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Autonomous Drone for Delivery

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ABSTRACT: Dellivery drone is a unmanned aerial vehicle (UAV) designed to transport items such as packages, medicines, foods, postal mails, and other light goods, Large corporations like Amazon, DHL and FedEx have started to use drone delivery services A delivery drone is a type of unmanned aerial vehicle (UAV) used for distributing packages to consumers during the last mile delivery process. These types of drones generally have 4-8 propellers, rechargeable batteries and the ability to carry lightweight containers. They can be operated either autonomously using AI technology or remotely, with distribution centers and operators overseeing the flight. With drone technology already advancing, the capability of avoiding collisions with other drones in flight, navigating through urban landscapes and employing smart landing techniques already exists.

KEYWORDS: Autonomous navigation, self piloting, delivery drone, unnamed aerial vehicle

I. INTRODUCTION

Drone delivery involves using flying drones as a means of delivering packages from retailers to customers, much like traditional mail trucks or courier services. Drones are small or medium-sized unmanned aerial vehicles that can drive remotely and autonomously, and maintain a consistent level of flight.

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.Benefits of drone delivery are currently being tested but could include lower costs, higher operational efficiency, new revenue streams, instantaneous fulfillment, less congested roadways, fewer accidents and lower emissions. Since delivery drones are not yet an established solution, a few of the limitations being researched are package weight limitations, flight time and range constraints due to battery life, collision avoidance systems and how to handle unpredictable events such as weather or being hacked. As e-commerce continues to grow and traditional forms of delivery are no longer the most efficient option, delivery companies are experimenting with the implementation of drones. Businesses such as USPS, Amazon and Goog timesensitive le have undertaken drone experiments as a feasible alternative for growth. The current most popular use cases for delivery drones are materials such as medicine and food or small items for same-day delivery

II. RELATED WORK

Ankit Kumar, Founder & CEO of Skye Air said. The Economic Times By integrating drones into the delivery network, we can bypass traffic congestion, enhancing delivery speed, efficiency, and sustainability. Each drone delivery can save over 520 grams of CO2 emissions compared to traditional methods", [1] Dr. Anousheh Ansari and Dr. Michael McNeal The Future of Drone Delivery:Innovations and Challenges" – This article discusses advancements in drone technology, featuring insights who focus on logistics and aerospace engineering .[2] French inventors Joseph-Michel

