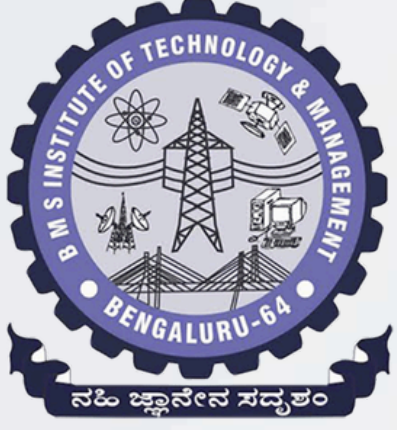




ಬಿ.ಎಂ.ಎಸ್. ತಾಂತ್ರಿಕ ಮತ್ತು ವ್ಯವಸ್ಥಾಪನಾ ಮಹಾವಿದ್ಯಾಲಯ
(ವಿ.ಟಿ.ಯು. ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT
(Autonomous Under VTU)



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Major Project on

Autonomous Delivery Drone with Web-Based Order Management and Onboard Obstacle Avoidance

Under the Guidance of
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Introduction

- Rapid growth of **hyperlocal delivery** demands faster **last-mile solutions**
- **Road-based delivery** faces congestion, fuel cost, and human dependency
- **UAVs (drones)** enable **autonomous GPS-based** delivery bypassing roads
- Existing systems are **high-cost** and lack **integrated safety & order management**
- Proposed system is a **low-cost autonomous drone prototype** for **controlled environments**



LITERATURE REVIEW

	Author(s)	Focus Area	Key Contribution	Takeaway
01	<i>Chang et al.</i>	UAV Navigation	Reviewed autonomous UAV navigation in GPS-denied and urban environments	Confirms the importance of robust waypoint navigation with local obstacle handling
02	<i>Saccani et al.</i>	Flight Control	Proposed MPC-based autonomous navigation with real-time obstacle response	Shows feasibility of combining waypoint missions with reactive obstacle avoidance
03	<i>Sun et al.</i>	Obstacle Avoidance	Used reinforcement learning for dynamic obstacle avoidance	Highlights need for adaptive onboard decision-making, noted as future scope

LITERATURE REVIEW

	Author(s)	Focus Area	Key Contribution	Takeaway
04	Chen et al.	Sensor Fusion	Demonstrated improved safety using multi-sensor fusion	Supports use of sensor-based collision prevention
05	Lindqvist et al.	Reactive Control	Proposed obstacle avoidance without full environment mapping	Validates lightweight, low-cost reactive safety mechanisms
06	Sasidhar et al.	Path Planning	Studied GPS-based waypoint navigation for drones	Confirms GPS waypoint missions are reliable for autonomous UAVs
07	Kadri	System Architecture	Proposed distributed UAV architecture using ground station + autopilot	Justifies separating mission planning and flight control (Raspberry Pi + Pixhawk)

