Ledrone @ FUSION CON

Mechanical

Sydney Mah

Tristan Dela Cruz

Nathan Tran

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Lena Sablan

Gavin Bautista

Khloe Antolin

Mechanical 🛠️

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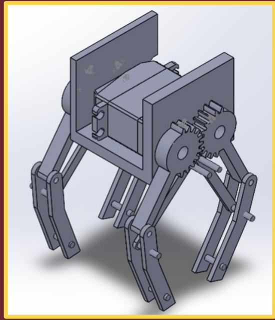
Mechanical Timeline

Design

- Component Selection
- CAD Frame Design
- CAD Claw Design

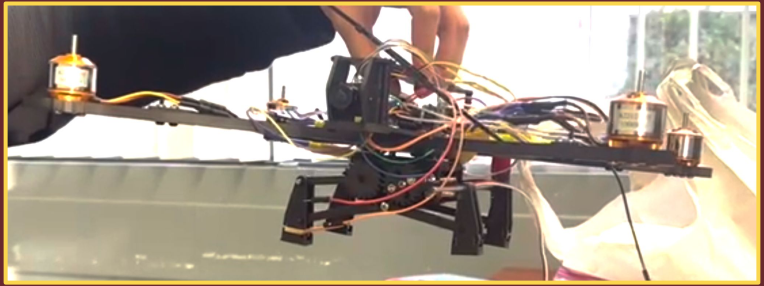
Fabrication

- 3D Printing



Integration

- Mounting Claw to Drone
- Mount Motor and Propeller
- Initial flight testing



Iterations

- Claw Redesign (CAD)

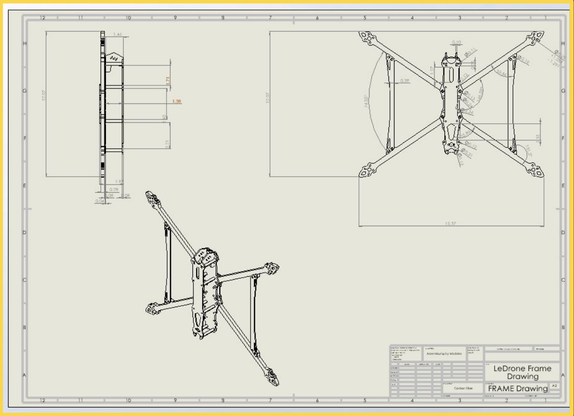
Frame

10-inch Carbon Fiber Hybrid-X Frame

- WheelBase: 427 mm

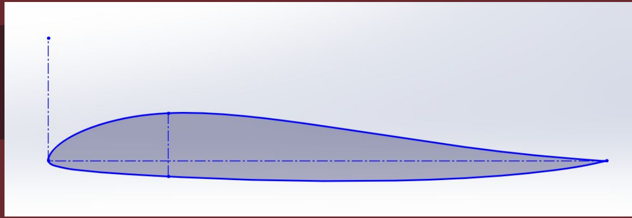
Why this Frame?

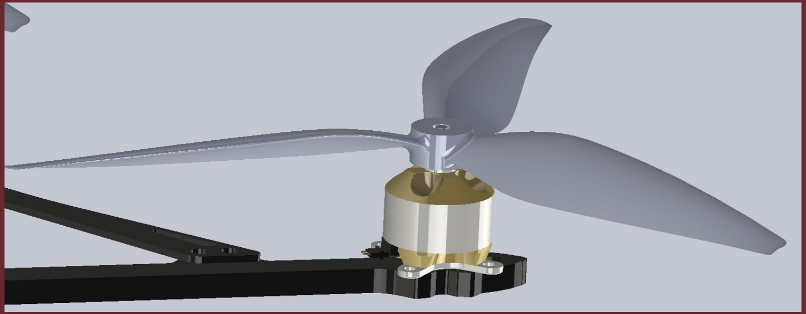
- Popular for freestyle and cinematic flying
- Centralized CG → better stability
- Higher pitch inertia → smoother motion
- Large surface area for attachments
- Modular



Propeller

- 10 x 4.5 x 3 inch 3-Blade Propeller
- 2 CW + 2 CCW Blades, diagonal to each other to cancel rotational torque
- Stable performance
- Generates more lift, can carry heavier payloads


