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RESEARCH ON SMART PUBLIC ANNOUNCEMENT AERIAL DRONE WITH PERSON DETECTION

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Abstract: Flood disasters often result in large-scale human displacement, making timely detection and rescue operations critical. Conventional ground-based approaches for locating stranded individuals are often time-consuming, labor-intensive, and limited by accessibility challenges. To overcome this limitation, the project combines an ESP32-CAM module with a drone system to provide lightweight aerial monitoring and real-time detection of individuals during flood emergencies. By deploying a lightweight version of the YOLO (You Only Look Once) object detection model, the ESP32-CAM processes live video streams and identifies individuals from a top-view perspective. The captured feed is transmitted via Wi-Fi and monitored through a laptop browser, providing rescuers with an efficient tool for rapid assessment. The system can detect people entering or exiting the frame and automatically count the number of individuals, offering valuable situational awareness. Additionally, communication between operators and the drone is supported via a walkie-talkie system to enhance coordination during rescue missions. This solution emphasizes portability, affordability, and real-time processing, making it suitable for disaster-prone regions with limited infrastructure. In summary, the proposed system seeks to connect drone-based monitoring with AI-powered disaster management by delivering a dependable, cost-effective, and fast-response solution for flood rescue operations.

Keywords: ESP32-CAM, YOLO, Flood Disaster, Drone, Person Detection, People Counting, Aerial Surveillance, Real-Time Monitoring.

I. INTRODUCTION

Floods are among the most devastating natural disasters, resulting in widespread destruction, displacement, and loss of human lives. During such emergencies, locating and rescuing stranded individuals becomes a top priority for disaster management authorities. However, traditional surveillance and rescue approaches are limited by accessibility challenges and slower response times. With the advancement of drones, ESP32-CAM modules, and lightweight machine learning (ML) models such as YOLO, real-time aerial person detection has become feasible even on resource-constrained hardware. The proposed project, “Smart Drone for aerial announcement” leverages an ESP32-CAM mounted on a drone to detect and count individuals from an overhead view. Using wireless video transmission and browser-based monitoring, rescuers can access live feeds and track the number of detected individuals. This integration of IoT, UAV (Unmanned Aerial Vehicle), and AI provides a cost-effective solution for rapid disaster response, enabling enhanced situational awareness and informed decision-making.

II. LITERATURE REVIEW

“Autonomous Aerial Surveillance for Drone Rescue Operation” by M. Catherine Deboral et al. [1]. An autonomous drone-based monitoring system is presented for rescue operations. The system utilizes GPS-enabled drones along with real-time surveillance to detect affected regions and help rescue teams take quicker and more effective actions.

“Gesture Control of Drone Using a Motion Controller” by A. Sarkar et al. [2]. This study introduces a gesture-based drone control system where hand movements are used to guide drone navigation, enhancing user interaction and simplifying control during emergency conditions.

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"Drones for Flood Monitoring, Mapping and Detection: A Bibliometric Review" by U. Iqbal et al. [3]. The study examines various research trends related to drone-assisted flood monitoring and highlights the growing importance of machine learning and computer vision in disaster management applications.

"An Integrated Convolutional Neural Network and Sorting Algorithm for Image Classification for Efficient Flood Disaster Management" by M. A. Islam et al. [4]. A CNN-based framework is proposed to classify flood-affected areas and prioritize relief tasks efficiently using deep learning combined with sorting techniques.
"Drone-Based Water Level Detection and Flood Disasters" by H. Rizk et al. [5]. A drone-assisted system is presented that uses aerial image analysis and deep learning methods to estimate water levels and improve the accuracy of flood monitoring.

"Efficient Aerial Image Classification for Drone-Based Emergency Monitoring Using Atrous Convolutional Feature Fusion" by C. Kyrkou and T. Theocharides [6]. A lightweight neural network model is proposed for real-time aerial image classification on resource-constrained UAV platforms.
"Applications of Drone in Disaster Management: A Scoping Review" by S. M. S. M. Daud et al. [7]. The study reviews different drone applications in disaster management, categorizing them into mapping, rescue, transportation, and training, while also identifying current research gaps.

"The Application of UAV Images in Flood Detection Using Image Segmentation Techniques" by N. S. Ibrahim et al. [8]. The study focuses on flood detection using UAV imagery and compares image segmentation approaches such as region growing and K-means clustering.

"Unmanned Aerial Vehicles in Hydrology and Water Management: Applications, Challenges, and Perspectives" by B. S. Acharya et al. [9]. The study discusses the use of UAVs in hydrology, emphasizing their importance in real-time monitoring and environmental data collection.
"Unmanned Aerial Vehicles in Hydrology and Water Management: Applications, Challenges, and Perspectives" by B. S. Acharya et al. [10]. The work further analyzes the challenges, limitations, and future scope of UAV-based systems in water resource management.

