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GPS Based UAV for Medical Emergency Application

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ABSTRACT

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have emerged as promising tools for addressing medical emergencies by facilitating swift transportation of medical supplies to remote or inaccessible areas. This paper proposes a GPS-based UAV system designed specifically for medical emergency response. The UAV is equipped with precise GPS navigation technology, enabling it to autonomously navigate to predefined coordinates or dynamically generated emergency locations. The system integrates advanced sensors and communication modules to ensure efficient and reliable delivery of medical payloads, including essential supplies like first aid kits, medication, blood samples, or organs for transplantation. Moreover, the UAV is designed with safety features such as collision avoidance systems and redundant fail-safes to mitigate potential risks during flight. The proposed GPS-based UAV system holds significant potential to revolutionize emergency medical services by providing rapid and efficient support, particularly in remote or disaster-stricken areas where traditional transportation methods face limitations. Future enhancements may focus on optimizing flight routes, enhancing payload capacity, and integrating real-time monitoring systems for enhanced situational awareness and response coordination.

Keywords: —Drone Technology, GPS Navigation, Medical Supply Delivery, Remote Areas, Safety Features

I. INTRODUCTION

In recent years, the integration of Unmanned Aerial Vehicles (UAVs), commonly referred to as drones, in various sectors has shown remarkable potential for revolutionizing traditional practices. One such area where drones are making a significant impact is in emergency medical services. The ability of drones to swiftly navigate through challenging terrains and deliver critical medical supplies to remote or inaccessible areas has garnered increasing attention from researchers, healthcare professionals, and policymakers alike.

This paper introduces a novel concept: the GPS-Based UAV for Medical Emergency Drone. The utilization of GPS (Global Positioning System) technology serves as the cornerstone of this innovative system, enabling precise navigation and autonomous flight capabilities. By leveraging GPS, these UAVs can accurately locate and reach predefined destinations or dynamically generated emergency locations, thereby expediting response times and potentially saving lives in critical situations. The integration of UAVs in medical emergency response addresses several challenges faced by traditional transportation methods, especially in remote or disaster-stricken areas. These challenges include limited infrastructure, impassable roads, and adverse weather conditions, all of which can hinder the timely delivery of essential medical supplies. By overcoming these obstacles, GPS-based UAVs offer a promising solution for improving the efficiency and effectiveness of emergency medical services. Furthermore, this paper explores the various components and features of the proposed GPS-based UAV system tailored specifically for medical emergency scenarios. These include advanced navigation systems, payload capacity, communication modules, and safety measures to ensure reliable and secure operation. Additionally, considerations regarding regulatory compliance, ethical implications, and public acceptance are also discussed, highlighting the need for a holistic approach to the implementation of UAVs in medical emergencies. In conclusion, the GPS-Based UAV for Medical Emergency Drone represents a significant advancement in emergency medical services, offering rapid response capabilities and enhancing access to critical healthcare resources, particularly in remote or underserved communities. Through continued research, development, and collaboration between stakeholders, the potential of UAVs to transform emergency medical response can be fully realized, ultimately improving outcomes for patients in need of urgent care.

The organizational framework of this study divides the research work in the different sections. The Literature survey is presented in section 2. In section 3 and 4 discussed about Existing and proposed system methodologies. Further, in section 5 shown Simulation Results is discussed and Conclusion and future work are presented by last sections 6.

II. LITERATURE SURVEY

In **Assem Alsawy**; Alan Hicks article "An Image Processing Based Classifier to Support Safe Dropping for Delivery-by-Drone" (published in the International Journal of Engineering and Advanced Technology in 2020) presents a comprehensive study on the design and implementation of a Drone in healthcare facilities. The article highlights Autonomous delivery-by-drone of packages is an active area of research and commercial development. However, the assessment of safe dropping/ delivery zones has received limited attention. Ensuring that the dropping zone is a safe area for dropping, and continues to stay safe during the dropping process is key to safe delivery. This paper proposes a simple and fast classifier to assess the safety of a designated dropping zone before and during the dropping operation, using a single onboard camera. This classifier is, as far as we can tell, the first to address the problem of safety assessment at the point of delivery by-drone. Experimental results on recorded drone videos show that the proposed classifier provides both average precision and average recall of 97% in our test scenarios [1].