Design sketch of the Propeller Blade


Side view of Propeller Blade in CAD assembly


Front view of Propeller Blade

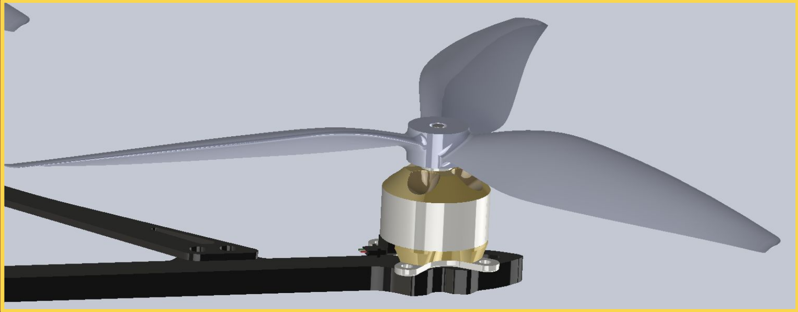
Propeller + Motor

10 x 4.5 x 3” (3-Blade)

- 2 CW + 2 CCW (torque-balances)
- Generates **higher** lift

A2212 1000kv Brushless Motor

- Lower Pitch → **efficient** thrust
- Operates with **low** strain



Assembly

- Mounted on top of frame
  - Better CG **alignment**
  - **Prevents** ground impacts
  - **Generates** compression forces

Motor

A2212 1000kv Brushless Motor

- 10 Volts
- 210000 RPM

Why this Motor?

- Lower Pitch - prevent nose from going to high/low.
- Operate without high strain
- Better for Lightweight Drones.

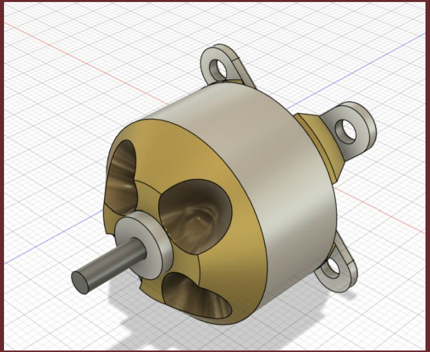


Fig 1: Isometric View

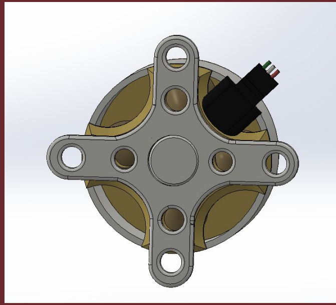


Fig 3: Bottom View

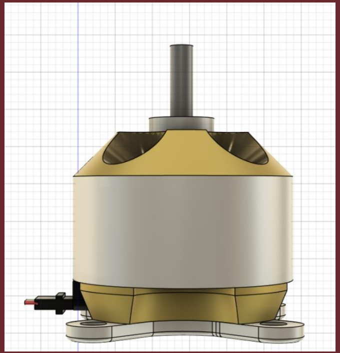
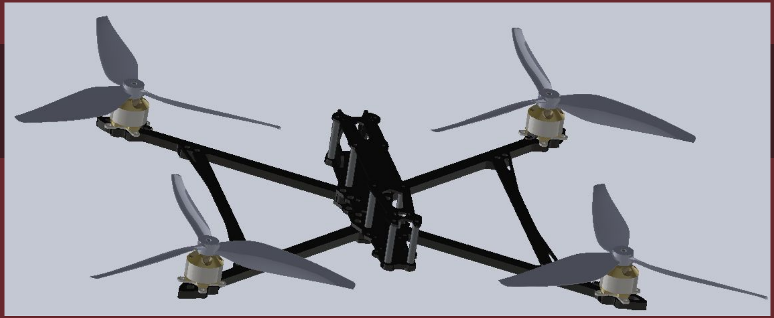


