FIRST RESPONDER EMERGENCY UAV

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Introduction:

Emergency response systems face significant delays—8–15 minutes in urban areas and over 30 minutes in rural regions—due to traffic, poor accessibility, and lack of real-time situational awareness. These delays critically impact survival rates during accidents, fires, and medical emergencies.

This project proposes an autonomous UAV-based emergency response system that integrates AI-based scene analysis, rapid deployment, and real-time communication. The drone can reach emergency locations within 2–5 minutes, analyze the scene using CLIP, and deliver first-aid payloads. Using zero-shot learning, the system achieves 93% detection accuracy without scenario-specific training.

Objectives:

1. List Develop autonomous GPS navigation with obstacle avoidance
2. Implement CLIP-based emergency classification (≥93% accuracy)
3. Design precise payload delivery (within 2 meters)
4. Build a Ground Control Station (GCS) for monitoring
5. Achieve ≥88% improvement in response time

Methodology:

1. Hardware System: Carbon-fiber drone frame, SpeedyBee F405 controller, brushless motors, dual LiPo batteries, M9N GPS with RTK, 4K + thermal camera, and MAVLink/ELRS communication. A servo-based payload system enables accurate delivery.

Figure 1: Assembled Drone

2. Software System: CLIP (ViT-B/32) for classification and BLIP for captioning. Multi-modal processing combines RGB and thermal data with hierarchical classification (accident, fire, medical, crime + severity levels).

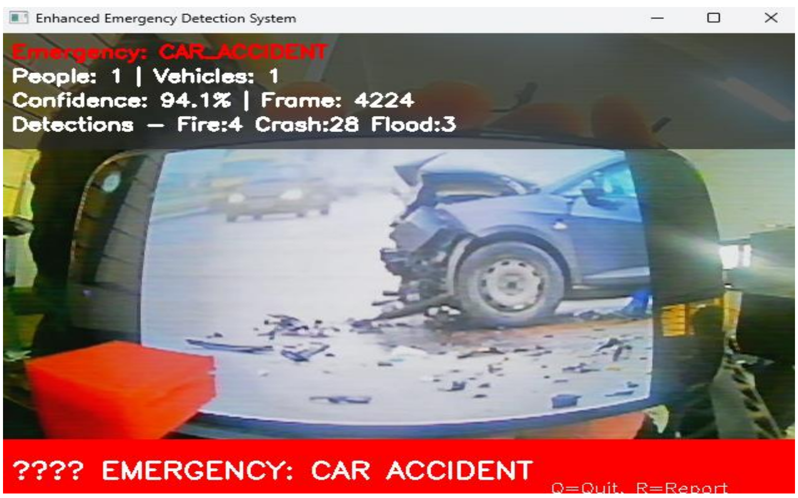

Figure 2: Demonstration of Emergency Detection

3. Navigation & Control: GPS waypoint navigation, modified A* algorithm, Extended Kalman Filter, obstacle avoidance, geofencing, and auto return-to-launch.
4. Ground Control Station: Developed using Flask for mission planning, telemetry monitoring, and alerts.

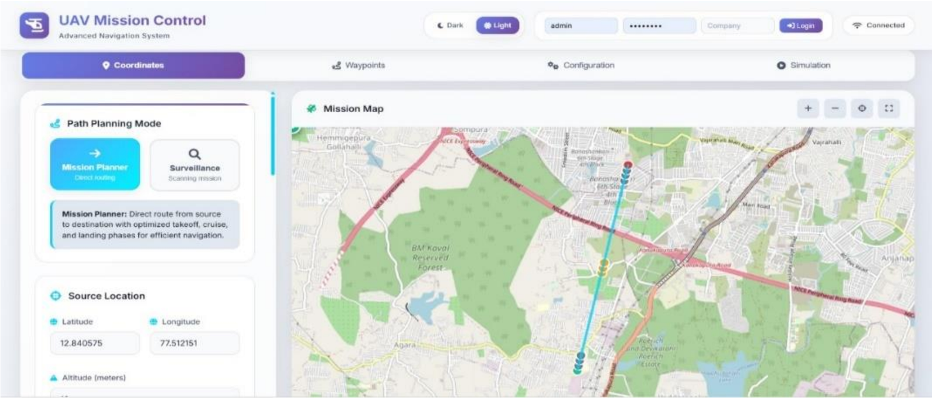

Figure 3: Ground Control Station Main UI

Result and Conclusion:

1. Navigation accuracy: ±1.8 m
2. Payload success: 100%
3. Flight endurance: up to 15 minutes
4. Detection accuracy: 93% overall
5. Response time: reduced to 2–5 minutes

The system significantly improves emergency response speed and efficiency, proving the feasibility of AI-powered UAV systems in real-world applications.

References:

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2. [2] Z. Liu, X. Gao, Y. Wan, J. Wang, and H. Lyu, “An improved YOLOv5 method for small object detection in UAV capture scenes,” *IEEE Access*, vol. 11, pp. 1326–1340, 2023, doi: 10.1109/ACCESS.2023.3241005.

Future Scope:
The future scope of this project includes:

1. Extended flight time: Improve battery efficiency to increase drone endurance for wider area coverage.
2. 5G communication: Enable faster, low-latency data transmission for real-time monitoring and control.
3. Multi-drone systems: Use multiple drones for coordinated operations and faster emergency response.