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Design and Fabrication of Multipurpose Drone

Siddhesh Mane[1], Ananta Masal[2]
[1, 2]*Mechanical Engineering, St. John College of Engineering and Management, Palghar (W), India*

Abstract: There is an overall lack of multipurpose aerial drones, or unmanned aerial vehicles (UAVs), around the world; and until recently, there was a lack of any feasible purposes for drones outside of military applications and those available in market has a very high cost associated with it. Drone technology has advanced to the point in which portable devices are now economically priced enough for civilians to afford as well as easy enough to use with little to no training; however, the main draw back with drones even today is the lack of flexibility n purposes. Most civilian drones are marketed for surveillance purposes only, making the purchaser the one responsible for the labor and economics of any type of design changes to allow for different or more functions. The problem then evolves itself to how to make an economical UAV that can be used for more than one purpose.

I. INTRODUCTION

There is an overall lack of multi-purpose aerial drones, or unmanned aerial vehicles (UAVs), around the world; and until recently, there was a lack of any feasible purposes for drones outside of military applications and those available in market has a very high cost associated with it. Drone technology has advanced to the point in which portable

Devices are now economically priced enough for civilians to afford as well as easy enough to use with little to no training; however, the main draw back with drones even today is the lack of flexibility in purposes. Most civilian drones are marketed for surveillance purposes only, making the purchaser the one responsible for the labor and economics of any type of design changes to allow for different or more functions. The problem then evolves itself to how to make an economical UAV that can be used for more than one purpose? Currently there are also many safety issues and there is need for proper surveillance where there is mass gathering and large functions and events. Also the crowded places like airports and railway stations are in need of proper surveillance. Production department plays a very important role in countries growth. Also individually all entrepreneurs will want to find the ways to increase their productivity and if this helps by decreasing the time required by using the technology they will surely apply it to their industries. Operating a fleet of drones in the transport of materials when manufacturing plastic products or similar like product in the plant will be evaluated by computer Simulation. It is designed a model that represents the manufacture and transport of materials and Semi-finished products, and the final assembly of the product in mini assembly lines.

II. PROPOSED SYSTEM

A growing interest has been evidenced in the UAV (Unmanned Aerial Vehicle) especially in those with vertical takeoff and landing (VTOL) They allow to perform horizontal flight avoiding obstacles, with characteristics of low speed and high precision in flight. Several structures and configurations have been developed with 4, 6 and 8 rotors; they all meet the necessary requirements for the operation proposed by this work. In this hexacopter, central hub is for payload attachment and six propellers are fixed in the end of the separate arms, which are attached with central hub with an angle of 60°. Central hub is also provides home for avionics components together with battery.

The propellers of the hexacopter are individually driven by an electric motor, which is attached _ at the end of the arm separately. All the propellers have fixed pitch blades, which increase the potential of the UAV, which makes craft more comfortable with low vibration. Essentially, this model has all of the same major advantages of a quad copter with a lot more added in safety, which means that a controller will be able to safely land the drone even if one motor is damaged. The maneuver controlling of the hexacopter depends upon its six propellers. Each propeller produces an upward thrust by pressing air downwards. Since the foundation of the upward force is situated exterior of the Centre of gravity, differential upward force can be used to rotate the UAV. The rotation of the motors and propellers also generates a reaction twisting force, which are acts opposite direction of the rotation. Since three propellers are spinning in_ clockwise direction, and the other three are in counter clockwise direction so the net torque when all rotors have equal speed is zero.

A. Selection of Hexacopter

The main reason for selection of 6 rotor drone i.e. Hexacopter is the comparison between quad rotor and hexacopter giver below when used same materials and same power.

Parameter	Quad copter	Hexa copter
Ground speed(m/s)	25	35
Rate of climbing (m/s)	10	20

Table-3.1. Comparison of Quad and hexacopter.

