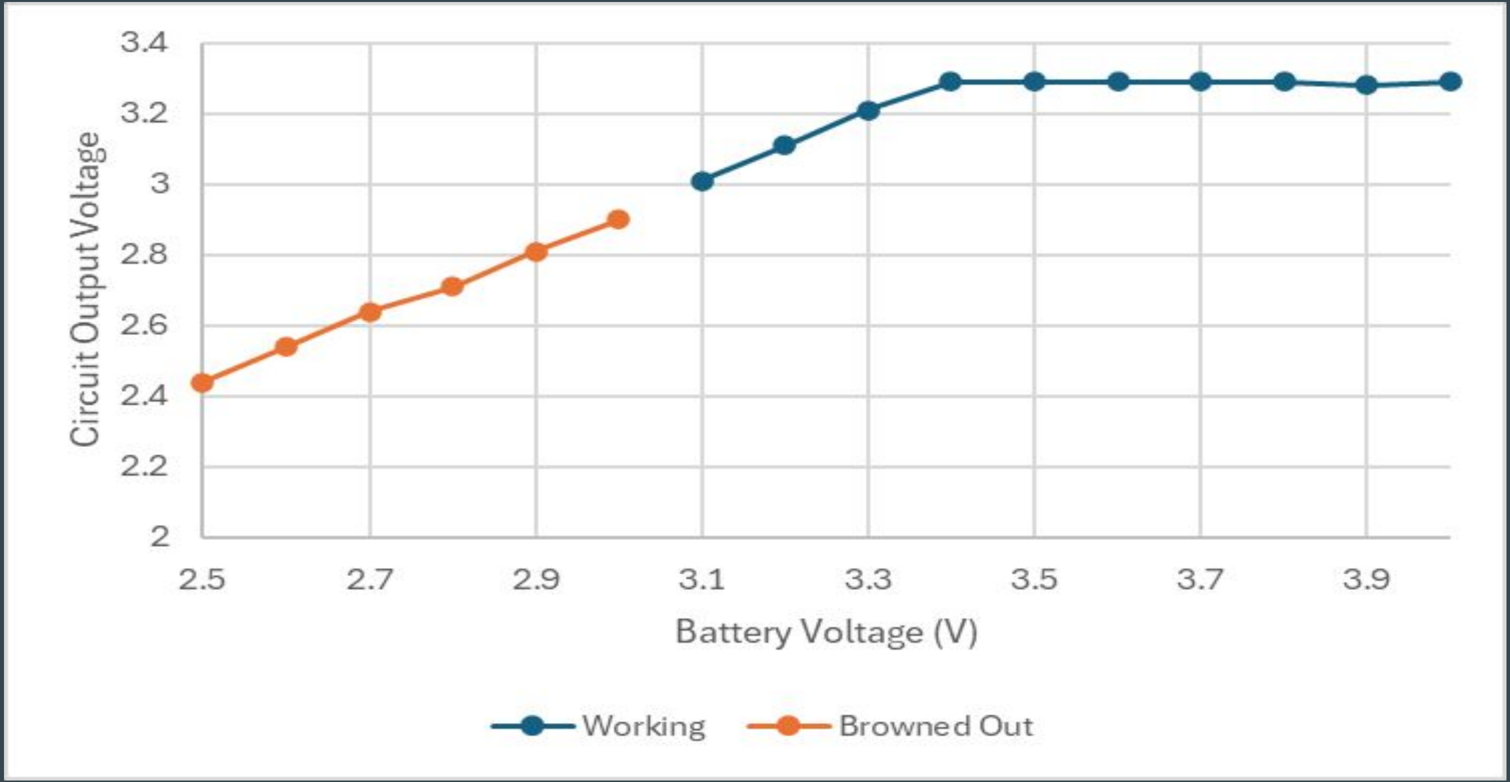
Drone and Headset Power Subsystems

AP2112K LDO

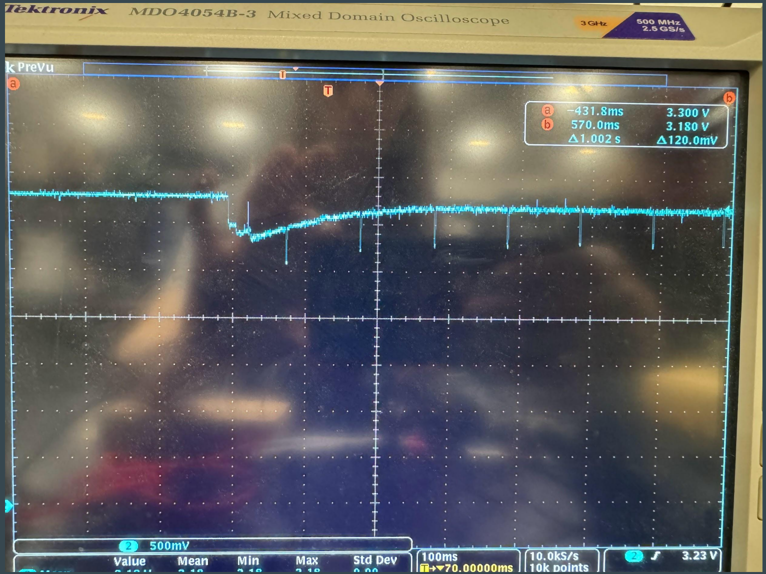
- Static 3.3V
- 600mA



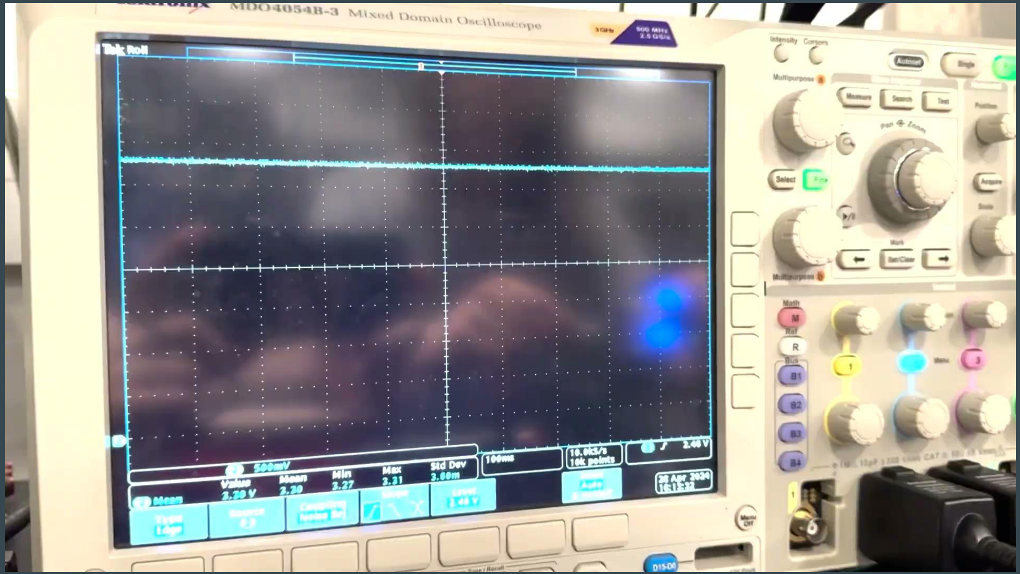
Drone and Headset Power Verification



Drone Power Verification



LDO output step due to motor turn on (low battery)



LDO output step due to motor turn on (high battery)

Successes:

- Drone flies while video is streaming
- Video is streamed from camera on drone to FPV Headset
- LEDs light up in selectable pattern
- Both boards maintain consistent power supply
- Board capable of generating composite video signal

Failures:

- Short camera lifetime
- Drone does not have full range of motion
- LEDs too dim to be detected by Vicon
- Use of laptop and HDMI to transmit video from webserver to the headset

Future optimizations

1) Shave weight:

- Design lightweight cam board
- Lighter connectors
- Half thickness PCB

2) Finish JPEG to Composite video conversion code

3) Brighter IR LEDs

OR

Crazyflie thrust package

Acknowledgements

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