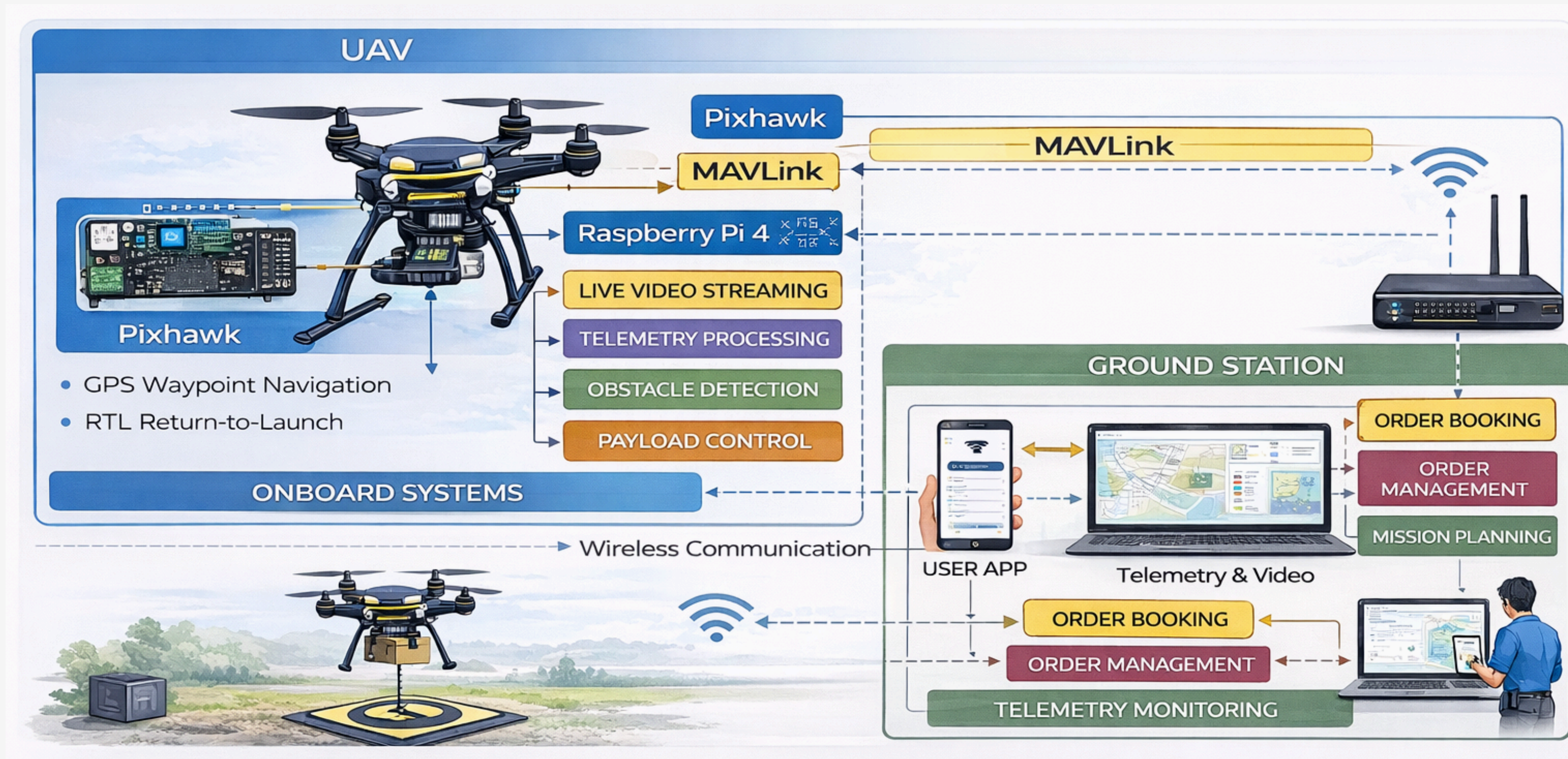
Extended Literature Review

	Author(s)	Focus Area	Key Contribution	Relavence
08	<i>Saha, S. et al., 2022</i> Design and Implementation of IoT-Based Drone Delivery System	Integration of drones with web-based platformsn	Real-time tracking and remote mission control	Similar to our backend + telemetry architecture
09	<i>Almulhem, A. et al., 2021</i> MAVLink in UAV Communication: Design and Applications	UAV communication protocols	Efficient telemetry and command exchange	Justifies use of MAVLink in our system
10	<i>Kim, J. et al., 2024</i> Deep Learning-Based Obstacle Avoidance for UAV Systems	AI-based obstacle detection	Enables autonomous decision-making in dynamic environments	Forms future scope for our project
11	<i>Raza, S. et al., 2023</i> Cloud-Connected UAV Systems for Smart Delivery Applications	UAV + cloud integration	Real-time monitoring and scalability	Matches our Flask backend + tracking system

