REVERSE ENGINEERING CHALLENGE

4K QUADCOPTER DRONE

TEAM 3383B ROBOHAWKS

IRVINE, CA

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SUMMARY REPORT- WHY A DRONE?

When our team came across ideas for a reverse engineering project, the team came across the VEX Aerial Drone Competition while researching. The drone competition featured competitors completing various tasks, such as landing on platforms and flying through rings suspended in the air while performing steady maneuvering skills. The team wondered how drones moved in all 4 directions without turning, and how a drone became popular enough to be made into a competition.

It is very common that families have at least one drone in their household, so we wanted to see what is inside this object that people all over the world are using daily. What makes this drone stand out is its camera, which can be used for videos and photos when paired with your phone to upload footage and images. Drones are becoming a popular recreational tool for people to have fun. Modern day drones also affect daily life. Drones are being used commercially such as delivering medical supplies, to plant trees, and surveying areas for a wide range of reasons.

4k Dual camera drone no. E88pro

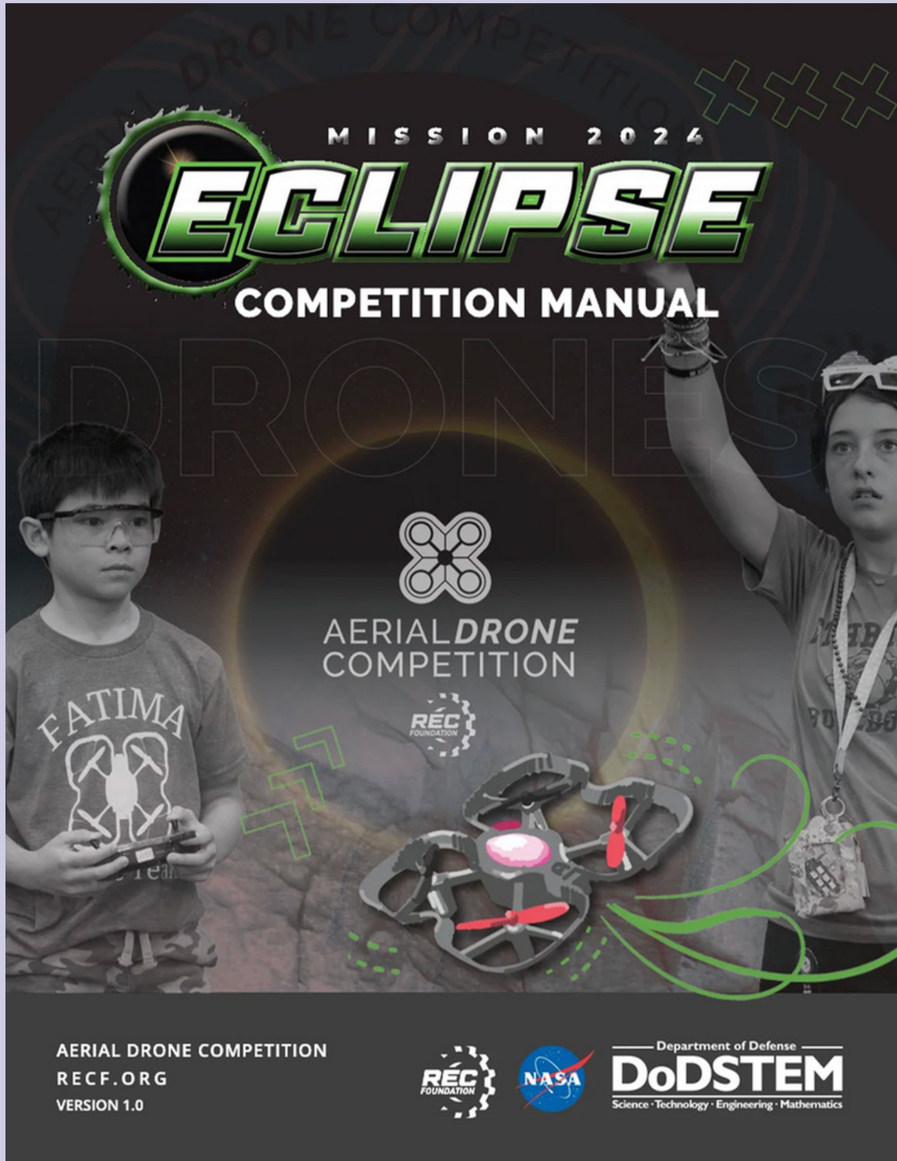
SUMMARY REPORT- WHY A DRONE? - (CONTINUED)

As we were researching drones, we have found that quadcopter is the most popular and widely used type of drone. We wanted to research deeper to see why this particular type of drone is preferred over others. Quadcopters are the most conventional drone design, as they are simple and have a large footprint. This means that the drone will be more stable than types of drones. Quadcopters also utilize their propellers to hover by pulling in opposite directions with equal force, and are very versatile. Therefore, we have chosen a quadcopter to deconstruct and see how the mechanisms work. The item that our team, 3383B is deconstructing for the reverse engineering challenge is the 4K dual camera drone.

When the team got together, we gathered all of the required tools and safety equipment. This included differently sized screwdrivers and safety goggles to successfully and safely take apart the drone. We were constantly supervised by guardians and removed any electrical parts and batteries before beginning. We first started taking apart the drone by removing the camera from the body of the drone. After removing the camera from the drone, the team unscrewed the casing and arms of the drone, revealing the motherboard and wires connecting the motors in the arms. Then, we took the casing off of the arms and revealed the motors powering them. Lastly, the team disassembled the arms and propellers.

