Jan 02/25

Thursday 02 JANUARY

Wk 01 002-363

2025

Mission being an Aerospace Specialist Engineering

* Path to become a top-tier aerospace innovator.

Topic

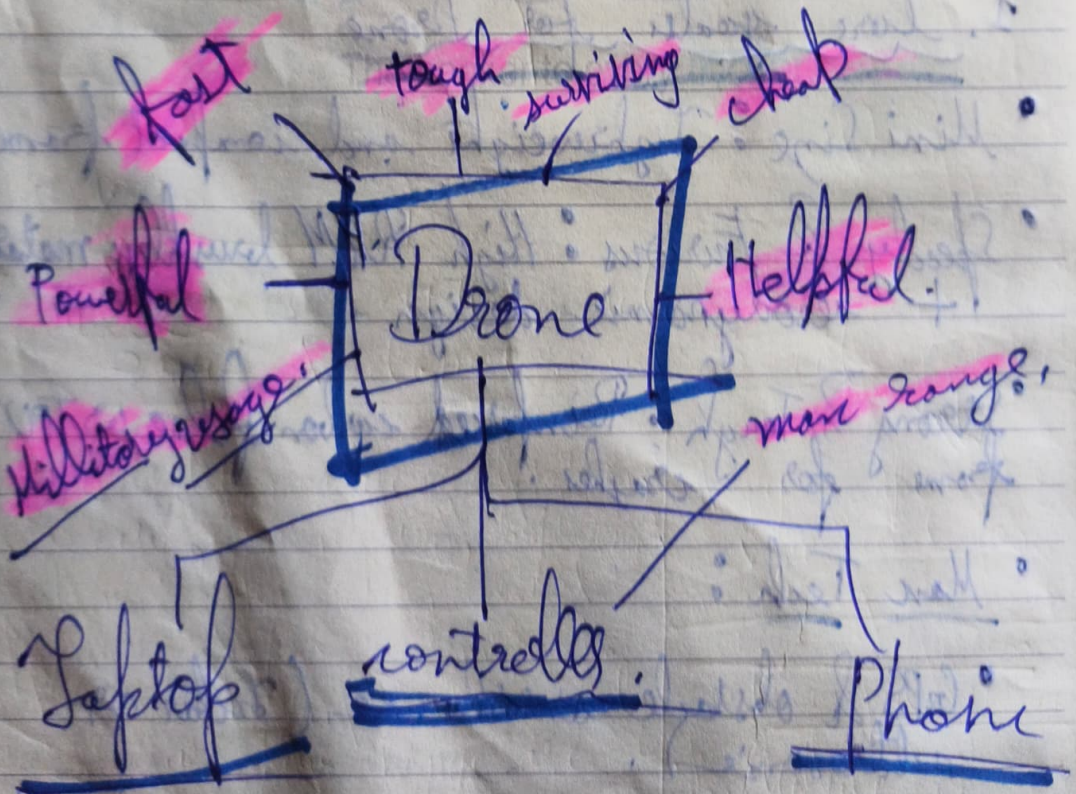
A mini drone with high speed, AI, and durability is ambitious - but totally achievable if we plan it step-by-step.

Roadmap

1. Core goals for Drone

- Mini Size: Lightweight and compact frame.
- Speedy & Furious: High RPM brushless motor + aerodynamic design.
- Strong & Tough: Reinforced carbon fiber or TPU frame for crashes.
- Max Tech:
- GPS & obstacle-avoidance (Lidar or ultrasonic).

- Camera with live streaming (FPV + AI vision).
- Flight controller with AI support (like Raspberry Pi or Jetson Nano).
- AI capabilities.
  - Object tracking.
  - Autonomous flight.
  - Voice or app control.
  - Obstacle avoidance.



Microcontrollers

Find components.
Make designs (with best aerodynamics).

for body → Wood

Should be budget friendly

Microcontroller → Arduino nano + Esp

Why using both ?

ESP 8266 → Wireless connections (Laptop/phone)

Ard Nano - Motor control and sensor & processing

What Exactly both components will do??

components	Role
ESP 8266	Wifi interface: recieves control commands from phone/laptop sends them to Nano via serial or I2C

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Nano | Main flight controller : reads sensor eg. MPU6050, runs PID, sends PWM to ESCs.

X controllers X

Modules

to be used on arduino nano.

* Micro Electro-Mechanical Systems (MEMS) module.

MPU6050

MPU6050 is a MEMS module that consists of a 3-axis Accelometer and 3-axis Gyroscope.

It is used to measure acceleration, velocity, orientation, displacement and many other motion related parameters of a system or obj. It has all the information needed to measure how things are shaking and spinning. It can measure acceleration in 3 direction (X, Y, Z).

