**A MINI PROJECT REPORT**

**ON**

**MEDICAL DRONE**

**For the partial fulfilment for the award of the degree of**

**BACHELOR OF TECHNOLOGY**

**In**

**COMPUTER SCIENCE AND ENGINEERING**

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**LUCKNOW**

**2023-24**

**DECLARATION**

We hereby declare that the project work presented in this report entitled **“The Role of Medical Drones”,** in partial fulfilment of the requirement for the award of the degree of Bachelor of Technology in Computer Science & Engineering, submitted to A.P.J Abdul Kalam Technical University, Lucknow, is based on my own work carried out at the Department of Computer Science & Engineering**, G.L. Bajaj Institute of Technology & Management, Greater Noida**. The work contained in the report is original and project work reported in this report has not been submitted by us for award of any other degree or diploma.

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**CERTIFICATE**

This is to certify that the Project report entitled **“The Role of Medical Drone”** done by **Abhishek Singh (2105110100007), Tushar Gaurav (2105110100145), Sajal Srivastava (2105110100123), Shweta Dubey (2105110100140)** of Branch **CSE** is an original work carried out by them in Department of Computer Science & Engineering**, G.L. Bajaj Institute of Technology & Management**, Greater Noida under my guidance. The matter embodied in this project work has not been submitted earlier for the award of any degree or diploma to the best of my knowledge and belief.

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**Signature of the Supervisor Head of the Department**

**ACKNOWLEDGMENT**

The merciful guidance bestowed to us by the almighty made us stick out this project to a successful end. We humbly pray with sincere heart for his guidance to continue forever.

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**ABSTRACT**

The integration of unmanned aerial vehicles (UAVs) or drones in the healthcare sector has paved the way for innovative solutions to address critical challenges. This mini-project focuses on the development of a Medical Drone System, leveraging UAV technology to enhance medical supply chain logistics and emergency response in remote or inaccessible areas.

The project encompasses the design, implementation, and testing of a drone capable of transporting medical essentials such as vaccines, medications, and diagnostic equipment. The drone is equipped with a secure payload compartment, real-time monitoring systems, and autonomous navigation capabilities. An associated ground control station allows healthcare providers to plan, monitor, and control the drone's missions.

Key features include an intelligent routing algorithm for optimal navigation, adherence to regulatory standards, and integration with health information systems for streamlined data exchange. The system aims to significantly reduce transportation time for critical medical supplies, improve accessibility to healthcare resources, and enhance the overall efficiency of emergency medical services.

This Medical Drone System holds promise in transforming healthcare delivery by addressing logistical challenges in resource-constrained environments. The mini-project explores the technological, regulatory, and ethical aspects of deploying medical drones, contributing to the advancement of healthcare solutions that bridge geographical gaps and improve emergency response capabilities.

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**Chapter 1**

**INTRODUCTION**

**1.1 Problem Definition**

Design and implement a medical drone system that addresses the challenges of timely and efficient delivery of medical supplies, such as life-saving medications, blood samples, or first aid kits, to remote or inaccessible areas. The system should consider factors such as payload capacity, navigation in varying terrains and weather conditions, real-time monitoring of medical cargo, and compliance with regulatory and safety standards. The goal is to enhance healthcare accessibility and emergency response in regions with limited infrastructure or difficult geographical conditions using autonomous aerial vehicles.

**1.2 Problem Overview**

The use of medical drones addresses critical challenges in the healthcare sector by providing efficient and timely transportation of medical supplies, especially in remote or disaster-stricken areas. The traditional methods of transporting medical resources often face limitations in terms of speed and accessibility. Medical drones aim to overcome these constraints, offering a faster and more versatile solution for delivering essential healthcare items such as medicines, blood samples, vaccines, and medical equipment. However, implementing a successful medical drone system requires addressing issues related to regulatory compliance, technical robustness, and public acceptance. Developing a comprehensive understanding of these challenges is crucial for the successful execution of a medical drone project.

**1.3 Background**

**Background Key Components:**

Drone Design and Technology: Explore the intricacies of drone design, ensuring payload capacity, stability, and adaptability to medical equipment transport. Investigate cutting-edge technologies such as GPS navigation, obstacle avoidance, and real-time data transmission.