In **Sreenivas Eeshwaroju**; Praveena Jakkula “An IoT based Three-Dimensional Dynamic Drone Delivery (3D4) System”Information System & Engineering Management, Harrisburg University of

Science and Technology, Harrisburg, Pennsylvania, USA The article highlights The next decades will witness a huge growth of cities whether from a population or an infrastructure standpoint. Consequently, services like lastmile delivery will be harder to manage and operate due to the complex city ecosystem (people, infrastructure, and services). Due to the increase in population, more high-rise buildings will be seen in cities. In addition, the rapid growth in information and communication technology will require smart ways to meet the delivery needs of people. This paper proposes a “Three-Dimensional Dynamic Drone Delivery (3D4)” system that aims to enable vertical deliveries by adding an extra dimension (Z-axis) to the conventional two-dimensional delivery systems. The proposed system enables the user to receive shipment anywhere as requested [2].

In **Kazuya Matsutani**; Shigetomo Kimura article "Delivery Routing to Reduce Calculation Load of Drones on Divided Logistics Areas for Drone Logistics Networks" (published in the Proceedings of the 6th International Conference on Information Technology for Cyber and Social Computing in 2018) The article highlights the a drone logistics system, a message delivery system in which the drone delivers messages for other users on the way to a parcel delivery destination has been proposed. To reduce the complexity of message delivery routes, this paper proposes a message delivery method that divides logistics areas and determines the message delivery routes in each area. The method also makes it possible for a later departure drone and an early departure drone to exchange information to add, cancel, and/or exchange their messages and delivery points. The simulation experiments show that compared with the previous method, the proposed method has lower computational complexity and can be assumed to cover almost the same the average delivery distance. It is also shown that when an early departure drone and a later departure drone exchange many message delivery points, the average delivery distance is reduce [3].

In **Ishii Keita**; Harashima Katsumi research paper "Optimal Layout of Purchased Delivery Drones at An Outlet Mall" (published in the International Journal of Engineering Research & Technology in 2018). The article highlights the importance of Optimal Layout of Purchased Delivery Drones at An Outlet evaluates highly efficient drone deployment in a drone-based shopping purchase delivery system. This delivery system divides an outlet into multiple areas, and each area has a collection point where shopper's shopping purchases are consolidated. In principle, drones that are not delivering purchases should wait in the area allowed to them. Therefore, the way has shown 13 Autonomous Drone for Delivery of Parcel in Medical Emergencies Department of Electronics & Telecommunication Engineering that efficient delivery efficiency. Simulation experiments have shown that efficient delivery can be achieved when there is a lot of overlap in drone delivery routes. emphasizing the importance of a real-time monitoring system for intravenous drip in healthcare to ensure patient safety and minimize the risk of adverse reactions [4].

III. EXISTING METHOD

Existing methods of GPS-Based UAV for Medical Emergency Drones typically involve the integration of GPS technology with UAV platforms to facilitate rapid and precise delivery of medical supplies to emergency situations. These methods vary in complexity and implementation, but they generally encompass the following key components:

UAV Platform: Existing systems utilize UAVs equipped with GPS receivers for navigation, propulsion systems for flight, and payload compartments for carrying medical supplies. These UAV platforms may range from small quadcopters suitable for urban environments to fixed-wing aircraft capable of covering longer distances in rural or remote areas.

GPS Navigation: GPS technology plays a central role in guiding the UAV to its destination accurately. The UAV's onboard GPS receiver receives signals from satellites to determine its precise location, allowing for autonomous or semi-autonomous flight to predefined coordinates or dynamically generated emergency locations.

Payload Delivery Mechanism: Medical emergency drones are equipped with payload delivery mechanisms that enable the transportation of essential medical supplies to the target location. These mechanisms may include compartments, baskets, or even specialized containers designed to securely transport items such as first aid kits, medication, blood samples, or organs for transplantation.

Communication Systems: Effective communication systems are essential for real-time monitoring and control of UAV operations, as well as for coordination with ground-based emergency responders. These systems may include telemetry links, remote control interfaces, and onboard sensors to relay vital information such as flight status, payload condition, and environmental data.

Safety Features: To ensure the safe and reliable operation of medical emergency drones, various safety features are incorporated into the system. These may include collision avoidance systems, redundant fail-safes, geofencing capabilities to restrict flight to designated areas, and compliance with airspace regulations and aviation standards.

Integration with Emergency Response Infrastructure: Successful deployment of GPS-Based UAVs for medical emergencies requires seamless integration with existing emergency response infrastructure. This involves collaboration with healthcare providers, emergency services, regulatory authorities, and other stakeholders to establish protocols, address logistical challenges, and ensure compliance with legal and ethical considerations.

In this existing system, manual operated drones are designed and it requires human intervention. Human has to be professionally trained to operate these drones.

IV. PROPOSED METHOD

The concept of medical emergency drone assures to avoid the human intervention and provide precision delivery. Thus the proposed drone can help to deliver medical supplies in less time and covering large areas.It can travel to the areas where human can't able to reach. The block diagram of a drone system is shown in figure 1. It shows the different components of the drone and how they are connected. The diagram is made up of different shapes and lines, with labels on each shape to explain what it is.

