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OPTIMIZATION OF A UNMANNED AERIAL VEHICLE FOR THE LAST MILE DELIVERY

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Abstract - *Unmanned aerial vehicle have recently become a promising solution for rapid parcel delivery due to advances in battery technology and navigation systems. Drones have inherited limitations in battery capacity and payload, which make their efficient operation and management a critical problem for a successful delivery system. With advancing drone technologies and increasing commercial usage, we believe the last mile shipping industry is ripe for disruption by delivery drones. Drones can significantly accelerate delivery times and reduce the human cost associated with the delivery. This paper examines the value chain and opportunities in the delivery drones' market. It also discusses the barriers for adoption. It concludes with our case for drones to handle the last mile of delivery of most lightweight packages.*

Key Words: **Rapid parcel service, Navigation systems, Commercial usage, Accelerate delivery time, Reduced human cost**

1.INTRODUCTION

The internet evolution continues. Whether it is online shopping, ordering food, buying gifts, grocery runs, shipping official or personal packages the consumer space is increasingly relying on fast and reliable door step delivery. The market for delivering goods is massive. Shipping, Logistics, Online shopping businesses are investing heavily in the entire supply chain up to the last mile delivery to make it fast and efficient. Which leads us to believe drones will handle the delivery of most lightweight packages. While 'Drones' have been predominantly used by the military until quite recently, they arrived meanwhile in the civilian domain and in everyday life. Hundreds of thousands of toy drones or quadcopters are around worldwide and we all got used to breath-taking shoots from so far unimagined perspectives. Increasingly we encounter surveillance drones, many of us have already watched a video clip of a "drones' ballet dance" or observed how a tourist films herself with a "flying selfie stick". In many other areas pilot tests are carried out to test the usefulness of drones, for in- stance in agriculture, in the humanitarian and medial sector, for inspection of facilities, in the field of mapping and surveying, and last but not least in research, just to mention a few examples. Furthermore, the large online retailers, a few post enterprises and numerous start-ups worldwide lead us finally to imagine a world, in which everyday commodities will be delivered by drones through the air.

1.1 PROBLEM STATEMENT

These days we are pretty habituated of home- delivery system through e-commerce platform, however there is a big dependency on delivery boys and vehicles for timely delivery of the items. We could potentially use Drones for last mile delivery of items. While current prevalent addressing mechanism such as flat/long and post code are good enough for humans, these won't work for drone delivery as all houses in a multi-storey building will have same flat/long or post-code. Design a solution which can help drones to identify each address / flat as a separate unit and deliver the item accordingly.

2. OBJECTIVE OF THE PROJECT

The purpose of a delivery drone is to provide services for delivering objects or commodities rapidly and in out-of-the-way locations. These unmanned aerial vehicles can be programmed to deliver specific items from their warehouse to a designated area – the address of the individual who ordered the product.

When delivery drones are working to provide services for an organization, then consumers and the employees involved in the process both benefit from the increased efficiency. It allows people to focus on other essential items of the purchasing process. With accurate locating programs, this service offers the potential of a lower error margin assuming that the addresses submitted through a shopping cart are accurate. Consumers receive their goods faster and that leads to higher levels of productivity. The emissions that a delivery drone is responsible for are far fewer than standard packages using traditional delivery mechanisms. There would no longer be a need for airplanes to transport some goods, delivery trucks to offer home delivery, and other fossil fuel costs because warehouses would be conveniently located in most urban areas. That reduces the price of shipping and handling because there are fewer logistics to complete. Although this process could reduce some job opportunities, there would be an increase in positions related to drone programming and maintenance.

3. COMPONENTS

Table -1: List of components

S.No	Parts	Quantity
1	Frame 450	1
2	Motor	4
3	Flight Control Board	1
4	Radio transmitter and receiver	1
5	Propeller	4
6	Battery	1
7	GPS	1
8	Camera	1
9	Telemetry System	1
10	Charger	1
11	Microcontroller.	1

3.1 FRAME

A frame is a structural system that supports the components of a Drone that helps to fly a drone. The Drone frame (f450) built from quality materials. The main frame is glass fibre while the arms are constructed from ultra-durable polyamide nylon. This version of the F450 features integrated PCB connections for direct soldering of your ESCs. This eliminates the need for a power distribution board or messy multi-connectors keeping your electronics layout very tidy. F450 also comes with stronger moulded arms, so no more arm breakage at the motor mount on a hard landing.