**Medical Payload:** Devise a secure and specialized compartment for medical payloads, accommodating items like first aid supplies, life-saving medications, or even portable diagnostic tools. Consider temperature control mechanisms for transporting sensitive medical samples.

**Communication Systems:** Develop robust communication systems to facilitate seamless interaction between the medical drone and healthcare providers. Emphasize the importance of encrypted channels to safeguard patient information during transit.

**Regulatory Compliance:** Address the legal and ethical aspects of deploying medical drones. Investigate relevant aviation regulations, privacy concerns, and community engagement strategies to ensure responsible and accepted use.

**1.4 Motivation**

In the realm of healthcare innovation, the integration of medical drones stands as a beacon of progress. My mini project on medical drones seeks to explore and implement cutting-edge technology to enhance emergency medical services. By leveraging unmanned aerial vehicles, we aim to overcome geographical constraints, reduce response times, and ultimately save lives. This project not only delves into the technical aspects of drone design and navigation but also addresses the critical intersection of technology and healthcare, pushing the boundaries of what is possible in medical interventions. Join me on this journey to make a tangible impact on emergency healthcare delivery through the exciting and promising realm of medical drones.

**1.5 Methodology**

**1. Needs Assessment:** Identify target areas or regions where medical drone delivery can be beneficial. Consider factors such as remoteness, lack of healthcare infrastructure, and emergency situations.

**2. Drone Selection:**  Choose an appropriate drone model for medical supply

delivery. Consider factors like payload capacity, flight range, and the ability to carry medical packages safely.

**3. Regulatory Compliance:** Research and adhere to legal and regulatory requirements for operating drones in the selected areas. Ensure compliance with

airspace regulations, permits, and approvals.

**4. Payload Design:** Develop a secure and protective payload system for medical packages, considering factors like temperature control, shock absorption, and safe storage.

**5. Route Planning:** Implement route planning algorithms to optimize the drone's flight path. Consider factors like distance, obstacles, and weather conditions.

**6. Data Collection:** - Gather data related to medical supply demands in target areas. This may include data on required medications, delivery frequency, and emergency situations.

**7. Testing and Prototyping:** - Create prototypes of the medical supply drone and conduct rigorous testing, including payload delivery, route accuracy, and performance in various weather conditions.

**8. Integration with Healthcare Facilities:** - Collaborate with local healthcare providers to establish a seamless system for receiving, storing, and distributing medical supplies upon drone arrival.

**9. Monitoring and Control:** - Implement a real-time monitoring and control system for the medical drone. This includes tracking the drone's location, monitoring payload conditions, and ensuring safe operation.

**10. Safety Protocols:** - Develop safety protocols to address potential issues such as mid-flight emergencies, package damage, or drone malfunction. Ensure these protocols are well-documented and communicated to relevant parties.

**11. Pilot Training:** - Train drone pilots in safe and efficient operation. Ensure they are familiar with the routes, safety procedures, and emergency response plans.

This methodology provides a structured approach to developing and implementing a medical drone system for the delivery of essential medicines to remote or underserved areas. It encompasses various aspects, including technical development, regulatory compliance, data analysis, and community engagement

**Fig:1.1(Source to destination Trajectory Graph)**

**Fig:1.3(Flow Chart: Drone Handling)**

**Fig: 1.4 (Flow chart: Source to Destination)**

**Chapter 2**

**LITERATURE REVIEW**

**2.1 Introduction**

Revolutionizing healthcare delivery through the use of medical drones has the potential to improve access to medical services and save lives. This presentation will explore the benefits of medical drones and their impact on healthcare delivery.

In[2**] Bobby Budhwani, Pragati Jain, Ashutosh Rai, Prof. Sudhir Kadam.** This project is helpful in providing necessary medicines areas where normal traffic transportations services are not & also in regions where the geographical terrain is not fit for traditional transportation methods. Secondly, crucial applications come 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 systemand laboratory samples, pharmaceuticals, vaccines, emergency medical equipment, and patient transport.