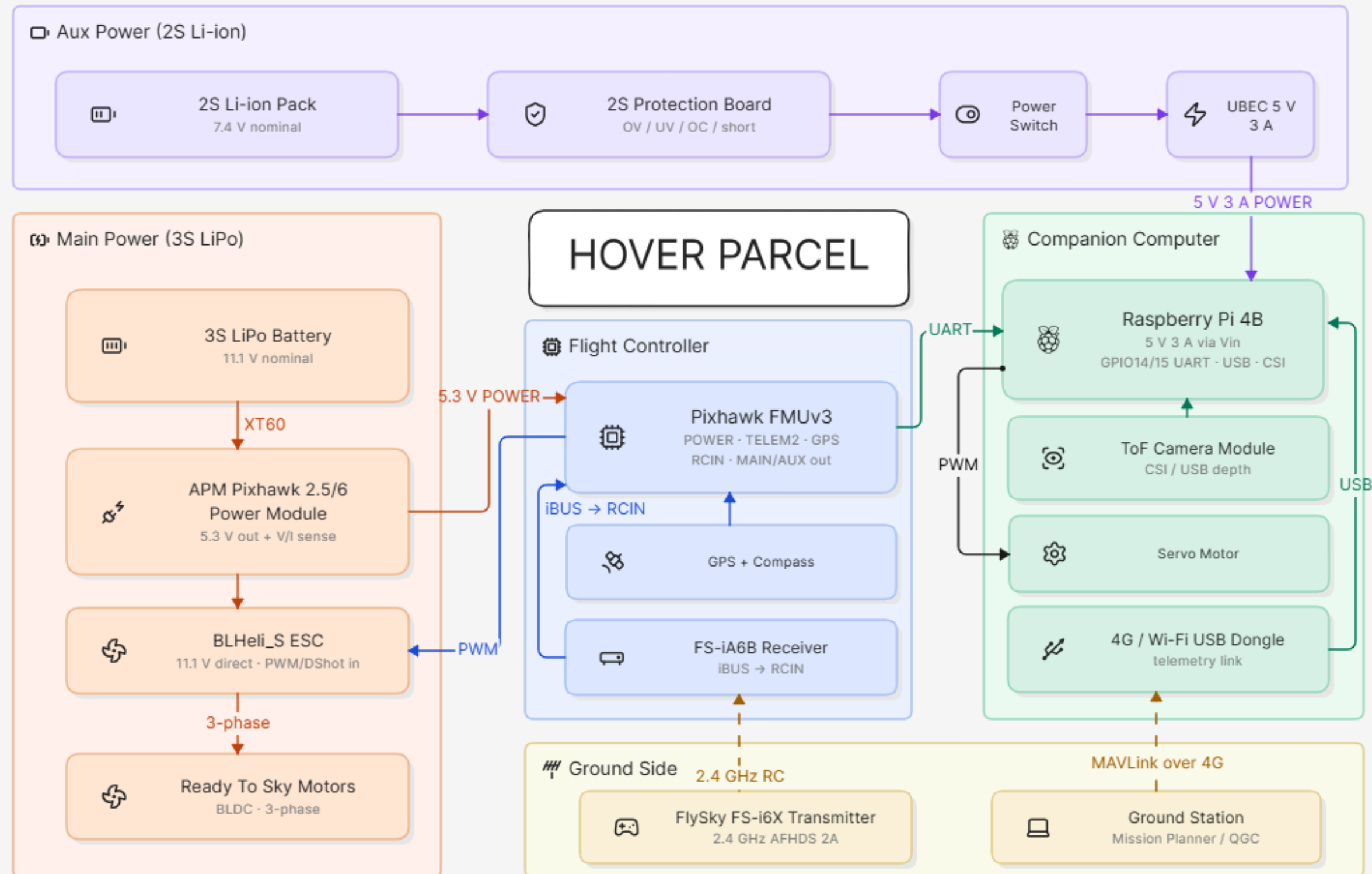
Objective

1. Design and implement a low-cost autonomous drone delivery system
2. Enable GPS-based waypoint navigation for fully autonomous mission execution.
3. Develop an API-based communication system for mission assignment, control, and real-time tracking between the drone and backend.
4. Ensure safe drone operation through fail-safe mechanisms such as Return-to-Launch, system monitoring, and controlled flight execution.
5. Implement secure communication and access control using authentication mechanisms to ensure only authorized systems can control the drone

Methodology



Block Diagram



Methodology

Drone Hardware Integration

- Assemble quadcopter frame, motors, ESCs, and battery
- Integrate Pixhawk flight controller and GPS module
- Mount Raspberry Pi 4 as onboard companion computer
- Connect Pi Camera and ToF sensor for perception

Communication Setup

- Establish MAVLink communication between Pixhawk and Raspberry Pi
- Configure telemetry data transmission and live video streaming