A gyroscope is a device used for measuring or maintaining orientation and angular velocity. In Module it measures rotational velocity.

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MOTORS

1. Racerstar 2205 2300KV Motors

4 pcs

- Good Thrust-to-weight ratio.
- Compatible with 5" props.
- Runs well on 3S LiPo
- Widely used in budget racing drones.

Problem → costly.

Others options

2. 1st Understanding Motors.

- What is KV in a Motor? KV?

⇒ [KV = RPM per volt]

It means how many revolutions per minute (RPM) the motor will make for every 1 Volt of electricity applied.

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for Example :

1. A 1000 KV on 11.1 V (3s battery) spins at:
↳ 1000 X 11.1 = 11,100 RPM

2. A 2300 KV motor on 11.1 V spins at:
↳ 2300 X 11.1 = 25,530 RPM

What happens if KV is lower?

Low KV (eg. 1000 – 1400)
↓
RPM → slower
↳ Torque → Higher
Prop size → bigger

Hence :

Low KV : Good for heavies, drones or longer flights (but slower).

High KV : Zippy and fast (but less stable, less lifting power)

CONCLUSION

✓ Robodo QP46 A2212/13T Brushless Motor - 2200KV

SPECS :

- Type : Brushless Outrunner (A2212).
- KV Rating : 2200KV - good for high RPM, Ideal for mini drones.
- Voltage : 2S - 3S LiPo (7.4V - 11.1V).
- Thrust : ~ 800 - 1000g (with the right prop).
- Weight : ~ 50g.
- Props (compatibility) : 5" to 6" (typically 6030 or 6045).

P.T.O →

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Electronics Stability Control (ESC)

(Speed)

* The ESC is used to control brushless motors.

• The ESC acts as the regulating middleman between the battery and the electric motor.

• For sensorless motors, you can connect the motor wires to the ESC in any order. For sensored motors, connect them according to their markings or color coding.

• The ESC is widely used in radio-controlled models (drones).

NEED :

(Brushless Motor ESC 20A x4.)

Aerodynamics

Electronics Stability Control

Aerodynamics

full Course

→ : NEED

X —— X —— X

Introduction To Aerodynamics

What is Aerodynamics?

=> Aerodynamics is the study of how air moves around things. If something moves through air (like a bird, car, plane or your drone), aerodynamics affects how fast, smooth, or stable it is.

Imagine you're running with a Bedsheet. The wind makes it flap and push back — that's air resistance. That's aerodynamics in action!

The four forces of flight

=> There are 4 invisible superheroes that control flying

1. **Lift** ÷ Pulls the drone/plane up. Created by wings or propellors pusing air downward.
2. **Weight** ÷ (Gravity) pulls it down.
3. **Thrust** ÷ Pushes it forward. Motors/propellers give it this power.
4. **Drag** ÷ slows it down. It's the air trying to stop you.

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27	28	29	30	31		

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Aerodynamics

"When lift = weight and thrust > drag, your first drone flies."

Air Pressure and Bernoulli's principle

When air moves faster, its pressure becomes lower. This idea is called Bernoulli's principle.

Think:

- On top of a wing (airfoil), air moves fast
  → Low Pressure
- Below the wing, air move slower
  → high Pressure

So, the wing is pushed up due pressure difference — and that's lift! Your drone's propellers work the same way, spinning fast to change air pressure.

P.T.O.

Drake

Drag - The invisible Brake

* Drag is air pushing against you when you move.

There are 3 types :

1. Parasitic Drag - From your body / frame shape (flat = more drag).

2. Form Drag - Bigger, fatter shapes face more wind = more drag.

3. Induced Drag - Caused by wings making lift.

To Reduce Drag

=> Use smooth shapes (aerodynamic design)

=> Make your drone sleek and light.

Lift - How Things stay Up

* Lift happens when wings or props force air down, and air pushes them up.

More lift = higher you go. But if you add weight, you'll need more lift (faster spinning props or more powerful motors).

Tips to make more lift :

- Use bigger or better-shaped propellers.
- Increase RPM (motor speed).
- Reduce drone weight.

Thrust and Propellers :

Your drone flies forward or up because of thrust.
— The force made by spinning propellers.

More thrust = faster movement.

To Increase Thrust :

- Use higher KV motors (more RPM).
- Use bigger / faster propellers.
- Use more ~~bigger~~ powerful batteries.

P.T.O

Stability and Control

To fly smooth like a pro, you need balance and control.

Control axes:

- Pitch = Tilt forward / backward.
- Roll = Tilt side to side.
- Yaw = Rotate left / right.

Use sensors like:

- Gyroscope – Detects rotation.
- Accelerometer – Measure speed changes.
- Barometer – Measure height by pressure.

And program your Arduino/ESP to react auto-matically to keep balance (auto-stabilization = basic AI!)