3.2 BRUSHLESS MOTOR

A brushless DC electric motor (BLDC motor or BL motor), also known as electronically commutated motor (EC motor) and synchronous DC motors, are synchronous motors powered by direct current (DC) electricity via an inverter or switching power supply which produces electricity in the form of alternating current (AC) to drive each phase of the motor via a closed loop controller.

3.3 ELECTRONIC SPEED CONTROLLER

An electronic speed control or ESC is an electronic circuit that controls and regulates the speed of an electric motor. It may also provide reversing of the motor and dynamic braking.

3.4 BATTERY

Orange batteries are known for performance, reliability, and price. It's no surprise to us that Orange Lithium polymer packs are the go-to pack for those in the know. Orange batteries deliver the full rated capacity at a price everyone can afford.

3.5 GPS

This UNIVERSAL GPS FOLDING ANTENNA BASE SET/BLACK is used to mount GPS device on the flight. GPS devices are most accurate if their antennas have a clear view of the sky. GPS/Compass modules are also prone to the electromagnetic interference generated by motors, ESCs, and radio transmission equipment.

3.6 CAMERA

This is all new High Definition 1200TVL CMOS Camera 2.8mm Lens FPV Camera for FPV RC Drone Quadcopter. It adopts 1/3CMOS SUPER HAD II Image sensor, low illumination reaches up to 0.01Lux/1.2F, easy to setup parameters.

Fig -1: Components

4. WORKING PRINCIPLE

4.1 METHODOLOGY

Fig -2: Work flow

4.2 ARIVAL OF PRODUCT

The product which is ordered by the customer is arrived to the nearest Warehouse which located near the delivery address.

4.3 LOADING OF PRODUCT

Our drone is designed and fabricated in such a way that it can carry approximately 1kg of load excluding the payload will withstand a steady flight motion. The product is loaded in the mechanism we created, which has been attached below the drone. When the product is loaded it does not tend to wobble or damage due to the vibration produced by the drone. Then the Address in the package is fed into the system which is used to create the path to fly the drone within the last mile i.e. in the range of one mile radius from the warehouse to the Apartment Before take-off the drone, it verifies the customer weather his/her is present or not in the apartment. If the customer is present, then the drone is ready to launch, else customer is not available, then the service will move to the next targeted customer.

4.4 TRACKING OF LOCATION

The address fed into the system give the data to the telemetry receiver in the drone and the data is continuously monitored by the GPS system integrated with the navigation system through mission planner. The loaded data on the mission planner software is controlled by a telemetry system. The given data from the mission planner is transmitted by the ground telemetry system to the air telemetry system. The air telemetry system sends the loaded data to the APM 2.8 and it permits the drone to take off. The flight controller (APM) receives the signal input from the receiver and sends the data to the ESC and to the BLDC motor.

4.5 LOCATING THE BUILDING

When the drone reaches the certain altitude, the drone starts to moves at the way point as directed. After the launching of drone the obstacles like trees, birds, street lamps and the electrical wires are been avoided by using the Ultrasonic Sensor. The camera is integrated with mini OSD for the live visual of the flight that is to be seen in the monitor. The location of the individual building or Apartment is obtained by accessing the global positioning system and the altitude by the means of altimeter. After the data is accessed by the drone, the service is done through us, by manually loading the product in the drone. After reaching the location by avoiding the obstacles, it locates the building and intimates the customer that the product is arrived to the location i.e. before reaching the building.

4.6. DELIVERY OF PRODUCT

After landing the drone to the ground level which is maintained at the certain altitude, it intimates the customer to pick up the product by unlocking it from the mechanism fitted in the bottom of the drone. After reaching the location, if the customer is not available to pick up the product after 10 minutes due to some other reasons, the product has to be returned to the warehouse by the above routine process. The product which has been returned to the warehouse, the intimation will be given to the customer to pick up the his/her product from the warehouse.