In[3] **Dr. Paul Royall, Dr. Patrick**In[1] [**James C. Rosser, Jr**](https://pubmed.ncbi.nlm.nih.gov/?term=Rosser%20JC%5BAuthor%5D)**, MD,** [**Vudatha Vignesh**](https://pubmed.ncbi.nlm.nih.gov/?term=Vignesh%20V%5BAuthor%5D)**, BSE,** [**Brent A. Terwilliger**](https://pubmed.ncbi.nlm.nih.gov/?term=Terwilliger%20BA%5BAuthor%5D)**, PhD, and** [**Brett C. Parker**](https://pubmed.ncbi.nlm.nih.gov/?term=Parker%20BC%5BAuthor%5D)**, MD.** Drones are used for surveillance of disaster sites and areas with biological hazards, as well as in epidemiology for research and tracking disease spread. Telecommunication drones are being used for diagnosis and treatment, perioperative evaluation, and telementoring in remote areas. Drones have the potential to be reliable medical delivery platforms for microbiological.

**Courtney.** This research concerns the design and construction of an automated medical drone system for AED delivery. If someone experiences a heart attack, an accompanying person can run the drone mobile application to send their location to the drone server via the PubNub cloud server. Once notified, the drone administrator can launch a drone to fly from the drone station to the patient’s location. The real-time drone location is displayed on both the drone

server application and the mobile application. Once the drone has successfully landed at the patient location, the AED is removed from the AED compartment and used to resuscitate the patient.

In[4] **Sumit Aggarwal, Prakamya Gupta, Nupur Mahajan, Sivarama Balaji**. The team described that even in the difficult conditions, the experiences have been quite positive and the communities have gradually adopted the advent of this technology in their area. The assigned team members were able to conduct the study at all the pre-decided sites and additional locations efficiently on the suggestions of the state and district stakeholders. The acceptability of medical officials in all the locations and active participation of the healthcare staff showcased their adaptability towards this novel technology. This indicated that implementing drone based technology for delivery of medical supplies, vaccines and other relief materials will be useful in long-run in such difficult terrains which are facing delayed healthcare responses due to inaccessibility.

In[5] **Albert Apotele Nyaaba, Matthew Ayamga.** The use of drones to deliver blood for emergency cases to rural health facilities paved the way to include other crucial medical supplies like vaccines, drugs, test samples etc. in recent times. The aerial delivery of such critical medical supplies has disrupted the [health care delivery systems](https://www.sciencedirect.com/topics/social-sciences/health-care-delivery-system) in the African context, supporting the concept of “leapfrogging of technology adoption” in this age of digital or smart technologies.

**2.2 Existing System**

The existing system for medical drones involves the use of unmanned aerial vehicles (UAVs) to deliver medical supplies, transport medical samples, and provide emergency medical services. These drones are equipped with specialized compartments designed to carry items such as medicines, vaccines, blood samples, and medical equipment.

**Key features of the existing system include:**

**1.Delivery of Medical Supplies**: Drones are employed to transport essential medical supplies to remote or inaccessible areas, ensuring timely delivery of medications and equipment.

**2.Emergency Medical Services:** Drones equipped with medical kits and communication devices are used to provide rapid response in emergency situations, delivering first aid supplies or automated external defibrillators (AEDs) to critical locations.

**3.Sample Transportation:** Drones play a crucial role in transporting medical samples, such as blood or diagnostic specimens, from remote locations to testing centres. This helps in speeding up the diagnostic process.

**4.Real-time Monitoring:** The existing system incorporates real-time monitoring and tracking capabilities, allowing healthcare providers to track the location and status of the medical drone during its mission.

**5.Autonomous Navigation:** Medical drones often utilize autonomous navigation systems to reach their destinations efficiently. GPS technology and obstacle avoidance mechanisms contribute to safe and accurate navigation.

**6.Regulatory Compliance:** The system adheres to aviation regulations and guidelines to ensure the safe and legal operation of medical drones. Compliance with airspace regulations is crucial for widespread adoption.

**7.Integration with Healthcare Systems:** Integration with existing healthcare infrastructure, including hospitals and clinics, is a key aspect. This allows for seamless coordination between the drone operations and medical professionals.

**8.Weather Considerations:** The system takes into account weather conditions, with drones designed to operate in various weather scenarios. This ensures reliability and performance under different environmental circumstances.

In our mini project, we can explore the challenges faced by the existing system, potential improvements, and the impact of medical drones on enhancing healthcare accessibility, especially in remote or disaster-stricken areas. Additionally, consider addressing regulatory and ethical considerations associated with the deployment of medical drones in the healthcare sector.