B. Selection of Material

We have used aluminium as the material for drone as Aluminium comes in a variety of shapes and sizes; you can use sheet aluminium for body plates, or extruded aluminium for the support arms. Aluminium may not be as lightweight as carbon fiber or G10, but the price and durability can be quite attractive. Rather than cracking, aluminium tends to flex. Working with aluminium really only requires a saw and a drill; take the time to find the right cross section (lightweight and strong), and try to cut out any nonessential material. So for that purpose we have selected this material, we can reduce the weight of material by giving cuts of specific patterns and analyzing it for strength in ANSYS. This is one of our major selection as it helps us in ease for fabrication, and mainly reducing our cost for fabrication.

III. DESIGN AND SELECTION

A. Calculations

1) Weights that will act on hexacopter.

a) Payload weight: 0.4 kg W
b) eight of propeller: 13*6 = 78g
c) Weight of the motor: 318 g (6* 53)
d) Weight of camera: 100 g
e) Weight of battery: 371 g
f) Weights of the Hexa Structure: 800 g
g) Overall weight (approx.): 2067 g

2) Calculation of Thrust: Calculations of static thrust are needed in order to ensure that the proper propellers and motors have been selected. Static thrust is defined as the amount of thrust produced by a propeller which is located stationary to the earth. This calculation is particularly important for this project because Hexacopter helicopters are more likely to perform at low speeds relative to the earth. This low-speed performance ensures that the calculations of static thrust can be applied to a wide range of flight conditions. Also, it is important to note that the final calculations of static thrust are estimates and not actual values. Thrust is always greater than overall weight Thus, thrust = 3x overall weight (to avoid overheating and overloading) i.e. 3* overall weight = 3x2067 =6201 g

3) Selection of Motors

a) Thrust required is 6.2 kg. Thus we should select motor that produces thrust greater than the required thrust.
b) Thus for the above parameters from set of motors we select Brushless DC Motor
c) Considering motor DJI 2212 920 Kv which has maximum thrust of 1.2 kg
d) Total of 6 motors = 7.2 kg
e) Since motors are producing thrust greater than required we select motor DJI 2212 920.
f) The standard ESC's used with this motor is FMT 30A

4) Selection of Battery

From all the values found above and the thrust and power requirement, the standard current of motor is 15-25 A
So considering 25 A current
For 6 motors, current required is 150 A
Considering Lipo battery of 30 C, 3S, 5300 mAH
Max current draw = battery cap x discharge
Rate =5.3x30 =159A
Hence the values that we got are safe against the required value. So selecting battery as Lipo 5300mAH 30C 11.1V

B. Modelling

The modelling of parts have been done in solid works according to the dimensions in calculation and some fixed dimensions that are been used.

1) *Top Plate:* This is made of aluminum and cuts are provided for reduction of weight, also they are checked in ANSYS for any deformation.The top plate takes the load of battery and end of plate are connected to arm.

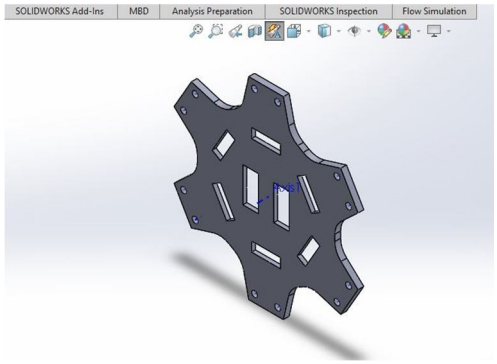

Fig 7.2.1 Top plate

2) *Base Plate:* This is also made of aluminium and cuts are provided for reduction of weight, also they are checked in ANSYS for any deformation.

The bottom plate carries mechanism for material handling, camera, as well as the landing gear are connected to it for landing purpose.