SUMMARY REPORT- WHY A DRONE? - (CONTINUED)

We have learned many complex components of a drone and that drones are being used throughout the world for commercial purposes, recreational usage and for educational activities. We have also learned about different types of drone and their advantages and disadvantages. In the future, drones could be used for many more commercial uses other than recreational use and the popularity will grow as technology evolves. Drones will help people to explore unknowns, make our lives convenient and fun. Team 3383D is very excited to have an opportunity to learn about such an exciting technology. (Word Count 500)



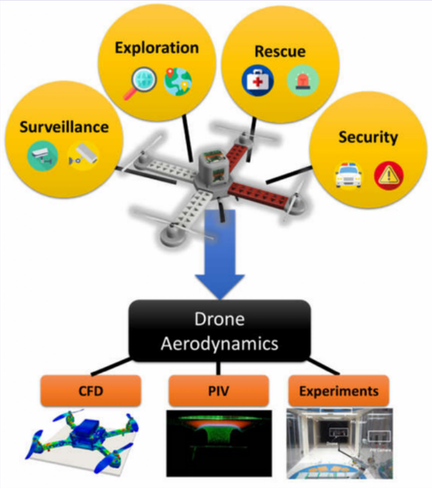
LESSON LEARNED-HOW DRONES ARE USED

- INFRASTRUCTURE
- INSPECTION AND MAINTENANCE
- SEARCH AND RESCUE OPERATIONS
- AGRICULTURE AND PRECISION FARMING

- ENVIRONMENTAL MONITORING AND CONSERVATION
- EMERGENCY RESPONSE AND DISASTER MANAGEMENT

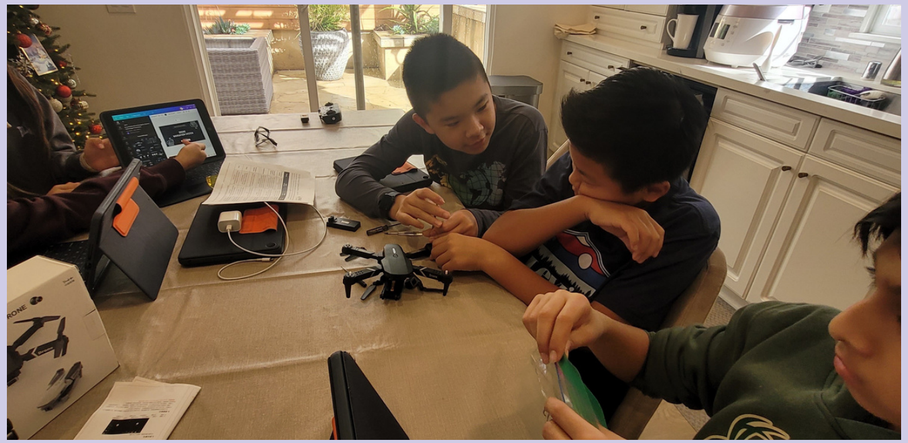
We have learned that drones are complex mechanism that are used in many different ways commercially and there will be more ways of using drones in the future.