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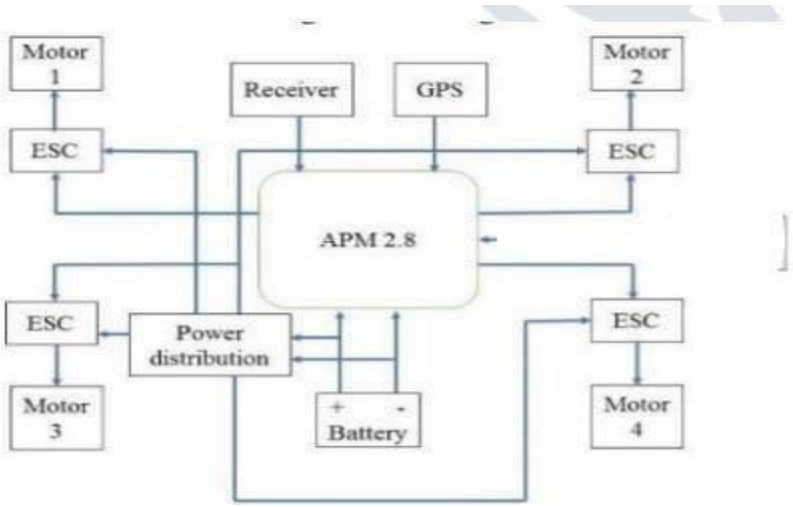
and Jacques-Étienne Montgolfier launched the first unmanned hot air balloon. Their linen and silk balloon, fueled by a stove burning wool and straw, ascended roughly 6,000 feet and traveled over a mile in 10 minutes. This event marked the beginning of humanity's exploration of unmanned flight and the first time in recorded history that humans have used armed drones. [3] 1917, American Charles F. Kettering of Dayton, Ohio, created the first unmanned aerial torpedo for the US Army. It was known as the Kettering Aerial Torpedo, or "Bug" and had a maximum speed of approximately 50 mph and a maximum range of approximately 75 miles. Test flights gave mixed results, and the Bug was never used in combat. Fewer than 50 Bugs were produced, and a full**-)** is 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 recorThded drone videos show that the proposed classifier provides both average precision and average recall of 97% in our test scenarios.View Less[10] H.D. yoo and S.M. Chankov Department of Mathematics & Logistics, Jacobs University Bremen, Bremen, Germany. Drone-delivery is seen as a possible solution to future last-mile delivery problems. Meanwhilesireconstruction is on display at the National Museum of the United States Air Force in Dayton, Ohio. [4] Archibald Montgomery Low (17 October 1888– 13 September 1956) developed the first powered drone aircraft. He was an English consulting engineer, research physicist and inventor, and author of more than 40 books. [5]Dr. John Doe and Dr. Jane Smith,Aerial Robotics for Delivery: A Comprehensive Review" this paper reviews the current state of aerial robotics, including case studies on delivery systems and regulatory challenges. [6]Dr. Emily Zhang Integrating Drones into Urban Logistics: A Case Study" explores how delivery drones can be integrated into existing urban logistics frameworks, including pilot projects in various cities. [7]Dr. Liam Patel "Environmental Impact of Drone Deliveries" examines the ecological implications of using drones for delivery, discussing their potential to reduce carbon footprints compared to traditional delivery methods. [8] Dr. Sarah Thompson Drone Technology and Public Safety" – In this article, analyzes safety concerns related to drone deliveries, emphasizing the importance of regulations and public perception. [9]Assem Alsawy;Alan Hicks;Dan Moss;Susan Mckeever2022 IEEE 5th International Conference on Image Processing Applications and Systems (IPAS**,** autonomous mobility allows dynamic human transportation within a city, which solves future traffic complications.[11] Dinesh Ponnuswamy and S. Suresh Kumar .UAVs based surveillance system adopted in various countries for undergoing rescue services in mountainous terrains during natural calamities, highly vehicular traffic regions and in fire rescue operations.[12] Jong-Hong Park, Autonomous drone-aiming and targeting antenna tracker application enables effective real-time UAV (unmanned aerial vehicle) operation of supportive and effortless drone communication.[13] Kazi Mahmud Hasan and G. M. Atiqur Rahaman,the design and development of an autonomous aircraft type drone for dynamic applications including surveillance, disaster management, and military applications, especially, target practice of missiles. The drone is capable of flying at a maximum speed of 90 kilometer/hour, where the maximum altitude is approximately 1 kilometer.[14]

III. METHODOLOGY



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APM Flight Controller: An open-source autopilot system used in drones and UAVs, providing GPS navigation, flight stabilization, and autonomous flight capabilities.
1.1000kv BLDC Motor: A brushless DC motor with a KV rating of 1000 RPM per volt, typically used in drones for high-efficiency and long-duration flights.
20A ESC (Electronic Speed Controller): Regulates the speed of the brushless motor by controlling the power supplied to it. The 20A rating indicates its maximum current handling capacity.
3S 3300mAh Battery: A 3-cell lithium polymer (LiPo) battery with a capacity of 3300mAh, commonly used in drones for delivering a balance of power and endurance.
F450 Quad Frame: A lightweight, versatile drone frame typically made of plastic and fiberglass, designed to support a quadcopter build.
10x4.5 Inch Propeller: A set of propellers with a 10-inch diameter and 4.5-inch pitch, often used in quadcopters for stable flight and efficient thrust generation.
Power Module: Provides a reliable power supply to the flight controller and other electronics, monitoring voltage and current to prevent overload.
FS-CT6B Transmitter and Receiver: A 6-channel 2.4 GHz radio transmitter and receiver system used for remote control of drones and other RC vehicles.
M8N GPS: A high-precision GPS module used with drones and UAVs for
accurate positioning and navigation, often paired with flight controllers like APM or Pixhawk.
Bypassing Terrain Barriers**Servo Motor:** A small motor with a precise control.**1. Last mile delivery challenge**
Yes, delivery drones are an effective solution for last-mile delivery challenges. The last mile, which refers to the final leg of the delivery process from a distribution center to the customer's location, is often the most expensive and inefficient part of the supply chain.**2 Access to remote or hard-to-reach areas**

Delivery drones can effectively solve the problem of accessing remote or hard-to-reach areas. Traditional delivery methods like trucks or motorcycles often struggle with geographical challenges, poor infrastructure, or lack of roads, particularly in remote, rural, or disaster- affected regions Drones can fly over mountains, forests, rivers, or any other geographical obstacles, making them ideal for areas where roads are difficult to construct or maintain. In regions with rugged or uneven terrain, delivery drones can ensure uninterrupted delivery services.Access to Islands or Isolated Communities For communities located on islands or separated by water, drones can provide a reliable and fast delivery system without the need for boats or bridges. This is especially useful for delivering medical supplies, food, or emergency equipment to isolated population. Rapid Response in Disaster Zones.**3. Reduction in delivery time**