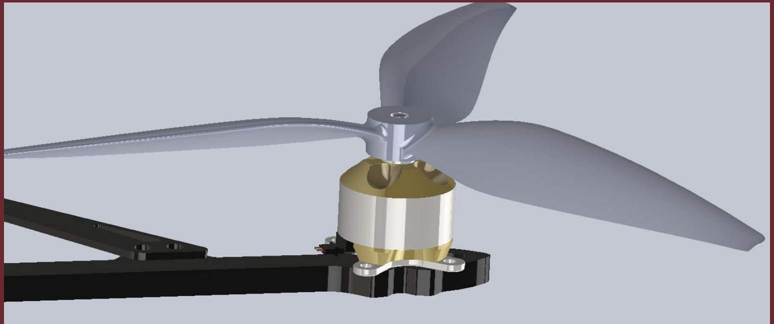
Fig 2: Front View

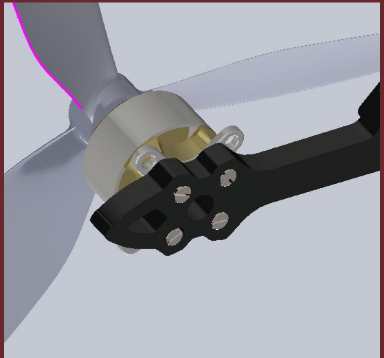
Assembly

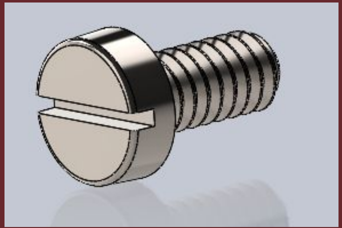
Motor + Propeller Attached to Drone Frame

- Motor + propellor on top of drone
    - Propellor pushes air downward
    - Center of thrust is closer to drones center of gravity
    - Prevents ground impacts
    - Creates compressional forces

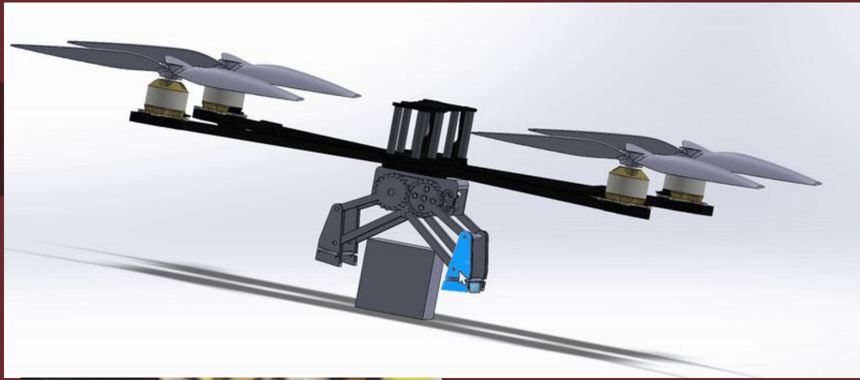








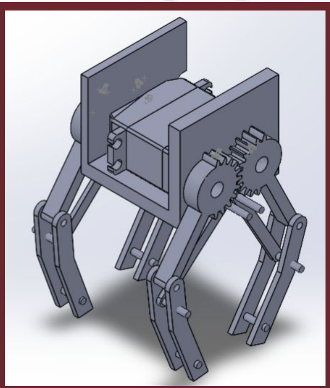
Claw + Attachment



- 3D printed, assembled using m3 nuts and bolts
  - Material: abs + carbon fiber print
- Powered using a 25kg servo
- 4-pronged claw provides a bigger grabbing area

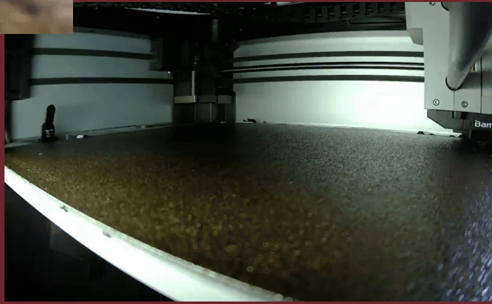
Servo Mount

- Screw the servo into servo mount
- Screw the servo mount into the bottom center plate of drone



Servo horn

- Servo attached to servo horn that is attached to a gear, driving the connected ball bearings allowing the claw arms to move.