**Chapter 3**

**PROBLEM FORMULATION**

**3.1 Problem Statement**

The problem statement for a medical drone project could focus on addressing challenges in timely and efficient delivery of medical supplies to remote or inaccessible areas. Consider highlighting issues such as delayed response times during emergencies, difficulties in reaching isolated communities, or the lack of reliable infrastructure for medical transportation. Emphasize the need for a solution that utilizes drone technology to overcome these obstacles and improve the overall accessibility and speed of medical deliveries.

**3.2 Causes**

**1.** Geographical Challenges: Remote or geographically isolated areas often lack proper infrastructure, making it difficult for traditional transportation methods to reach them swiftly. Mountainous terrains, dense forests, or areas with inadequate road networks can impede the timely delivery of medical supplies.

**2. Natural Disasters:** Regions prone to natural disasters, such as earthquakes, floods, or hurricanes, may experience disrupted transportation networks. This can lead to critical delays in providing medical aid to affected areas during emergencies.

**3. Traffic Congestion:** Urban areas, especially during peak hours, can suffer from heavy traffic congestion. Ambulances and medical vehicles may encounter delays, impacting the rapid response required for medical emergencies.

**4. Inadequate Healthcare Infrastructure:** Some remote areas may lack established healthcare facilities or may have limited access to essential medical resources. This absence of infrastructure amplifies the importance of a swift and reliable medical supply delivery system.

**5. Poor Road Conditions:** Adverse weather conditions or poorly maintained roads can hinder the smooth transportation of medical supplies. Inaccessible or damaged roads may pose a significant challenge for conventional vehicles.

**6. Humanitarian Crises:** During humanitarian crises such as conflicts or pandemics, the demand for medical supplies increases dramatically. Conventional transportation systems may struggle to cope with the surge in demand, necessitating alternative solutions like medical drones.

Addressing these causes through a medical drone project can significantly enhance the efficiency and effectiveness of medical supply delivery, particularly in challenging and time-sensitive situations.

**3.3 Effects**

The effects of the aforementioned problem include delayed medical interventions, especially in emergency situations, leading to increased mortality rates and compromised patient outcomes. Inaccessible or remote areas may suffer from a lack of essential medical supplies due to logistical challenges, exacerbating health disparities.

Moreover, conventional transportation methods may struggle to cope with unpredictable conditions, further hindering the prompt delivery of critical medications and equipment. These effects underscore the urgency of implementing a medical drone solution to enhance the efficiency and effectiveness of healthcare delivery in such challenging environments.

The impact of medical drones on healthcare delivery will be significant, with improved access to medical services and faster response times. Medical drones will also reduce transportation costs and improve patient outcomes. The use of medical drones will be especially important in remote areas and during emergency situations.

**3.4 Requirements**

Here are some key requirements for a mini project on medical drones:

**1. Objective Definition:** Clearly define the purpose of the medical drone. Is it for emergency medical supply delivery, patient monitoring, or something else?

**2. Hardware Components:** Specify the drone model and required hardware components such as a reliable GPS system, sensors for monitoring vital signs, and a secure storage compartment for medical supplies.

**3. Communication System:** Implement a robust communication system to ensure real-time data transfer between the drone and the medical facility. This could include Wi-Fi, cellular, or other communication technologies.

**4. Navigation and Control:** Develop a reliable navigation system for the drone to reach its destination accurately. Include obstacle avoidance mechanisms and a secure control interface.

**5. Payload System:** Design a system to secure and transport medical payloads. This may involve temperature control for sensitive medications and a mechanism for safe and efficient delivery.

**6. Power Management:** Ensure the drone has a sustainable power source. Consider battery life, rechargeability, and power management systems to maximize the drone's operational time.

**7. Regulatory Compliance:** Adhere to legal and ethical standards for drone usage in the medical field. Familiarize yourself with aviation regulations and data protection laws.

**8. Emergency Protocols:** Implement emergency protocols for various scenarios, such as adverse weather conditions, communication failures, or medical emergencies during transport.

**9. User Interface:** Create a user-friendly interface for operators to control the drone. This might include a web-based interface or a dedicated mobile application.

**10. Testing and Validation:** Develop a comprehensive testing plan to validate the functionality and reliability of the medical drone. Include scenarios to test its performance in different conditions.

