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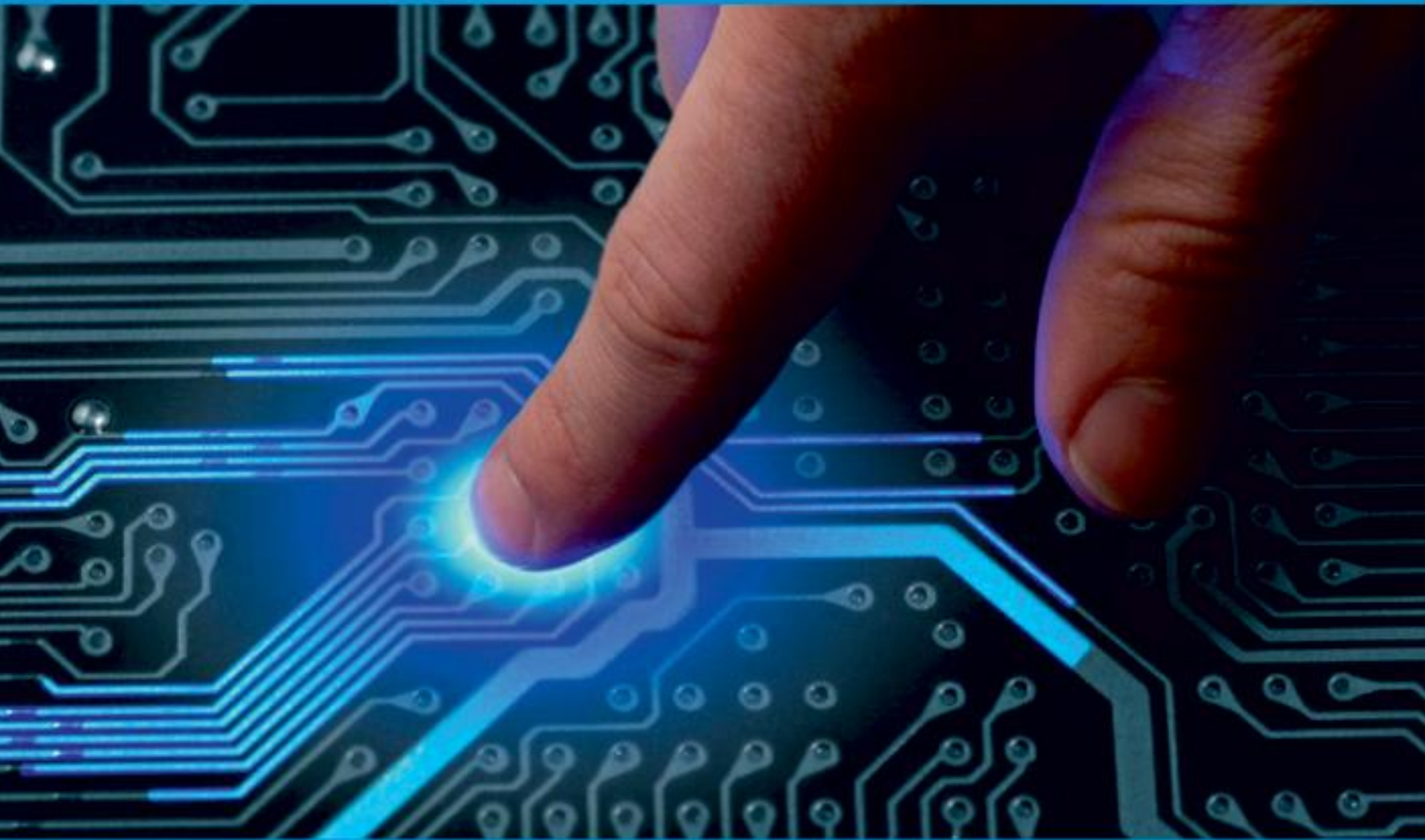

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AI based Automatic Alarm Generation and Dropping Payload at a Particular Object through a Drone

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ABSTRACT: Innovative solutions are needed to address problems like natural disasters, security breaches, and logistics in remote places in a world that is changing quickly. The efficacy and response times of conventional approaches are frequently inadequate. We require more rapid, intelligent, and flexible solutions. A landslide happened recently at Irshalwadi, Raigad, Maharashtra, India, on July 19, 2023. Heavy rains precipitated the landslide, which resulted in 26 confirmed deaths and 109 unaccounted-for deaths. Additionally, more than 50,000 people lost their lives and over a lakh were injured in the earthquake in Turkey. Thus, quick and efficient disaster relief is necessary to preserve lives and lessen suffering in instances like natural disasters, humanitarian crises, and emergency scenarios.

