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Delivery Drone Using GPS and FPV Camera

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Abstract- *Delivery drones are logistical devices that will carry products from a retail outlet to the consumer's address. The GPS is inbuilt within the drone to determine the exact location. There will be a tracking system by which the location of the drone can easily be determined. The package is handed over to the consumer after entering the correct OTP provided by the retailer. The drone will pick up the package from the nearest store of the delivery location and return to the warehouse if not getting the next delivery request. It will be the same as the current delivery system in which the customers are able to trace the location of their order. This technology helps in the fast delivery of medicines, foods, etc in an emergency.*

Keywords *- Drone, GPS, OTP, Delivery, Quadcopter, Autonomous Flight.*

I. INTRODUCTION

It is the powered aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, and can fly autonomously or be piloted remotely, and can carry a small payload.

The present courier delivery system takes time to deliver the order, so to reduce the time, we need to incorporate some technology and the drone is the device that fills this time gap and provides several services like food delivery, medicine delivery, etc in minimum time. Impulse buys will flourish due to the speed of drone delivery. It will be beneficial for consumers and retailers.

The current delivery system is not very efficient. Many times it does not reach the customer due to lack of exact delivery location tracking. It is much slower so that sometimes delivery becomes too late and the customer wants to return the package. And sometimes customers have to move to the delivery location and wait for the delivery. But in the Drone Delivery system the delivery address of the customer can be traced by the GPS which gives the live location of the customer and customers are also able to trace the live location of the drone and the drone delivers the package in the specific time. Customers can get their package without any hassle by verifying OTP.

Fig. 1 Delivery Drone

II. PRINCIPLE OF DRONE OPERATION

The basic principle of a quadcopter - whenever the downward thrust is greater than the gravitational pull then the drone starts lifting upward. A basic drone has four rotors which are attached at the equal distance from the central point where the flight controller is fixed, which is the brain of the drone and all the rotors are in the same plane. For vertical lift two opposite rotors should spin in the same direction, ensuring that the other rotor's momentum remains balanced which is done by spinning the two rotors in the opposite direction. For moving the drone forward and backwards the rotors of the drone should apply thrust which keeps the drone balanced by the spin of the rotors. For landing the speed of the rotor should decrease and the direction should be opposite.

Fig. 2 A Prototype Quadcopter

There are two types of quadcopter working principle. They are -

- " + " configuration : In the + configuration, opposite two motors rotate clockwise and other two motors rotate anti-clockwise. Drone operating motherboard's front will be pointing rotor -1, shown in Fig-3.

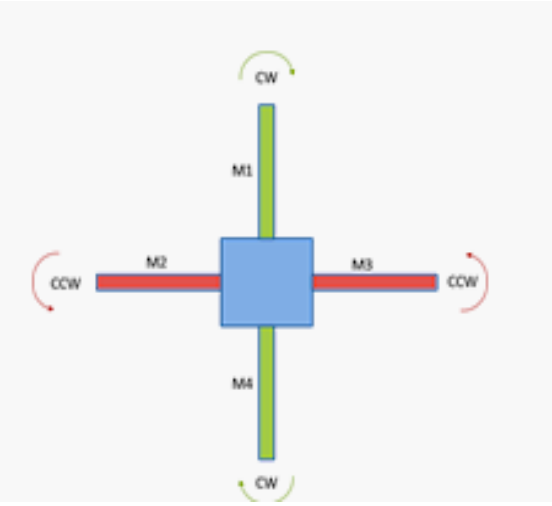

Fig. 3 "+" configuration

- " X " configuration : This configuration is almost the same as " + " configuration. The only difference is the quadcopter operating motherboard's front will be pointing to the direction between rotor-1 and rotor-2, shown in Fig. 4.

