FlySpy - AI Enabled Spy Drone Platform for Reconnaissance and Research

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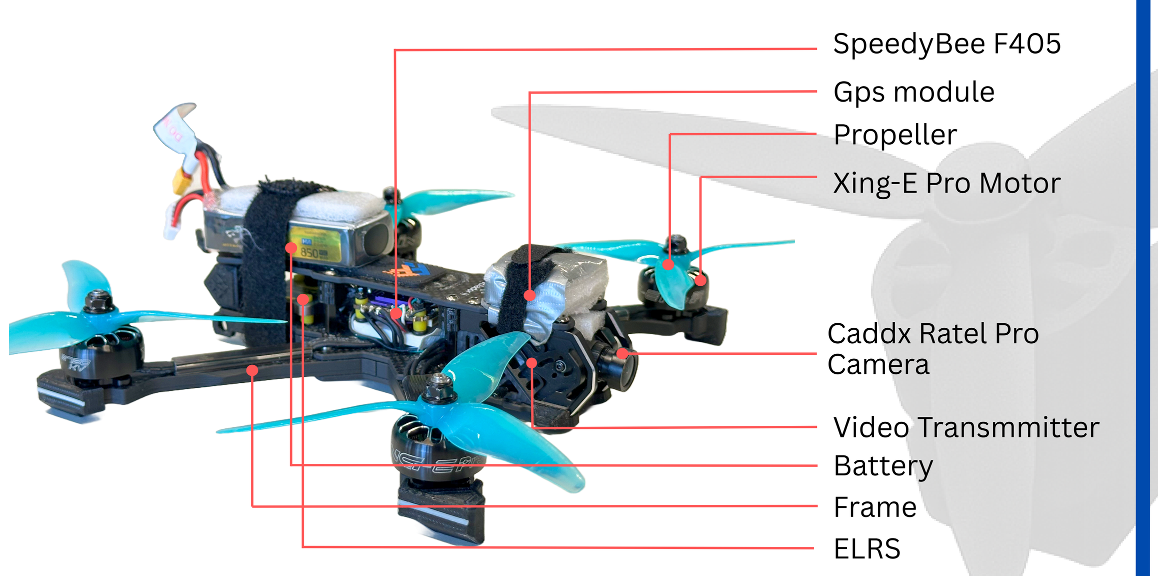
1 About

FlySpy is an open-source, AI-powered First-Person View (FPV) drone platform developed as part of the Master's Project – Intelligent Systems (SS2025) at Frankfurt University of Applied Sciences. The goal of the project is to design a cost-effective and modular drone system capable of performing real-time human detection, with practical applications in reconnaissance, academic research, and educational use. For easy reproducibility, FlySpy is built using accessible hardware, open-source software, and features a browser-based dashboard that displays live telemetry and live stream with human detection

2 Drone Structure and Components

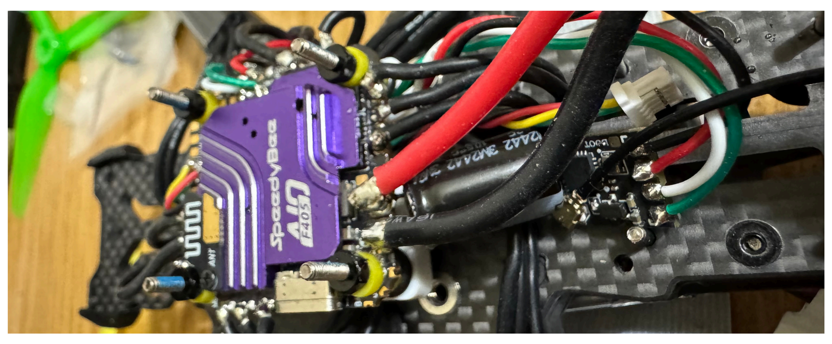
- Architecture divided into three layers:
  - Onboard drone hardware
  - Video streaming setup
  - Ground station AI system
- Drone Frame: 5-inch FlyFishRC Volador II VX5 O3 frame
- Core Electronics:
  - Flight Controller: SpeedyBee F405 AIO 40A
  - FPV Camera: Caddx Ratel Pro (analog)
  - Video Transmitter (VTX): SpeedyBee TX800
  - Receiver: ELRS (e.g., Radiomaster RP1)
  - Remote Controller: Radiomaster BOXER
- Power System:
  - Motors: Xing E-Pro motors
  - Propellers: HQProp T3.5x2x3 tri-blade (3.5 inch)
  - Battery: 3–6S LiPo
- Video Streaming Setup:
  - FPV feed sent to Skyzone Cobra X V4 goggles. Routed via RCA → USB capture card → laptop
- Ground Station (Laptop): Connects to drone via Bluetooth Low Energy (BLE) to transmit telemetry data.