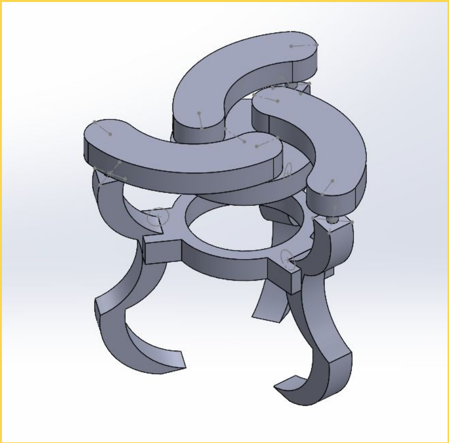
1st Claw Iteration

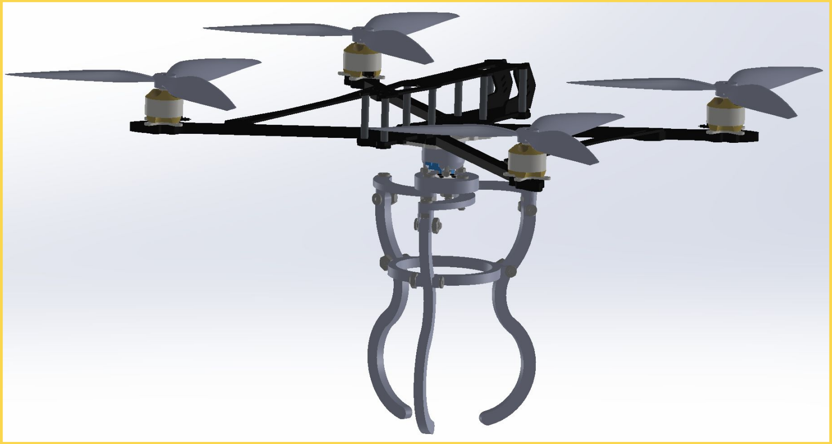
3 Arm Claw

- Servo Horn turns clockwise → arms protract
- Servo Horn turns counter clockwise → arms contract

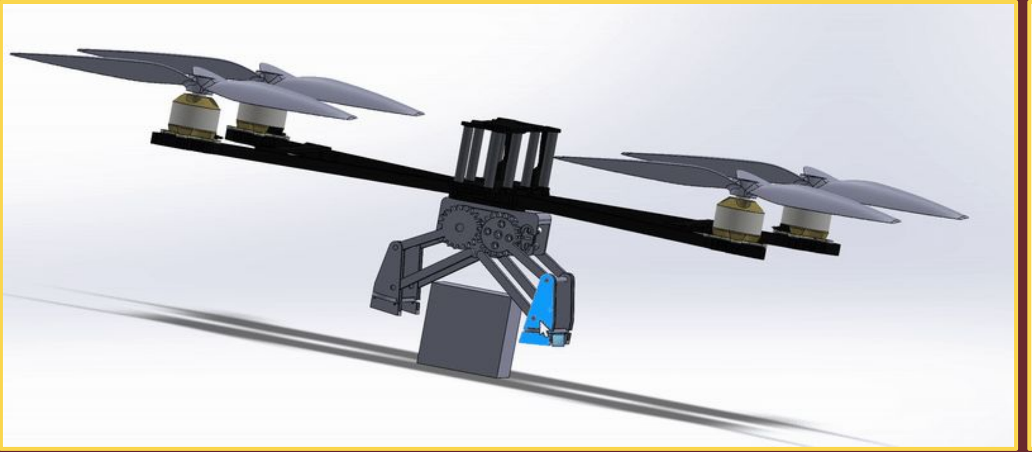
Design Issues

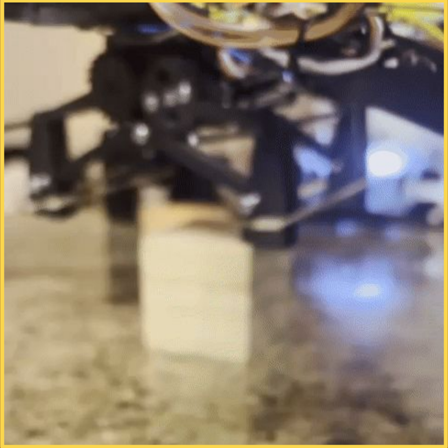
- Size concerns
- Contact points
    - Unstable landing mechanism
    - Difficulty securing the block