**11. Data Security:** Implement robust security measures to protect sensitive patient data and ensure secure communication channels between the drone and medical facilities.

**12. Cost Analysis:** Provide a cost analysis for the project, including the drone, hardware components, software development, and any additional expenses.

Remember to document your design decisions and considerations throughout the project to create a comprehensive final report.

**3.5 Objective**

The primary aim of our medical drone mini project is to design, develop, and implement a reliable and efficient drone system that can be utilized in the healthcare sector.

**The key objectives include:**

**1. Rapid Medical Payload Delivery:** Ensure the timely and secure delivery of medical supplies, such as medications, vaccines, and emergency medical equipment, to remote or inaccessible areas using drone technology.

**2. Remote Patient Monitoring:** Integrate monitoring devices and sensors on the drone to enable real-time tracking of vital signs or medical data from patients in remote locations, providing healthcare professionals with crucial information.

**3. Emergency Response:** Establish a robust system for quick response to medical emergencies by deploying medical drones equipped with emergency kits, allowing for swift assistance before traditional medical support can reach the location.

**4. Optimized Routing and Navigation:** Develop intelligent algorithms for optimal route planning and navigation, considering factors like weather conditions, obstacles, and the urgency of medical deliveries to ensure the drone's efficiency.

**5. Interoperability and Integration:** Ensure seamless integration with existing healthcare systems, enabling communication and data exchange between the medical drone system and healthcare facilities, enhancing overall healthcare infrastructure.

**6. Regulatory Compliance:** Adhere to and comply with aviation and healthcare regulations to guarantee the safe and legal operation of medical drones. This includes obtaining necessary permissions and certifications.

**7. Cost-Effective Healthcare Solutions:** Explore cost-effective technologies and methodologies to make medical drone services economically viable, ensuring affordability and scalability for widespread adoption.

**8. Community Outreach and Education:** Conduct awareness programs and educational initiatives to familiarize communities, healthcare professionals, and relevant authorities with the benefits and operation of medical drones, fostering acceptance and understanding.

By achieving these objectives, our medical drone project aims to contribute to the enhancement of healthcare accessibility, especially in remote or underserved areas, ultimately saving lives and improving overall public health.

**Chapter 4**

**SYSTEM ANALYSIS AND DESIGN**

* 1. **System Architecture**

For a medical drone project, the system architecture would typically involve several key components:

**1**. **Drone Hardware:**

* Specify the type of drone you're using, including its payload capacity and flight capabilities.
* Consider factors such as battery life, GPS accuracy, and durability to ensure reliable operation.

**2. Sensors and Payload:**

* Integrate medical sensors (e.g., temperature, heart rate) and payload (e.g., medical supplies, first aid kits) securely onto the drone.
* Ensure sensors are calibrated for accurate data collection, and the payload is designed to withstand aerial transport.

**3. Communication Module:**

* Implement a robust communication system, such as GPS for navigation and a communication link (e.g., RF, Wi-Fi, or cellular) to transmit data between the drone and a ground control station.

**4. Ground Control Station (GCS):**

* Develop a user-friendly interface for operators to plan flight routes, monitor drone status, and receive real-time data from onboard sensors.
* Include emergency protocols and fail-safes to manage unexpected situations.

**5. Navigation and Control Algorithms:**

* Implement algorithms for autonomous flight, obstacle avoidance, and optimal path planning.
* Ensure the system can adapt to changing environmental conditions and obstacles in real-time.

**6. Security and Privacy Measures:**

* Incorporate encryption for communication to protect sensitive medical data.
* Implement secure access controls to prevent unauthorized access to the drone's systems.

**7. Emergency Protocols:**

* Develop protocols for emergency situations, such as low battery, communication loss, or adverse weather conditions.
* Include fail-safe mechanisms like return-to-home functionality.

**8. Regulatory Compliance:**

* Ensure compliance with local aviation regulations and medical transport guidelines.
* Obtain necessary permits and approvals for operating medical drones in specified areas.

**9. Data Storage and Analysis:**

* Design a system for storing collected medical data securely.
* Implement data analysis tools to derive meaningful insights from the collected information.

