Autonomous Drone with Waypoint Navigation

CSE-316 Microprocessor, Microcontroller And Embedded Systems Sessional Project

Niloy Kumar Mondal (2105044),
Raihan Rashid (2105046),
Jonayed Mohiuddin (2105060)

June 3, 2025

Bangladesh University of Engineering and Technology

Motivation

Problem Statement:

- Delivery of important or life saving goods faces challenges in congested or remote regions.
- Need for autonomous drones that can navigate to any location without full human intervention.

Motivation

Significance:

- Efficient, contactless delivery system.
- Real-world applications in logistics, disaster relief, and medicine.

Motivation

Personal Interest:

- Passion for drones and embedded systems.
- Opportunity to combine hardware and autonomous navigation.

Equipments

Hardware List:

- Raspberry Pi 5
- Pixhawk Flight Controller
- ESP32 Microcontroller
- GPS Module
- ESC $\times 4$, Brushless Motors $\times 4$
- Battery (12V, 5500 mAh)
- PI Camera Module
- F450 Drone Frame, Flexible GPS Stand
- Propellers $\times 4$
- RC Transmitter & Receiver

Schematic

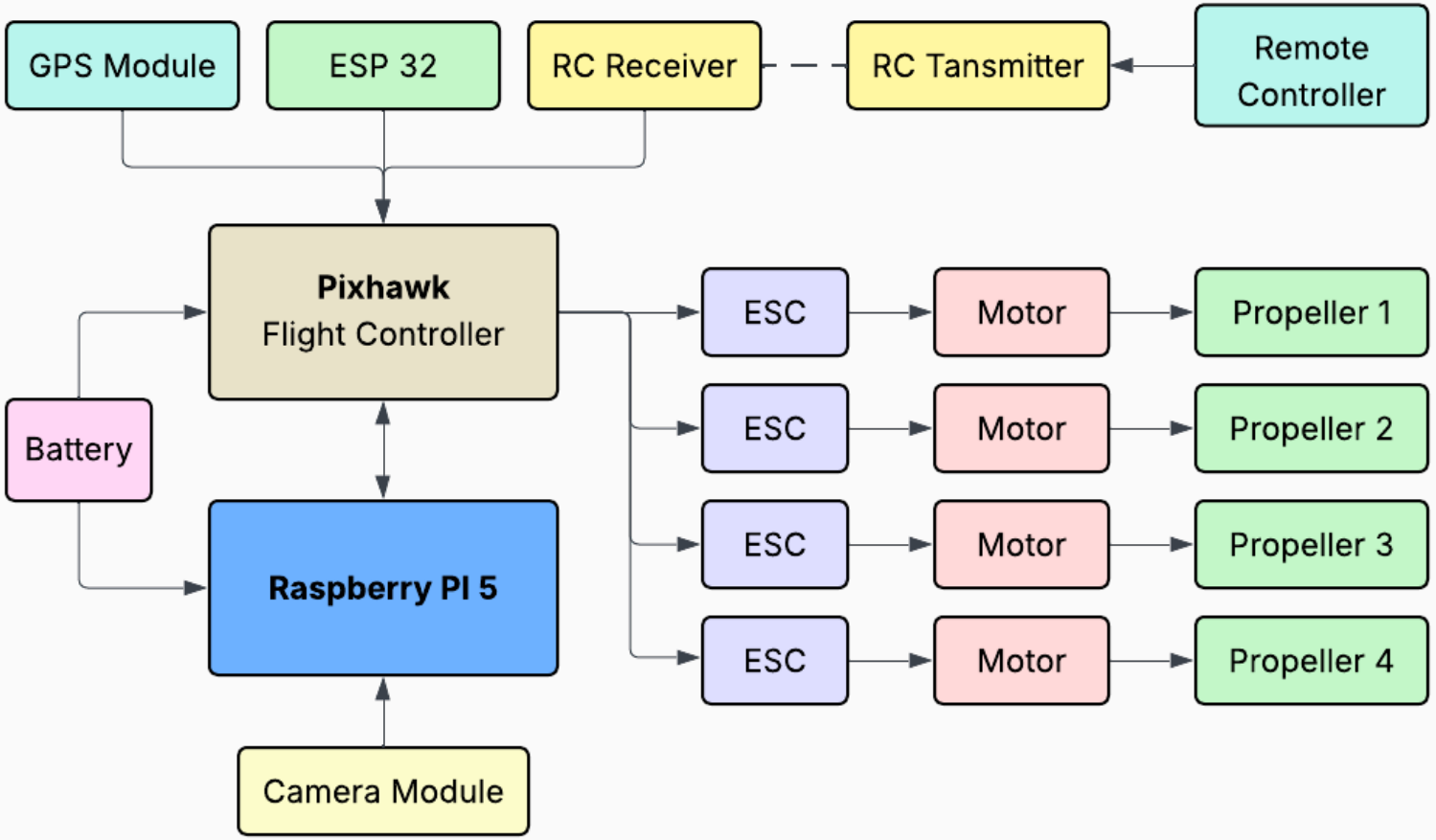

Figure 1: High-level block diagram of the drone system

Component Roles

- **Raspberry Pi:** PWM to PPM Conversion, PI Camera Streaming, Failsafe Logic
- **Pixhawk:** Flight control and real-time stabilization.
- **GPS Module:** Navigation and waypoint guidance.
- **ESP32:** Acts as a communication bridge between Pixhawk and external platforms (e.g., ArduPilot) via Wi-Fi.
- **RC (Remote Controller):** Manual control of the drone, including throttle, yaw, pitch, and roll inputs; communicates with Pixhawk via a receiver.
- **ESC & Motors:** Propulsion system.
- **Camera:** Visual input for detection tasks.
- **Battery:** Power supply to all components.

Process

Expected Outcome

- Drone can be manually flown using Remote Controller.
- Autonomously navigate to predefined GPS waypoints.
- Land safely if disconnects from RC.

Process

Development Plan

1. Assemble frame, connect ESCs, motors, Pixhawk.
2. Setup Pixhawk firmware and Mission Planner.
3. Calibrate sensors and test manual flight.
4. Integrate GPS for waypoint navigation.
5. Connect Raspberry Pi.
6. Implement waypoint navigation system
7. Implement video capturing and safe land mechanism.

Use of Raspberry Pi

Justification for using Raspberry Pi:

- Captures video using Pi Camera for live streaming or recording.
- Acts as a companion computer to the Pixhawk via MAVLink.
- Implements failsafe routines (e.g., auto-land on signal loss or low battery).
- Converts and processes control signals (e.g., PWM to PPM).
- Provides flexibility for scripting and mission control.

Challenges and Future Scope

Challenges:

- GPS signal reliability
- Sensor calibration and tuning
- Real-time image processing on Raspberry Pi

Future Scope:

- Face detection with AI for effective delivery
- Object detection and avoidance
- Payload delivery system

Thank You!

Questions?