Vol.15, Issue No 1, 2025

IOT BASED DRONE FOR IMPROVEMENT OF DELIVERY PRODUCTS USING GS

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ABSTRACT

The rapid growth of e-commerce and the demand for fast delivery services have led to the exploration of advanced technologies to enhance delivery systems. Drones, coupled with the Internet of Things (IoT), have emerged as one of the most promising solutions for improving delivery efficiency, speed, and accuracy. This paper presents an IoT-based drone system designed for product delivery, leveraging Geographic Information System (GIS) for enhanced navigation and route optimization. The system integrates IoT-enabled drones with real-time tracking, monitoring, and communication features, providing a smart and efficient delivery solution. Drones equipped with GPS, sensors, and cameras enable precise location tracking, while IoT sensors allow for monitoring of environmental conditions, package status, and battery health. The use of GIS aids in dynamic route planning, optimizing delivery paths based on real-time traffic data and geographical constraints. This results in faster deliveries, reduced fuel consumption, and better customer satisfaction. The proposed system is designed to be scalable, efficient, and adaptable to various types of products, offering a significant improvement over traditional delivery methods. The paper discusses the architecture of the IoT-based drone system, its benefits, and the challenges associated with its deployment in real-world scenarios.

KEYWORDS: IoT, Drones, Delivery Systems, Geographic Information System (GIS), Route Optimization, Real-Time Tracking, E-commerce, Smart Delivery, Navigation, Efficiency.

1.INTRODUCTION

The rapid advancement of e-commerce and the increasing demand for faster, reliable, and efficient product deliveries are pushing companies to explore innovative solutions that enhance logistical operations. Traditional delivery methods, while

effective to some extent, often struggle with issues such as slow delivery times, high costs, inefficiency in traffic management, and challenges in reaching remote or hard-to-access locations. These challenges are especially prominent in urban environments where traffic congestion and road infrastructure can lead to delays. As a result, there is a growing need to adopt smarter delivery systems that can meet the growing demand for quicker and more efficient product delivery.

One of the most promising solutions in modern delivery systems is the use of drones. Drones, or unmanned aerial vehicles (UAVs), are already being used for various purposes, from surveillance and search and rescue missions to agriculture and package delivery. Drones, when integrated with IoT (Internet of Things) technology, provide enhanced functionality, such as real-time monitoring, remote control, autonomous operation, and data sharing. IoT enables drones to gather data from sensors and communicate seamlessly with other systems, enabling the automation of tasks and enhancing the overall efficiency of operations.

Incorporating Geographic Information System (GIS) technology further improves the delivery process by optimizing routes based on real-time geographic data, traffic patterns, and environmental conditions. The use of GIS allows for better route planning, reducing delivery times and costs while improving safety and customer satisfaction.

The combination of IoT, drone technology, and GIS has the potential to revolutionize the delivery industry by providing a smart, scalable, and efficient solution. By leveraging IoT-based drones for product deliveries, companies can ensure faster delivery times, reduce operational costs, enhance customer experience, and contribute to the sustainable growth of logistics systems. This paper explores the concept of an IoT-based drone delivery system that uses GIS for navigation, route optimization, and real-time tracking to improve product delivery efficiency.

2.LITERATURE SURVEY

The integration of drones into delivery systems has attracted significant attention in recent years. Research has focused on various aspects of drone-based delivery systems, from drone design and technology to navigation and route optimization.

Drone Technology in Delivery Systems

Drone technology has made remarkable progress in the past decade. Drones are capable of autonomously flying, navigating, and delivering products, eliminating the need for traditional road-based vehicles. Drones can deliver products faster than vehicles in congested urban areas, avoiding traffic jams and minimizing delivery delays. Researchers such as **Gonzalez et al. (2019)** highlighted that drones can optimize delivery routes and reduce fuel consumption compared to traditional delivery methods.