KEYWORDS: UAV, Payload, Artificial Intelligence

I. INTRODUCTION

Emergencies and disasters demand swift responses to minimize harm and save lives, making effective logistics and communication vital. Leveraging drone payload delivery and AI-based alert creation presents innovative solutions to address the challenges of disaster response.

This study delves into the integration of drone technology and artificial intelligence (AI) to create a sophisticated system capable of accurately delivering payloads to specified locations during emergencies while automatically generating alerts. It explores the technology, implementation strategies, practical applications, and potential future advancements of this groundbreaking approach to disaster relief.

The project's objective is to design, develop, and automate a drone system tailored for disaster response scenarios. This system aims to utilize AI, machine learning (ML), and autonomous capabilities to assist rescue teams by autonomously identifying and aiding individuals and delivering essential supplies.

II. LITERATURE SURVEY

Paper	Review/Findings
"AI and Web Application in Medicine DeliveryDrones" Published in: 2022 International Conference on Applied Artificial Intelligenceand Computing (ICAAIC)	AI and web applications are implemented to enabledrones to deliver medicineto people.Through the application, the user canregister and order the medicine without requiring any human interaction. Theuser can share their location with the device, which will then deliver the medicine to the exact location.

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"A survey of UAV applications and technologies for civil infrastructure monitoring" Authors: T. Kim, M. B. Suleiman, and H. W. Park	Unmanned Aerial Vehicles (UAVs) are rapidly advancing in civil applications, particularly in infrastructure. This paper reviews UAV uses, market trends,challenges, and future prospects, emphasizing a $45 billion market value.
Convolutional Neural Network-Based Real- Time Object Detection and Tracking for Parrot AR Drone 2 Author: Ali Rohan,Mohammed rabah,Sung-ho-kim,south-korea	The Parrot AR Drone 2 is used for this application. Convolutional Neural Network (CNN) is used for object detection and target tracking.
"Internet of Things for disaster management: State-of-the-art and prospects" Authors: S. R. Mishra, A. R. G. Anpalagan, and S. M. Azimi	The Internet of Things (IoT) transforms disastermanagement by connecting devices forreal-time data collection.Integrated with AI, it enables informed decision-making, expediting emergency responses, minimizing damage, and reducing costs. Overcoming challenges like highprices and securityconcerns is crucial for maximum effectiveness.[3]

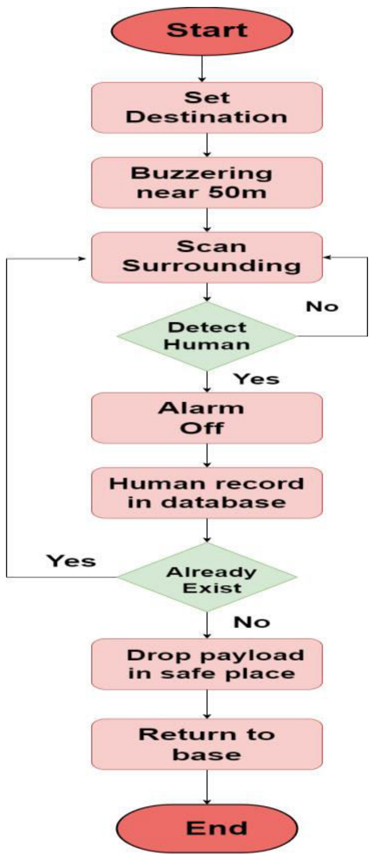

Figure 1. Flowchart of Autonomous Delivery Drone

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III. METHODOLOGY

Hardware and software components must work together tocreate an AI-based autonomous alert generation and payload delivery drone for disaster relief.

