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Life saver Drone: AI-Based Search and Rescue with Real-Time Alerts

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Abstract
Through our research, we found that many existing drone systems do not clearly solve the problems related to thermal detection in disaster areas, and they often fail in providing reliable real-time human detection. These issues are important to address because search and rescue operations need to be more efficient, time-saving, and economic. Since UAVs are extremely useful in locations where humans cannot reach easily, improving their performance in such missions becomes essential for future emergency response systems. In this work, we propose a drone system designed to detect humans more effectively by using audio, video, and thermal inputs. Our approach focuses on integrating GPS, computer vision, and artificial intelligence to automate the drone's operation and support real-time data processing. The drone captures photos, videos, audio, or thermal images, and the AI model confirms whether a human is present and potentially in need. Once detection is verified, the system immediately processes and sends the information to rescue teams in real time. It can also hold its position or circle around the target until responders arrive. The implications of this system show that faster alerts, improved detection accuracy, and economic design can significantly support rescue teams and help save more lives during emergencies.

Keywords: *Unmanned Aerial Vehicle (UAV), Search and Rescue (SAR), AI, SAR, thermal detection, and real-time alerts.*

1. Introduction

In today's world, natural disasters and the destruction that follows are frequently seen across news channels. We often hear about the severe damage caused to human life and how difficult it becomes to rescue people [1][2] trapped in such areas. Many victims remain stuck for long periods, waiting in hope of rescue, which often gets delayed due to the lack of advanced technology [2] —even in an era where drones and artificial intelligence (AI) are rapidly advancing [17]. Drones are no longer limited to military surveillance [3] entertainment, or aerial shows; they can also play a crucial role in rescue scenarios, especially in regions that are dangerous or hard to access. Compared to traditional rescue operations, which are time-consuming and risky for responders, drones offer a faster, easier, and safer alternative for locating victims. To enhance their effectiveness, we integrate AI into the drone system to support automation [4] real-time decision-making, and human detection. GPS is included to provide accurate real-time location data [16]. We felt it was necessary to research this area because existing systems still lack reliability, accuracy, speed, and affordability [5] [5]—factors that are essential for real search and rescue missions. Our proposed system uses audio, video, and thermal sensing to detect victims with the help of AI models [6][4] [6], while the GPS module determines the exact location and sends real-time alerts to rescue teams. Once a victim is detected, the drone can hold its position or circle around the target until responders reach the site. Overall, our system offers a more refined and reliable version of existing drones, especially in terms of detection accuracy,

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real-time alerting, and location reporting.

2. Literature Review

Researchers have increasingly explored the use of Unmanned Aerial Vehicles (UAVs) in search and rescue (SAR) operations [1][2], especially in disaster-struck regions where human access is limited. Previous studies show that drones have been deployed to scan large areas, capture aerial images, and detect victims using both visual and thermal data [2][5]. These systems help responders gain a wider view of the affected region and reduce the time spent searching manually. We observed from earlier research that many investigators have already started working toward enhancing UAV-based detection. They have successfully used aerial imaging, thermal sensors, and automated scanning to identify people in collapsed or obstructed environments. A range of techniques—including YOLO, CNN, Faster R-CNN, thermal cameras, audio–video detection, and even signal-processing methods [5][6] to recognize human sound waves—have been applied to improve recognition accuracy in different conditions. However, despite the progress, several limitations remain consistent across these works. A major issue is that many systems struggle with real-time communication and are unable to relay location information fast enough [3][4] during active rescue missions. Real-time detection and alerting are often hindered by limited onboard processing power and unstable network connectivity in remote disaster zones. In addition, several models lack full autonomy and rely heavily on manual piloting or ground-based coordination [2][3], which slows down the entire mission. Thermal detection also becomes unreliable in cluttered or low-visibility environments, and high-quality sensors add to the overall cost, making many solutions impractical for large-scale deployment. Some recent studies have attempted to fuse thermal and RGB imagery to improve detection performance [3][6], while others explored GPS and IoT-based communication modules to support information sharing. Edge-AI acceleration has also been tested for faster processing on lightweight processors [4]. Even with these advancements, current systems still fall short of providing a fully integrated and dependable solution that combines detection, navigation, communication, and real-time alerting within one affordable platform. These gaps show the need for a more refined and unified drone system capable of real-time human detection, quick location transmission, and autonomous decision-making. Addressing these shortcomings forms the motivation behind the proposed Lifesaver Drone system.