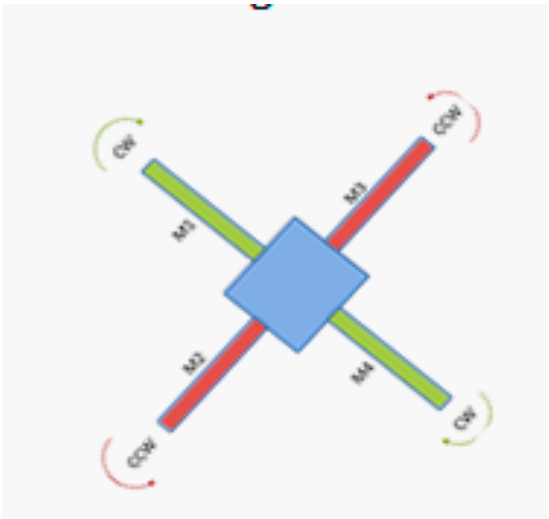

Fig. 4 " X " configuration

III. COMPONENTS USED IN DRONE

The important components used in making delivery drone are -

- Frame
- Motor
- Electronic Speed Controller
- propellers
- Flight Controller
- Power Distribution Board
- Battery
- Battery Monitor
- RC Receiver
- GPS
- FPV camera
- A/V Transmitter

Frame is the part of the drone on which all the other parts are fixed. Motor (rotor) on which the propellers are mounted and it rotates the propellers. The propellers are the most important part of the drone which produces thrust when rotated. Electronic Speed Controller controls the speed and the direction of rotors. The Flight Controller is the brain of a drone which sends the signal to the ESCs and it also controls the GPS and Camera and the RC receiver. Battery Monitor is used to regulate and monitor the battery performance. GPS is used to trace the current location of the drone and it sends the data to the device and server as well so that it can be traced from anywhere and it also helps the drone to maintain its stable condition. FPV Camera is used to avoid any kind of collision and for it is also used for security so that it can record unintended events.