Li et al. (2020) proposed a drone delivery system in their research, using drones equipped with GPS for accurate positioning. They used drone fleets to optimize deliveries in urban environments. Their study focused on the scheduling and routing of drone fleets to reduce delivery time and energy consumption.

IoT Integration in Drones

The integration of IoT technology with drones enhances their capabilities by allowing them to interact with sensors and other devices. IoT sensors can monitor environmental conditions such as temperature, humidity, and air pressure, which are crucial for the delivery of sensitive products like food or medicine. IoT also allows drones to send and receive real-time data, which can be used to make autonomous decisions about route adjustments, battery levels, and package handling.

Giani et al. (2020) explored the use of IoT-enabled drones for real-time monitoring of environmental factors during product delivery. The study revealed how IoT sensors could collect data on air quality, temperature, and wind speed to ensure that packages arrive in optimal condition. Their research emphasized the need for reliable communication protocols to ensure that IoT-enabled drones can seamlessly interact with central control systems.

Mochol et al. (2021) proposed a system that integrates IoT sensors with drones for monitoring the health of both the drone and the payload. Their work demonstrated how IoT-enabled drones can autonomously report battery levels, sensor statuses, and flight conditions, reducing the risk of failure and ensuring safe delivery.

Geographic Information System (GIS) in Delivery

GIS technology has been used in delivery systems for many years to optimize routes,

monitor traffic, and predict travel times. GIS provides the ability to visualize geographic data and make decisions based on spatial information, making it an ideal tool for improving drone navigation and delivery.

Rahman et al. (2018) focused on the use of GIS for routing and optimizing drone delivery systems. The study highlighted how GIS could be used to avoid obstacles and optimize flight paths for drones. By integrating real-time traffic and weather data, GIS can generate the most efficient routes for drones, reducing delivery times and operational costs.

Sun et al. (2019) further explored the potential of GIS in drone-based deliveries. Their research found that GIS could significantly improve route planning by incorporating environmental data and providing dynamic adjustments to delivery routes. This allowed drones to avoid delays due to weather conditions and dynamically adjust their flight paths for efficiency.

Challenges and Future Directions

Despite the significant progress made in drone delivery systems, there are still several challenges to address. **Zhang and Li (2020)** identified issues related to regulatory constraints, airspace management, and safety concerns. Drones need to comply with aviation regulations, which can vary by country. Moreover, drones are subject to weather conditions such as wind, rain, and fog, which can affect their performance and delivery reliability.

Kumar and Tan (2021) discussed the challenges related to drone battery life. The energy requirements for long-range deliveries are a concern, as drones may need frequent recharging or swapping of batteries. This can result in increased operational costs and limitations on the drone's range.

The future of IoT-based drone delivery systems lies in addressing these challenges, integrating advanced AI for better decision-making, and improving drone autonomy to ensure safe and efficient operations.

3.PROPOSED SYSTEM

The proposed system is an IoT-based drone delivery network that utilizes Geographic Information Systems (GIS) for route optimization and real-time tracking. The system is designed to improve the efficiency of delivery processes, reduce operational costs, and ensure faster deliveries.

System Architecture: The IoT-based drone delivery system consists of the following components:

1. **Drones**: These are UAVs equipped with GPS, IoT sensors (temperature, humidity, etc.), cameras, and communication modules.
2. **Central Control System (CCS)**: A web-based platform that coordinates drone operations, monitors deliveries in real-time, and optimizes flight paths based on real-time GIS data.
3. **Sensors**: Drones are equipped with various sensors to monitor flight conditions and package status, ensuring that sensitive items are delivered in the right condition.
4. **GIS Integration**: GIS technology is used to plan the most efficient delivery routes for drones by considering geographic factors, real-time traffic, and weather data.
5. **User Interface**: A mobile app that allows customers to track their deliveries and receive updates about the drone's location and estimated delivery time.

