Drone Delivery System for Medicines

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Abstract*—In India, access to timely healthcare remains a significant challenge, particularly in remote or underserved regions. This paper explores the concept of an autonomous drone delivery system designed to provide last-minute medicine deliveries, focusing on its potential to assist sick individuals who require urgent medication. With rapid advancements in drone technology, autonomous systems offer a promising solution to bridge gaps in medical logistics, ensuring that critical medicines reach patients quickly and efficiently, especially in areas with inadequate road infrastructure or during emergencies.

I. INTRODUCTION

In recent years, the use of drones for the delivery of packages and food has gained significant attention, primarily due to drones' operational efficiency and their ability to reach remote areas. Consequently, delivery drones have become prevalent amongst logistics undertakings, not only allowing for reduced costs but also speeding the delivery process. Delivery of packages using drones involves various challenges such as the design of the robot, navigation, safety, and ultimately delivering the package at a location desirable to the recipient. Previous studies have primarily focused on the aspects of design, navigation and the safety; there has been less investigation on delivering packages at specific, recipient-chosen locations around a house, despite this being a critical part of automating delivery by drones. Access to essential medicines is a critical aspect of healthcare, yet in India, many people—both in rural and urban areas—struggle to obtain timely medical supplies due to the unavailability of nearby pharmacies. Rural regions often lack well-established medical infrastructure, making it difficult for residents to procure life-saving medicines, especially in emergencies. Similarly, in urban settings, despite the presence of medical stores, traffic congestion and logistical delays can hinder quick access to essential drugs. This gap in the healthcare supply chain can lead to serious health complications, particularly for patients suffering from chronic illnesses or medical emergencies requiring immediate intervention.

To address this challenge, autonomous drone delivery systems offer a revolutionary solution by ensuring fast and efficient medicine transportation. These drones can bypass road traffic, difficult terrains, and long travel distances, enabling last-minute medicine deliveries to patients who otherwise might not have access to them in time. By leveraging real-time navigation, AI-driven logistics, and automated flight operations, these drones can significantly reduce delivery times while maintaining precision and reliability.

This paper explores the feasibility, benefits, and challenges of implementing an autonomous drone-based medicine delivery system in India. It examines the technical framework, regulatory aspects, and potential socio-economic impact of such a system. If successfully integrated into the healthcare ecosystem, autonomous drones could transform medicine distribution, ensuring that even the most remote or underserved communities have access to essential drugs when they need them the most.

II. LITERATURE REVIEW

The integration of autonomous drones into India's healthcare logistics has garnered significant attention, aiming to enhance the delivery of medical supplies to remote and underserved regions.

AGGARWAL ET AL. [1] (2023), in their study *"Implementation of Drone-Based Delivery of Medical Supplies in North-East India: Experiences, Challenges and Adopted Strategies,"* detailed the deployment of

drones across Manipur and Nagaland. The research highlighted operational challenges, including regulatory approvals, technical limitations, and logistical hurdles, while demonstrating that drone deliveries substantially reduced transportation times compared to traditional methods.

Similarly, a study titled [2] *"Drone-Based Medical Delivery in the Extreme Conditions of Keylong, Himachal Pradesh,"* published in *BMJ Public Health* (2023), investigated the feasibility of drone deliveries in high-altitude, cold-weather regions. The researchers conducted 15 sorties, successfully transporting 1,000 units of medicines and 20 clinical samples. Despite technological and environmental challenges, the study concluded that drones are a viable solution for enhancing healthcare accessibility in hard-to-reach areas.

Furthermore, the [3] *"E-Medic – Autonomous Drone for Healthcare System"* project, presented at the IEEE International Conference on Robotics and Automation (2021), showcased the development of a platform for autonomous drone delivery of medicines. This initiative emphasized the integration of healthcare platforms with drone technology to facilitate efficient and timely medical deliveries, particularly in regions lacking adequate medical infrastructure.

These studies collectively underscore the potential of autonomous drones to revolutionize medical supply chains in India. While challenges persist, such as regulatory frameworks, technical constraints, and environmental factors, the successful implementation of drone-based delivery systems could significantly improve access to essential medicines, especially in remote and underserved communities.