3. Methodology

3.1. Research Approach

Our research follows a qualitative approach, relying heavily on secondary data collected from previously published academic work [1][3]. We systematically reviewed research articles available through platforms like Google Scholar and IEEE Xplore, focusing on drone systems equipped with AI, GPS, and thermal imaging for search and rescue (SAR) applications [2][3]. Each selected paper was evaluated based on its achievements, limitations, and future scope. This comprehensive review guided the conceptualization and design of our own drone-based rescue system.

3.2. System Overview

The proposed AI-based drone system is designed to autonomously detect and locate disaster victims in inaccessible or hazardous environments [4][5]. It integrates image recognition, real-time video analysis, GPS-based location tracking, and wireless communication modules into a single, compact unit. The system is divided into several functional modules, as detailed below Shown in Figure 1.

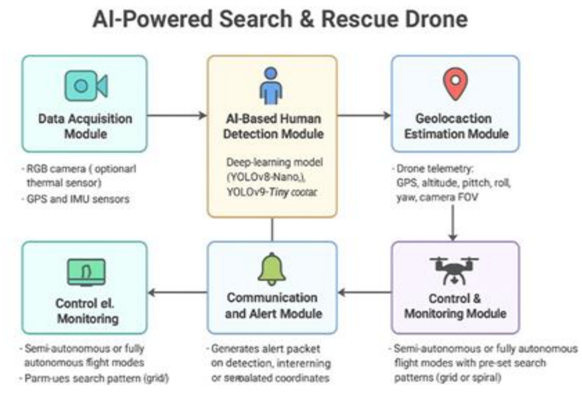

Figure 1 **Proposed Approach**

The Lifesaver Drone follows a structured workflow designed to support autonomous search and rescue operations. Each stage is aimed at improving detection accuracy, real-time alerting, and timely

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response in emergency environments

3.2.1. Mission Setup

The mission begins by defining the search area and uploading the intended flight route. Environmental factors such as lighting, terrain, and possible obstacles are checked to ensure safe and uninterrupted operation.

3.2.2. Data Capture

The core aim of our system is to provide an AI-based drone that can send real-time alerts during human rescue missions. The drone collects data using multiple sensors, including RGB cameras, thermal imaging sensors, and onboard microphones. This multi-modal data helps capture a clearer picture of the environment, even in difficult conditions. All captured frames and audio signals are tagged with GPS coordinates for accurate location tracking.

3.2.3. Preprocessing

Once the data is collected, the onboard system stabilizes the video, removes unnecessary noise from audio recordings, and aligns thermal and RGB frames [6]. This step improves the quality of the data before AI processing, making the final detection more reliable.

3.2.4. AI Detection Module

The preprocessed data is analyzed in real time using AI-based computer vision models [3][6]. The system examines RGB images, thermal signatures, and audio clues together to detect the presence of a victim. If needed, additional processing is done to improve clarity and reduce errors. Detection confidence is constantly monitored to avoid false alarms [4] caused by background activity, reflections, or misleading heat sources. This aligns with our mission—using AI not only to interpret raw data but also to refine it, making the results more accurate and trustworthy.

3.2.5. Risk Evaluation and Real-Time Alerts

Once the system confirms a valid detection, it prepares relevant evidence such as images, thermal frames, audio clips, or short video segments. This information is immediately transmitted along with precise GPS coordinates to the rescue team [2][5], ensuring that responders are alerted without delay.

3.2.6. Autonomy Actions

After locating a victim, the drone either holds its position or circles the target to maintain visual contact [1][6]. This autonomous behaviour prevents the system from losing track of the person and helps rescuers identify the exact spot quickly.

3.2.7. Post-Operations Review

All mission data is stored and later analyzed to evaluate system performance [5][6]. The information helps refine the AI model, improve detection accuracy, and optimize future missions.

3.2.8. Hardware Summery

This section presents the final prototype of our AI-based search and rescue drone system [1]. The drone is carefully designed to integrate all major components outlined earlier, including the RGB camera, GPS and IMU sensors, and the onboard microcontroller.

