

RESEARCH ARTICLE

DRONEX: A Secure Drone-Based Delivery System

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Abstract – In the present scenario, the government and business services are adapted in a fast manner. In this concern, the various mechanisms are incorporated with different technologies in order to bring fastness in executing the services. Though many technologies are present in the current trend, still few flaws have occurred with every technology. Even then, drones are used in many applications such as monitoring natural disasters monitoring and the entertainment industry. In the same way, it is proposed the framework for delivering the product or Intellectual property based on the request made by the customer or user in a secure manner.

Index Terms – Drone, intellectual property, product.

I. INTRODUCTION

Delivering the products to the customers who own them, is an important task in e-commerce. Doing these product deliveries fast and effectively is also very crucial to the business, so that's why recently drones have been introduced that are capable of delivering products. But there are many disadvantages because there is no capable software that has the ability to surpass the operational and technical constraints. So, our framework is advanced software that will drastically improve the control over drones and make them more productive in terms of delivery and logistics.

At present, drones have been developed for their applications in smart cities. With the need for delivering services more rapidly and more efficiently to residents, drones are the best resolution because they have an enormous quantity of potential to help cities better serve the residents. Drones are not only being used to improve city life but also are expected to increase significantly. However, this potential trend would bring both advantages and new challenges for theoretical and practical aspects. Besides, the delivery services must be quicker and more efficient to meet the demands of smart citizens. These demands can be satisfied by applying drones for delivering packages. Because all these drones meet the new standards in security, so these drones are also capable of delivering intellectual

properties and confidential parcels and many more. In this way, the customers may receive the purchased item within minutes, and the delivery cost is less than that provided by traditional logistic networks.

II. LITERATURE REVIEW

Nguyen Dinh Dung, proposes drone-following models for managing drones in the transportation management system in smart cities. These models are based on the initial idea that drones flight towards a leading drone in the traffic flow. **Simon Karanja Hinga**, proposes a bridge to connect actual happening in areas that cannot be navigated easily by security personnel of corporate institution as the Drone will be used to hover and record the actual happening as it transmit to a ground station. **Raja Sengupta**, proposes a safe flight path planning algorithm that allows sufficient time for the sensors for basic operations such as imaging and image processing. Also, this algorithm satisfies the yaw rate and sensor range constraints of the vehicle. **Jyoti Waykule**, proposed an idea Drones can significantly accelerate delivery times and reduce the human cost associated with the delivery and to the drone manufacturers. This report examines the value chain and opportunities in the delivery drone's market. It also discusses the barriers for adoption.

Murray and Chu, proposed the operational challenges associated with drone delivery. The authors suggest a new variant of the Traveling Salesman Problem (TSP), in which a drone is operated from a vehicle to make deliveries. They assume that drones can only depart and land at a customer location. **Hong et al**, develop a maximal coverage location model with a given number of warehouses and charging stations. The objective is to maximize drone coverage while minimizing the average network distance between the warehouse and charging stations.

III. PROPOSED ARCHITECTURE

so, when it comes to this secure drone delivery system [4] framework there will be to aspects and two important things:

- 1) Secure delivery
- 2) Fast delivery

Secure Delivery

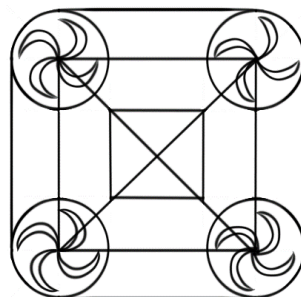


Fig 1: Heavy duty drone

This is a heavy-duty drone, which is built in view, in which the security of a package is more important. A custom developed architecture and new design, makes this drone is capable flying with even bearing 10-15 kgs load.[1] It is not only meant to deliver the heavy Products but also confidential products and intellectual properties, that are very more important to people who really thinks about privacy of their things like for example documents that are confidential and designs related documents and govt related documents.

Specifications of Heavy-Duty Drone

Table 1: Drone Dimensions and Approaches.

Motor Dimensions	58.5*36.5mm
Power	285 KV
Weight	267 g
Current(A)	50.93
Continuous power	1034.0
Internal resistance	46m Ω

Fast Delivery

Now a days faster delivery is one of the important things in e-commerce,[2] if we want to make deliveries faster and more efficient than the conventional delivery methods that means we want also faster drones, sometimes a category of customers like to prefer faster delivery because of several reasons and the product, they ordered is very important, this shows us that the customer gives how much importance to the arrival of the product in time.

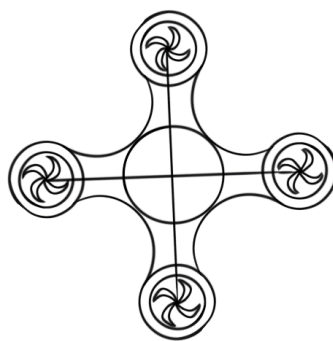


Fig 2: Swifter Drone

Swifter Drone

This is a swifter drone which is built point of view that it should be deliver the product within time. so, to make a drone faster there are standards in the design, because of the swifter drone's

aerodynamic design it flies in the air with very much ease. Because of this Swifter drone’s compact design, it is capable enough to reach very narrow and small places and because of its flexibility it can employed in the medical domain. for example, pharmacy and emergency medical services and continuous inspection of patients in Intensive Care Unit (ICU).

