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Development of Drones for Delivery of Essential Medicines in Hilly Areas

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Abstract - *Throughout the globe, access to life-saving and critical health products like delivering of blood and organs to hospitals is delayed by the last-mile problem - the inability to deliver the needed medicine/blood from a city to rural or remote locations because of many such reasons such as inadequate transportation, communication or supply chain infrastructure, etc., To solve this connectivity problem, national drone delivery system needs to be created to carry urgent medicines to patients in need in Hilly and inaccessible areas. In a view, to find solution for this, we designed a drone that can deliver essential medical products such as blood and organs of up to 2.0 kilograms per flight with the cold chain system and has a flight time of about 30 minutes and above as per the requirement .The drone is conceptually designed. It is able to work autonomously. Also, it should be usable in emergencies, and disaster prone areas.*

Key Words: Cold chain, Pixhawk, LiDAR, Mission planner, Peltier module, Thermostat

1.INTRODUCTION

Our main aim is to construct an autonomous hybrid power generator powered quadcopter for Delivery of Essential Medicines by Drones in Hilly Areas capable of lifting upto 2Kg payload and with an endurance of 30 Min Flight time. Also, it should be capable of maintaining a cold chain (2 Degree to 8 Degree Celsius) for storing vaccines such as DPT, DT, TT, Measles, BCG, Hepatitis B.

Firstly, the major requirement of this service is for those patients who are under long term medication in such areas where there is not a proper transportation facility. Secondly, in hill station hospital whenever there is a need for blood or organ donation and also in need of some emergency situations we can use this kind of service than by transporting it through road which consumes a lot of time.

2. LITERATURE SURVEY

Pragathi Jain, Ashutosh Rai, Bobby Budhwani in their medicine delivery drone they have used battery to produce necessary power to the motor, in case of our drone the flight time is for about 30 minutes and above. And on using extra batteries simultaneously the weight increases. So, here we used hybrid generator that could provide necessary power input for the drone [1]. Luke Kamrath, James Hereford included that due to addition of extra sensors, large amount of side drift was observed and elimination of drift is much difficult. In case of, our drone, we have used limited number of sensors for autonomous flying and for navigation purpose [2]. Moulesh Kumar, Nitish Kumar, Dr T H Sreenivas used Raspberry pi for navigation purpose, instead in our drone, Pixhawk flight controller with GPS module and Pixhawk compatible LiDAR is used [3]. Anurag Singh Rajpoot, Namrata Gadani, Sagar Kalathia in their work included the advantage of brushless DC motor that current can be easily connected with the armature which can produce high Thrust to Weight Ratio [4].

3.METHODOLOGY

3D models are designed by using Autodesk Fusion 360 software. Fusion 360 is a 3D designing and modelling tool for product development developed by Autodesk. Here, we have designed 3D models of frame and payload box in fusion 360. And, Mission planner is a software used for creating waypoint. Through that predefined path, the quadcopter will be directed.

4. DRONE COMPONENTS SPECIFICATIONS

The working and operation of each hardware components and software are given below

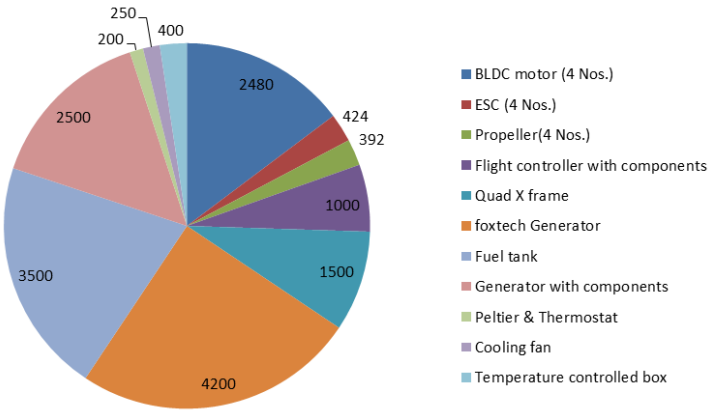

Chart-1: Mass of Drone components (In grams)

4.1 FRAME

Frame we will be using is a CAD designed 3D printed frame, which is capable to hold all components over it including payload and cooling system, also with landing gear.