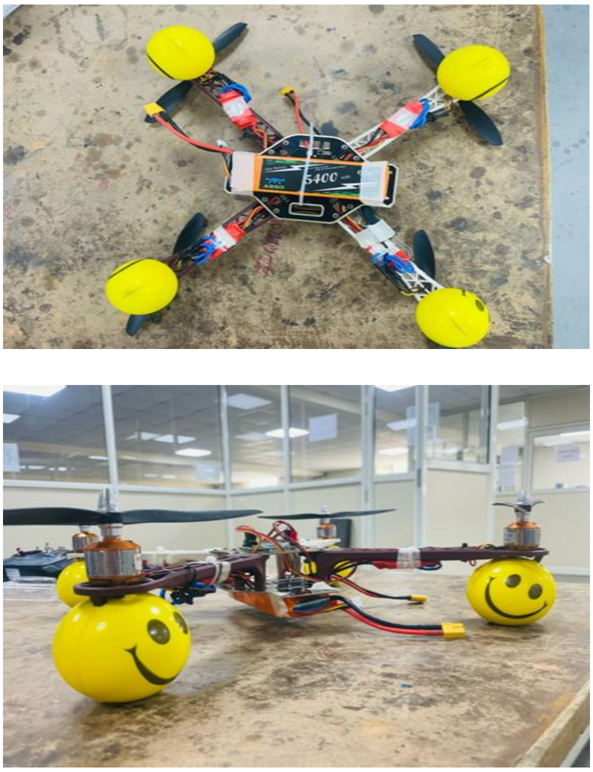

Figure 2 {A, B]: Prototype of Proposed Module

The assembled prototype is shown in Figure 2(a,b) , demonstrating how the sensor and AI modules are embedded into a compact, field-ready drone system capable of semi-autonomous or fully autonomous operation.

4. Results and Discussion

The performance of the proposed AI-based drone system was evaluated in terms of detection accuracy,

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reliability, and flight stability. The system showed clear improvement when compared to manual search efforts and to approaches reported in earlier research. By using RGB cameras, thermal sensors, and audio signals together, the drone was able to identify victims more consistently, even in challenging environments where visibility was low or obstacles were present. The real-time alert feature worked as intended and provided immediate notifications to responders. The integrated GPS module delivered precise location details, ensuring that the exact coordinates of the detected victim were available without delay. This capability supports faster decision-making during rescue missions. In terms of navigation, the drone demonstrated stable autonomous behaviour. After detecting a person, it was able to circle the area or hold its position until rescue teams arrived, reducing the risk of losing visual contact. The system also maintained steady communication throughout the mission and showed efficient battery usage, allowing it to operate for extended periods without major interruptions. Overall, the results show that the proposed system functions effectively as an AI-based lifesaving drone capable of real-time operation and immediate data transmission. This is crucial in emergency scenarios, as the ability to detect victims quickly and provide accurate location information can significantly speed up rescue efforts. By improving accuracy, reducing search time, and offering autonomous support, the system enhances traditional rescue methods and has the potential to help save more lives during critical situations.

Conclusion

The proposed AI-enabled Lifesaver Drone demonstrates that integrating autonomous flight, multi-sensor imaging, and real-time deep-learning analysis can significantly improve the effectiveness of search and rescue operations. The system was designed with the main objective of detecting humans accurately, sending real-time alerts, and providing precise GPS-based location information. Through the combination of RGB cameras, thermal sensing, audio cues, and AI processing, the drone was able to identify victims more reliably than traditional manual search approaches and earlier research systems. The implemented workflow—covering data capture, preprocessing, AI detection, alert transmission, and autonomous target tracking—allowed the drone to operate efficiently and maintain stable performance throughout the mission. Its ability to hold position or circle around the detected victim further supports responders by ensuring continuous visibility until help arrives. The results highlight that the system improves detection accuracy, reduces search time, and supports safer emergency response, particularly in environments where human access is difficult or dangerous. In practical applications, this system can support disaster management authorities, rescue teams, and first responders by accelerating victim identification and delivering crucial information without delay. The combination of real-time decision-making, communication stability, and efficient battery usage makes the drone a dependable tool for field operations. Recommendations for future development include enhancing multi-modal sensor fusion (such as adding LiDAR or radar for dense environments), enabling coordination between multiple drones, optimizing the AI model for faster inference, expanding dataset training for better generalization, and designing improved dashboards for emergency responders. These improvements can further strengthen the system's capability and increase its impact during life-saving missions.

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