- LAW ENFORCEMENT AND PUBLIC SAFETY
- AERIAL PHOTOGRAPHY AND VIDEOGRAPHY
- MAPPING AND SURVEYING



- TELECOMMUNICATIONS AND POWER LINE INSPECTION
- MEDICAL AND CARGO DELIVERY

TEAM GETTING READY

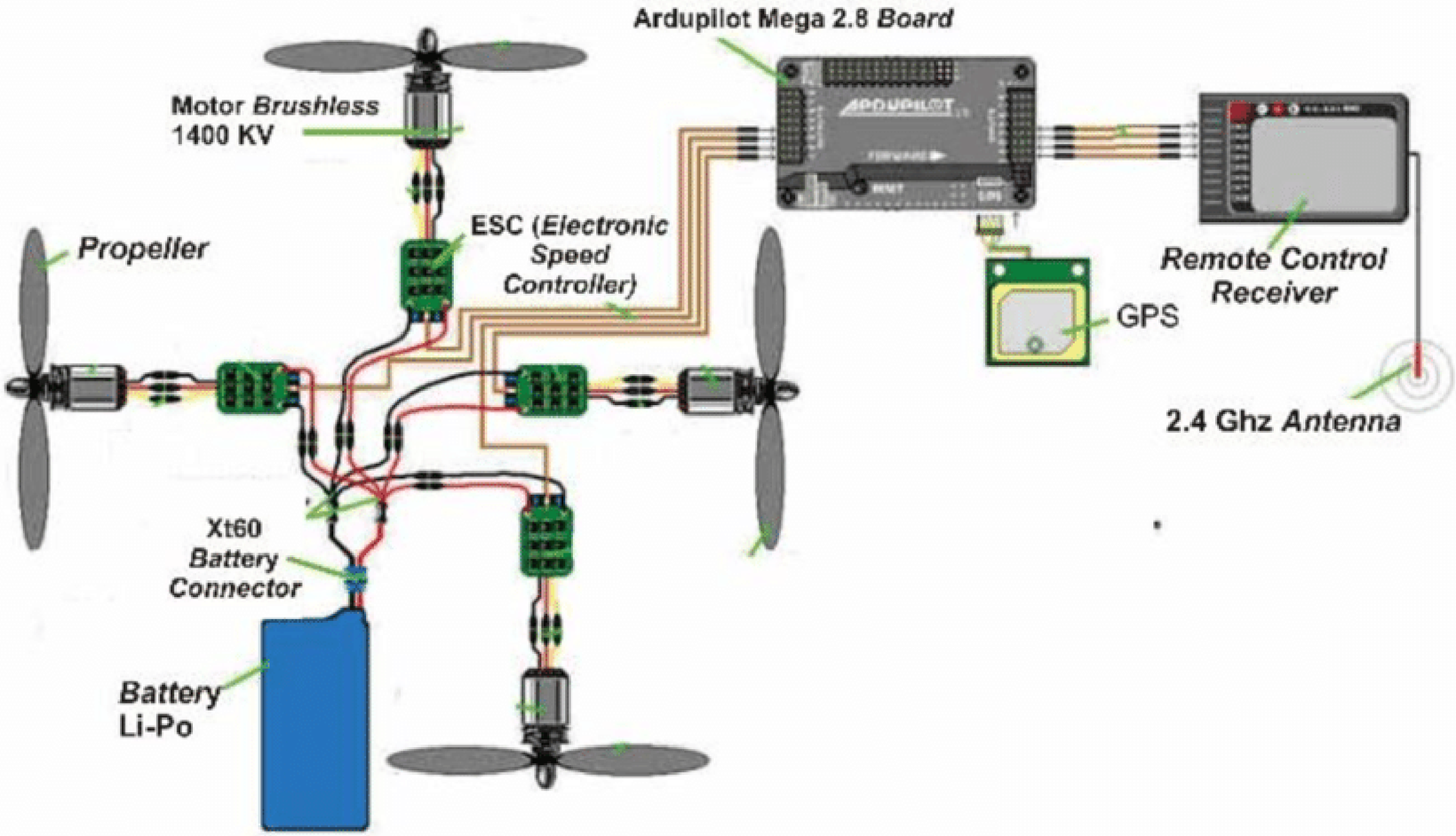


The team had decided to deconstruct a quadcopter drone. On December 22, 2023, the team met together to research, deconstruct a drone and to work on the reverse engineering challenge.

RESEARCH - COMPONENTS OF A DRONE

Drones have many components and main parts, such as propellers, battery, a transmitter(Sends commands from the controller to the drone) and receiver(Receives commands from the controller), as well as a PBD(Power Distribution Board) and ESC(Electric Speed Controller). There are also frames to support this, engines to power the propellers, and a flight controller(The “brains” of a drone that controls it’s movement).

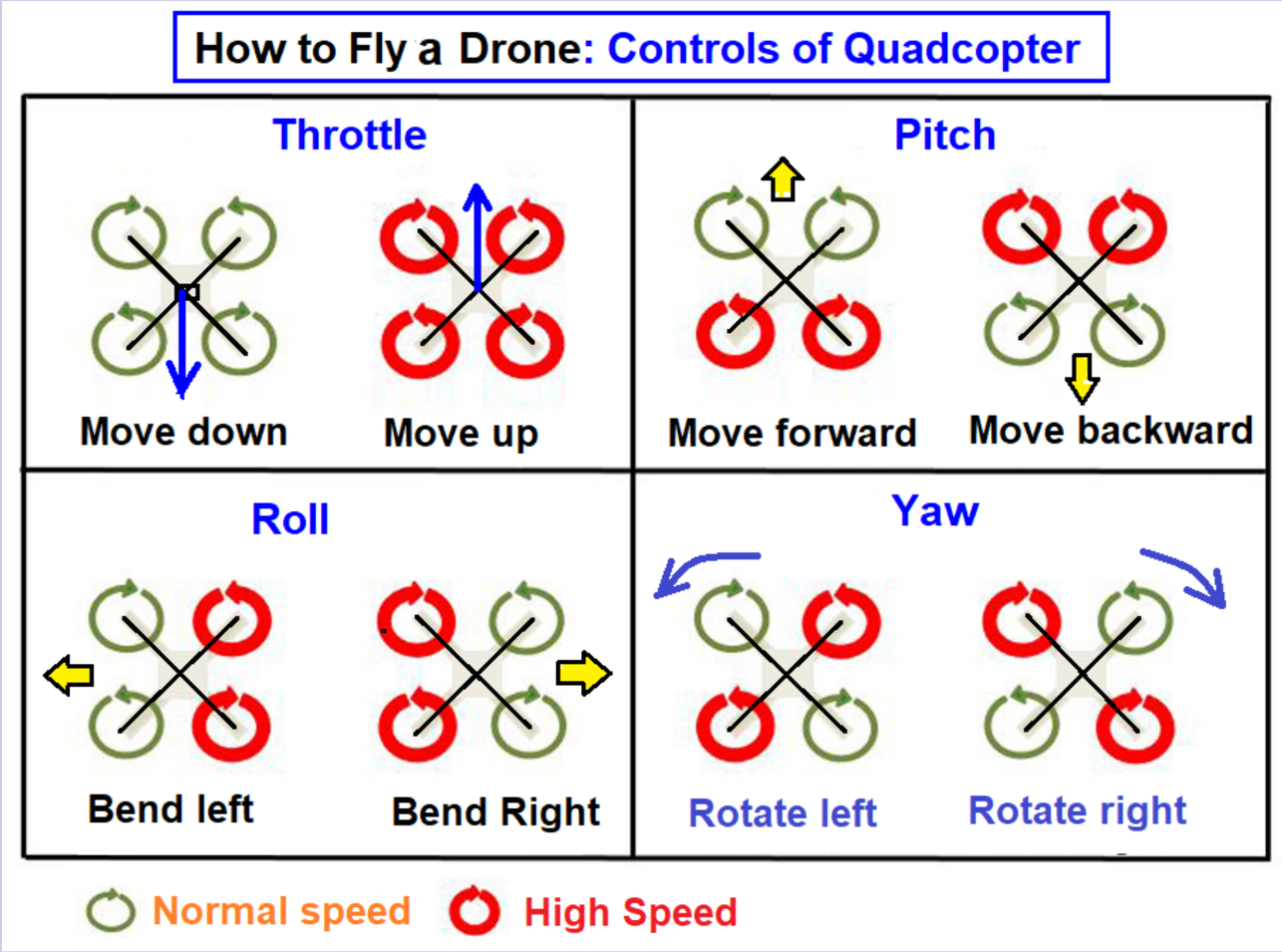
RESEARCH - ELECTRICAL COMPONENT



The team learned about how circuits connected all the parts of the drone, distributing power to each one equally. Most of this power was given to the motors and propellers.

RESEARCH - MECHANISM

A Quadcopter Mechanism



Quadcopters generally have two rotors spinning clockwise (CW) and two counterclockwise (CCW). Flight control is provided by independent variation of the speed and hence lift and torque of each rotor. Pitch and roll are controlled by varying the net center of thrust, with yaw controlled by varying the net torque.