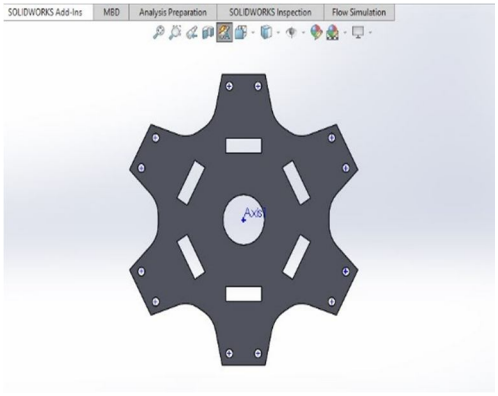

Fig 7.2.2 Base plate

3) *Arm:* The hexacopter has six arms, each connected to one motor. The arm is made of aluminium each weighing 45 grams. The motors are to be connected on the one end of arm while esc will lie on top of the arm connecting connection to motors.

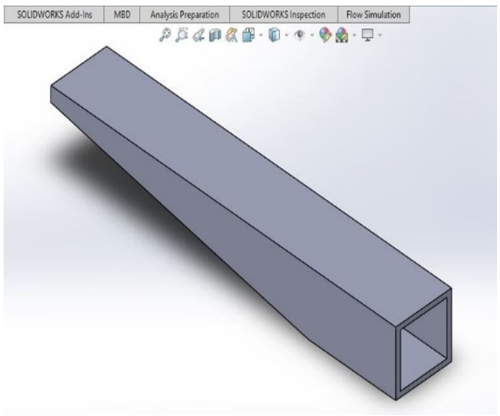

Fig 7.2.3 Arm

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IV. DESIGN ANALYSIS

Analysis of base plate, Top plate and arm.

The analysis was performed in ANSYS and deformation was being checked for. There is no amount of deformation that is unsafe. Thus we proceeded further.

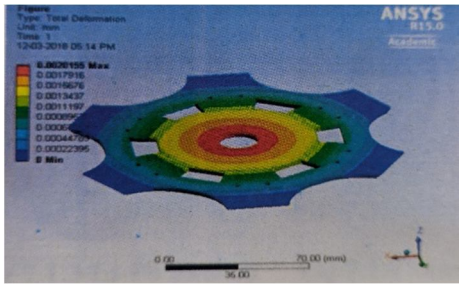

Fig 5.1 Total deformation on base plate

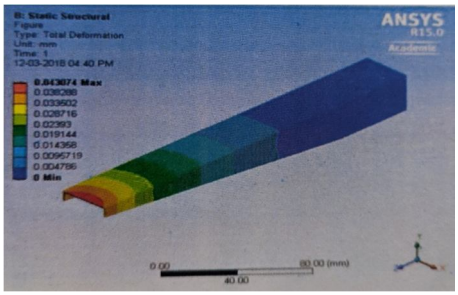

Fig 5.2 Total deformation of arm

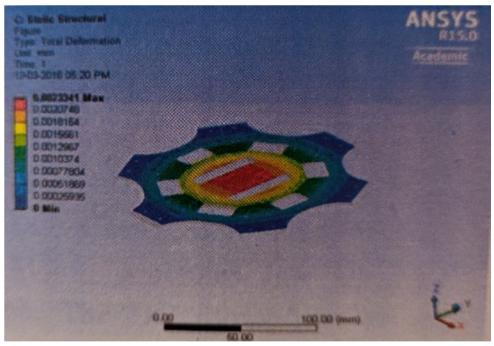

Fig 5.3 Total deformation on Top plate

V. ASSEMBLY AND FABRICATION

A. Description of Selected Parts

1) Motors: DJI 2212 920KV_ Brushless Motor 'for Quadcopter/Multirotor/Drone 920Kv Brushless DC Motor is a Brushless DC electric motor (BLDC motors, BL motors) also known as_ electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter switching power supply, which produces an AC electric signal to drive the motor.