Autonomous Navigation

- Implement GPS waypoint navigation
- Configure Return-to-Launch (RTL) safety feature

Application Workflow Development

- Develop user interface for booking delivery
- Develop business dashboard for order management

Methodology

Software Tools

- ArduPilot Firmware for autonomous flight control
- MAVLink Protocol for communication
- Python for telemetry, streaming, and AI processing
- OpenCV / AI models for obstacle detection
- HTML, CSS, JavaScript for web applications
- Flask / Node.js for backend server development
- Gazebo for Machine Learning

Hardware Components

- Pixhawk Flight Controller
- Raspberry Pi 4 (Onboard AI Companion Computer)
- Quadcopter Frame, BLDC Motors, ESCs
- GPS Module
- Pi Camera Module
- ToF Sensor (Obstacle Detection)
- Servo Motor (Payload Release)
- Li-Po Battery and Power Distribution System
- Laptop Ground Station

Raspberry Pi Setup

Controlling the drone with raspberry pi, Sending telemetry logs to mission planner

Data Base

Assigning API key, connecting backend to the database, sending the drone to the location

Front-end + security

Building front-end, creating payment gate way, secured connection and adding additional functions

Drone foundation

Drone Hardware Setup

Backend

Controlling the drone with server insted of local script

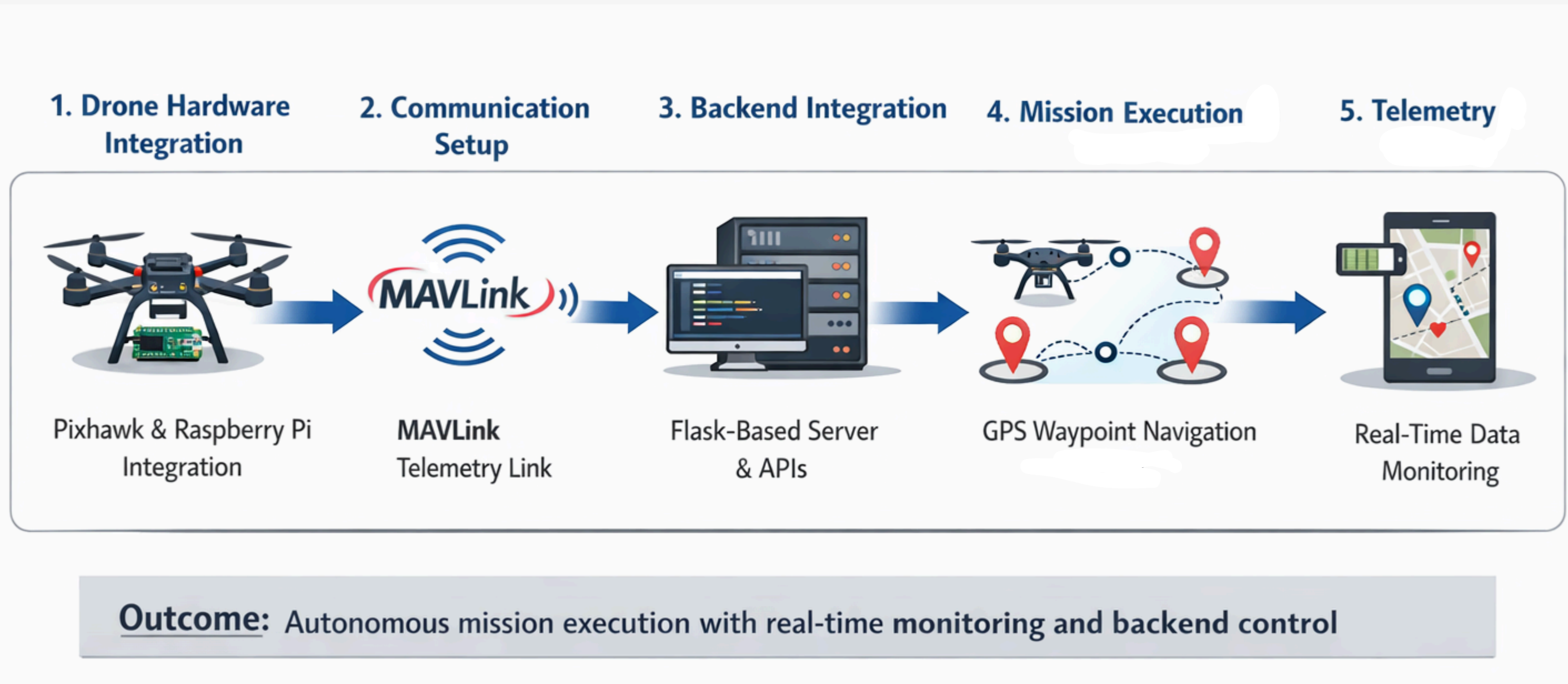
Camera + ML model

using gazebo to train the model, and using the trained data to implement it to the drone, and adding dropping mechanism

Finalalization

Validating reliable communication, stable flight, secure arcitecture, controlled api's

Result



Result [Backend]

FastAPI

0.1.0

OAS 3.1

/openapi.json

default

^

GET

/

Root

▼

POST

/telemetry

Send Telemetry

▼

POST

/generate-api-key

Generate Api Key

▼

POST

/create-delivery

Create Delivery

▼

GET

/get-mission

Get Mission

▼

POST

/update-status

Update Status

▼

Schemas

^

Result [Database]

Telemetry

 id	uuid	drone_id	text	lat	float8	lon	float8	battery	int4	timestamp	timesta...
a8d509c0-4ce5-476d-8ab5-72aa48c47871		DRONE_001		13.08		77.54		90		2026-04-23 05:43:14.47108	
