

Development of an Intelligent Autonomous UAV Rescue Drone Controller

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Abstract: Unmanned Aerial Vehicles (UAVs) are widely used in surveillance, monitoring, and disaster management operations. However, UAVs operating in remote or hazardous environments may experience system failures, power loss, or communication breakdowns, leading to mission interruption and potential equipment loss. This paper proposes a Drone-to-Drone Rescue System designed to assist and recover malfunctioning UAVs during flight operations. The system utilizes a wireless radio controller to deploy a rescue drone capable of navigating to the location of the affected UAV and performing mechanical stabilization or towing using a tethering mechanism. The rescue drone is controlled remotely and operates without relying on camera-based detection or complex sensor systems, making the design simpler and cost-effective. The proposed approach enhances operational reliability, reduces UAV loss, and improves mission continuity in critical environments. This system demonstrates the potential of cooperative UAV operations for aerial support and emergency recovery applications.

Keywords: Unmanned Aerial Vehicles (UAV), Drone-to-Drone Rescue System, UAV Recovery Mechanism, Wireless Radio Controller

1. INTRODUCTION

Unmanned Aerial Vehicles (UAVs), commonly known as drones, are widely used in applications such as surveillance, disaster management, monitoring, and industrial inspection because they can access remote and hazardous areas easily. However, during flight operations, drones may experience problems such as battery failure, communication loss, or mechanical faults, which can lead to mission interruption or drone loss. To address this issue, a Drone-to-Drone Rescue System is proposed, where a rescue drone is deployed to assist a malfunctioning UAV during flight. The rescue drone is controlled using a wireless radio controller and approaches the affected drone to stabilize or guide it to a safe landing location. This approach improves operational reliability and reduces the risk of drone loss during aerial missions.

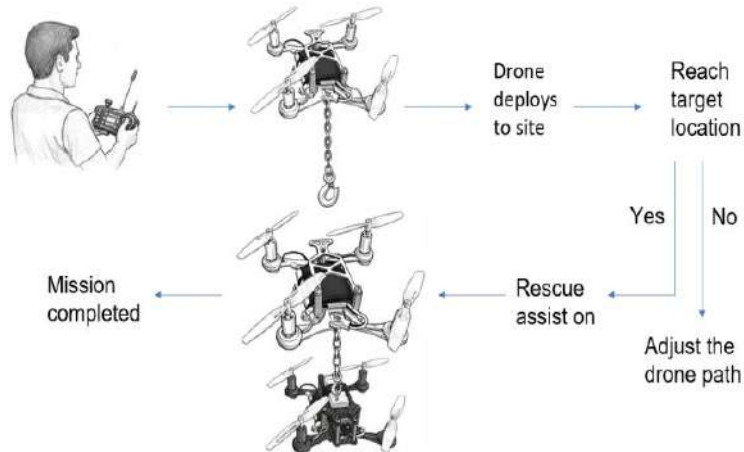
2. SYSTEM DESIGN

The proposed Drone-to-Drone Rescue System consists of two main units: a rescue drone and a target drone. The rescue drone is controlled using a wireless radio controller that allows the operator to navigate it toward the malfunctioning drone. When a failure occurs in the target drone, the operator deploys the rescue drone to reach its location. The rescue drone is equipped with a mechanical coupling that helps stabilize or guide the failed drone during flight. After establishing support, the rescue drone assists the target drone in moving toward a safe landing area. The propulsion system is built using coreless DC motors and propellers, which generate the necessary thrust and lift for aerial movement. These motors are controlled by Electronic Speed Controllers (ESCs) that regulate motor speed based on control signals received from the wireless receiver. The entire system is powered by a Lithium Polymer (Li-Po) battery, which provides lightweight and high-energy power suitable for drone operations. For communication and navigation, a 2.4 GHz radio transmitter and receiver module is used to establish a reliable wireless link between the operator and the drone. The receiver interprets the signals from the transmitter and sends appropriate commands to the ESC and flight control system to control the drone's movement in different directions.

3. METHODOLOGY

- 3.1 System Integration: Assemble coreless DC motors, propellers, ESC, Li-Po battery, transmitter, receiver, and servo release unit.
- 3.2 Power Supply: Li-Po battery provides lightweight, high-energy power for the UAV system.
- 3.3 Wireless Communication: 2.4 GHz transmitter to receiver enables real-time control between operator and drone.
- 3.4 Flight Control: ESC regulates motor speed to control take-off, movement, and hovering.
- 3.5 Navigation: Operator directs the UAV to the disaster or target location.
- 3.6 Mission Completion: After delivery, the drone returns safely to the base station.

4. FLOW CHART



5. DISCUSSION

The proposed Autonomous UAV Rescue Drone Controller demonstrates the practical use of drone technology in disaster management and emergency rescue operations. The system achieves stable flight and responsive control using components such as coreless DC motors, electronic speed controllers, and a lithium polymer battery. The wireless transmitter–receiver system enables real-time control and accurate navigation of the drone. The drone can reach remote or hazardous areas where human access is difficult, improving rescue response time. However, the system has some limitations such as limited flight time due to battery capacity and possible environmental effects like wind or signal interference. Despite these limitations, the system shows good potential for improving the efficiency of rescue operations.



6. CHALLENGING

6.1 Limited Battery Life: UAV rescue drones have limited flight time due to battery capacity, which restricts long-distance rescue operations.

6.2 Environmental Conditions: Weather factors such as strong wind, rain, or dust can affect the stability and performance of the drone.

6.3 Payload Limitations: UAVs can carry only limited weight, which restricts the amount of rescue equipment or supplies delivered.

6.4 Navigation Accuracy: Without advanced sensors or cameras, accurately locating and approaching the target area can be difficult.

7. CONCLUSION

The Drone-to-Drone Rescue System designed to assist malfunctioning UAVs during flight operations. The proposed system uses a rescue drone controlled by a wireless radio controller to approach and support the affected drone. By guiding the malfunctioning drone to a safe landing area, the system helps reduce drone loss and mission failure. The design avoids the use of complex cameras and sensors, making the system simple, cost-effective, and easy to implement. Overall, the proposed approach improves the safety and reliability of UAV operations and demonstrates the potential of cooperative drone systems for emergency recovery applications.

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