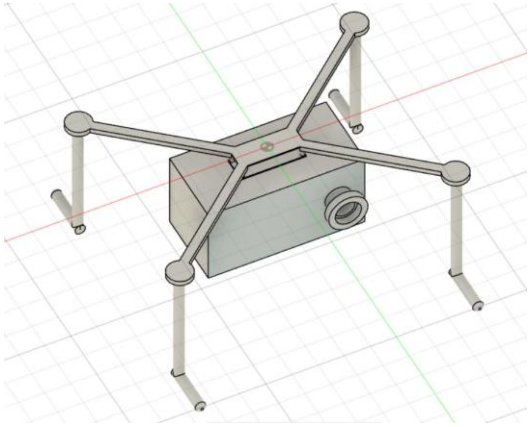

Fig.4.1.1. CAD design of frame and payload box

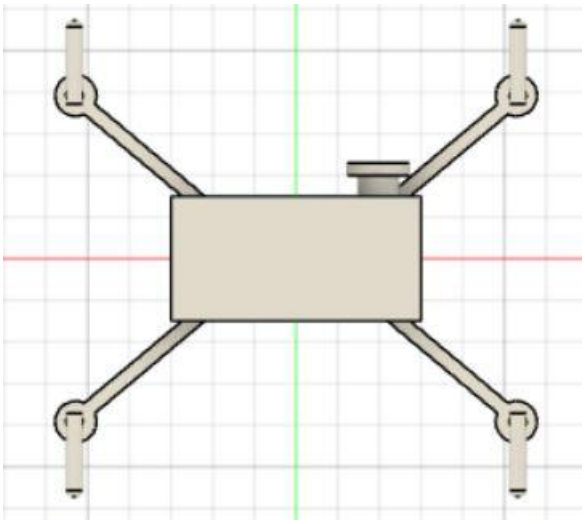

Fig.4.1.2. Bottom view of frame

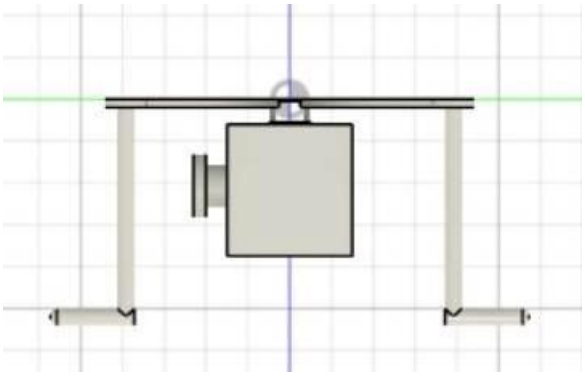

Fig.4.1.3. Side view of frame

4.2 BRUSHLESS MOTOR

These motor shows some similarity to that of DC motors. These motors do not have brush instead there are three coils. The Brushless motors that we have used is MN805-S of current rating 150 kV.

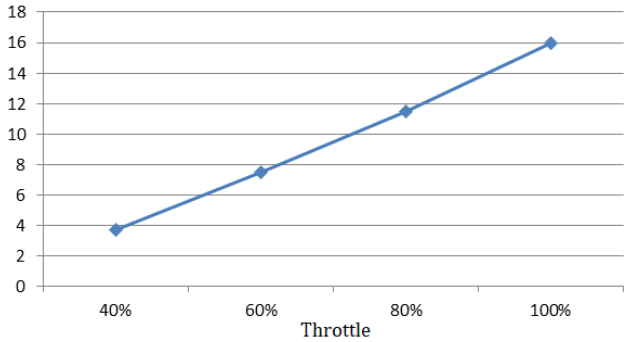

Chart-2: Throttle Vs Thrust(kg) for single motor

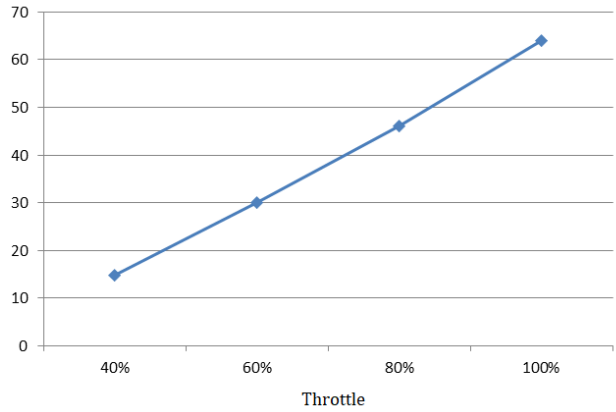

Chart-3: Throttle Vs Thrust(kg) for the 4 motors

4.3 ELECTRONIC SPEED CONTROLLER

It plays a major role in continuously transforms high frequency signal to electric supply which is fed into the motor. ESC we have used are 80A current rating.

4.4 GENERATOR

In our drone there is a need of huge amount of power to supply both for motor and for cooling system, so instead of using many number of batteries here we have used NOVA 2400 generator that produces output power of 2000w.