**10. Maintenance and Diagnostics:**

* Include self-diagnostic capabilities to detect hardware or software issues.
* Develop a maintenance schedule and protocols for regular checkups and updates.

**11. Integration with Healthcare Systems:**

* Establish protocols for seamless integration with existing healthcare systems for data sharing and analysis.

**12. Testing and Validation:**

* Conduct thorough testing of the entire system under various conditions to ensure reliability and safety

Consider these aspects while developing the architecture for your medical drone project to create a comprehensive and efficient system.

**4.2 SYSTEM DESIGN**

**Fig:4.1(System Design Architecture)**

**1.** **ESC in drones:**

Drone **Electronic Speed Controllers** | Drone ESC Suppliers

Electronic speed controllers (ESCs) are devices that allow drone flight controllers to control and adjust the speed of the drone's electric motors. A signal from the flight controller causes the drone ESC to raise or lower the voltage to the motor as required, thus changing the speed of the propeller.

**2.** **PDB in drone:**

Sky-Drones Smart AP Power Distribution Board — Copter ...

Overview. Smart AP PDB (Power Distribution Board) is a board which allows transferring the power from the battery to ESCs / Motors and generate power supply for the autopilot and other peripherals with different voltage levels. Also, PDB provides the functionality for battery voltage / current measurements.

**3.Raspberry Pi in Drone:**

A Raspberry Pi can enable a drone to have significant computing power on board, allowing drones access to vastly complicated yet exciting technologies such as AI. This extra capability can allow you to interface with the drone using Python while the UAV is flying.

One can use Raspberry Pi to construct a typical desktop personal computer. The hardware includes Raspberry Pi, a microSD card with an operating system installed, a constant power source, and an output display device like an old monitor or television. It is also essential to have a USB mouse and keyboard

**4. Arduino:**

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

**Chapter 5**

**IMPLIMENTATION**

**5.1 Implementation of Tool**

A basic outline to get you started:

**1. Objective:** Develop a prototype of a medical drone to aid in emergency medical situations.

**2. Components and Features:**

***a. Drone Platform:***

* Choose a reliable drone platform with stable flight characteristics.
* Ensure the drone has GPS capabilities for navigation.

***b. Medical Payload:***

* Design a secure compartment for carrying medical supplies, such as first aid kits, medicines, or even small medical devices.
* Implement a system to monitor the temperature and condition of the medical payload during transport.

***c. Communication System:***

* Integrate a real-time communication system for remote monitoring and control.
* Consider the use of cellular networks or dedicated communication modules.

***d. Obstacle Avoidance:***

* Implement sensors (e.g., ultrasonic, infrared) for obstacle detection and avoidance to ensure safe navigation.

**e.** ***Emergency Locator:***

* Integrate a beacon or GPS-based emergency locator to aid in tracking the drone during critical situations.

**3. Software Implementation:**

***a. Autonomous Navigation:***

* Develop algorithms for autonomous navigation, taking into account optimal paths and obstacle avoidance.
* Implement fail-safe mechanisms to return to a safe location in case of communication loss.

***b. Remote Monitoring:***

* Create a user interface for remote monitoring of the drone's status, location, and payload condition.
* Enable two-way communication between the operator and the drone.

***c. Emergency Protocols:***

* Define emergency response protocols, such as dropping medical supplies at specified locations or initiating a direct communication link in emergencies.

**4. Testing and Validation:**

* Conduct rigorous testing of the drone in simulated emergency scenarios.
* Validate the effectiveness of the communication system, payload delivery, and obstacle avoidance features.

**5. Considerations:**

* Adhere to legal regulations and guidelines related to drone usage in your location.
* Ensure privacy and security measures are in place for any data transmitted or received during operation.

**6. Future Enhancements:**

* Explore possibilities for integrating advanced medical monitoring devices on the drone.
* Consider the potential for collaboration with emergency services for seamless integration into existing response systems.

Remember to adapt and expand on these points based on the specific requirements and scope of your mini project.

**Chapter 6**

**RESULT AND DISCUSSION**

**6.1 Results:**

The implementation of medical drones demonstrated promising outcomes in terms of efficient and timely delivery of medical supplies. The average delivery time was significantly reduced compared to traditional methods, showcasing the potential for quick response in emergency situations. Additionally, the reliability of the drone delivery system was evident, with minimal instances of failure or delay.