2) ESC: The ESC selected is 30AMP BLDC ESC Circuit. This is fully programmable 30A BLDC ESC Circuit with 5V, 3A BEC. Can drive motors with continuous 30Amp load current, It has sturdy construction with 2 separate PCBs for Controller and Electronic Speed Controller power MOSFETs... Bt is most suitable for UAVs, Aircrafts and Helicopters

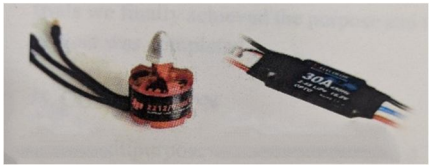

Fig 9.1,1 Motor Fig 9.1.2 ESE

3) *Battery:* 5300MAH 11.1 volt gens Lipo battery with 30 C and 371 grams.
4) *Camera:* Cp plus Wi-Fi camera with recording mode

Fig 7.1.3 Li-Po Battery Fig 7.1.4 camera

5) *Naza Auto Pilot System:* For our hexacopter we have selected NAZAM V2 control system, The Naza-M V2 is a powerful flight controller. It's easy to install, simple to configure and above all, extremely stable.

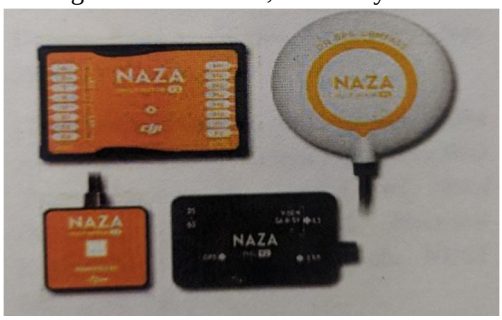

Fig 7.1.5 Autopilot system

6) *Gripper Arm:* Gripper module is state of the art robotic arm it can be used in various 'pick and place' kind of robots. It works on DC Motor (9 to 12V DC). Change in rotation direction of the DC Motor, generates Jaw Open & Close Action. The DC motor can be easily be controlled with the help of DPDT Switch (manual mode) or with the help of any microcontroller along with L293D Motor Driver module.

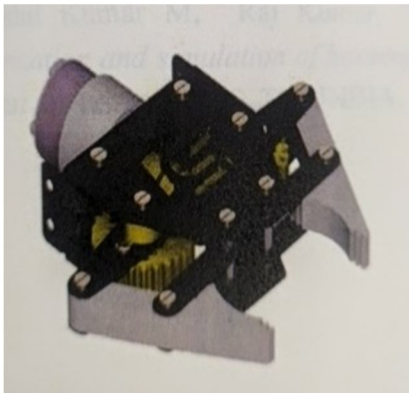

Fig 7.1.6 Gripper Arm

VI. CONCLUSION AND RESULTS

A. *Results*

The aim of developing an economical and multitasking drone is fulfilled. It served its first purpose of multitasking i.e. it had a camera installed that was able to give real time streaming as well as has night vision. The next implementation was a gripper arm which acted as a pick and place tool. The second purpose was to make it economical so as to make it available at low cost as compared to the existing drones. Both its objective was fulfilled and finally a low cost multipurpose drone was made and successfully tested in the field. While doing so a lot of difficulties was faced, but after few trials we finally achieved the purpose and the project was completed.

B. Conclusion

The multipurpose drone which aimed at providing a low cost and useful in many aspect served its purpose .Its multifunction at single time 'proved beneficial in many application. It can do surveillance and give real time monitoring. Its material handling can pick and place objects from one place to another. The cost of manufacturing was also maintained in the affordable range. This can give motivation to add new features and add to its multifuntionality. Hence the multipurpose drone proved beneficial and reached to its aim as specified in the beginning. We can use this hexacopter for serving purpose in industry making it beneficial by reducing cost as well as human effort. Besides it also reduces the chance of error produces by human giving 100 percent efficiency. The camera can serve various purpose for commercial as well as security needs at high risk places.