From the above studies, it is evident that the integration of drone technology with artificial intelligence and image processing greatly enhances flood disaster management. However, many existing approaches demand high computational power or do not support efficient real-time processing on embedded systems. Therefore, the proposed system aims to develop a cost-effective and real-time human detection solution using ESP32-CAM and a lightweight YOLO model.

III. METHODOLOGY

The research methodology begins with system design and hardware integration of the ESP32-CAM with the drone platform. A lightweight YOLO model is trained and optimized to run directly on the ESP32-CAM for real-time person detection. The drone is deployed to capture an overhead view of flood-affected areas, transmitting the live feed via Wi-Fi to a laptop browser for monitoring. Detected individuals are automatically counted, with entry and exit events tracked to ensure accuracy. A walkie-talkie module enhances operator-drone communication during field deployment. Finally, system performance is evaluated through simulations and real-time testing to validate accuracy, efficiency, and reliability.

BLOCK DIAGRAM

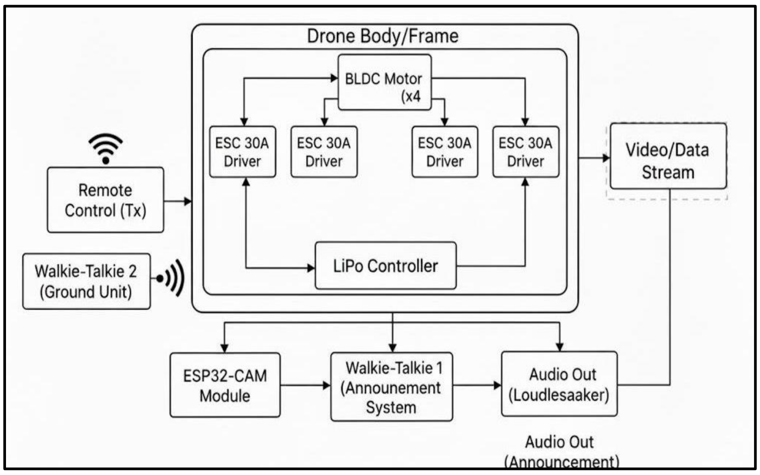

Fig. 1 Drone System Architecture with Communication and Control Modules

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DESCRIPTION

The block diagram shows a simple drone system where four BLDC motors, four ESC 30A drivers, and an 11.1V battery pack form the internal power and flight structure. Under the drone, an ESP32-CAM provides live video and detection, while two walkie-talkies enable aerial announcements. The Flysky remote controls the ESCs and motors, allowing stable flight and communication.