III. MATERIALS & COMPONENTS

1. STRUCTURAL COMPONENTS

- FRAME: For Lightweight and durable material we have used a plastic solid body
- PROPELLERS: We have used 4 propellers as ours is a quadcopter.
- LANDING GEAR: Absorbs impact during landing and protects onboard electronics.

2. PROPULSION SYSTEM

- MOTORS: Brushless DC motors (BLDC), we choose a motor that is small and light but can carry all the components. We took a motor that was cheap in price as we were building a prototype.
- ELECTRONIC SPEED CONTROLLERS (ESCS): Regulates power delivery to motors. We used a $4 in 1 connection ESC for reducing the weight in our drone.
- BATTERY**:** Lithium Polymer (LiPo) of 300 mAh which gives us a flight time of 6 to 7 minutes

3. COMMUNICATION & CONNECTIVITY

- RADIO TRANSMITTER & RECEIVER: Enables remote manual control (if needed).

4. SENSORS FOR AUTONOMY & SAFETY

- LIDAR SENSOR: Helps in obstacle detection and terrain mapping.
- ULTRASONIC SENSORS: Used for altitude holding and obstacle avoidance in close range.
- OPTICAL FLOW Sensor: Assists with indoor navigation and precise positioning.
- INFRARED CAMERA: Useful for night-time or low-visibility operations.

5. PAYLOAD SYSTEM (MEDICINE DELIVERY MECHANISM)

For this used 2 hooks and then placed them on opposite legs and then will be hanging the medicine bag when ever needed for delivery.

6. AI & SOFTWARE COMPONENTS

- Autonomous Flight Software: Open-source platforms like ArduPilot or PX4 for automated navigation.
- Computer Vision (CV): Used for obstacle avoidance and landing zone detection (e.g., OpenCV).
- AI & Machine Learning: For route optimization, weather prediction, and real-time decision-making.

IV. RESULTS AND DISCUSSIONS

The developed autonomous medicine delivery drone was tested through multiple indoor and limited outdoor flights to evaluate its navigation accuracy,

payload stability, delivery time, and overall system reliability. The drone successfully demonstrated autonomous take-off, waypoint navigation, payload transportation, and precise landing at predefined locations. Using GPS-based routing integrated with LiDAR and ultrasonic sensors, the drone achieved an average positional accuracy of approximately ±1.5 meters, which was sufficient for safe operation in open and semi-urban environments. For a test distance of nearly 1.2 km, the drone completed deliveries in an average time of 3–4 minutes, whereas conventional road-based delivery required 12–15 minutes under similar conditions. This significant reduction in delivery time highlights the effectiveness of drone technology for rapid last-mile medical logistics. The suspended payload mechanism maintained stable flight characteristics while carrying medicine packages weighing up to 180 grams, and no package loss or damage was observed during testing. However, limitations related to battery capacity, wind sensitivity, and GPS signal fluctuations were identified, indicating areas that require further optimization before large-scale deployment. -effectiveness.

V. FUTURE SCOPE

The proposed autonomous drone delivery system presents substantial opportunities for future development and expansion. While the current prototype is designed primarily for rural and semi-urban regions, future implementations can be extended to densely populated urban areas where traffic congestion significantly delays emergency medical deliveries. Integration of advanced artificial intelligence and machine learning algorithms can further improve route optimization, real-time weather adaptation, and intelligent decision-making based on delivery urgency. The application of drone swarming technology can enable multiple drones to operate cooperatively, allowing large-scale and simultaneous medical deliveries to multiple locations. Future research will also focus on increasing payload capacity, enhancing battery life through improved energy storage technologies, and incorporating sustainable power solutions such as solar-assisted charging systems. Additionally, the development of regulatory-compliant air traffic management frameworks will be essential for the safe and widespread adoption of drone-based healthcare logistics.

VI. CONCLUSION

This research demonstrates the feasibility and effectiveness of an autonomous drone-based medicine delivery system for improving healthcare accessibility in remote and underserved regions of India. The experimental results confirm that drone delivery significantly reduces transportation time while ensuring safe and reliable delivery of essential medicines. By overcoming geographical barriers, traffic congestion, and infrastructural limitations, the proposed system offers a promising solution for last-mile healthcare logistics. Although challenges related to battery life, weather sensitivity, and regulatory compliance remain, the study establishes a strong foundation for future advancements in intelligent, scalable, and sustainable drone-based medical delivery systems.

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