Throttle- Nose of the aircraft going up or down
Pitch- Nose of the aircraft moving forward or backward
Yaw- Nose of the aircraft turning left or right
Roll- An Axis running from the front to the back of the aircraft - tilt

RESEARCH-TYPES OF DRONES

Single - Roter Drones		Advantages: • Longer endurance • Long blades - efficiency • Able to hover heavy payload • Built strong and durable • Used for aerial laser scan, crone surveying, carrying heavy payload	Disadvantages: • Complex and expensive • Vibrate/Not as stable • Require a lot of maintenance • Long, heavy spnning blades can be dangerous
Fixed-Wing Drones		Advantages: • Cover long distances - is able to stay aloft for 16 hours + • Able to map large area and loiter for long times • Able to fly high altitude • Used for aerial mapping, drone surveying, agriculture, inspection, construction, Security	Disadvantages: • Can be expensive • Takes trainings to control the flight such as soft landing • Requires a launcher • Always moving forward • Moves a lot quicker

RESEARCH-TYPES OF DRONES (CONTINUED)

Multi-Rotor		Advantages: • Better control during flight • Better maneuverability • able to fly closer to structure and buildings • Suitable for aerial photography & videography, surveillance, visual inspections, thermal reports, 3D scans	Disadvantages: • Limited endurance and speed • Limited battery life - typically about 20-30 min when carrying a lightweight camera • Restricted to electric motors due to need for fast and high-precision throttle changes to keep them stable
Fixed-Wing Hybrid		Advantages: • Rotors attached to the fixed wings • Autopilot can be stable • Perfect at ether hovering or forward flight • Drone delivery- Amazon's Prime Air Delivery drones	Disadvantages: • Only a handful of fixed-wing hybrid are available • beginning stage of technologies used for these drones

SAFETY PRECAUTIONS

To make sure safety of all members and every step went the right way, we had to make sure precautions were taking place.

- The device was approved by all members
- Extreme caution was taken when deconstruction the device
- Everyone wore safety goggles when involved in disassembling process
- Adult supervision during deconstruction
- Any power source or batteries were removed before the deconstruction
- All tools were handled with extreme caution

HAZARDS

- Chocking hazard- small parts need to be handled with care/parent or adult supervision
- Power turned off/Batteries were removed and stored separately
- The deconstruction process happened away from water

INTRODUCTION: 4K DUAL CAMERA DRONE

MODEL: K3/E99PRO

Figure1: top view

Figure2: bottom view

Voltlage and curent reuremens for usB chrgng lines

Input voltage	DC4. 7-5. 3V
Adapter current	0. 5-2A

Figure 5: voltage

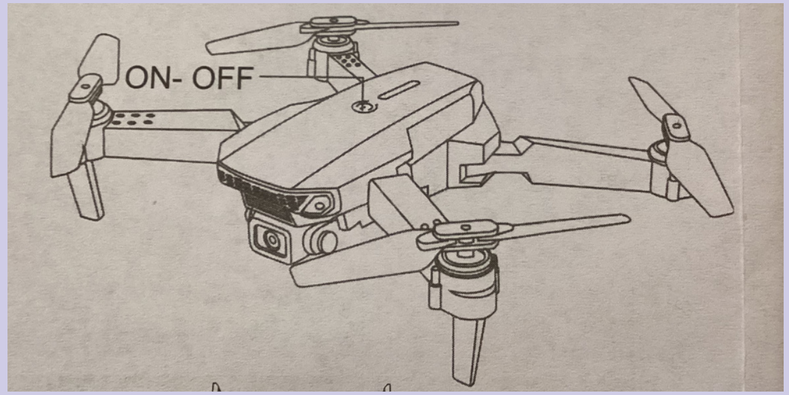


Figure 6: on/off button

Figure 3: top view with flank folded

Figue 4: side view

Figure 7: side view with battery out

DECONSTRUCTION PROCESS

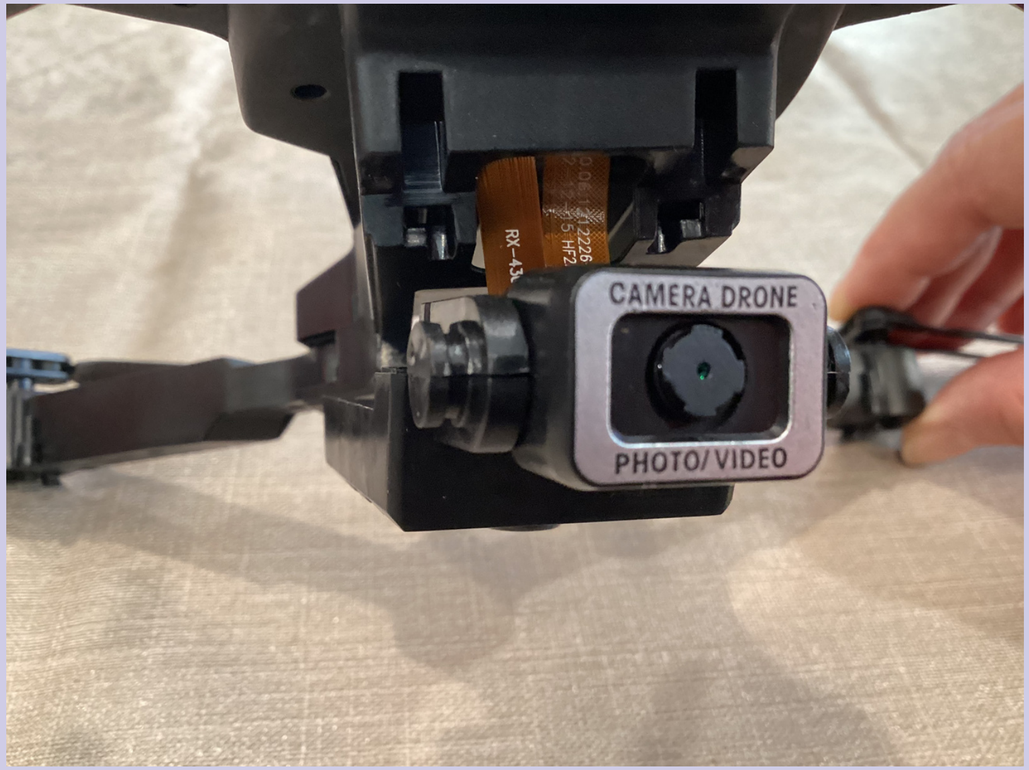
Step 1: get all safety gears

Step 2: get the tools needed

DECONSTRUCTION PROCESS -(CONTINUED)