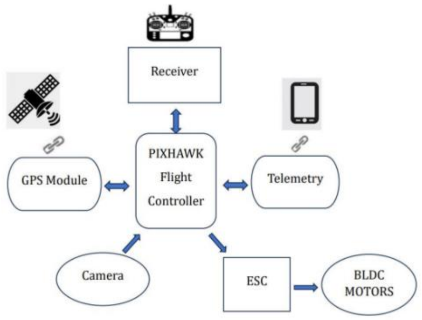

Figure 1. Block diagram of Proposed method

The components of the drone system include a receiver, GPS, camera, ESC, BLDC motors, telemetry, and a Pixhawk flight controller. The receiver is connected to the Pixhawk flight controller, which is connected to the ESC and BLDC motors. The GPS and camera are also connected to the Pixhawk flight controller.

The receiver is a device that receives signals from the remote control and sends them to the flight controller. These signals typically include commands for various drone functions, such as throttle, pitch, roll, and yaw. The receiver then relays these commands to the flight controller.The GPS is used to determine the drone's location and altitude. It relies on signals from multiple satellites to calculate the drone's position with high accuracy. This information is crucial for features like waypoint navigation, return to home, and Geo fencing. The camera is used to capture images and video. Drones can be equipped with various types of cameras, including RGB cameras for photography, and specialized cameras for tasks like thermal imaging or multispectral analysis. The camera's feed is often transmitted to the operator's ground station for real time monitoring or recording.The ESC (Electronic Speed Controller) controls the speed of the motors. An electronic speed controller or ESC is a device installed to a remote-controlled electrical model to vary its motor's speed and direction. It needs to plug into the receiver's throttle control channel. The BLDC motors (Brush-less DC motors) are used to power the drone and provide lift. They are more efficient and durable compared to brushed motors. BLDC motors are often used in combination with propellers to generate thrust and lift, allowing the drone to move in different directions. The telemetry is used to transmit data between the drone and the ground station. It can include information such as battery voltage, GPS coordinates, altitude, and more. Telemetry data is crucial for real-time monitoring, mission planning, and ensuring the drone's safe operation.The Pixhawk flight controller is the brain of the drone, which processes all the data from the sensors and controls the drone’s movement. It processes data from various sensors, including GPS, accelerometer, gyroscopes, and barometers. The flight controller uses this data to stabilize the drone, control its movement, and execute flight plans. It also manages communication with other components like ESCs, GPS, and telemetry.

METHODOLOGY

Requirements Analysis: Define the operational requirements and mission objectives for the medical emergency drone, considering factors such as surveillance range, payload capacity, flight endurance, and environmental conditions.

Component Selection: Research and select appropriate components including Pixhawk flight controller, GPS module, high-resolution camera, receiver module, telemetry system, BLDC motors, and electronic speed controller based on their compatibility, reliability, and performance characteristics.

System Integration: Integrate the selected components into the drone's airframe, ensuring proper wiring, mounting, and compatibility between different subsystems. Configure the Pixhawk flight controller to communicate with the GPS module, camera, receiver, telemetry system, BLDC motors, and electronic speed controller.

Software Development: Develop and customize software algorithms for the Pixhawk flight controller to enable autonomous flight capabilities, waypoint navigation, and mission planning. Implement image processing algorithms to enable real-time video streaming and analysis from the onboard camera system. Develop software interfaces for telemetry data transmission and reception between the drone and ground control station.

Testing and Calibration: Conduct comprehensive testing of the drone's subsystems, including flight control, navigation, camera, telemetry, and propulsion systems. Calibrate sensors, actuators, and communication modules to ensure accurate and reliable operation under various operating conditions.

Flight Testing: Perform flight testing in controlled environments to evaluate the drone's performance, stability, and reliability.Validate autonomous navigation capabilities, waypoint following, and mission execution under realistic scenarios. Collect data on flight parameters, sensor readings, and system behavior for analysis and optimization.

Operational Deployment: Deploy the military security drone in operational environments, adhering to safety protocols and regulatory requirements.Conduct field trials and exercises to assess the drone's effectiveness in fulfilling mission objectives such as surveillance, reconnaissance, and security monitoring. Gather feedback from operators and stakeholders to identify areas for improvement and refinement.

Training and Maintenance: Provide training to operators and maintenance personnel on the operation, maintenance, and troubleshooting of the military security drone system. Establish maintenance schedules and procedures for regular inspection, servicing, and repair of drone components to ensure continued operational readiness.