FLOW CHART

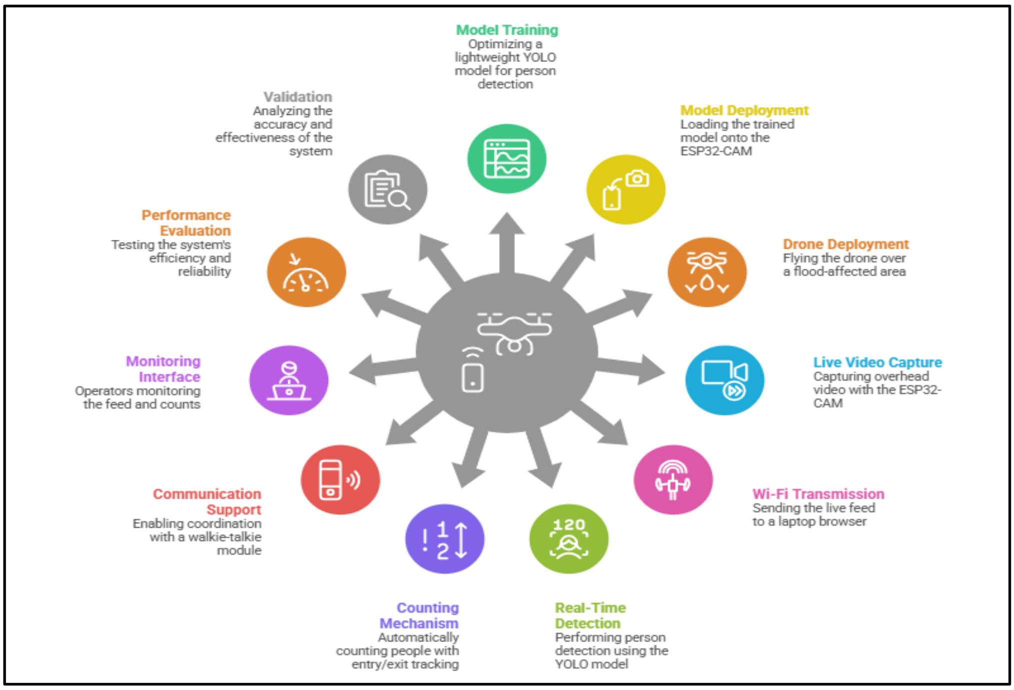

Fig. 2 Functional Block Diagram of Smart Drone System

WORKING

The smart drone system operates by integrating an ESP32-CAM module mounted on a quadcopter to capture real-time aerial video of flood-affected areas. A lightweight YOLO model, trained and optimized for low-power hardware, runs on the ESP32-CAM to perform real-time person detection from a top-view perspective. The processed video stream is transmitted wirelessly via Wi-Fi to a laptop, where it is accessed through a browser-based interface for live monitoring. Detected individuals are automatically counted using an entry and exit tracking mechanism, providing accurate situational awareness to rescue teams. In parallel, a walkie-talkie communication module enables real-time coordination between operators and field personnel, allowing instructions and announcements to be delivered effectively. This integrated workflow ensures rapid detection, monitoring, communication, and decision support for efficient flood rescue operations.

IV. SYSTEM REQUIREMENT

HARDWARE REQUIREMENT

1] NodeMCU
2] ESP32-Camera Module
3] BLDC Motor *4
4] Walkie-Talkie Module [Baofeng Walkie Talkie BF-888S] *2
5] ESC 30A BLDC Motor Driver *4
6] Flysky CT6B Remote 6 Channel
7] Drone Frame [INVENTO F450 HJ450 4-Axis Multi-Rotor Quadcopter]
8] Battery Pack (11.1 V)

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SOFTWARE REQUIREMENTS

1] Arduino IDE
2] YOLO (Tiny/Lightweight Version)
3] Python Libraries (OpenCV, TensorFlow Lite)
4] Flask / Web Server