Step 3: Remove battery from drone

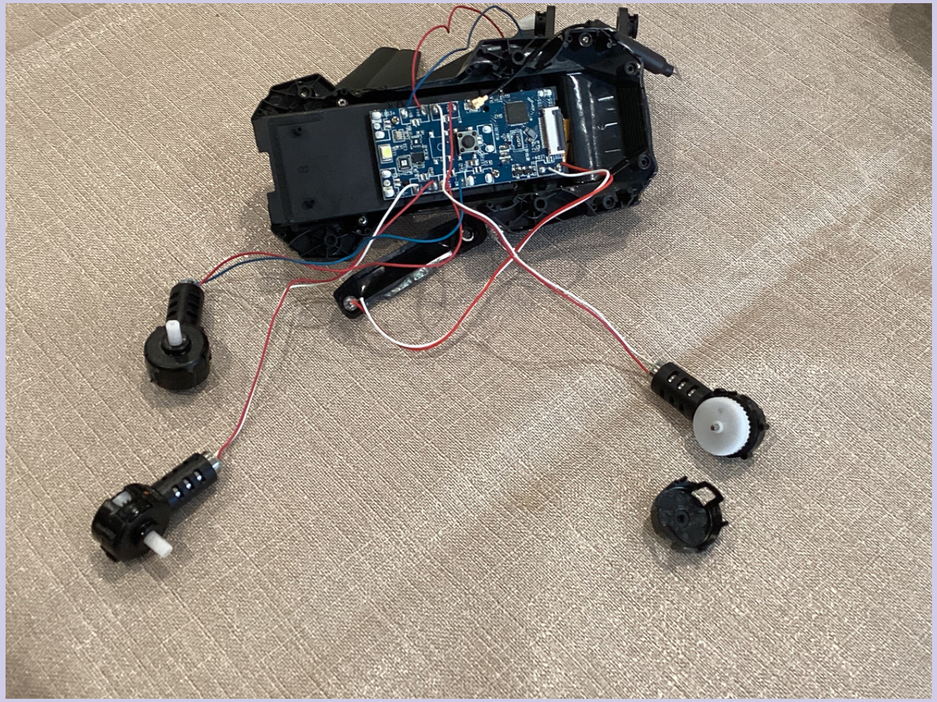
Step 4: Detatch camera from drone



DECONSTRUCTION PROCESS-(CONTINUED)