1. Software Requirement
2. Hardware Requirement.

A. Software Requirement : -

1. **Flight Control Software: -** For low-level control of motors and sensors, use open-source or customized flight control software (such as PX4 or Ardupilot).Firmware integration with the flight controller.

2. **Software for AI and Machine Learning: -** To create AI algorithms, use Python, TensorFlow, PyTorch, or scikit-learn.Machine learning models for payload management, obstacle avoidance, and autonomous navigation.Sensor data feature engineering and preprocessing.

3. Path planning and navigation algorithms in disaster areas are covered in section four. Integration of environmental mapping and GPS data. Path planning and navigation algorithms in disaster areas arecovered in section four**.**

4. **Software for Communication and Telemetry**: - Web-based or desktop software for ground control stations used for mission planning and tracking. Telemetry software for remote piloting and real-timedata transmission.

5. **Data Analysis and Visualization**: - Python libraries for data analysis (e.g., NumPy, Pandas). Mission data visualization tools (e.g., Matplotlib,Plotly).

6. **Backend Services**: - Databases and backend servers (SQL/NoSQL) for the purpose of storing logs and missiondata. APIs for connecting to external systems and retrievingmission data.

7. **Web development**: Using HTML/CSS and JavaScript, web-based ground control station user interfaces can be created.Payload Tracking and Sensors: Specialized sensors, such as gas sensors and temperature sensors Front-end frameworks for interactive user experiences,such as Angular and React.

8. **Security Measures**: - Secure communication channels and encryption protocols to guard data and stop illegal access.

B. Hardware Requirement : -

1. **Drone Frame and Motors:** The drone frame gives the UAV stability and structure.
    a. Matching propellers and superior brushless motors are necessary for dependable flight.

2. **Power System: -** High energy density lithium-polymer (LiPo) or lithium-ion (Li-ion) batteries.
    a. Safe charging and discharging are ensured by a battery management system (BMS).

3. **Flight Controller: -** A flight controller unit for autonomous navigation, stabilization, and real-time flight control (such as Pixhawk or CC3D).
    a. A GPS module for precise location tracking and waypoint guidance.

4. **Sensors: -** An Inertial Measurement Unit (IMU) equipped with gyroscopes and accelerometers for motion and orientation detection.
    a. Barometric sensor for controlling altitude.
    b. Compass (magnetometer) for heading information.
    c. LiDAR sensors for obstacle detection and mapping.
    d. High-resolution cameras (RGB, thermal, multispectral) for perception.

5. **Communication Systems:**
    a. Radio control transmitter and receiver for manual control.

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b. Telemetry links (4G/5G, satellite, or proprietary radio) for real-time data transmission.
c. Long-range communication systems for beyond-line-of- sight operations.

6. **Payload Handling:**
   a. A payload bay or mounting system to accommodate cargo or equipment.
   b. An automated release mechanism for precise payload deployment.

7. **Safety and Redundancy Systems:**
   a. Parachute recovery system for emergencies.
   b. Redundant flight controllers, GPS modules, and communication links for enhanced reliability.

8. **Collision Avoidance Systems:**
   a. Obstacle detection sensors (ultrasonic or infrared) for collision avoidance.

9. **Environmental Protection:**
   a. Weatherproofing measures to protect components from environmental factors.

10. **Custom Payload Monitoring and Sensors:**
    a. Specialized sensors (e.g., temperature sensors, gas detectors) to monitor cargo conditions during transport.