Continuous Improvement: Continuously monitor andevaluate the performance of the military security drone system in operational deployments.Incorporate feedback and lessons learned to iteratively improve system capabilities, reliability, and effectiveness over time.

FLOW DIAGRAM

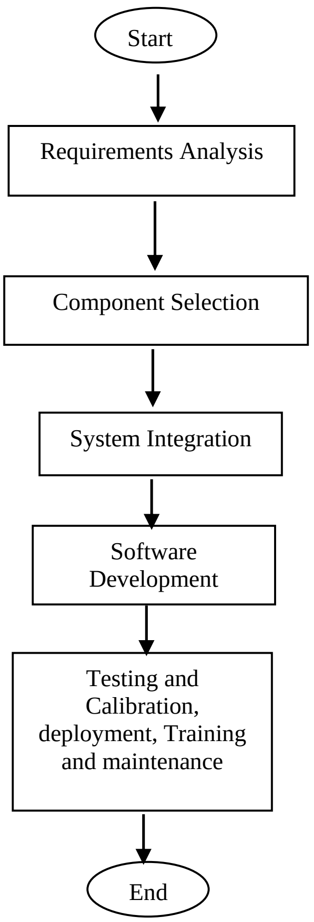

Figure 2. Flow Diagram

Software Requirements:

QGround Control: QGround Control is open-source ground control station software that supports a variety of unmanned systems, including drones equipped with Pixhawk flight controllers, which is consistent with your component list. QGround Control provides a versatile and intuitive interface for mission planning, vehicle setup, and real-time telemetry monitoring. Mission Planner: Mission Planner is a ground control station (GCS) software used in conjunction with unmanned aerial vehicles (UAVs), commonly known as drones. It plays a crucial role in planning, monitoring, and controlling the flight operations of the drone. Its user-friendly interface, real-time monitoring capabilities, and support for autonomous flight contribute to its popularity among drone operators.

V. RESULTS AND DISCUSSIONS

Below are the images captured by the developed proposed model of drone in various stages.The figure 3 shows drone in standby mode. The parameters set in the Qground control software are:

a) Flight speed – 11.2 m/s

b) Altitude – 4m

c) Hold – 3 sec

Figure 3. Drone in standby mode.

The below diagram 4 shows drone in Take-off mode.

Latitude: 13°39'30.59"

Longitude: 79°29'11.63"

Figure 4. Drone in Take-off mode.

The below diagram 5 shows drone in flight mode.

Latitude: 13°39'30.02"

Longitude: 79°29'10.84"

Figure 5. Drone in Flight mode.

The below diagram 6 shows drone in landing mode.

Latitude: 13°39'30.66"

Longitude: 79°29'11.62"

Figure 6. Drone in Landing mode.

The below diagram 7 shows drone in operating mode.

Latitude: 13°39'30.47"

Longitude: 79°29'11.53"

Figure 7. Drone in operating mode.

The various images which are captured using drone are shown in figure 8, figure9.

Latitude: 13°39'30.02"

Longitude: 79°29'10.84"

Figure 8 :Image 1

Latitude: 13°65'83.84"

Longitude: 79°48'64.26"

Figure 9 :Image 2

VI. CONCLUSION AND FUTURE SCOPE

This proposed method is helpful in providing necessary medicines in areas where normal traffic transportation's services are not & also in regions where the geographical terrain is not fit for traditional transportation methods. Secondly, crucial applications comes in emergency situations like floods earthquake etc. where the resident and doctors need vital medicines which can be delivered easily via our medicine drone delivery system. Thirdly, this Drone comes handy in cities also. The rising population and tremendous increase in private vehicles on city roads have increased traffic congestion's making it difficult for the traditional delivery systems to function effectively. Hence this drone finds its application their also.

FUTURE SCOPE

Some key areas of future scope include:

Advanced Navigation and Autonomous Capabilities: Future UAV systems can leverage advancements in GPS technology, as well as complementary navigation systems such as inertial navigation, computer vision, and machine learning algorithms. This would enable UAVs to navigate more accurately and autonomously, even in complex urban environments or adverse weather conditions.

Integration of AI and Robotics: Integrating artificial intelligence (AI) and robotics technologies can enhance the capabilities of medical emergency drones. AI algorithms can optimize flight paths, predict demand for medical supplies, and enable adaptive decision-making in dynamic emergency situations. Robotics can improve payload handling, enable in-flight medical procedures, and enhance interaction with ground-based personnel.

Multi-Modal Transportation: Future UAV systems can incorporate multi-modal transportation capabilities, allowing drones to seamlessly transition between air, ground, and possibly even water-based operations. This would enable UAVs to navigate through diverse terrains and deliver medical supplies to a wider range of locations, including remote or disaster-affected areas.

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