4.5 PROPELLER

Quadcopter consists of 4 propellers each mounted on the motor. Two spins in clockwise and the other two motors spins in counterclockwise direction as well as propellers are also designed as clockwise and counterclockwise. The propellers are of size 28 x 9.2

4.6 GPS MODULE

It provides navigation for the system also to fly the quadcopter autonomous.

4.7 TRANSMITTER & RECEIVER

The signals are transmitted manually whenever required through Transmitter and Receiver.

4.8 TELEMETRY

Telemetry is a digital two-way data stream, which can both send data about the flight down to a ground station (in our case, the Mission Planner) and send command up to the autopilot. The telemetry used is CUAV P9 900MHZ Radio Telemetry Wireless Transmission Module.

4.9 FLIGHT CONTROLLER

It is the flight movement controller which is responsible for the takeoff, landing and also controlling sensors.

4.10 LIDAR

LiDAR stands for Light detection and ranging. It is used for measuring distances inorder to avoid obstacles.

4.11 MISSION PLANNER SOFTWARE

The features of mission planner software are listed below:

- With current point and click way point entry using google maps, autopilot can be controlled.

Fig.4.11.1. Waypoint created in Mission planner

- It has full ground station support for monitoring missions and sending in flight commands.
- It checks the sensor output and test the autopilot performance.
- It also can download mission log files and analyze them.
- Pixhawk setting can be configured depending on the kind of frame configuration that is being used.
- It has user friendly interface with loads of useful functions.

Fig.4.11.2. Waypoint created in Mission planner (Autonomous mission planning)

- Finally, we can load firmware onto Pixhawk, configures in different ways to use the Pixhawk chip from different aerial and ground vehicles.

5. COLD CHAIN COMPONENTS

5.1 PELTIER MODULE

Thermoelectric Peltier module is device that creates temperature differential on each side. Peltier module we have used is TEC12706.

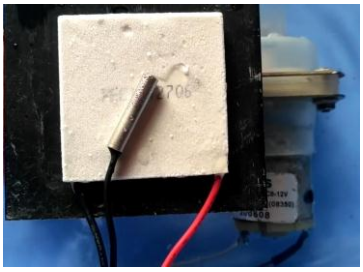

Fig.5.1.1. Peltier module

5.2 HEAT SINK

It is used for exchanging of heat generated by the Peltier module to the fluid medium

5.3 DIGITAL THERMOSTAT

It is used for regulation of heat as required, in constant temperature.

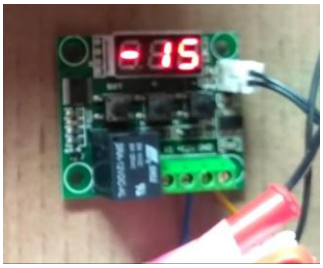

Fig.5.3.1. Digital Thermostat

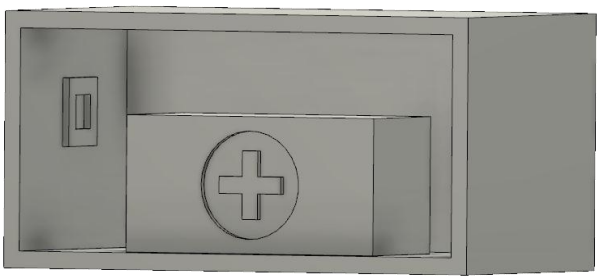

Fig.5.3.2. Interior of Payload Box

Code	Description	Range	Default Value
P0	Heat/Cool	C/H	C
P1	Backlash Set	0.1-15	2
P2	Upper Limit	110	110
P3	Lower Limit	-50	-50
P4	Correction	-7.0 ~ 7.0	0
P5	Delay Start Time	0-10 mins	0
P6	High Temperature Alarm	0-110	OFF

Table-1: Settings chart of thermostat

6. FEATURES OF OUR DRONE

- The Brushless motor and ESCs are Weatherproof
- Centimeter level accuracy for Hovering
- Telemetry Range up to 60 Km
- Much efficient than Lithium ion Batteries
- 0.75 litre of Gasoline for 30 Min Flight
- Lidar based Altitude Hold for Hill Maneuvering
- All in One featured Ground Control System
- High Precise GPS for Autonomous Missions
- Cold Chain Temperature can be set on Digital Thermostat

7. RESULTS

- High speed Transportation of Live Organs, Blood, Vaccines that are stored in cold chain to rocky and terrain area.
- Less Human resource needed as Missions performed are autonomously Preplanned using GCS
- Every corner of India can be treated for any medical conditions

8. CONCLUSIONS

As per using the components specified and using mission planner software, the quadcopter can be developed and can be tested for delivery of medicines in hilly areas. By using GPS module, the navigation can be successful by creating waypoints and quadcopter can be directed autonomously.

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