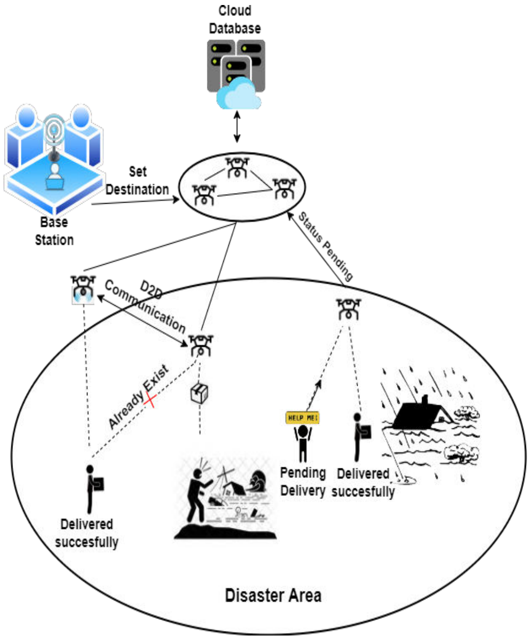

Figure 1 . Actual Implementation

IV. ALGORITHMS

4 .1 Location:

Two essential elements for developing an AI-based automated alert generation and payload delivery dronefor disaster relief scenarios are simultaneous localization and mapping (SLAM) and proportional- integral-differential (PID) control. These technologiesensure the safe and efficient operation of the drone in different but complimentary ways. The integration of SLAM and PID algorithms into a system can be achieved as follows:

1) **Simultaneous Localization and Mapping, or SLAM**: This is a vital technology for drones that operate in uncharted territory or in areas where GPS reception is unavailable. It lets the drone map itsenvironment and estimate its own position on that mapall at the same time.In recent years, SLAM has been used as a smart technique for building a 3D map of the environment using sensor fusion algorithms.[2]

2) **PID (Proportional-Integral-Derivative) Control:** PID control is a time-tested method for regulating the motion

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and stability of drones.
Hardware Component Selection: Select appropriatehardware components such as current sensor, voltage sensor ,esp32, and WiFi modules, that are suitable foryour project requirements

3) Combining PID and SLAM:
We take into consideration the following actions to incorporate SLAM and PID control into an AI-baseddrone for disaster relief: Sensor Integration: Install cameras, LiDAR, and anIMU on the drone to enable precise navigation and SLAM.

4) **SLAM Algorithm**: To generate and update environment maps, implement a SLAM algorithm thatcan handle sensor input in real-time.

5) **PID Controllers**: Use PID controllers to control position, heading, and altitude. These controllers oughtto receive localization information and maps producedby SLAM.

4.2 Human Detection:

LIDAR : LIDAR (Light Detection and Ranging): AI- based automated alert generation and payload deliverydrones for disaster assistance benefit greatly from the application of LIDAR (Light Detection and Ranging) technology for person detection. Lidar sensors produceprecise 3D point cloud maps of their surroundings by pulsating lasers and measuring how long it takes for the beams to return after striking things.

1) Acquisition of Lidar Data: Give the drone a 360- degree field of vision using one or more Lidar sensors,usually placed on the body or payload bay.
To recognise humans at different distances, lidar sensors need to have an appropriate range (distance coverage) and resolution (detail level).

2) Object identification: - Using segmented point cloud data, apply object identification algorithms to findhuman-shaped clusters. Humans may be distinguished from other items by their characteristic proportions andforms. Human characteristics in Lidar data can be usedto train machine learning algorithms such as Random Forests, Support Vector Machines (SVM), and Convolutional Neural Networks (CNNs).

3) Motion Detection: - Use algorithms for motion detection to recognise people based on their gait patterns. This can aid in the differentiation of movingitems from living beings.

4) Alarm Generation: - The AI system has the ability to automatically trigger an alarm when it detects human presence in potentially dangerous places or in emergency situations. For quick action, the alarm may indicate the location of any persons found.

4.3 Payload dropping :

Allocating resources more efficiently may be achievedby integrating human recognition and queue management .Using these algorithms for payload dumping in disaster assistance scenarios may be doneas follows:

1) Identification of People and Objects:
Process visual data from the drone's cameras, whichmay include RGB, thermal, or multispectral sensors,using computer vision algorithms. To detect and identify people in the video stream, useobject detection frameworks like YOLO (You Only Look Once) or deep learning models like Convolutional Neural Networks (CNNs).[5]

2) Payload Delivery Mechanism: -
Include in the drone an automated payload delivery system that can drop cargo precisely at predetermined coordinates. To prevent injury to people or property, make sure the payload delivery system can discharge payloads precisely and securely.