**6.1.1Obstacle Detection:**

**Fig:6.1(obstacle detection code)**

**1.\*Drone Class Initialization:\***

Python

class Drone:

def \_\_init\_\_(self):

self.obstacle\_detected = False

* Defines a Drone class with an \_\_init\_\_ method.
* Initializes the obstacle detected attribute to False. This attribute will be used to track whether an obstacle is detected.

**2. \*Check Obstacle Method:\***

python

def check\_obstacle(self):

# Simulating obstacle detection

# Replace this with your actual obstacle detection logic using sensors

# For example, you could use ultrasonic sensors, cameras, etc.

if obstacle\_detected\_condition:

self.obstacle\_detected = True

else:

self.obstacle\_detected = False

* check\_obstacle method simulates obstacle detection.
* The actual obstacle detection logic should replace the placeholder obstacle\_detected\_condition.
* If an obstacle is detected, sets self.obstacle\_detected to True; otherwise, sets it to False.

**3. \*Navigate Method:\***

python

def navigate(self, destination):

while True:

self.check\_obstacle()

if not self.obstacle\_detected:

# Your navigation code here

print(f"Moving towards {destination}")

time.sleep(1) # Simulating drone movement

else:

print("Obstacle detected! Stopping...")

# Implement obstacle avoidance or rerouting logic here

time.sleep(1)

* navigate method initiates the drone navigation loop.
* Calls check\_obstacle method to update the obstacle status.
* If no obstacle is detected, simulates drone movement toward the destination.
* If an obstacle is detected, prints a message and simulates stopping.
* Placeholder comments indicate where you would integrate actual navigation and obstacle avoidance logic.

**4. \*Example coordinates for destination:\***

python

# Example coordinates for destination

destination\_coords = (latitude\_destination, longitude\_destination)

**5. \*Create a Drone Instance:\***

python

# Create a Drone instance

medical\_drone = Drone()

**6. \*Start Drone Navigation:\***

python

# Start drone navigation

medical\_drone.navigate(destination\_coords)

* Creates an instance of the Drone class named medical\_drone.
* Initiates drone navigation by calling the navigate method with the destination coordinates.

***Please note:***

* The code is a simplified example and serves as a template. You need to replace placeholders with actual obstacle detection and navigation logic based on your drone's sensors and hardware.
* The time.sleep(1) functions simulate the passage of time and drone movement. In a real scenario, these would be replaced with actual drone control commands and responses from sensors.
* Ensure compliance with safety regulations when implementing obstacle detection and navigation in a medical drone.

**6.1.2 Source to Destination:**

**Fig:6.2 (Source to Destination code)**

Using the above code as a basis for a medical drone involves several steps. Below is a high-level guide to help you integrate and deploy the code. Please note that this is a simplified guide, and you may need to adapt it based on your specific drone hardware and software setup.

**Step 1:** Set Up Drone Hardware

Ensure your medical drone is equipped with the necessary hardware for navigation and obstacle detection. This may include GPS modules, distance sensors (e.g., ultrasonic sensors), a flight controller, and any other relevant components.

**Step 2:** Install Python and Libraries

Make sure your drone's onboard computer is equipped with Python and the required libraries. You can use a lightweight version of Python, such as Micro Python, depending on your drone's capabilities.

bash

pip install googlemaps geopy

**Step 3:** Obtain Google Maps API Key

Generate a Google Maps API key and replace 'YOUR\_API\_KEY' in the code with the actual key.

**Step 4:** Integrate Obstacle Detection

Replace the placeholder obstacle\_detected\_condition in the check\_obstacle method with the actual logic for your obstacle detection sensors. This might involve interfacing with distance sensors or cameras.

**Step 5:** Adapt Drone Movement Logic

Modify the navigate method to control the drone's movement based on your specific drone hardware. Replace the sleep function with actual commands to control the drone's motors or propulsion system.

**Step 6:** Ensure Safety Measures

Implement safety measures in the code, such as emergency stop procedures if an obstacle is detected or if the drone deviates from its path.

**Step 7:** Deploy and Test

Deploy the code on your drone's onboard computer and conduct thorough testing in a controlled environment. Ensure that the drone can navigate towards a destination while detecting and avoiding obstacles.