4.7 SAMPLE IMAGES

These are some of the sample images during calibration of APM and drone

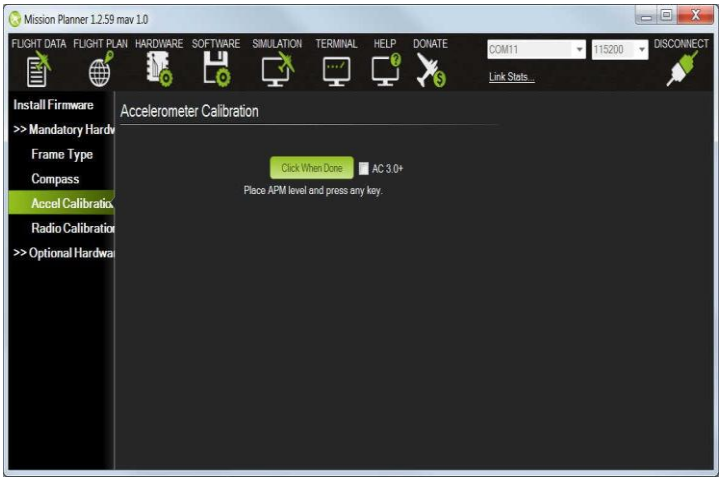

Fig -3: Acceleration calibration

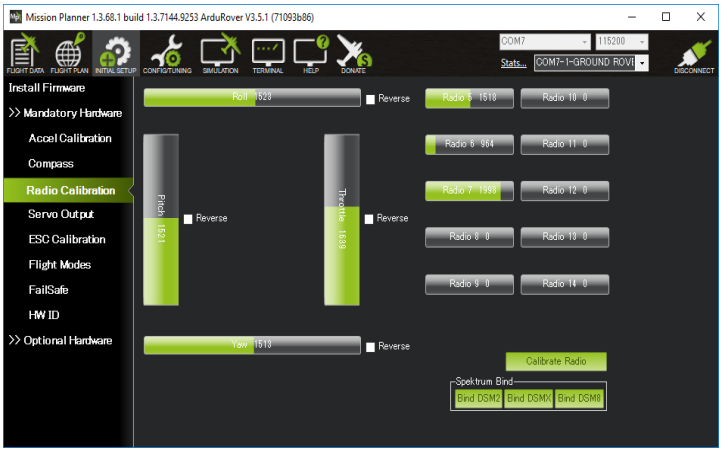

Fig -4: Remote calibration

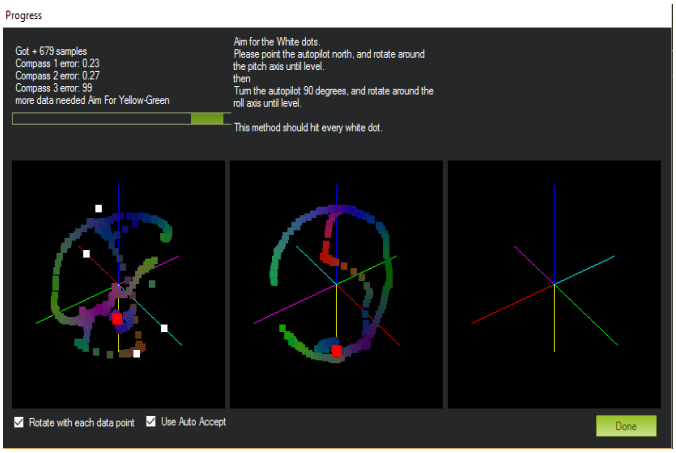

Fig -5: Compass calibration

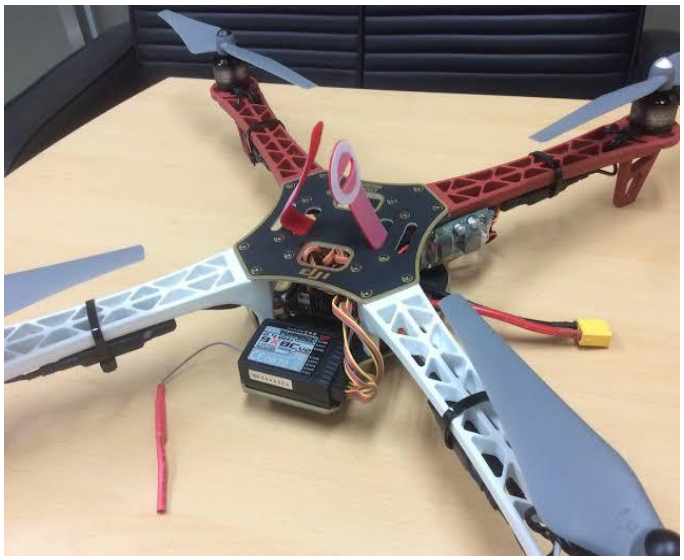

Fig -6: Drone

5. CONTEXT

5.1 SHOW STOPPER

[1] **Fluctuations of RF signals** due to limitations in signal range or signal bandwidth

[2] Abnormal climatic conditions like **heavy rain**, **cyclone**, **snow** etc.... can cause damage to drone components

[3] Abnormal flight direction due to **wrong calibration** of drone

[4] Limitations in **distance** and **time** of flight of drone

[5] **Interruptions** in RF signals due to the many signals of different frequencies

[6] **Always needs** a person with **high technical familiarity** to handle and repair the drone when necessary

5.2 DEPENDENCIES

[1] **GPS** (For Detecting Location)
[2] **GIS** (For Geographic Information)
[3] **Radio Signals** (For Passing Information To Drone)
[4] **LIDAR** (Advanced Technology For 3D Image Processing)
[5] **Camera** (For Visualization)
[6] **IR SENSORS** (For Detecting Obstacles)
[7] **Altimeter** (To Measure Altitude)
[8] **Structure** (Aero Dynamic and Light Weight)

6. POTIENTAL IMPACTS OF DRONE FOR DELIVERY

In this chapter, we give an overview about the possible impacts of the introduction of commercial delivery drones. In this overview study, only a preliminary analysis can be made, which should be explored in a follow-up study. The topics addressed here are: environmental risks, health risks.

6.1 ENVIRONMENTAL ASPECTS

As drones would move in the environment (both natural and man-made) they pose potential risks for it. The first concern is the drones' effect on wildlife, and birds especially. When drones intrude into the habitat of animals, there would be a double risk: either the animals may be harmed, or they could be a threat to the effective operation of drones. Concerning the latter, such scenario has already been documented in Austria when eagles mistook drones for food. Regarding the former, there are concerns that due to the possibility of collision, the safety of birds could be at higher risk (see the related discussion with regard to windmills). Note that it is not only wildlife that could be affected. Depending on the territory the drones would be allowed to fly through, they could have an impact on various range of domesticated animals (pets and farm animals) as well.