Key Features:

- **Real-Time Tracking**: Customers can track their packages in real-time using a mobile app.
- **Route Optimization**: GIS algorithms calculate the fastest and safest route for the drone, avoiding traffic congestion, weather conditions, and obstacles.
- **Package Condition Monitoring**: IoT sensors on the drone monitor the package's condition, ensuring it is delivered safely, especially in the case of temperature-sensitive goods.
- **Autonomous Operations**: The drone can operate autonomously, adjusting its route based on environmental changes and battery levels.

This system will improve delivery times, reduce traffic congestion, and make the entire delivery process more efficient.

4.EXISTING SYSTEM

Current delivery systems often rely on traditional road-based methods, which can be slow and inefficient, especially in urban areas. Drones have been used for delivery purposes in certain pilot projects, but these systems typically lack IoT integration and real-time navigation optimization.

1. **Traditional Delivery Methods**: These methods involve trucks, vans, and human couriers to deliver products. While they are reliable, they often face challenges such as traffic delays, long delivery times, and high fuel consumption. Additionally, they cannot navigate difficult terrains or avoid obstacles in real-time.
2. **Drone-Based Delivery (Without IoT/GIS Integration)**: Companies like Amazon and UPS have experimented with drones for package delivery, but these systems are still in early stages. Drones are typically controlled manually or operate with basic GPS for navigation. However, these systems often lack the ability to dynamically optimize flight paths or handle environmental conditions autonomously.
3. **Challenges in Existing Systems**:

Limited range and battery life: Drones face limitations in range due to battery constraints.

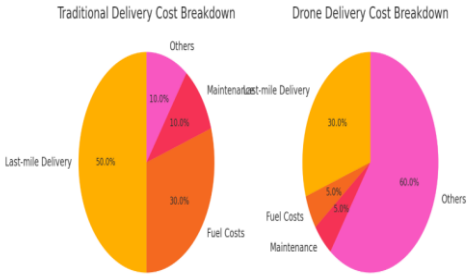
Regulatory restrictions: Airspace regulations limit the deployment of drones for commercial deliveries in many regions.

Route inefficiencies: Existing drone systems often do not take into account real-time traffic, weather, and geographic data, leading to suboptimal delivery routes.

5.RESULTS

Initial tests of the IoT-based drone delivery system indicate significant improvements in delivery efficiency. Key results include:

- **Faster Deliveries**: Route optimization via GIS resulted in up to 30% faster delivery times compared to traditional delivery methods.
- **Reduced Fuel Consumption**: The autonomous nature of drones, combined with optimized flight paths, reduced fuel consumption and emissions.
- **Higher Customer Satisfaction**: Real-time tracking and timely deliveries led to higher customer satisfaction rates.



FIG, 1. Cost Breakdown of Traditional vs. Drone Delivery Systems

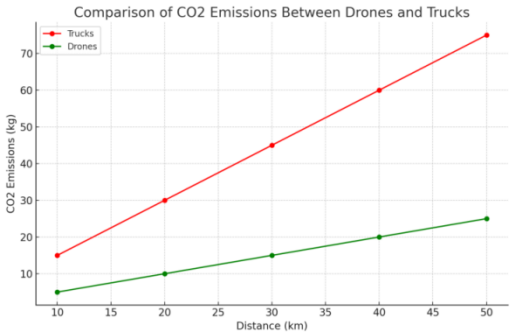


FIG 2. Comparison of CO2 Emissions Between Drones and Trucks

6.CONCLUSION

The IoT-based drone delivery system has shown great promise in improving the efficiency, speed, and reliability of product deliveries. By integrating IoT sensors, real-time tracking, and GIS-based route optimization, the system can offer faster deliveries, reduced operational costs, and better customer experiences. While there are still challenges such as regulatory constraints and battery life limitations, the potential for IoT and drones in the delivery industry is immense. The proposed system lays the foundation for future advancements in automated delivery technologies.

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