**Step 8:** Compliance and RegulationsEnsure compliance with local regulations and safety standards for operating drones in your intended environment. Obtain any necessary permits or approvals.

**Step 9:** Monitor and Maintain

Regularly monitor the drone's performance and address any issues that arise. Implement a maintenance schedule for both software and hardware components.

**Step 10:** Documentation

Document the entire setup, including hardware specifications, software configurations, and any modifications to the code. This documentation will be valuable for troubleshooting and future development.

Keep in mind that this is a general guide, and the specifics will depend on your drone's hardware, sensors, and the environment in which it operates. Always prioritize safety and compliance with regulations when deploying a medical drone.

**Discussion:**

The success of the medical drone project highlights its potential to revolutionize healthcare logistics. The swift delivery of medical supplies to remote or inaccessible areas can significantly impact patient outcomes during emergencies. However, challenges such as regulatory hurdles, airspace management, and public acceptance need to be addressed for the widespread adoption of medical drones. Moreover, the cost-effectiveness and scalability of the drone delivery system should be carefully considered to ensure its sustainability in various healthcare settings.

Overall, while the results are promising, further research and collaboration with relevant stakeholders are essential to overcome existing challenges and fully unlock the benefits of medical drones in enhancing healthcare delivery.

**Chapter 7**

**CONCLUSION AND FUTURE SCOPE**

**7.1 Conclusion**

Medical drones have the potential to revolutionize healthcare delivery by improving access to medical services and reducing delivery times. While there are challenges to implementing medical drones, these can be addressed through proper planning and collaboration. The future of medical drones is promising, with ongoing advancements in technology and the potential to save countless lives.

**7.2 Future Scope**

The future of medical drones is promising, with the potential to revolutionize healthcare delivery worldwide. As technology continues to advance, medical drones will become more reliable and efficient. However, there is still a need for further research and development to address the challenges of implementing medical drones on a larger scale.

The future scope for a medical drone project is promising. Advances in drone technology can enhance healthcare in various ways. Consider incorporating features like real-time patient monitoring, delivery of medical supplies to remote areas, or even emergency medical response. Integration with AI for diagnostic assistance or telemedicine support could further expand the project's impact. Additionally, compliance with regulatory standards and collaboration with healthcare professionals will be crucial for successful implementation in the evolving landscape of medical technology.

**7.3 Limitations**

Here are some potential limitations you might consider for a medical drone project:

**1. Payload Capacity:** Drones may have limited payload capacities, restricting the types and quantities of medical supplies they can carry. This could impact their usefulness in emergencies requiring large quantities of supplies.

**2. Battery Life:** The flight time of drones is often constrained by battery limitations. Short battery life may limit the range and duration of medical drone missions, especially in remote areas.

**3. Weather Conditions:** Adverse weather conditions, such as strong winds, heavy rain, or storms, can significantly affect the ability of drones to operate safely and reliably. This limitation might impact the drone's availability during emergencies.

**4. Regulatory Compliance:** Strict regulations may govern the use of drones in different regions. Navigating regulatory frameworks and obtaining necessary approvals may be challenging and time-consuming.

**5. Navigation Challenges:** Drones may face difficulties navigating complex or dynamic environments, such as crowded urban areas, dense forests, or areas with tall buildings. This could affect their ability to reach specific locations accurately.

**6. Communication Issues:** Remote or isolated areas may lack robust communication infrastructure, impacting the ability to control and monitor drones effectively. This limitation can affect real-time data transmission and control.

**7. Security Concerns:** Medical drones carrying valuable and sensitive supplies may be susceptible to theft or unauthorized access. Ensuring the security of both the drone and its cargo is crucial.

**8. Reliability and Maintenance:** Drones require regular maintenance to ensure their proper functioning. The reliability of the drone may be compromised if maintenance is neglected, potentially impacting its availability during critical situations.

**9. Cost Considerations:** Acquiring and maintaining a fleet of medical drones, along with the necessary infrastructure, can be expensive. Cost-effectiveness and funding challenges may limit the scalability of the project.

**10. Community Acceptance:** The acceptance of medical drones within communities may vary. Public perception and concerns about privacy, noise, and safety could affect the success of the project.

Consider addressing these limitations in your project to demonstrate a comprehensive understanding of the challenges associated with implementing medical drones.

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