6.2 HEALTH AND SAFETY

There are two kinds of health risks resulting from accidents. First, malfunctions of the navigation system, in particular in bad atmospheric conditions, may lead to accidents. In particular in urban areas with a dense population collision of drones with humans are possible and injuries are quite likely, as the rotors are sharp and a loaded drone weighs a few kilograms. As long as delivery drone systems are not in place and also depending on the scenario implemented, it is difficult to estimate the likelihood of accidents for now.

7. CONCLUSION

Drone Delivery is indeed a big leap in the field of logistics, but as excited as we forget our parcels delivered by the air drones, it still has a long way to go! If we talk about the developing country like India, where the roads and traffic are not organized, unmanned air vehicles could prove to be disastrous if not programmed well! Further, air traffic, cybersecurity, hacking, delivery cost, and other concerns should also be considered. Drones are set to become the future of logistics with their reduced cost, higher convenience and delivery times of less than 30 minutes. Both online retailers and brick and mortar stores will adopt it to smoothen their last mile delivery process. Stores like Walmart can experience increased efficiency and convenience with their local presence while online retailers like Amazon can offer quick deliveries at reduced costs. The early adopters will be the winners as they will be able to provide their services at cheaper and quicker rates leading to brand promotion. It is obvious that drone technology is an important part of the future of warfare and is set to become a big commercial industry. The fact that drones' capabilities pose a threat to the liberties of people around the globe is also apparent. Legislating on drones now is of paramount importance because it sets the necessary limitations to protect rights as drones are used in the future.

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