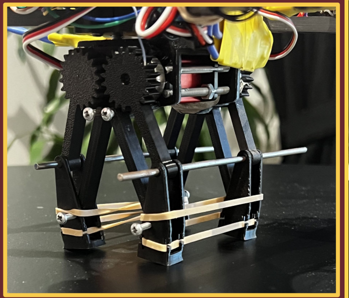
Final Claw + Attachment

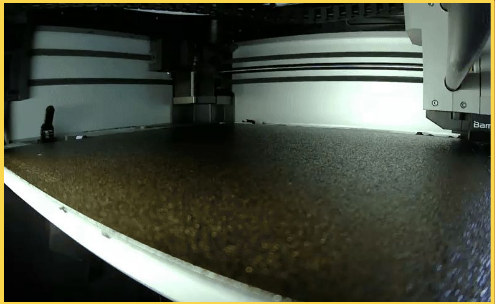




- Powered using a 25kg servo
- 4-pronged claw
- Assembled using m3 nuts and bolts

- Rubber bands wrapped around claw prongs→ versatile grabbing mechanism
- Servo mount screwed at bottom center plate on drone frame
- Servo horn attached to driving gear → all 4 claw arms move through connecting rods





- 3D printed, Abs and Carbon Fiber Print

Claw Attachment

Servo Mount

- Screw the servo into the servo mount
- Screw the servo mount into the bottom center plate of cage

Servo horn

- Attached to the servo will be a servo horn that is screwed into the finger mount of the claw