V. EXPERIMENTAL SETUP & RESULT

EXPERIMENTAL SETUP

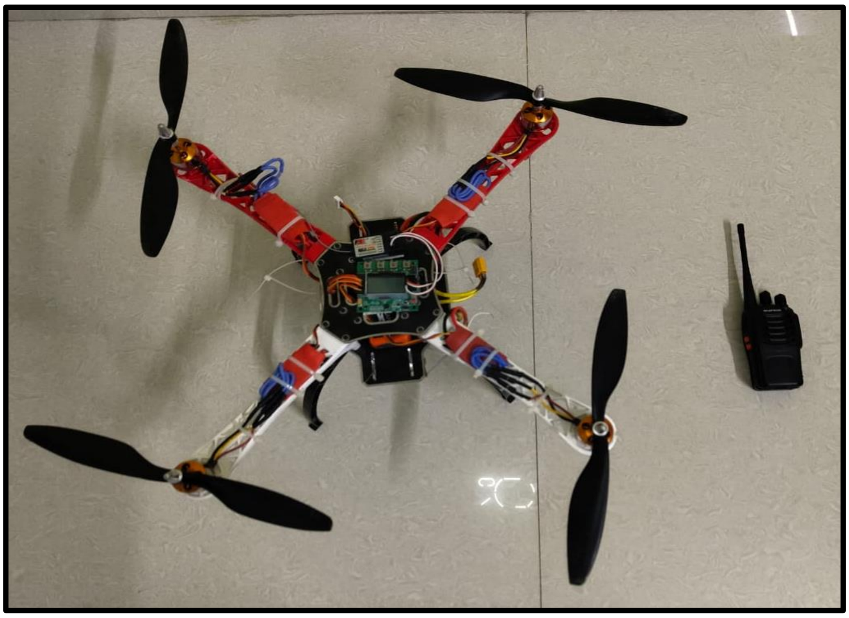

Fig. 3 Experimental Setup of Proposed System

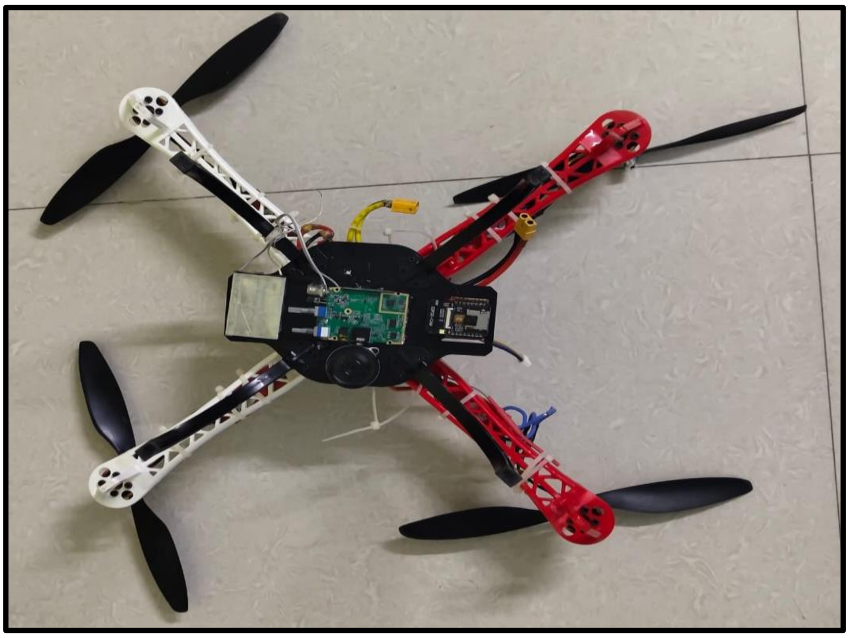

Fig. 4 Back View of the Experimental Setup of the System

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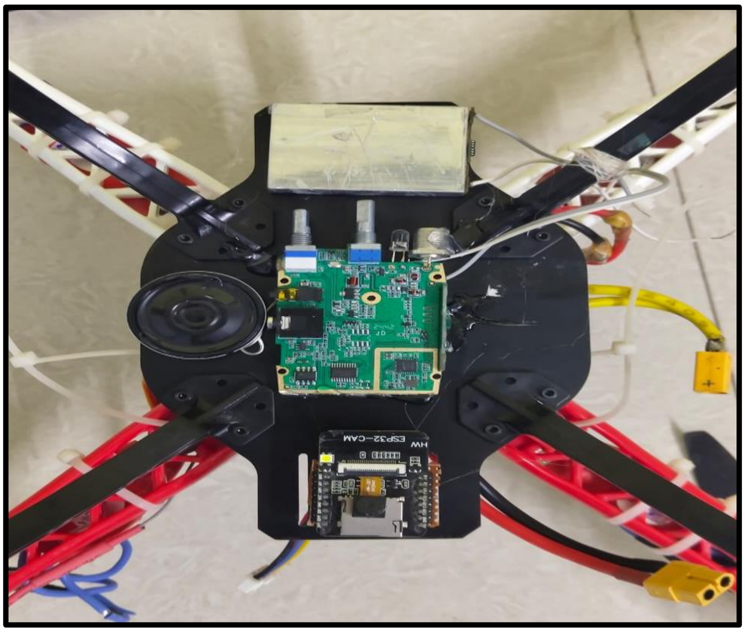

Fig. 5 Top View of the Experimental Setup of the System

RESULT

The developed smart drone system successfully demonstrates real-time aerial surveillance and person detection for flood disaster scenarios using an ESP32-CAM and a lightweight YOLO model. The system is able to transmit live video over Wi-Fi, accurately detect and count individuals from a top-view perspective, and display the results on a browser-based monitoring interface. Communication support through the walkie-talkie module enhances coordination between rescue teams and operators. Overall, the project proves to be a low-cost, portable, and efficient solution for rapid situational awareness and improved rescue operations in disaster-affected areas.