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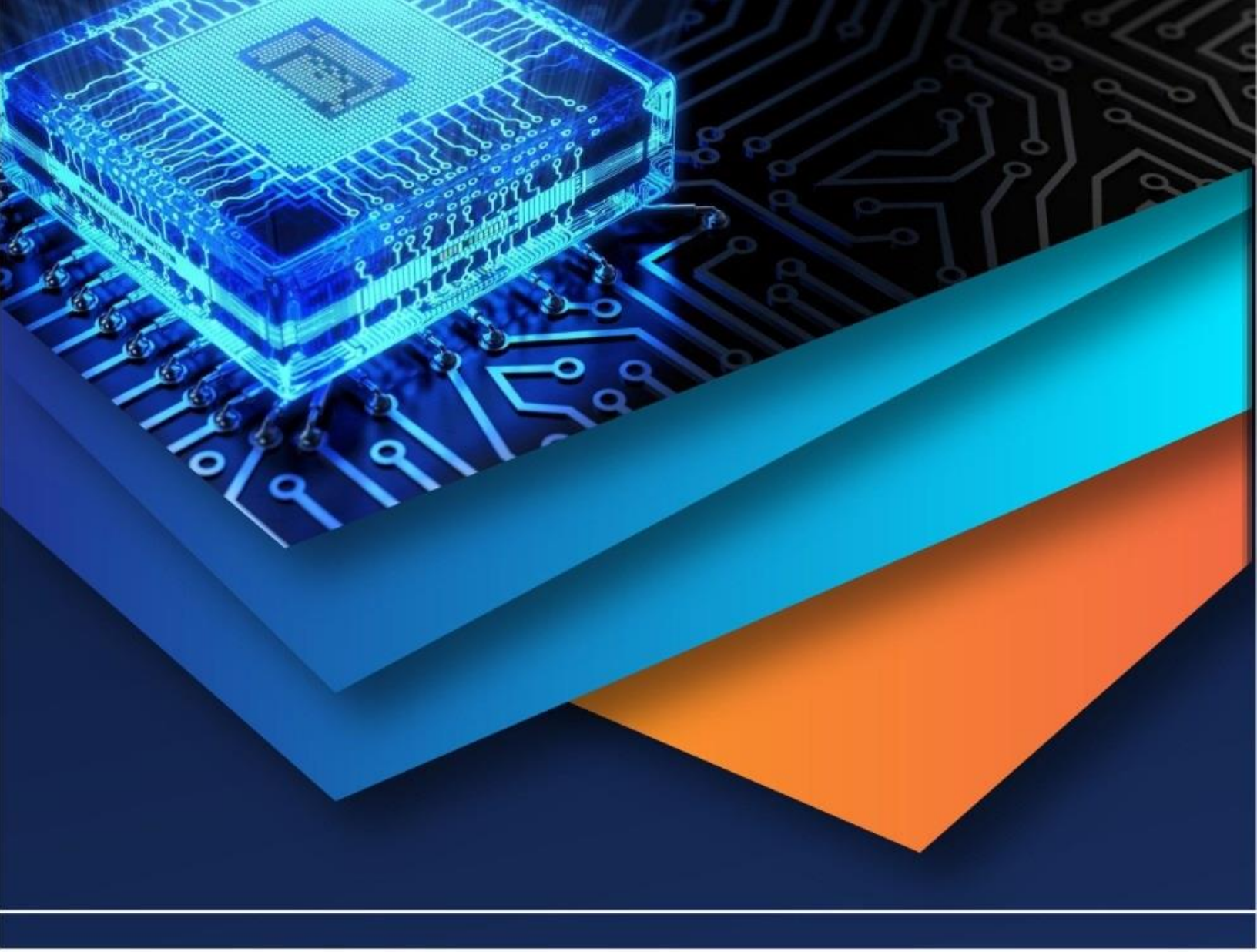

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