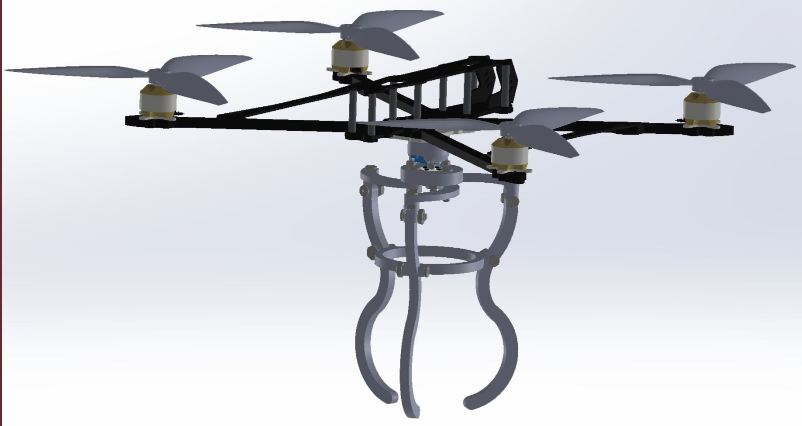


Fig 1: Full Assembly

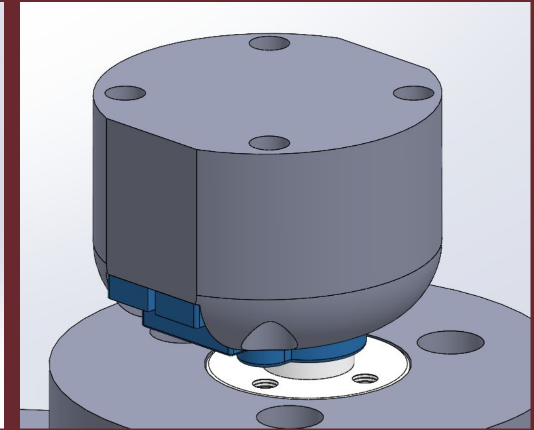


Fig 2: Servo mount and horn

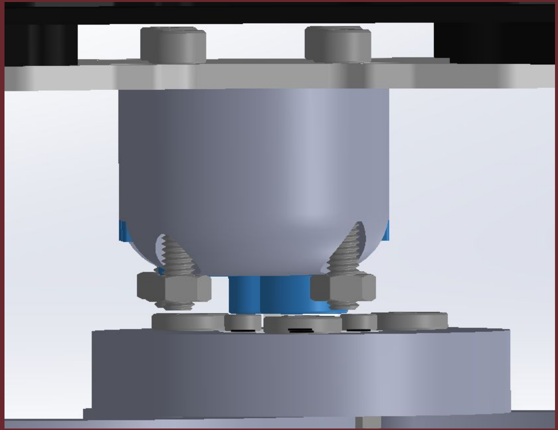


Fig 3: Point of Contact with Frame


Hardware 👨‍💻

LeDrone | Hardware Sub-team

David Dela Cruz
Isaac Cruz
Hailey Gumanab
Miles Jennings
Chris Luong

Hardware

Hailey Gwen Gumanab

Miles Jennings

Isaac Cruz

David Dela Cruz

Chris Luong

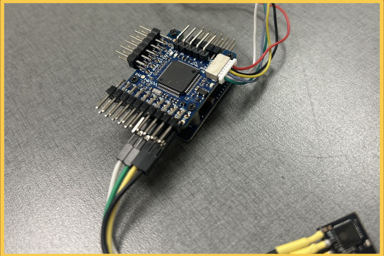
Hardware Timeline

Design

- Component Selection
- Wiring Diagram
- Power Budget

Testing

- Arduino Servo Testing
- PCB Soldering Practice
- Firmware Setup



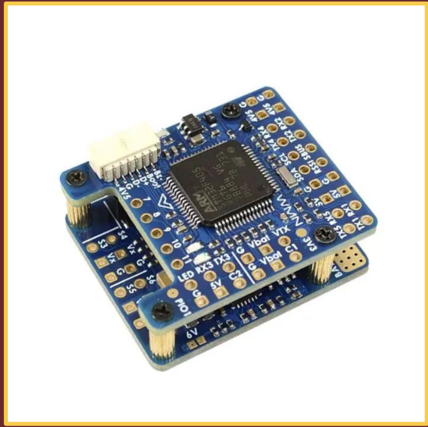
Integration

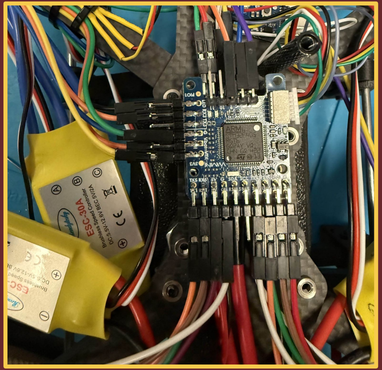
- Wiring to Flight Controller
- Motor & Servo function
- Initial flight testing