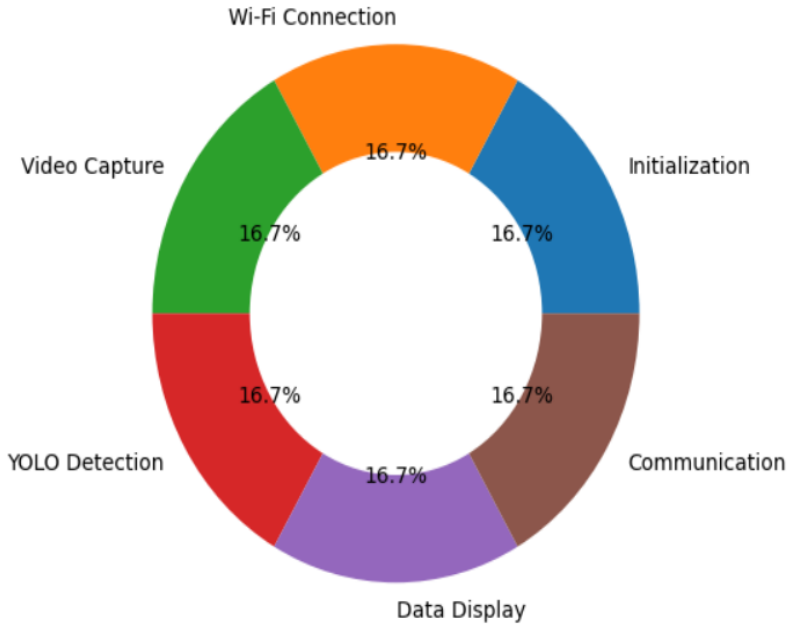

Fig. 6 Functional Stages of Smart Drone System

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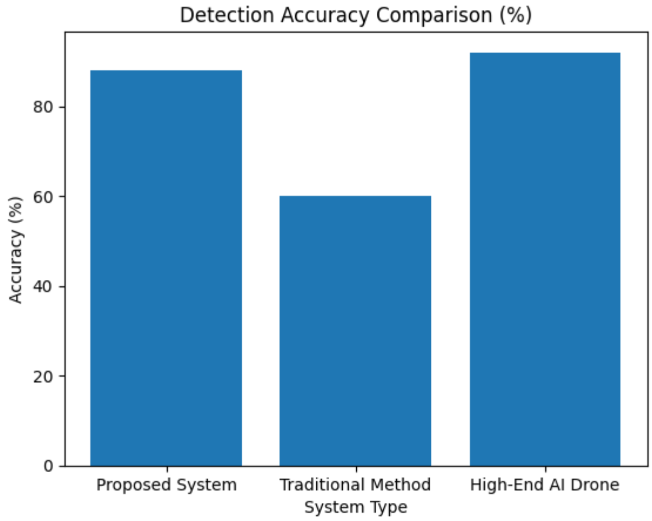

Fig.7 Comparative analysis of detection accuracy (%)

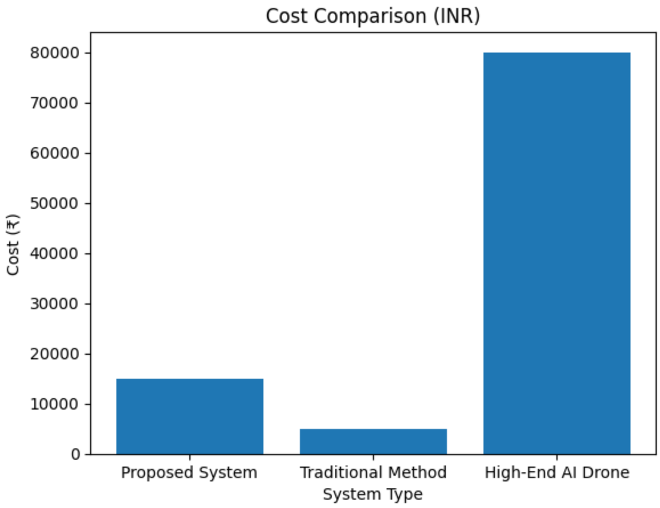

Fig. 8 Economic Comparison of Surveillance Systems

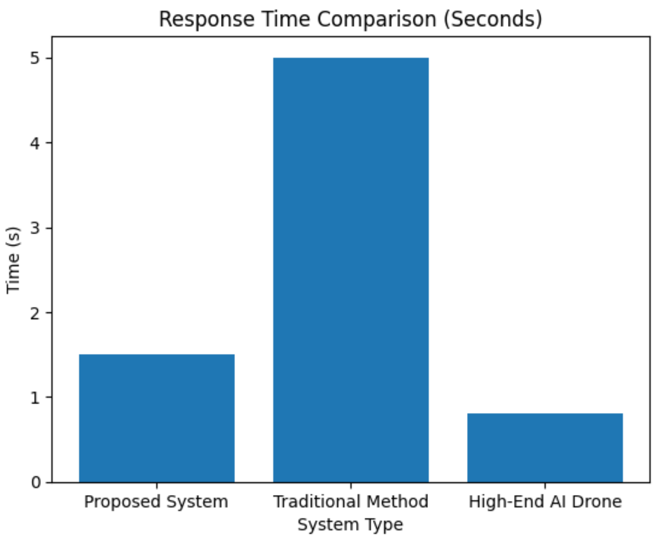

Fig. 9 Performance Evaluation Based on Response time

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VI. CONCLUSION

The smart drone for aerial announcement project successfully demonstrates an efficient integration of drone technology, ESP32-CAM, and lightweight AI for real-time person detection and monitoring in flood disaster scenarios. The system provides a low-cost, portable, and reliable solution for rapid situational awareness, enabling faster and more effective rescue operations. By combining aerial surveillance, people counting, wireless communication, and real-time monitoring, the project proves its potential as a practical and scalable tool for modern disaster management and emergency response systems.

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