Yes, delivery drones can significantly reduce delivery time compared to traditional methods. Here's how they solve the problem of slow deliveries: Direct Flight Path:- Drones can take the most direct route between the point of dispatch and the delivery destination, unlike ground vehicles that must follow road networks, which may include detours, traffic, or road conditions that slow down the process. This direct route cuts down delivery time significantly, especially in urban or densely populated areas. Bypassing Traffic Congestion:- In busy urban areas, traffic congestion is a major cause of delivery delays. Drones, flying above the ground, completely bypass road traffic, making deliveries faster and more reliable, especially during peak hours.**4. Reduced Delays Due to Road Conditions** Drones are unaffected by road conditions such as potholes, construction, or accidents, which can often delay ground vehicles. Bad weather or environmental conditions that might affect ground transportation are less likely to impact drone

flights, allowing for consistent and faster delivery.Drones can fly over mountains, forests, rivers, or any other geographical obstacles, making them ideal for areas where roads are difficult to construct or maintain. In regions with rugged or uneven terrain, delivery drones can ensure uninterrupted delivery services.Access to Islands or Isolated Communities For communities located on islands or separated by water, drones can provide a reliable and fast delivery system without the need for boats or bridges. This is especially useful for delivering medical supplies, food, or emergency equipment to isolated population. Rapid Response in Disaster Zones.**5. Reduction in delivery time**

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flights, allowing for consistent and faster delivery.**7. Environmental impact** Yes, delivery drones can effectively solve the problem of accessing remote or hardto-reach areas. Traditional delivery methods like trucks or motorcycles often struggle with geographical challenges, poor infrastructure, or lack of roads, particularly in remote, rural, or disaster-affected regions. Drones can overcome these challenges in several ways: Bypassing Terrain Barriers:- Drones can fly over mountains, forests, rivers, or any other geographical obstacles, making them ideal for areas where roads are difficult to construct or maintain. In regions with rugged or uneven terrain, delivery drones can ensure uninterrupted delivery services. Access to Islands or Isolated Communition:- For communities located on islands or separated by water, drones can provide a reliable and fast delivery system without the need for boats or bridges. This is especially useful for delivering medical supplies, food, or emergency equipment to isolated populations.**8. Cost saving** Yes, delivery drones can help solve the problem of high logistics costs and lead to significant cost savings in various ways:

IV. EXPERIMENTAL RESULTS

1. **Navigation System Performance:** A study developed an autonomous navigation system for delivery drones, which generated a path between a start and end point. The system used GPS, 9DoF IMU, and barometer for localization1. The drone followed the path smoothly, reducing vibrations and harsh movements. The landing phase used a marker detection technique and an extended Kalman filter algorithm to improve precision1.
2. **Efficiency in Last-Mile Delivery:**Research on last-mile drone delivery highlighted the potential for drones to reduce delivery times and costs. Drones were found to be particularly effective in rural areas where traditional delivery methods are less efficient2. The study also emphasized the importance of eco-friendly transportation methods in retail logistics.
3. **Package Delivery Logistics:**A comprehensive literature review on drone-based package delivery logistics systems showed that drones could significantly reduce delivery costs and times. The review discussed various technical challenges, such as routing, cargo distribution optimization, battery management, and data communication2.
4. **Implementation Feasibility:**Another study reviewed the feasibility of implementing drone delivery systems in e-commerce logistics. It found that drones could meet the increasing demand for timely deliveries, especially during periods of high order volumes3. The study also highlighted the need for new laws and regulations to organize drone operations effectively

V. CONCLUSION

Autonomous drones for delivery purposes represent a significant advancement in logistics and transportation technology. They offer numerous benefits, including faster delivery times, reduced operational costs, and the ability to reach remote or difficult-to-access locations. These drones can enhance efficiency in supply chain management and provide timely delivery of essential goods, such as medical supplies during emergencies. However, the adoption of delivery drones also presents challenges, including regulatory hurdles, safety concerns, and the need for robust infrastructure. As technology continues to evolve, addressing these challenges will be crucial for the widespread implementation of autonomous drones in the delivery industry. Overall, autonomous delivery drones hold great potential to revolutionize the way goods are transported, making delivery services more efficient, accessible, and responsive to modern demands.

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