IV. PROPOSED SYSTEM

A. Working of Drone

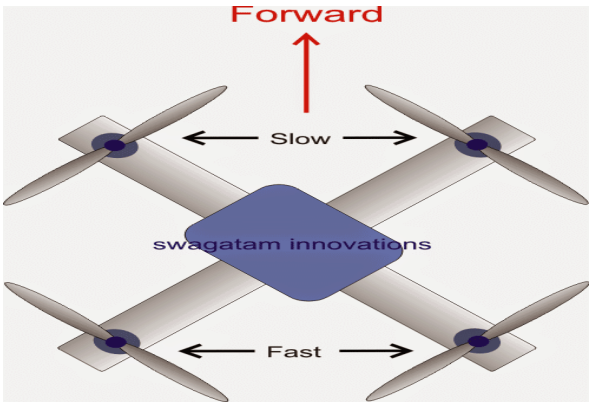

Fig. 5(a) Rotational Direction of Propellers

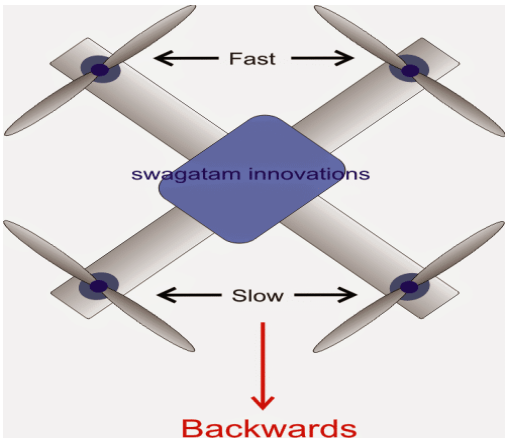

Fig. 5(b) Rotational Direction of Propellers

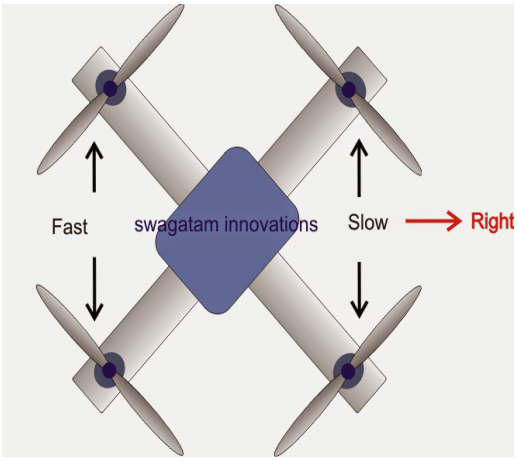

Fig. 5(c) Rotational Direction of Propellers

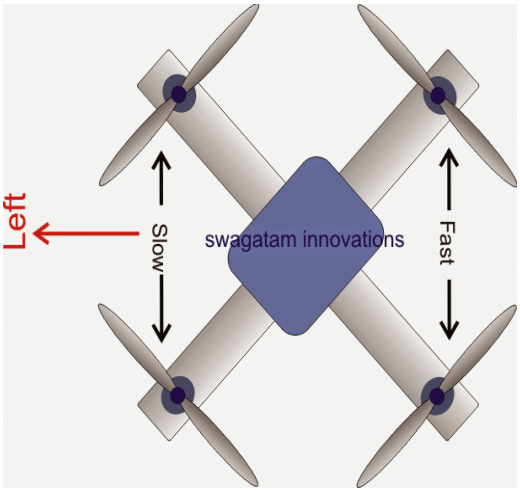

Fig. 5(d) Rotational Direction of Propellers

As from the above figures, by increasing or decreasing the suitable amount of speed of a set of rotors, or tweaking the speeds as per the desire the drone can be made to fly in the sky in any desired direction.

Fig. 5(a) shows that the drone moves forward; it can be achieved by increasing the speed of the backward set of rotors. By doing this, the forward set of rotors become slower than backward and result in forward motion to the drone. For the backward motion the speed of the forward set of rotors should be increased and backwards rotors become slow and the drone moves backwards. Similarly for the right and left direction as shown in fig.5(c) and fig 5(d). However any other odd directions can be achieved by adjusting the appropriate speed of the relevant rotors.

For example, in order to fly the drone in S/W direction then only need to increase the speed of the N/E rotor. Similarly for the other odd directions.

B. Working Module

Fig 6(b) shows flowchart of Working Module of Drones. When a base station receives a request for delivery then the base station allot a available drone for that delivery request and send the delivery details to that drone. After getting the package the drone flies out rising to a higher altitude to avoid obstacles and also the drone will get a disturbance free path at this altitude. After reaching the higher altitude the drone starts tracking the customer location and constantly updates the location as it moves towards the destination, and drone potion can also be tracked by using GPS on the drone. After reaching the exact location the drone will ask OPT from the customer which has been already sent to the customer while booking for the delivery. The customer enters the OPT. After the confirmation of OTP the drone will lower itself and deliver the package and return to the base station. Otherwise, if OTP is not valid then the drone will not lower itself and return back to the base station without delivering the package. The whole drone delivery procedure is shown in Fig. 6(a).