Configuration

- Sensor Tuning
- Flight mode setup
- Final Flight

Flight Controller

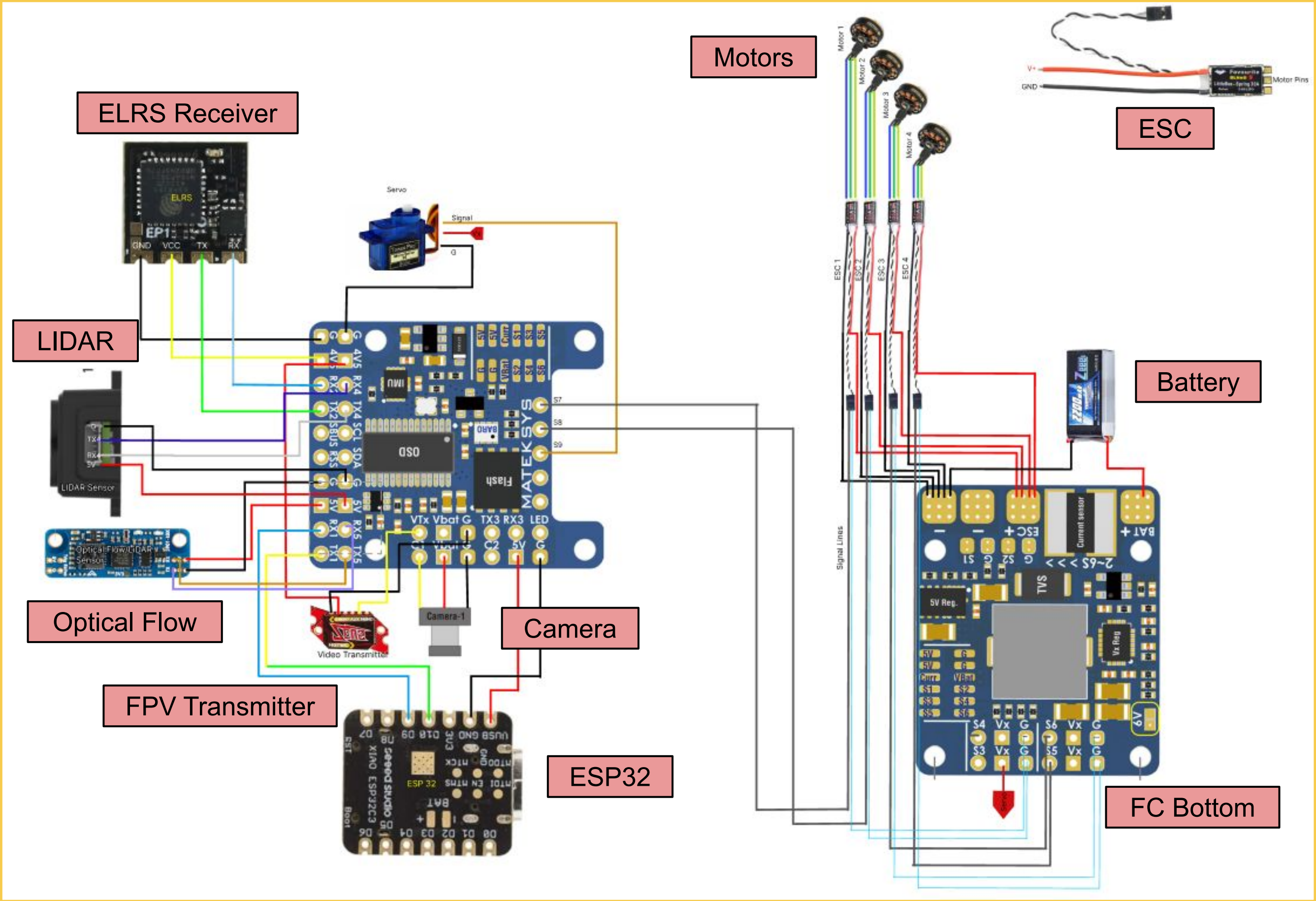




MATEKSYS F405-WMN

- 5x UARTs, 1x I2C, 12x PWM outputs
    - Suitable ports for peripherals
- 6-30V DC in, 132A Current
- Compatible with Ardupilot
- Unsoldered holes (can attach header pins)
    - Easy soldering & troubleshooting

Wiring Diagram



Power Budget

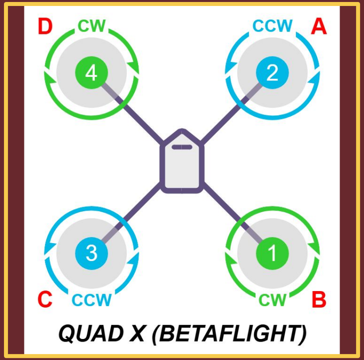
Component	Quantity	Op. Voltage	Current (mA)
Motors	4	~10V	40000
Camera	1	5-12V	200
FPV Transmitter	1	5V	75
Optical Flow Sensor	1	4.5-5.5V	40
Lidar Sensor	1	5V	70
ELRS Receiver	1	5V	40
Flight Controller	1	6-30V	70
Total			40425

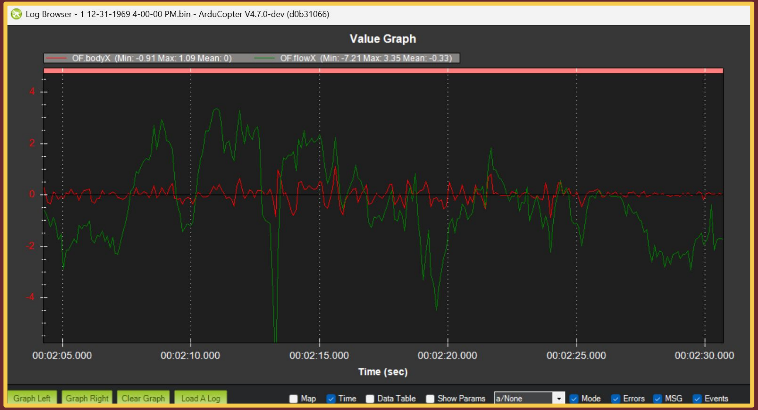
Battery Capacity (mAh)	Flight Time (min)
2200	3.27
3200	4.75
5000	7.42
5200	7.72
6000	8.91
6500	9.65
8000	11.87