Specifications Of Swifter Drone

Table 2: Swifter drone dimensions and specifications

Motor Dimensions	58.5*36.5mm
Power	320 KV
Weight	81.7g
Current(A)	19.68
Continuous power	432.6 W
Internal resistance	170 mΩ

Generally, when we want to employ the drones in e-commerce and other delivering services the way they sense the environment around them is very important. So how these drones will sense their surroundings and the environment. Both heavy-duty drone and swifter drone are equipped with some sensors that helps drones to sense their surroundings.

1. Gyroscope Sensor

A gyroscope is a device that uses Earth's gravity to help determine orientation. Its design consists of a freely-rotating disk called a rotor, mounted onto a spinning axis in the centre of a larger and more stable wheel. As the axis turns, the rotor remains stationary to indicate the central gravitational pull, and thus which way is down. It helps the drone to track the motion occurring on itself by the gravity. Using this sensor efficiently and working together with the Accelerometer sensor, it provides numerous of applications in case of drones.



Fig 3: Gyroscope sensor

2. Accelerometer Sensor

An accelerometer is a compact device designed to measure non-gravitational acceleration. When the object it's integrated into goes from a standstill to any velocity, the accelerometer is designed to respond to the vibrations associated with such movement. It uses microscopic crystals that go under stress when vibrations occur, and from that stress a voltage generated to create a reading on any acceleration. by using this sensor the drone is able to sense its motion in the air in all 6 axis directions.



Fig 4: Accelerometer sensor

3. CMOS imaging sensor

Now a days imaging sensors are very capable and smart enough to capture detailed videos and images, and when it comes to the drones imaging sensors helps the drone and at the same time the drone pilot. We will use the imaging sensors that are very power efficient and they are CMOS sensors i.e.; Complementary Metal Oxide Semi-conductor.

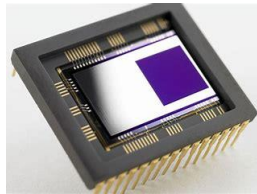


Fig 5: CMOS imaging sensor

4. 3D iToF sensor

The 3D iToF sensor measures the distance between the camera and the object in an instance. It does that by detecting the time difference between the emission of the infrared rays and their return to the sensor after being reflected by the object.



Fig 6: 3D iToF sensor

IV. CHALLENGES & SOLUTIONS

Although there are drones which are used to deliver the products. [3] But there are no sufficient software and technology to operate these drones efficiently. So, we provide features that can be used for drone delivery system, to make it even smarter.

1. Tetheron

It is a custom developed networking software, it is a WLAN network among these drones which tethers the drones by establishing a network among themselves, allowing them to intercommunicate

with other drones. First drone pilots have the access to the Tetheron software, this allows the pilots to know about the state of drone and the path that the drone is choose to deliver the product, also this software allows the drones have access to information about state of other drones. For example, active or inactive states of the internal and both external hardware like propulsors, camera and others peripherals of a drone.

Tetheron is also gives us numerous benefits to us, i.e.; making drones smarter enough to face and solve the real-time problems that may occur to them while flying in the air. Like let us consider a real-time problem, that drones usually come across in all situations is that colliding with fellow drones and objects. For this “Anti-collision” algorithm which is exclusively designed for these drones, which allows them to identify the fellow drones which are very nearer and identify them to avoid the possibility of a collision among them.

2. Smart evade

Another problem that these drones face in real-time are collision with objects in surrounding environment. For example, the drone collides with objects like trees, rocks and any other objects in environment, that possibly causes the damage to the drones. So, for this problem our solution is “**smart evade**”. Smart evade uses the 3D iToF sensor to calculate the distances between the objects and the drone, with the help of semantic segmentation technology to identify the objects with their respective shape and gives them a colour to identify objects that are similar to them. And by calculating distance of that object the drone chooses to evade that object to avoid any possible.



Fig 7: Smart evade

3. Instant drop & payments policy

Both heavy-duty and swifter drones are provided with a cluster of imaging sensors called “Sensing hub” and the sharp LCD visual module, which shows the QR code for the payment of particular product, this allows customer to scan the QR code and make a payment transaction for the product he/she ordered. The drone delivers the package to the person who owns it, if and only if the transaction is successful that the customer paid for the package and the business site received the amount, then only the drone pilot allows the drone to releases the package to the customer.[5]



Fig 8: Instant drop of package

Sensing Hub

A sensing hub is a cluster of imaging sensors, there are two types of sensors

- 1) CMOS imaging sensor : for capturing pictures and videos
- 2) 3D iToF sensor : for depth mapping and semantic segmentation

