

Disaster Response Observation Network (DRON): Autonomous UAV Swarm for Disaster Assessment

Ian Wilhite | Texas A&M University | ian.wilhite0@tamu.edu

Keywords: *Aerial Autonomy, Mapping, Navigation, Disaster Response*

Introduction

Emergency responders routinely operate in chaotic, data-scarce environments where seconds determine outcomes. Structural fires demand rapid decision making and situational assessment despite hazardous conditions and obstructed visibility [1]. The Disaster Response Observation Network (DRON) seeks to implement autonomous aerial swarms to augment human decision-making through rapid data collection for situational awareness. By combining contemporary flight-control architectures with distributed sensing and visualization pipelines [2], DRON seeks to demonstrate that low-cost, modular Unmanned Aerial Vehicles (UAVs) can form an intelligent network capable of mapping and communicating key environmental variables without constant human intervention [3].

Objectives

The project's overarching objective is to realize a proof-of-concept system that integrates mechanical, electrical, and computational subsystems into a coherent autonomous platform. Specific goals include:

1. Designing a modular multirotor chassis emphasizing field maintainability, vibration damping, and electronic protection.
2. Implementing a PX4-based autopilot architecture via the Robot Operating System (ROS2) for off-board command and telemetry.
3. Developing a stereovision and infrared perception suite to generate depth-aware thermal representations of fire environments.
4. Establishing a ground-station pipeline for real-time data fusion and multi-drone coordination.

Together, these objectives form a foundation for scalable swarm intelligence applicable to future emergency-response systems.

Methods

The system architecture unifies three engineering domains. Mechanically, the airframe employs lightweight printed polymers reinforced with aluminum standoffs, enabling component interchangeability and rapid battery access. Electrically, an F7 flight-controller governs propulsion and attitude stabilization, while a Raspberry Pi 5 onboard computer executes ROS 2 nodes that handle perception, networking, and control messaging. Computationally, a research standard layered software stack integrates PX4 autopilot telemetry with custom ROS topics [2, 3], allowing autonomous and manual flight modes through MAVLink via MAVROS. The stereo RGB and infrared sensors are calibrated for spatial alignment and fused into a point-cloud pipeline rendered within Unity 3D for intuitive operator visualization. Testing has included subsystem verification on thrust stands and bench communication trials. It will continue with supervised outdoor flights under Part-107-certified pilots to evaluate stability and data integrity.

Results

Initial integration confirmed subsystem verification for visualization, simulated autonomy, telemetry systems, propulsion tests, and structural systems. These outcomes established a robust baseline for subsequent autonomy and multi-agent development, and they lay the foundation for field validation and dataset collection.

Conclusions

This project reaffirmed that autonomy in robotics is not merely a question of control or computation but of systems coherence — the orchestration of mechanical precision, electrical discipline, and algorithmic intent toward a shared purpose. Developing DRON revealed how theory transforms into embodiments when interdisciplinary engineering meets a clear humanitarian aid. The experience cultivated technical fluency and philosophical insight into the future of machine agency. DRON stands as an academic proof-of-concept demonstration of how open-source autonomy can evolve into a practical architecture for disaster response and humanitarian efforts.

References

- [1] R. R. Murphy, *Disaster Robotics*. Cambridge, MA: MIT Press, 2014.
- [2] L. Meier et al., “PX4: A node-based architecture for autonomous multirotors,” *IEEE Aerospace Conf.*, 2015.
- [3] M. Brambilla, E. Ferrante, M. Birattari, and M. Dorigo, “Swarm robotics: A review from the swarm engineering perspective,” *Swarm Intelligence*, vol. 7, pp. 1–41, 2013.