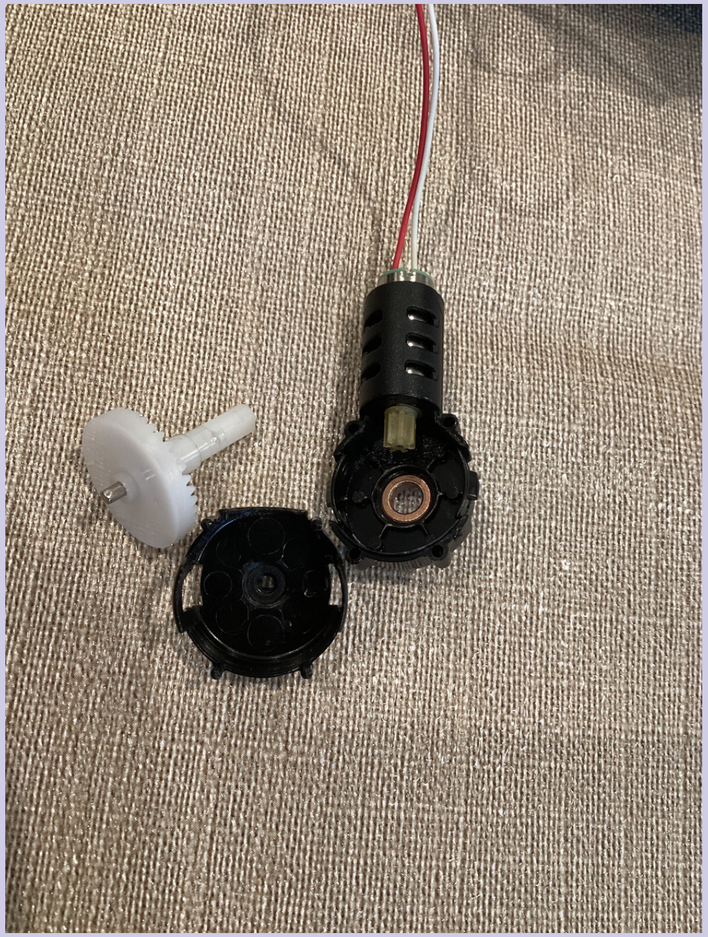
Step 5: Remove arms of the drone

Step 6: Remove drone arm casing and expose motors

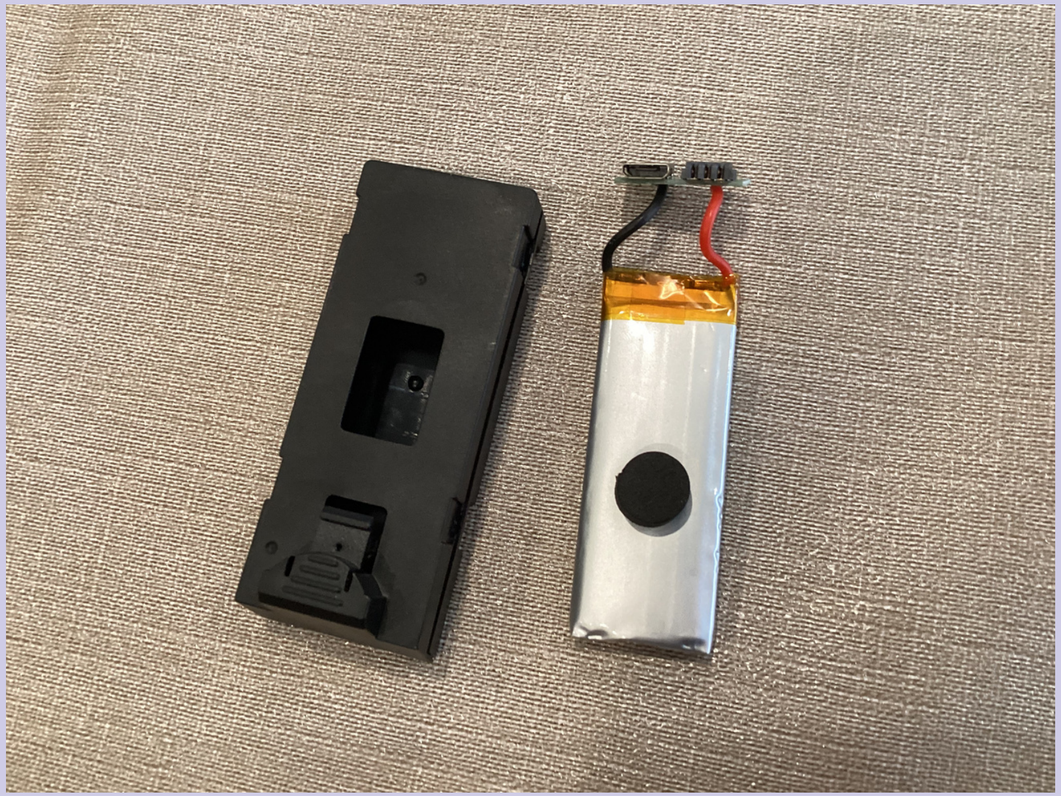


DECONSTRUCTION PROCESS-(CONTINUED)

Step 7: Deconstruct motors



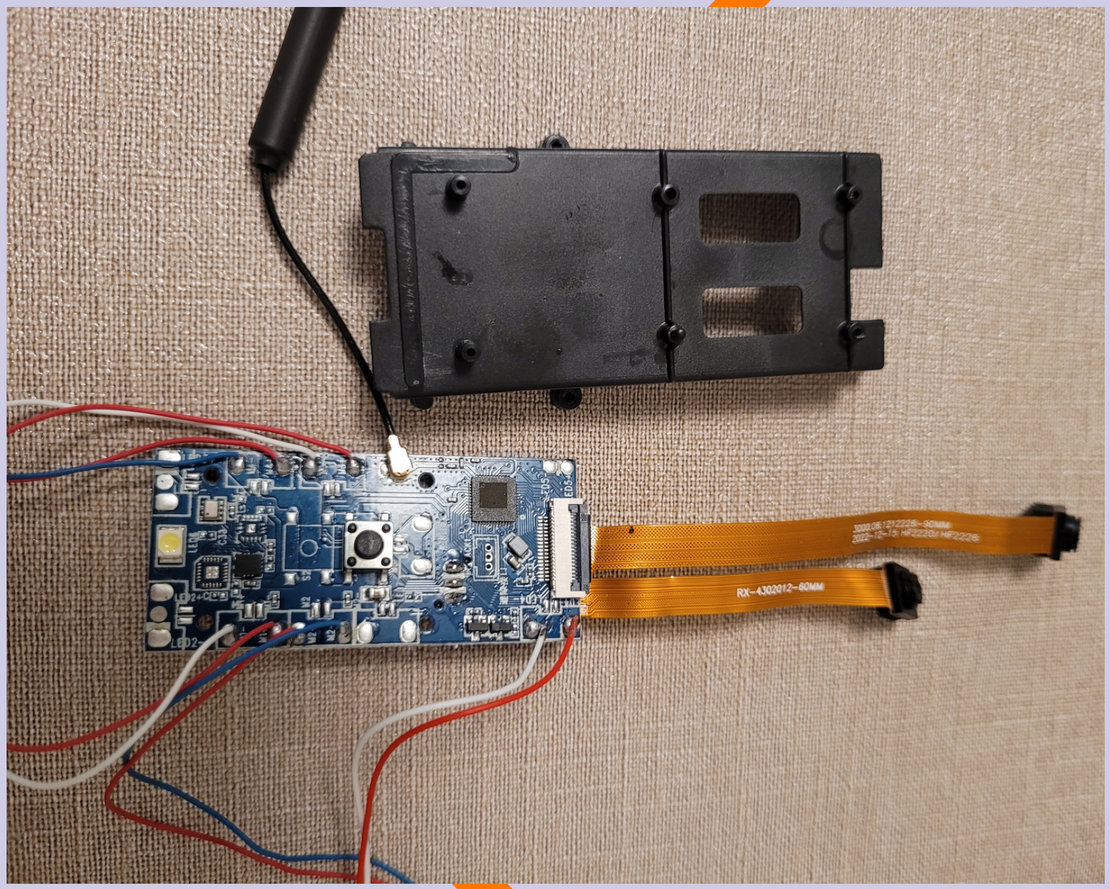
Step 8: Open up battery and expose components



DECONSTRUCTION PROCESS-(CONTINUED)