P.T.O

Wing and Propeller Design

Shape Matters !!

- **Airfoil shape** – curved top and flat bottom makes more lift.
- **Angle of attack** – slight tilt in wing / prop increase lift!
- **Propeller Pitch** – how far it "bites" the air in one rotation.

Choose wisely :

- Low pitch = more control.
- High pitch = more speed.

Energy and Efficiency

Project

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Saturday 25 JANUARY 2025

Wk 04 025-340

Autonomous Garbage Collecting Drone.

Quad rotors.

Such Drone

→ An autonomous drone that uses AI, computer vision, and robotics to detect garbage in public places, collect it using a robotic arm or suction gripper, and dispose of it into dustbins, while also being able to return to a charging station when its battery is low.

Purpose:

- To make cities and public spaces clean by reducing plastic any garbage littles.
- To assist municipal corporations in monitoring and cleaning areas.
- To show how AI + robotics can solve real-~~solve~~ world problems in sustainability.
- To inspire the vision of a clean India using smart Tech -

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Phase by phase breakdown

Phase 1 : foundation (Drone setup & flight control).

Definition :
Build and configure a stable drone that can fly manually and carry small payloads.

Tasks :

- Assemble a quadcopter frame (250-450)
- Install flight controller (Pixhawk/APM).
- Add motors, ESCs, and propellers.
- Connect a battery (LiPo).
- Attach FPV camera for live video feed.
- Test manual control with RC transmitter.

Outcome :

A working drone that can fly safely and carry extra components.

Phase 2 : Vision & Detection (Garbage + Bin recog).

Definition :
Enable the drone to see and understand objects using AI.

Tasks :

- Collect images of garbage items (plastic bottles, wrappers, cups) and dustbins.
- Label the dataset using annotation tools (Labelimg).
- Train an AI model (YOLO v8) to detect these objects.
- Run detection in real-time on Jetson Nano or Raspberry Pi.

Outcome :

Drone can identify and ~~list~~ highlight garbage and dustbins in camera feed.

Phase 3 : Autonomous Navigation (patrolling & Mapping).

Definition :
Make the drone fly automatically in a given area and save coordinates of detected garbage & bins.

Tasks :

- Add GPS and obstacle sensors (ultrasonic / Li DAR)
- Program autonomous flight paths (ArduPilot / PX4).
- Implement a grid-like scanning pattern to cover zones.
- Store detected garbage / dustbins coordinates (Latitude / Longitude).

Outcome :

Drone can patrol a fixed area and remembers where garbage / bins are.

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Phase 4: Gripper & collection system

Definition:
Enable the drone to pick up & carry small garbage items.

Task:

- Build/mount a robotic gripper (servo claw) or suction based claw.
- Program drone to hover, descend, grab & lift, and lift.
- Write logic: If garbage detected → pick → find nearest bin → drop.

Outcome:

Drone can pick up light garbage (wrappers, bottles) and drop them into bins.

Phase 5 : Smart charging & Return-to-home.

Definition :
Allow the drone to charge itself automatically without human help.

Task :

- Design a landing pad with charging system (metal contacts or wireless charging).
- Program drone to monitor battery level.
- Return to docking station when battery is low.
- Auto-land and recharge.

Outcome :

Drone can operate longer by charging itself without manual intervention.

Users of Product

Phase 1. goals

↳ Custom PCB's. (with Raspberry Pi 3b+ header).
power regulation, MPU 6050, ESC

↳ 4 x Brushless motors + 30 A ESCs.

↳ 11.1 V lipo battery.

↳ Chassis (mount-fit frame for components).

↳ WiFi or Bluetooth control via mobile phone (no RC controller).

↳ Basic flight software + PID tuning for Stability.

Target

→ Stable ~~take~~ takeoff, hover, and landing.

→ Control via smartphone app.

→ Real-time telemetry (altitude, orientation, battery).

Goal

→ drone fly perfectly.

→

Stable, flyable platform controlled from your phone.

Raspberry Pi duties — **Controller hub**

1) Act as the flight controller
- Communicate with sensor (MPU 6050).
- Process orientation (pitch, roll, yaw) using a complementary or Kalman filter.
- Run your PID control loop to stabilize the drone.
- Send PWM signals to the 4 ESCs (through your custom PCB).

2.) Provide a communication interface.
- Wifi or Bluetooth connection to your mobile app.
- Receive control commands (throttle, pitch, roll, yaw).
- Send back telemetry (battery, angle, maybe altitude if you later add a barometer).

3) Handle safety / utilities.
- Arm disarm logic.
- Battery voltage monitoring.
- Emergency stop or kill switch.

Recommended software stack for ph:
(phase 1):

- OS: Raspberry PI OS lite
- -> Language: python 3 for prototyping.