

Review on Light Weight Delivery Drone

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Abstract - — Delivery using drone is one of the most trending topics and is an attraction for all. Many deliveries consist of a small or light weight packages. Since the deliveries are lighter, it is important to consider the aspects such as payload weight, battery life and existing technologies. This paper reviews the existing status of drone assisted delivery. This paper reviews commercial, emergency services and different applications of drone delivery system. This paper also reviews the technologies used in delivery as well as their advantages. Comparing fixed wing and multirotor drone this paper makes an attempt to find out the drone configuration suitable for delivery.

Key Words: drone, UAV, delivery, fixed wing, multirotor

1. INTRODUCTION

Delivery using drone is being accomplished at many commercial platforms including amazon, UPS, DHL, Google and zipline. [1][2] Also, Delivery using drone is conducted for essential services like blood bank, medicinal delivery, flood relief etc. [1][2] The drones can deliver over difficult to travel and hazardous terrain and in case of emergencies such as cardiac arrest equipped with various sensors such as GPS and Camera.[3] Many industries have been using drones for internal logistics and deliveries. This technology has a reach beyond the oceans including the concept of medicinal and cargo delivery in Peruvian amazon rainforest to the practical delivery in Rwanda by Zipline.[4][5] Drone assisted life ring delivery for the rip current to assist life guards is one of new application in drone delivery which suggests there is large untapped potential in the sector of drone delivery.[6]

Thus, beyond the talks of legislations and privacy concerns over drone assisted delivery, the drone has reached people's lives and making a huge impact both commercially and socially.[7] Commonly used delivery configuration for drones include the fixed wing and multirotor drones. In multirotor drones there is also a distinguish according to the number of rotors/motors used for e.g. Quadcopter, Hexacopter, Octacopter etc. Finding out the suitable configuration is necessary as well as addressing the issues related to them is the concern of this paper. Hence this paper is attempting to review different delivery services and issues related to the drone delivery.

2. LITERATURE SURVEY

Eid, S. E., & Sham Dol, S. (2019). [8] In this paper author explained about the design and development of small sized drone which can be used to delivery floating device to the worker drowning during their offshore work like oil rigs. For this purpose, their drone gone through various frame test to get efficient frame design. For examining the structural integrity and flight endurance for a long period of time a computational study of this drone is done. As the location of this places are at remote areas so the flight endurance of the drone is highly tested. By using Acrylic material to design a drone with giving importance to the flight endurance and structural integrity. After passing the stress analysis this drone can be used to deliver flotation device.

Dr. Vinay Pandit, Dr. Arun Poojari (2014) [9] According to the author quadcopter technology uses GPS technology to get access to the delivery location. The parcel can be delivered within the 30 minutes by drone when the parcel should meet certain condition. The order must fit in the cargo box which is attached to drone. It has also some weight limitation up to 5 pounds (2.27Kg) and will come under ten miles(16.09Km) radius.

Anne childhood et al [10] In this paper author discussed about carbon dioxide emission and vehicle miles travelled done by two mode of transport i.e. truck and another is drone. More likely drone is preferred for delivery due to less Carbon dioxide emission as compared to truck. According to this paper, drones are suitable for lightweight and shorter deliveries. They provide an aided advantage of less CO2 emission per VMT. The paper suggests that using the combination of delivery vehicles and drones will be the best for deliveries.

Micheal C.achtelik et al (2011) [11] The paper provides an insight into the design of MAV and their control architecture. This paper also discusses the size, payload and flight time consideration along with position control system. Flight control

In this paper author advocates the use of laser or ultrasonic sensor for height control instead of pressure sensors. A robust mechanical design should be chosen for reliability in different application.

Pranay Gadiya, Et al [12] In this paper author discussed about the delivery of medicines and medical drugs with the

help of drone with video surveillance. In this paper author build a drone which can be given semi auto commands like auto homing by using wireless devices. This drone contains sensor boards, microcontrollers, RF camera, speed controller, Trans-receiver and another component. Author studied flight principle and different component used for stable flight. After studying and designing this delivery drone, this drone is proved that small scale drones can have broad range of applications.