Step9: Remove propellers

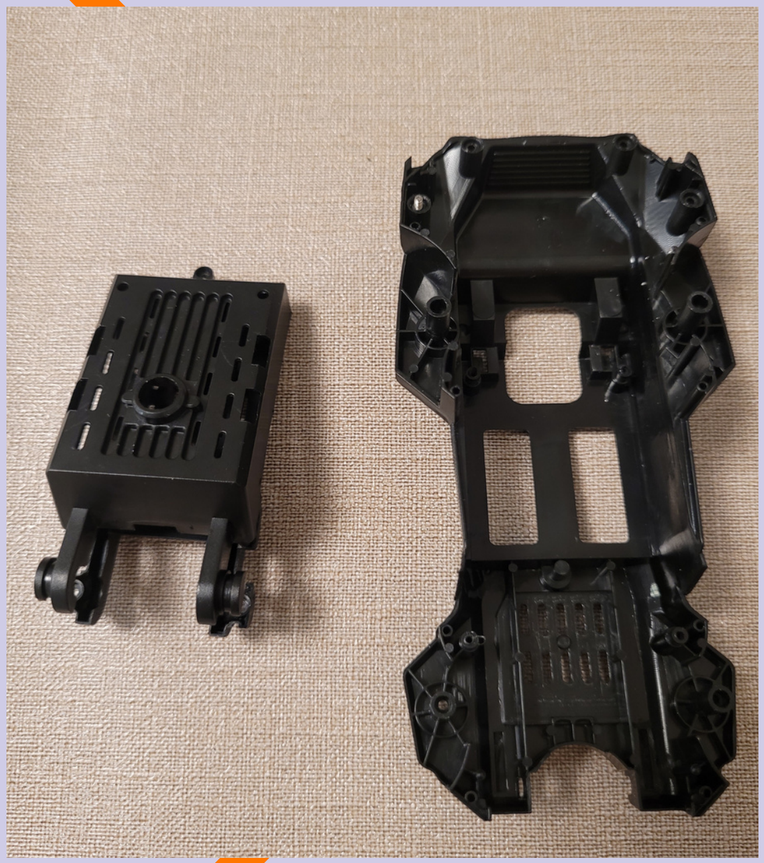
Step 10:Disconnect the FFC cable



DECONSTRUCTION PROCESS-(CONTINUED)

Step 11: Disassemble the light bulbs

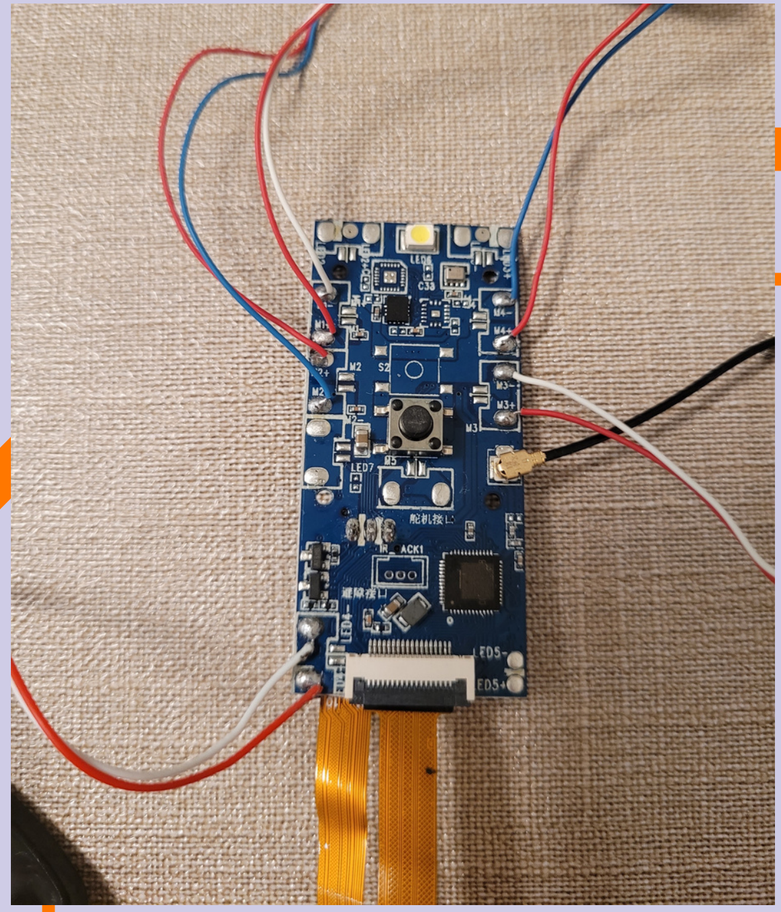
Step 12: Remove body casing



DECONSTRUCTION PROCESS-(CONTINUED)

Step13: Deconstruct motors

Step 14: Remove PBD (Power Distribution Board)