3) Automatic Alarm Generation: -
Put in place methods for automatically raising alarms when particular criteria are met, like: - A queue that getslonger

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than a predetermined amount of time.
The presence of susceptible people in a lineTraffic jams or delays in the queue
Set off alarms to notify ground staff or arrange forfurther aid to be provided.

4) Visualization of Queues:
On the ground control station or user interface of the drone, display queues visually. Display the locations, priority levels, and length of the queue using graphical components.

5) Communication System Integration:
Integrate the drone's communication systems to send data to ground control and relief coordination centers regarding payload delivery, resource allocation, andqueue status. Make sure there is two-way communication so that decisions and coordination can be made quickly.

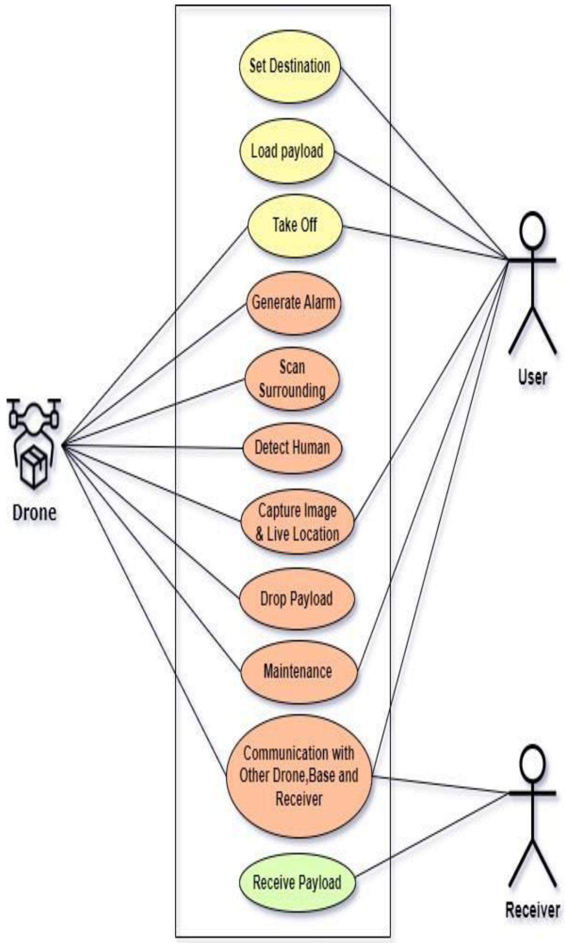

Figure 2 . Use Case Diagram

V. ADVANTAGES

1.**Quick Deployment**
Time is of the importance during the crucial initial phases of disaster response. Artificial intelligence (AI)-powered delivery drones can be quickly deployed to disaster-affected areas, accessing places that might be unreachable by traditional means.

2.Entry to Inaccessible Locations:
Debris, destroyed infrastructure, and difficult terrain are common features of disaster zones. Delivering help to areas that are most in need, these drones can access far-off and difficult-to-reach places.

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3.Flexibility in Payload:
Delivery drones powered by AI have a flexible cargo capacity. Various supplies, including as food, water, medical equipment, communication devices, and more, can be transported by them based on the particular requirements of the relief effort.

4.Improved Interaction:
In order to provide responders and impacted people with the critical connectivity they need, these drones can set up communication networks in disaster-affected locations.

5.Economy of Cost:
It is noteworthy how cost-effective it is to use AI-based delivery drones for disaster assistance. They save a lot of money because they can deliver supplies quickly and require less people.

VI. CONCLUSION

In conclusion, An innovative method of responding to disasters is the use of drones to deliver payloads in emergency zones and generate automatic alarms using artificial intelligence. This combination of state-of-the- art technology provides quick critical event detection, quick reaction via precise payload delivery, and the ability to save lives in communities hit by disasters.

It's obvious that drone technology and artificial intelligence will continue to develop as we work through issues with safety, privacy, ethics, and regulatory compliance. This creative strategy is set to become an even more crucial component of disaster response plans with continued study, technology developments, and international cooperation, offering comfort and hope in the midst of hardship

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