3 Building the Drone

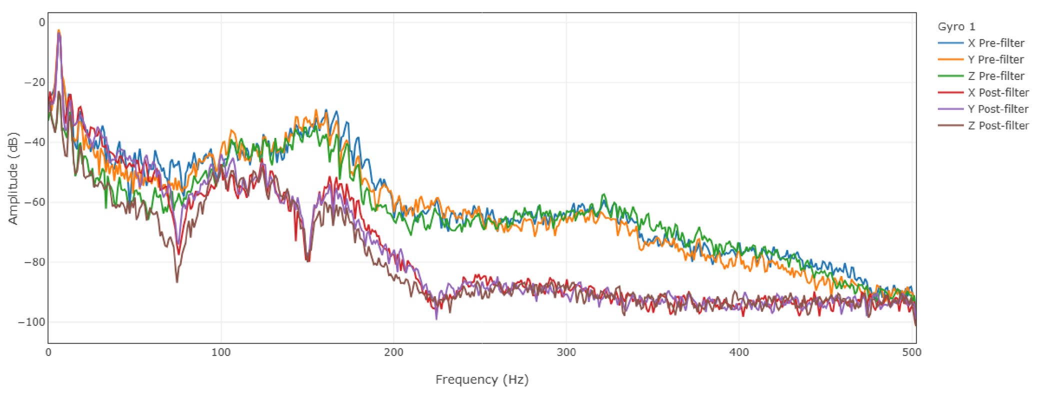
The drone platform was built from the ground up, emphasizing modularity, firmware flexibility, and real-time video integration for AI experimentation.

Assembly & Soldering:
All components were manually assembled and soldered, allowing full control over layout, wiring, and EMI reduction. Care was taken to ensure clean power delivery and noise isolation between subsystems.



Firmware Selection & Tuning:
The initial setup used Betaflight for its low-latency flight and user-friendly tuning. Later, ArduPilot was explored to leverage advanced flight modes, GPS features, and detailed data logging.

Log-Based Optimization:
Flight logs from both Betaflight (Blackbox) and ArduPilot were analyzed to guide tuning. Key focus areas included gyro noise, motor response, and vibrations. PID gains and filters (gyro, notch) were refined iteratively to improve flight stability using real-world data.