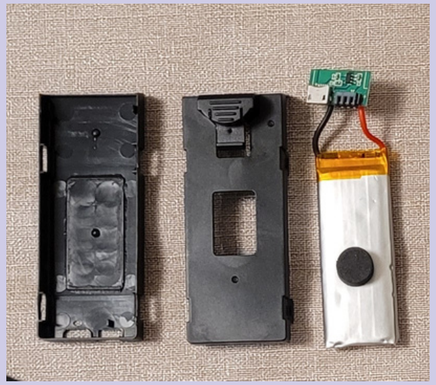


FULLY DECONSTRUCTED DRONE

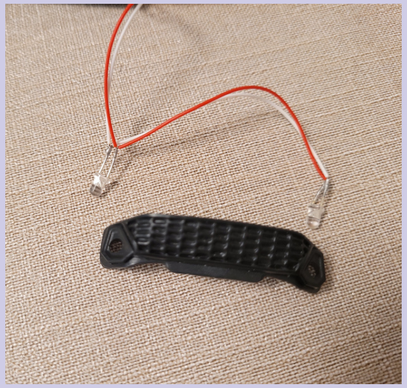
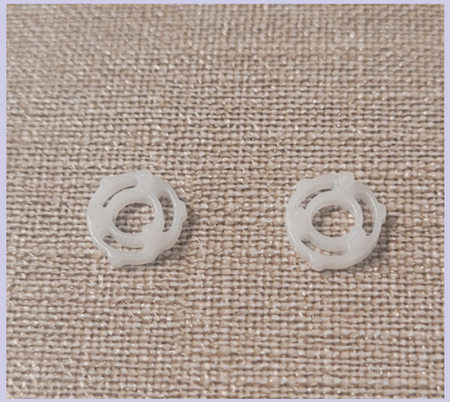
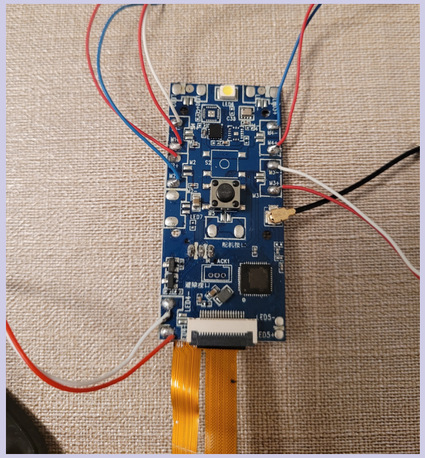
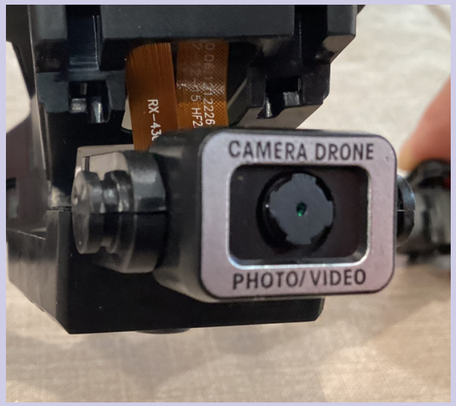
The team has learned that there are many parts in a drone. A simple nano quadcopter drone can even have such complicated parts and components.

It consists of frame/casing, battery casing with a battery, four propellers and motors attached to four arms. Also, it had a casing for Power Distribution board with FFC cables connecting to the camera.

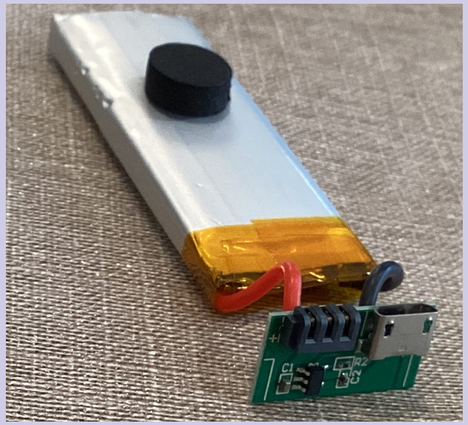
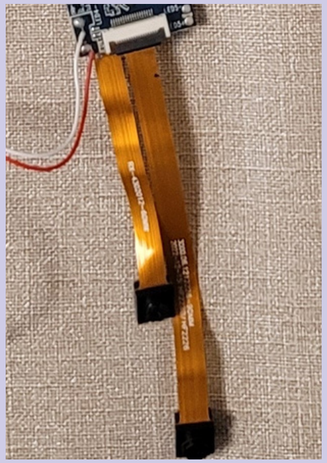
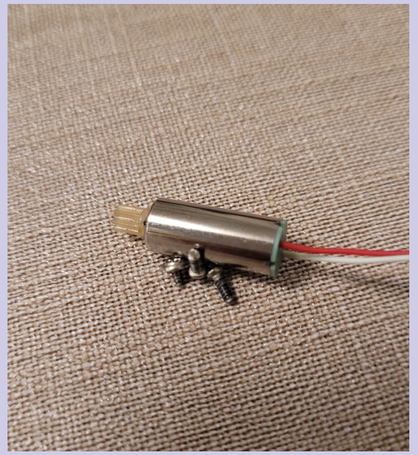
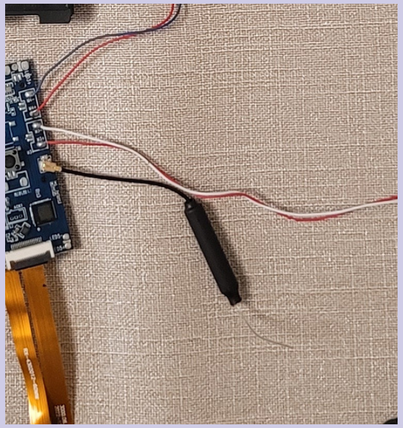
COMPONENTS

				
Body Casing X1	Battery Casing X1	Propellers X4	Arms X4	Screw X45
Protect the internal components	Protect the battery	The propellers allow the drone to fly.	Connecting motors, body and propellers	They keep the drone together and the parts safe.

COMPONENTS-(CONTINUED)

				
Light Casing & Light Bulbs	Motors X4	Pivoting Gears X4	PBD (Power Distribution Board) X1	4K Camera Casing
Lights for the drone	Generate power to the propellers	Enable arms to swivel	Allow transferring the power to ESC (Electronic Speed Controller)	Protect 4K camera lens and keep in place

COMPONENTS- (CONTINUED)

				
Li-Polymer Battery X1	4K Camera Lens	FFC Cable	Magnetized motor RC Drone Engine X4	Antenna X1
Rechargeable Lithium Polymer battery	To capture images	Interconnection cable from PBD to Camera	Convert electrical energy into mechanical energy	Converting eletrical signals into electromagnetic waves

RESEARCH- CITES

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Design Award
CALIFORNIA
SOUTH REGION
CHAMPIONSHIP
2023
Jake McCann
3383F Hailey Bae
SUBSYSTEMS
Aaron Knoll
Indra Mahale
ENGINEE
WHO FEEL LIKE
SUNSHI

THANK YOU