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Autonomous Delivery Drones for LightWeight Payload Transpotation a Comprehensive Review

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Abstract.

Health care services are about to get a new face with the emergence of medical drone delivery services. These drones transport medications, vaccine, and blood to rural areas with unmatched promptness and efficiency. Moreover, these drones minimize human interaction, ensuring both timely delivery of medicines and low costs. When it comes to dealing with a pandemic situation, medical drones could be a better option for the delivery of medicines while adding enhanced effectiveness to emergency patient services, eventually saving thousands of lives. Rather than dealing with traffic or difficult terrain issues, medical delivery services through drones ensure that patients in underserved areas get direct access to medicines from urban health care systems. This significantly impacts health care accessibility while hinting at a brighter future that is rapid and technology-based. Pharmaceutical delivery by drones is more of a need than a solution. These services contribute significantly to ensuring that better health care systems are established with equity. While overcoming the challenges of time, space, and infrastructure, health care technology through drones offers hope for saving lives in emergency situations, eventually changing the perception of the global community with regard to the availability of health care services.. It aims to set a new standard of care that is quick and reliable. However, we need regulations for delivering medications and other supplies to fully realize the potential of drones for global health.

Keywords.medical drones, healthcare logistics, UAVs, emergency response, remote access, healthcare innovation, global health.

1. INTRODUCTION

Logistics and transportation are one of the most fast-evolving sectors in modern times, and autonomous delivery drones-or UAVs-play a vital role in ensuring efficient and flexible delivery. Conventional methods on the ground suffer from a number of disadvantages due to growing traffic congestion and geographical factors. Finding an alternative for fast, reliable, and sustainable last-mile delivery has become necessary. Lightweight delivery drones offer a revolutionary substitute, bypassing traffic and accessing difficult terrain to transport critical lightweight payloads such as medical supplies, documents, and commercial goods[1].

Drones have a strong impact on healthcare logistics by delivering medications and blood to the most rural and/or underserved regions, therefore improving emergency response and saving lives. The other crucial usage of drones would be in general logistics, where they reduce delivery times and lower carbon emissions compared to fuel-based vehicles. The workflow for such operations is guided through GPS and involves some other key security features like digital locker access codes, especially in non-emergency situations[2].

But these have several drawbacks, with short battery life, restricted payload, very susceptible to weather conditions such as strong winds, and regulatory challenges regarding airspace.

The paper was aimed at reviewing autonomous drone technology for lightweight payload delivery. The focus is on hardware, navigation algorithms, and payload handling systems, with benchmarking done on a number of existing systems for performance, power efficiency, and operational feasibility. Thus, it addresses the growing pressures for efficient, reliable, and sustainable delivery, with the positioning of UAVs as a critical enabling component for logistics systems in the future[3].

2. METHODOLOGY OF WORK FLOW

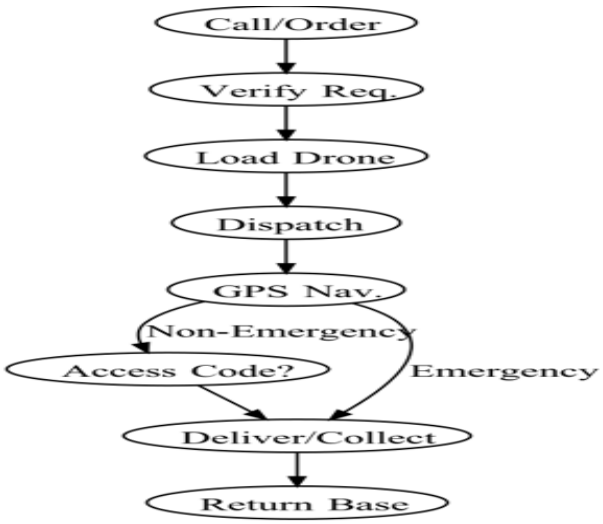

Fig.2.1

The approach makes use of the quadcopter delivery system, which is designed for fast, safe, and efficient transportation of medical supplies over both urban and rural areas. The operational workflow of the approach is presented below and is shown in the figure.

A. Workflow Initiation and Dispatch

B. The process starts with a request of urgency for medical supplies:

1. **Call/Order:** The process is initiated through an emergency call at a designated drone station, such as a hospital in an urban setting, or a request via an online web portal, such as a patient submitting a prescription in a rural setting.

2.**Verify Request (Verify Req.):** This confirms the medical need or prescription.

3. **Load Drone:** The quadcopter is loaded with the appropriate medical payload.

4. **Dispatcher - Dispatch:** This is where the drone is sent on its mission.

B. Navigation and Safety Policy

The drone uses GPS navigation and follows a protocol that changes based on the priority of the delivery:

GPS Navigation: The GPS in the drone system provides greater accuracy for the flights to their final destination.

Decision Point (Emergency vs. Non-Emergency):

Emergency: In the immediate urban response context, this security step is bypassed for the fastest possible deployment and delivery of time-critical cargo.

Non-Emergency: For scheduled or non-critical deliveries-frequently in rural settings-an added security measure is implemented by using a digital locker in the payload compartment.

• Access Code Verification - Access Code?: On non-emergency missions, authentication is needed from the receiver's end. For this, an access code is forwarded to the end-user via SMS or email, which the recipient needs to use to gain access to the digital locker.

C. Delivery and Completion of Mission

Deliver/Collect: The point of arrival itself, the drone achieves its main purpose, which may be delivering the payload to the end-user or collecting samples for return and analysis.

Return Base: This involves the quadcopter making its way independently back to a base station after the completion of delivery or collection.

The structured workflow guarantees quick response time, security due to verification, and efficiency in serving all healthcare needs, whether scheduled or even due to emergencies..

3. REFERENCES

[1] D. Kelemen and S. Szen´ asi, “Optimization and Representation of´ a Network of Food Delivery Drones in Simulation,” in Proc. 2023 IEEE 21st Jubilee Int. Symp. on Intelligent Systems and Informatics (SISY), Pula, Croatia, Sep. 21–23, 2023, pp. 1–7, doi: 10.1109/SISY60376.2023.10417932.

[2] F. Schiano, P. M. Kornatowski, L. Cencetti, and D. Floreano, “Reconfigurable drone system for transportation of parcels with variable mass and size,” arXiv preprint arXiv:2211.09161, Nov. 2022

[3] R. Alshanbari, S. M. Khan, N. El-Atab and M. M. Hussain, "AIPowered Unmanned Aerial Vehicle for Payload Transport Application," in Proc. 2019 IEEE National Aerospace and Electronics Conference (NAECON), Dayton, OH, USA, Jul. 2019, pp. 420–424, doi: 10.1109/NAECON46414.2019.9058320.

[4] V. Hassija et al., “Fast, reliable, and secure drone communication: A comprehensive survey,” IEEE Communications Surveys Tutorials, vol. 23, no. 4, pp. 2802–2832, 4th Quart., 2021, doi: 10.1109/COMST.2021.3119487.

[5] A. Bagloee, M. Tavana, M. Asadi, and S. Pooyan, “Design challenges in drone delivery systems: A comprehensive review,” Sensors, vol.
23, no. 3, p. 1463, Jan. 2023, doi: 10.3390/s23031463

[6] H. Shakhatreh, A. H. Sawalmeh, A. Al-Fuqaha, Z. Dou, E. Almaita,
I. Khalil, N. S. Othman, A. Khreishah, M. Guizani, "Unmanned Aerial Vehicles: A Survey on Civil Applications and Key Research Challenges," IEEE Access, vol. 7, pp. 48572–48634, 2019, doi: 10.1109/ACCESS.2019.2909530.

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