HYBRID DRONE FOR DISASTER RELIEF AND RESCUE OPERATIONS

Project Reference No.: *49S_BE_3844*

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Keywords:

Hybrid Drone, Disaster Relief, Two-way Communication, Payload Delivery, Fail-Safe, Night Vision, Crowd Management, Emergency Response, Broadcasting.

Introduction:

Natural and human-made disasters such as floods, earthquakes, wildfires, and crowd stampedes often result in high casualties due to delayed rescue, poor communication, limited night visibility, and difficult terrain. Ground rescue teams often struggle with flooded areas and communication breakdown, as seen in the 2024 North Indian floods, where lakhs of people were stranded in submerged villages, and Crowd Control failures as seen in the 2025 Bengaluru RCB victory stampede, where 11 lives were lost due to a lack of proper emergency response. Unmanned Aerial Vehicles (UAVs) have proven useful in such situations by enabling rapid deployment and aerial surveillance, with studies showing up to an 80% success rate in victim identification. However, most existing drones are limited to surveillance and lack features like two-way communication, payload delivery, and crowd control. This project addresses these limitations by developing a hybrid rescue drone equipped with HAM radio communication, a searchlight for night operations, a payload delivery system, a siren, and fail-safe mechanisms, making it a more effective solution for disaster response.

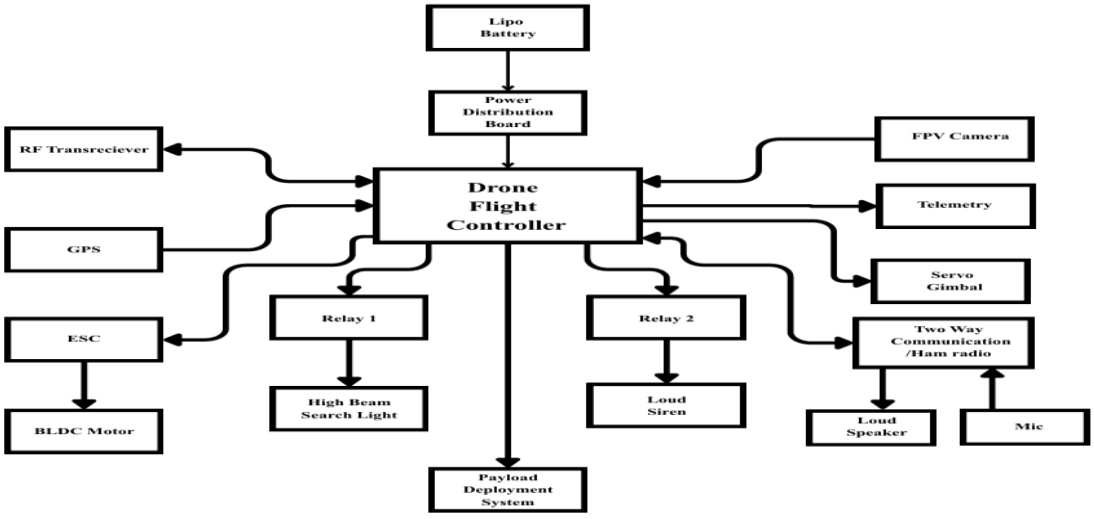

Figure 1: Hybrid Drone for Disaster Relief and Rescue Operations

Objectives:

1. To design and develop a hybrid, radio-controlled drone capable of stable flight in disaster and emergency environments.
2. To integrate HAM-radio-based two-way communication enabling real-time contact between rescue teams and survivors.
3. To implement smart fail-safe mechanisms, high-beam searchlights for night operations, and a loud siren for crowd management
4. To enable controlled payload delivery of medicines, food packets, and first-aid kits to remote or inaccessible locations during disasters.

Methodology:

1. The proposed system is a smart rescue drone controlled by a central flight controller that manages all its operations. The drone is operated remotely using a transceiver, while a GPS module helps it navigate accurately to disaster-affected areas. The flight controller ensures stable flight and coordinates all connected components. A camera mounted on a servo gimbal provides smooth live video, allowing the operator to clearly monitor the situation. At the same time, telemetry continuously sends important data such as location, altitude, speed, and battery status to the ground station for real-time monitoring and better decision-making.
2. The drone is also equipped with a two-way communication system using HAM radio, which allows rescuers to communicate directly with victims. A microphone captures voices from the ground, and a speaker is used to give instructions or reassurance. The system includes a controlled payload mechanism to deliver essential supplies like food, water, or medical kits to people in need. For better rescue operations, a high-beam searchlight is used for night visibility, and a loud siren helps in crowd control and alerting people during emergencies. All these features work together to provide faster response, better communication, and more effective disaster management.

Result and Conclusion:

In conclusion, the proposed rescue drone system offers an effective solution for disaster management by combining navigation, surveillance, communication, and rescue support into a single platform. Using GPS for accurate navigation, a stabilised camera for real-time video monitoring, and continuous telemetry data to track parameters such as location and battery status, the system enables better decision-making during emergencies. The HAM-radio-based two-way communication allows direct interaction with victims, improving coordination, while the controlled payload mechanism ensures precise delivery of essential supplies such as food, water, and medical kits. Additionally, the high-beam searchlight supports night-time operations, and the loud siren helps in crowd control and alerting people. Overall, the system improves response times, enhances communication, and supports rescue operations in difficult-to-access areas.

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Future Scope:

The future scope of this project includes:

1. **Autonomous Vision & Detection:** Integration of AI-based computer vision enables real-time survivor detection and obstacle avoidance, minimising the need for manual pilot intervention.
2. **Enhanced Durability and Sensing:** Equipped with noise-dampening propellers, a waterproof body, and a thermal camera for survivor detection in low visibility conditions.
3. **Solar-Powered VTOL Capability:** Combining Vertical Take-Off and Landing with solar panels allows for runway-independent operation and significantly extended flight duration in remote areas.