a9adae71-072f-4bb3-8e21-bc06d83a3b98		DRONE_001		13.08		77.54		90		2026-04-27 09:21:22.4606	
aa06e07c-c01f-4989-9d8e-e56d09bd96b		DRONE_001		13.08		77.54		90		2026-04-27 09:21:11.102819	
aa18bf5b-1ed2-4c32-b017-ad8b128ef744		DRONE_001		13.08		77.54		90		2026-04-22 06:40:36.9558	

deliverys

 id	uuid	api_key	text	lat	float8	lon	float8	alt	float8	status	text
828c90ec-d515-4162-af5c-2b285d37c423		sk_37d24343d963eb47154e59c4410bd44		10		12		2		FAILED	
ab153074-f2ac-4ea2-9d7d-bc274be5d66b		sk_37d24343d963eb47154e59c4410bd44		13.13459		77.567328		1.5		COMPLETE	
d00e3e40-c20b-4935-a36c-b9ff2cb5ec6		sk_37d24343d963eb47154e59c4410bd44		17		13		5		FAILED	

API-keys

 id	uuid	user_name	text	api_key	text	+
2e549b20-52fd-4da1-a09f-82752e9e72bc		test_user		sk_a402d66a6a04da98703306258c23534		
3fcae2bc-7ac2-4ea4-abb6-d3911c16fc8e		test_user		sk_712a233e39eae9b73848c5306143ef01		
b5134780-29fd-4827-b60b-6147df85888b		test_user		sk_37d24343d963eb47154e59c4410bd44		

Result [Server]

```
(venv) C:\Users\Admin\hoverparcel-backend>uvicorn app.main:app --host 0.0.0.0 --port 8000
INFO:      Started server process [7620]
INFO:      Waiting for application startup.
INFO:      Application startup complete.
INFO:      Uvicorn running on http://0.0.0.0:8000 (Press CTRL+C to quit)
INFO:      127.0.0.1:63235 - "POST /create-delivery?lat=13&lon=14&alt=2.5 HTTP/1.1" 200 OK
INFO:      127.0.0.1:65298 - "GET /get-mission HTTP/1.1" 200 OK
INFO:      127.0.0.1:59400 - "POST /telemetry HTTP/1.1" 200 OK
```

Pending Work

1. Client Dashboard – Build the customer interface for orders, delivery status, tracking, and history.
2. Admin Panel – Build management tools for users, orders, drones, missions, telemetry, and deliveries.
3. Database Integration – Connect the production database with the backend and implement persistent data storage and APIs.
4. Real Drone Testing – Test the complete system with the Raspberry Pi, Pixhawk, GPS, ToF sensors, servo mechanism, flight, delivery, RTL, and recovery.

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THANK
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