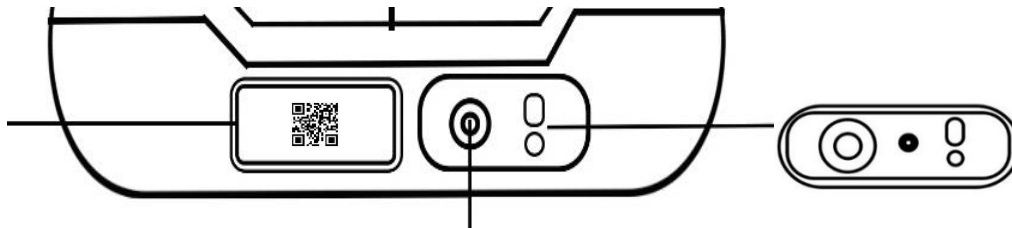


Fig 9: Sensing hub of drones

Interface For Drone Pilots

Drone pilots play a very important role in this secure drone delivery system. The pilot who is operating the drone should be aware of all the features and have knowledge about, how efficiently can the drone do product delivery to the customer. For this we are providing custom-developed software which is exclusively designed for the drone pilots. **“DroneX”** is a custom developed software which is used by drone pilots to control the drones. For the better understanding, for what drones are capable in case of delivering the products and to use drones for efficient, secure , and fast delivery drone pilots will be provided with very elegant and intuitive user interface, that allows drone pilots to achieve better control over the drones, so these drones perfect for delivering the products.

V. EXPERIMENTAL MODEL

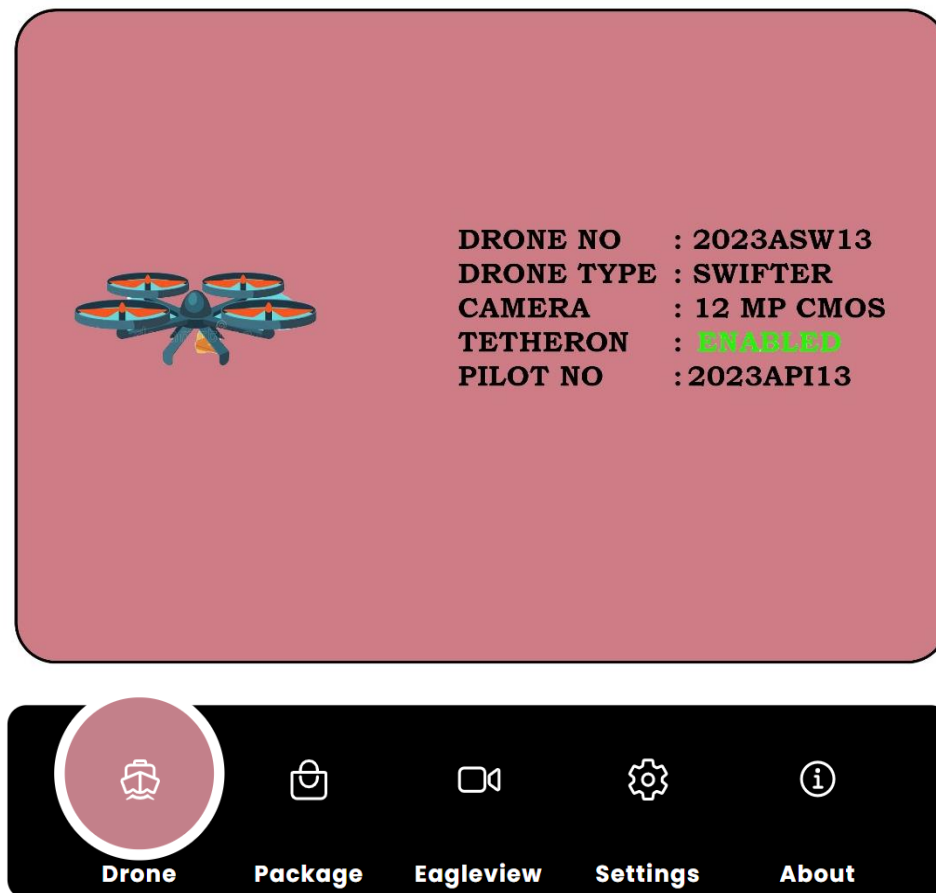


Fig 10: Interface of Tetheron

VI. REVOLUTIONIZING DRONE DELIVERY WITH 5G

With 5G the whole technology world is going to evolve and, when it comes to drone delivery system the communication between the drones and the drone pilot is very crucial. The commands by the drone pilot to operate the drone, they should be with low latency so 5G enables this in case of drone delivery system.

VII. CONCLUSION

In this paper, we proposed a custom developed software's and solutions to the drone delivery system, to make these drones very efficient in terms of package delivery. Although there are many circumstances and challenges in the drone delivery system with the help of above proposed technologies and frameworks, we will surpass the limitations of the logistics and give a break through

for new era where the drone delivery system is employed everywhere, and commercialization of this technology results smart logistics and smart transportation.

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