Valentina Gatteschi, Fabrizio Lamberti (2015)[13]

According to the author drone using for delivery can have great applications in research as well as commercial field. To limit the risk of auto delivery of goods by drone different hardware choices are made and the placement and shipment of order is shown. For emergency cases this delivery drones are very useful to deliver drugs which can be used to treat the patient in emergency in the areas which is difficult to reach. Author stated that the drone-based delivery system is easy from legal point of view. Due to the different weights of the product, design of drones should be modified in such a way that delivery becomes fast and feasible.

Jaihyun Lee (2017)[14] In this paper author gives the new design of drone which provides operational benefit like reducing overall fleet size and increase fleet readiness. For delivery using drone author gives potential value of modular design of delivery drone. The given operational method of modular drone help in improving delivery time and make less energy consumption.

The results in the paper shows that if we use dynamic programming and proposed method can be useful for stable drone delivery system. Between comparison of modular and non-modular drone system, modular system is better than non-modular system.

Victor Olivares et al(2015)[15] This paper is trying to address the internal logistic within a plant using UAV. The paper has identified certain requirements which includes vertical takeoff and landing , horizontal flight, speed and precision. The author enlists few advantages of quadcopter design viz low dimension, good maneuverability, simple mechanics and available payload capacity. The paper points out the battery limitation and low payload weight but also anticipates that this limitation will be overcome within few years. Despite this limitations quadcopter proves that it is more advantageous than that of AGV, belt conveyors, and hand truck.

Gordon Ononiwu (2016) [16] This paper deals with the quadcopter for payload delivery and its control design. The control model was modelled for attitude and altitude control. The payload weight selected for the quadcopter was 1.26kg. The control model controls the quadcopter not only in normal conditions but also in presence of external

disturbances. The speed over shorter durations is an advantage which ensures timely delivery.

Vergouw, B et al (2016) [17] Different types of drones with types and payloads are analyzed by the author. According to the author, when compared fixed wing and multirotor drones, multirotor drones are less noisy have capability to hover and doesn't required landing strip while the fixed wing can fly faster and for longer distance. Hence multirotors are better when it comes to precision deliveries for shorter distance.

Sangyoung Park et al (2017) [18] The paper talks about the recent advances in battery system. It also talks about the battery assignment and its advantages in delivery business. Battery management is essential in order to reduce frequent charging, increasing life and cost incurring due to faults. This paper has provided a basis for battery management and assignment by which author claims to have reduces the electricity and battery purchase cost by 25% and average packet waiting cost by 50%.

Maryam Torabbeigi et al [19] While addressing the design of drone assisting parcel delivery the paper talks about Battery Consumption Rates (BCR). The design based on payload-based battery consumption is essential since overestimating the consumption incurs higher cost than required while underestimating it can cause failure. The author has designed an algorithm for scheduling and optimizing BCR based on payload. The author concludes that 3 out of 5 paths are not feasible while planning the flight paths when BCR is not planned.

3. CONCLUSION

The paper has studied the delivery system equipped with drones. While analyzing different drone delivery systems, the problems such as external disturbances such as wind, battery life, drone weight, path of delivery, limitations with respect to delivery path and payload are some of the issues that should be considered for design. The fixed wing drone is suitable for long range, and non-precision deliveries while the multirotor is suitable for short range, lighter, precision and can travel on complicated path. Also, the multirotor does not require a flying strip and is less noisy. Hence multirotors are better for short range, commercial, emergency and precision deliveries and it needs significant developments in the issue found out while the analysis.

REFERENCES

- [1] Murray, C. C., & Chu, A. G. (2015). "The flying sidekick traveling salesman problem: Optimization of drone-assisted parcel delivery." *Transportation Research Part C: Emerging Technologies*, 54, 86–109. doi: 10.1016/j.trc.2015.03.005