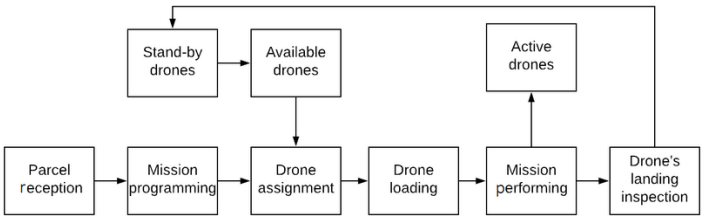

Fig. 6(a) Drone Delivery Procedure

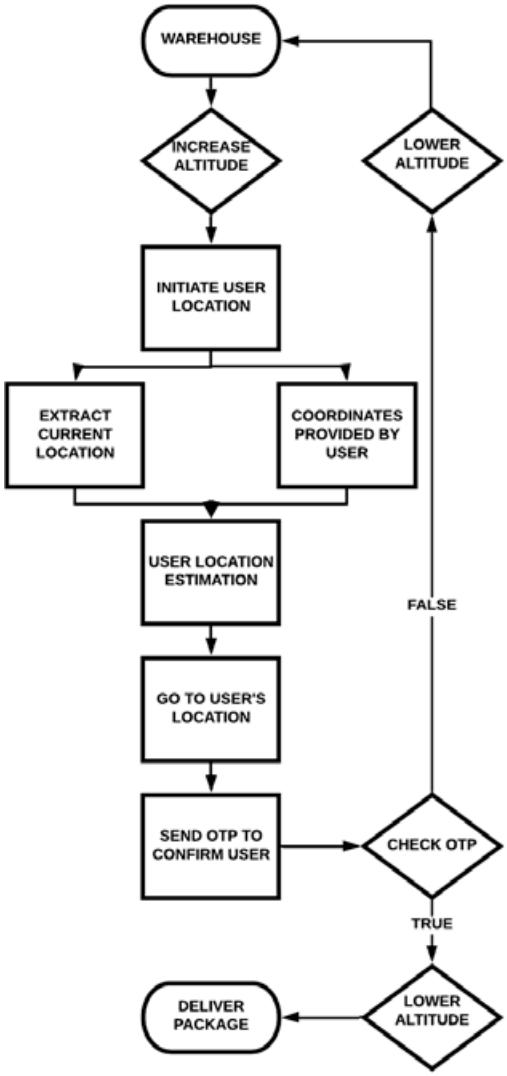

Fig. 6(b) Flowchart of Working Module of Drones

C. Location Tracker

Location tracking is an important part of the delivery system because of this technique the drone is able to get the correct address of the customer and deliver the package to the correct customer. The location tracking system works in such a manner that when a user requests for delivery on that customer also provides the delivery address that address is sent to the available drone. After getting the package the drone will take off and reach upto a safe height then it searches for the user's location and after getting the location it selects the best path. It uses GPS for the live tracking of the user's location. The drone has its base station's location so that it can return after delivery in the same manner. Fig 7 shows the location tracking flowchart.

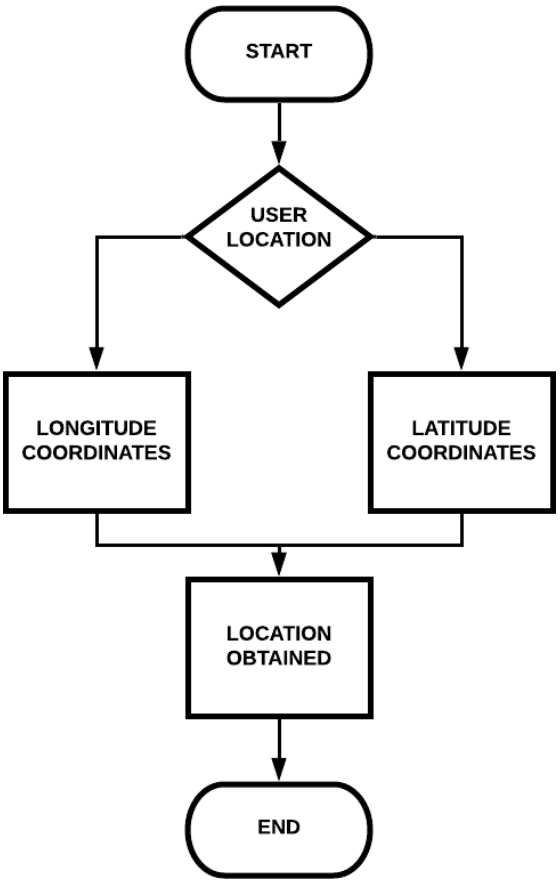

Fig. 7 Location Tracking Flowchart

D. Drone Route

Fig. 8 shows the drone route .In drone delivery system, the drone can not give the maximum efficiency on Google map because it provides a road map but the drone needs different kinds of navigation through which a drone could fly over the buildings and towers so that the drone can choose a short path and deliver the package fast .