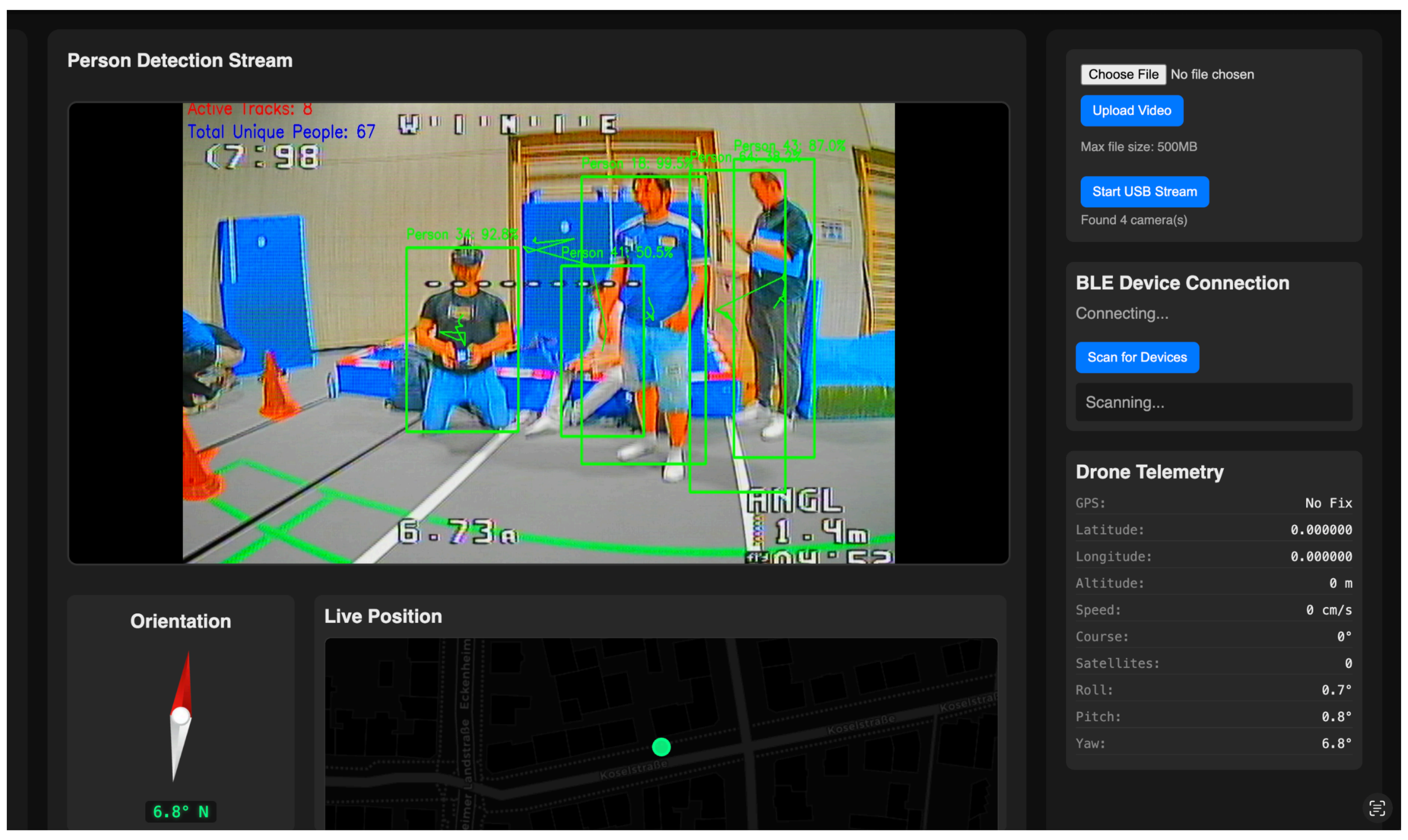
Frame & Layout Optimization:
The lightweight carbon fiber frame offered rigidity. Component layout was optimized to enhance satellite lock reliability and reduce vibration. GPS placement was tested in multiple locations, and crash protection was improved using soft-mounts, foam, and 3D-printed guards.

Video System Integration:
The analog FPV system supported both pilot view and AI processing. Capacitive filtering and clean power rails were used to maintain a stable, interference-free video feed.

Testing & Iteration:
Multiple flights were conducted under different firmware setups. This iterative process informed decisions on tuning, GPS configuration, and compatibility with real-time object detection pipelines.

4 Human Detection & Dashboard

Live Video Streaming & Human Detection:
The system streams FPV video via a USB capture card from analog goggles. Video processing is handled using OpenCV, and real-time human detection is performed using MobileNet-SSD via cv2.dnn.



Backend Architecture:
The backend is built using Flask, designed for lightweight deployment and fast API response. All detection, tracking, and telemetry modules are integrated and run concurrently using eventlet, allowing non-blocking real-time processing.

Drone Telemetry via BLE:
Drone telemetry is received asynchronously over Bluetooth Low Energy (BLE) using the bleak library. The system communicates using MSP (MultiWii Serial Protocol) to parse live GPS, speed, and orientation data (roll, pitch, yaw).

Real-Time Web Dashboard:
A browser-based dashboard displays live AI detection and telemetry. Flask-SocketIO is used to push real-time updates to the frontend without page reloads, making the system interactive, responsive, and extensible to any MSP-compatible drone.

5 Challanges and Future Scope

FPV drone development is constrained by short battery life, signal instability, high crash risk, and legal limitations on autonomous and camera-equipped systems. These challenges affect flight reliability, safety, and real-world deployment—especially in urban or restricted airspace.
Moving forward, FlySpy can evolve in three impactful directions:

1. Autopilot capabilities using GPS, IMUs, and AI for semi-autonomous missions.
2. Advanced detection use cases like identifying whether a person is armed, a child, or a woman—critical for defense, surveillance, and rescue operations.
3. Payload delivery for mission-specific tasks such as dropping supplies, sensors, or surveillance devices.

6 Github Page

The complete documentation and source code for the dashboard—including real-time human detection and live telemetry display—are available here:
https://harshsshah999.github.io/FlySpy-FPV-Drone/

Scan Here