- [2] Dorling, K., Heinrichs, J., Messier, G. G., & Magierowski, S. (2017). "Vehicle Routing Problems for Drone Delivery." *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 47(1), 70–85. doi:10.1109/tsmc.2016.2582745
- [3] Claesson, A., Bäckman, A., Ringh, M., Svensson, L., Nordberg, P., Djärv, T., & Hollenberg, J. (2017). "Time to Delivery of an Automated External Defibrillator Using a Drone for Simulated Out-of-Hospital Cardiac Arrests vs Emergency Medical Services." *JAMA*, 317(22), 2332. doi:10.1001/jama.2017.395
- [4] Paredes, J. A., Acevedo, J., Mogrovejo, H., Villalta, J., & Furukawa, R. (2016). Quadcopter design for medicine transportation in the Peruvian amazon rainforest. 2016 IEEE XXIII International Congress on Electronics, Electrical Engineering and Computing (INTERCON). doi:10.1109/intercon.2016.7815570
- [5] Ackerman, E., & Strickland, E. (2018). "Medical delivery drones take flight in east Africa." *IEEE Spectrum*, 55(1), 34–35. doi:10.1109/mspec.2018.824173
- [6] Xiang, G., Hardy, A., Rajeh, M., & Venuthurupalli, L. (2016). Design of the life-ring drone delivery system for rip current rescue. 2016 IEEE Systems and Information Engineering Design Symposium (SIEDS). doi:10.1109/sieds.2016.7489295
- [7] Therese Jones "International Commercial Drone Regulations and Drone Delivery Services." Rand Corporation, Santa Monica, California, USA 2017
- [8] Eid, S. E., & Sham Dol, S. (2019). Design and Development of Lightweight-High Endurance Unmanned Aerial Vehicle for Offshore Search and Rescue Operation. 2019 Advances in Science and Engineering Technology International Conferences (ASET). doi:10.1109/icaset.2019.8714418
- [9] Dr. Vinay Pandit, Dr. Arun Poojari "A Study on Amazon Prime Air for Feasibility and Profitability-- A Graphical Data Analysis." *IOSR Journal of Business and Management (IOSR-JBM)*. Volume 16, Issue 11. Ver. I (Nov. 2014), PP 06-11
- [10] Anne childhood et al "Delivery by drone: An evaluation of unmanned aerial vehicle Technology in reducing CO2 emissions in the delivery service Industry"
- [11] Micheal C.achtelik et al "Design of a Flexible High Performance Quadcopter Platform Breaking the MAV Endurance Record with Laser Power Beaming" IEEE/RSJ International Conference on Intelligent Robots and Systems
- [12] Pranay Gadiya, Et al, "Design, Analysis and Fabrication of QuadCopter for Emergency Medical Services using GPS" *International Journal of research In Mechanical engineering & technology*
- [13] Valentina Gatteschi, Fabrizio Lamberti," New Frontiers of Delivery Services Using Drones: A Prototype System Exploiting a Quadcopter for Autonomous Drug Shipments "2015 IEEE 39th Annual International Computers, Software & Applications Conference
- [14] Jaihyun Lee," Optimization of a Modular Drone Delivery System" IEEE 2017
- [15] Víctor Olivares et al," MODELING INTERNAL LOGISTICS BY USING DRONES ON THE STAGE OF ASSEMBLY OF PRODUCTS" *Information Technology and Quantitative Management (ITQM 2015)* doi: 10.1016/j.procs.2015.07.132
- [16] Gordon Ononiwu," Quadcopter Design for Payload Delivery" *Journal of Computer and Communications*, 2016 <http://dx.doi.org/10.4236/jcc.2016.410001>
- [17] Vergouw, B., Nagel, H., Bondt, G., & Custers, B. (2016). Drone Technology: Types, Payloads, Applications, Frequency Spectrum Issues and Future Developments. *The Future of Drone Use*, 21–45. doi:10.1007/978-94-6265-132-6_2
- [18] Park, S., Zhang, L., & Chakraborty, S. (2017). Battery assignment and scheduling for drone delivery businesses. 2017 IEEE/ACM International Symposium on Low Power Electronics and Design (ISLPED). doi:10.1109/islped.2017.8009165
- [19] Torabbeigi, M., Lim, G. J., & Kim, S. J. (2019). Drone Delivery Scheduling Optimization Considering Payload-induced Battery Consumption Rates. *Journal of Intelligent & Robotic Systems*. doi:10.1007/s10846-019-01034-w