Fig. 9 shows the working of drones while selecting the best route to deliver the package to the customer. The drones can automatically choose the best route to reach the customer in a short time. The drone is programmed to avoid any kind of obstacles and can change its path accordingly and with the help of a tracking system it will continuously trace the user's location and move on the path accordingly. The drone is able to change its path but in an optimised manner so that it can minimize the flight time and can deliver the package safely and return to its base station.

Fig. 8 Drone Route

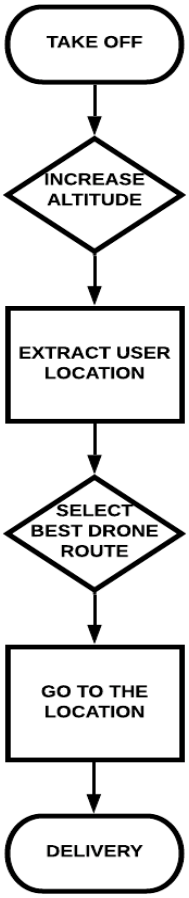

Fig. 9 Flowchart of selection of best route by drone

E. Load Calculation

Let's assume Total empty mass of the drone is 800 gram. The expected maximum payload capacity of the drone has been considered as 300 grams, so the drone must be capable of flying with a total mass of 1100 grams.

Thrust of QC can be expressed,

$$T = \frac{\pi}{4} D^2 \rho v \Delta v \quad (1)$$

Where,
T = Thrust
D = Propeller diameter (m) = 0.3556 m
ρ = Density of air (1.225m kg/cubic meter)

Now,

$$v = 1/2\Delta v$$

Here,
v = Velocity of air at the propeller (m/s)
Δv = Velocity of air accelerated by propeller (m/s)

Putting the value of v in (1),

$$T = \frac{\pi}{8} D^2 \rho x (\Delta v)^2 \quad (2)$$

But power,

$$P = \frac{T(\Delta v)}{2}$$

Putting the value of Δv in (2),

$$T = \frac{\pi}{8} D^2 \rho (\frac{2P}{T})^2$$

$$\text{Or, } T = [\frac{\pi}{2} D^2 \rho P^2]^{\frac{1}{3}} \quad (3)$$

Now, total mass lifted by QC,

$$m = \frac{thrust}{acceleration\ due\ to\ gravity} = \frac{T}{g}$$

$$m = \frac{[\frac{\pi}{2} D^2 \rho P^2]^{\frac{1}{3}}}{g}$$

Again,

$$P = propeller\ constant\ x\ (\frac{rpm}{1000})^{power\ factor}$$

For, APC Electric "E" Series propeller (14" diameter × 10 Pitch), propeller constant is 1.118 and power factor is 3.2.
Here, rpm of the motor = 3350.

$$\text{Hence, } P = 1.118\ x\ 3.35^{3.2}$$

$$= 76.931 \text{ W}$$

Therefore,

$$m = \frac{[\frac{\pi}{2} x 0.3556 x 1.225 x 76.931]^{\frac{1}{3}}}{9.81}$$

$$= 1.15113 \text{ kg}$$

= Empty mass of QC (800 gram) + Payload (351.13 gram)

The results of the calculation of the QC clearly showed that it would be capable of flying with a 300 gram payload safely.

F. Advantage of Delivery Drone

Advantage of proposed system over other methods of package delivery:

- It is fast and reliable
- It reduces the risk of transmission during delivery.

- It will avoid thefts and hassel faced by customers.
- Customers will not have to wait in a fixed location for the package.
- It is robust and spontaneous
- It reduces the delivery cost.
- Can be controlled with voice if AI is used in it.
- Limited physical contact.

V. CONCLUSION AND FUTURE SCOPE

In COVID-19 situation the drone improves the supply chain in an easy manner in most remote areas with little or no manpower and requires the least amount of energy and in minimum time. This pandemic has certainly helped to speed up adoption and uses of drones. The drone delivery system needed less effort, time and energy. Due to these reasons why drones are being adopted worldwide. Medical and Military are the sectors where the drones helped in the emergency. For a more advanced and efficient system, the drones delivery system is going to be implemented with AI which can self process the path and can avoid any living object too.

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