FPV Camera

- FPV Camera sends live video feed to FPV Receiver through video transmitter
    - Frequency Range: 4900 - 5900 MHz
- Transmits both Audio and Video
- OSD
    - Live drone data displayed on view

Ardupilot Configuration





- Flight Modes:
  - **Stabilize**: free control of throttle & lateral

    AltHold: throttle held, free lateral control
  - **Land**: throttle lowered, free lateral control
- LIDAR and Optical Flow Tuning
  - Better performance in well-lit environments
  - Strong correlation between sensor readings and IMU readings

Results

Results

Hardware

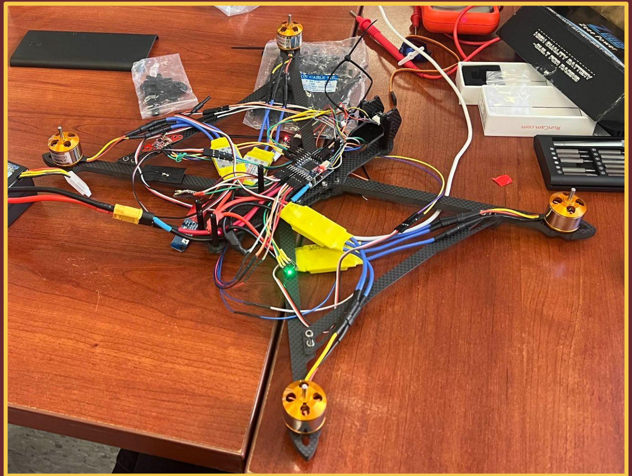
- All components operated within functional voltages/current levels (nothing fried!)
- Drone displayed stable flight without excessive jittering or movement in yaw axis

Mechanical

- Drone assembly displayed proper intended functionality without structural failure
- Claw operated effectively, successfully lifting and releasing blocks as required

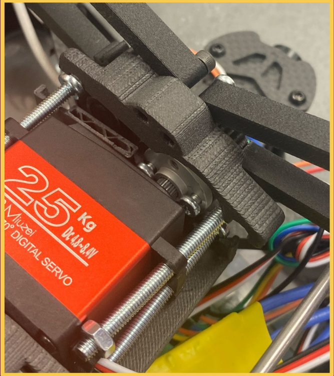
Lessons Learned (hardware)

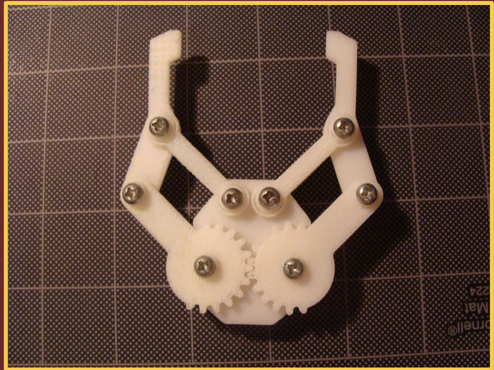
- **Use GPS!**
  - Much more reliable for outdoor and high altitude usage
- **Consider using FC/ESC Stack**
  - Reduce loose wire and overall cleaner design, but more difficult troubleshooting
- **Component Protection**
  - Implement power-protection (BEC’s, capacitors, or smoke stoppers) to protect important components from overcurrent or overvoltage

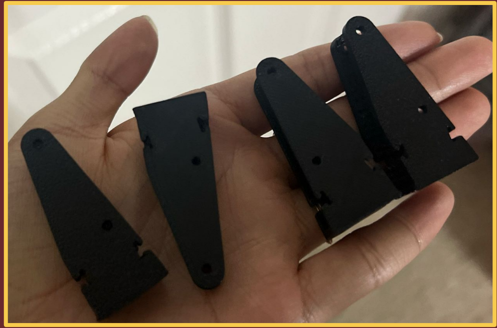


Lessons Learned (mechanical)

- **Stronger 3D Printing Materials**
  - Use more durable filament to prevent claw fractures caused by servo torque.
- **Looser Tolerances**
  - Adjust part dimensions in CAD to simplify assembly and reduce stress during fitting.
- **Crash Preparedness**
  - Anticipate potential crashes by printing spare parts or refining the design for easier repairs.







Thank You! 🦾