International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016 [ICSSCCET 2016]

ISBN	978-81-929866-6-1	**VOL**	02
Website	icssccet.org	**eMail**	icssccet@asdf.res.in
Received	25 – February – 2016	**Accepted**	10 - March – 2016
Article ID	ICSSCCET047	**eAID**	ICSSCCET.2016.047

Design and Analysis of Quadcopter

R Nallappan[1], CasindraHellanMaxim[2], P BarathKumar[3]
[1,2,3] Karpagam Institute of Technology, Coimbatore

Abstract: *Quadcopters are unmanned air vehicles that are playing a predominant role in different areas like surveillance, military operations, fire sensing and many other important complexities areas. The weight of the quadcopter is the main constrain. The main purpose of the paper is to deal with the design of the Quadcopter. The regular design of the quadcopter is alter and the static analysis is done on frame to sustain the loads generated. Result shows a small deformation on the center plates are safe and within the limit.*

Keywords – *Quadcopter, Unmanned air vehicle, surveillance.*

I. INTRODUCTION

Quadcopters also known as quadrotors or multirotor aircrafts are emerging vibrantly in the unmanned aerial vehicle (UAV) design. Since as early as 1920, multicopter vehicles have been designed, built and are used to experiment with aerial vehicle designs. The quadcopter design is one example of the many prototypes produced. This particular design uses four identical rotors mounted symmetrically; the result is a very stable flight platform. Each rotor is connected to fixed pitch propellers and is lifted up high in the air with the help of propellers. These propellers convert rotational motion into thrust.

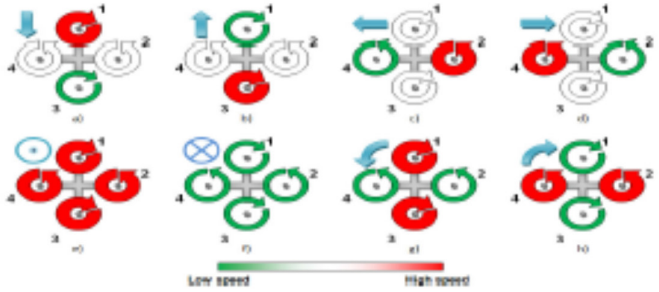

Figure 1: Illustration of the various movements of a quad rotor

II Problem Statement

Today, there is a lack of use of unmanned aerial vehicles around the world and until recently, there is a lack of any feasible purposes for drone use outside military applications. Drone technology has advanced widely to a point in which portable devices are now economically priced and easy enough to use with little or no training. However, the main draw back today is the lack of flexibility in

Cite this article as: R Nallappan, CasindraHellanMaxim, P BarathKumar. "Design and Analysis of Quadcopter". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 248-252. Print.

purposes even now. Thus the problem evolves itself to how to make an economical UAV that can be used for more than one purpose.

III Motivation

These Quadcopters have so many applications due to:

- No gearing required between the motor and the rotor.
- No variable propeller pitch required for alternating rotor
- Minimal mechanical complexity
- Low maintenance
- Payload augmentation

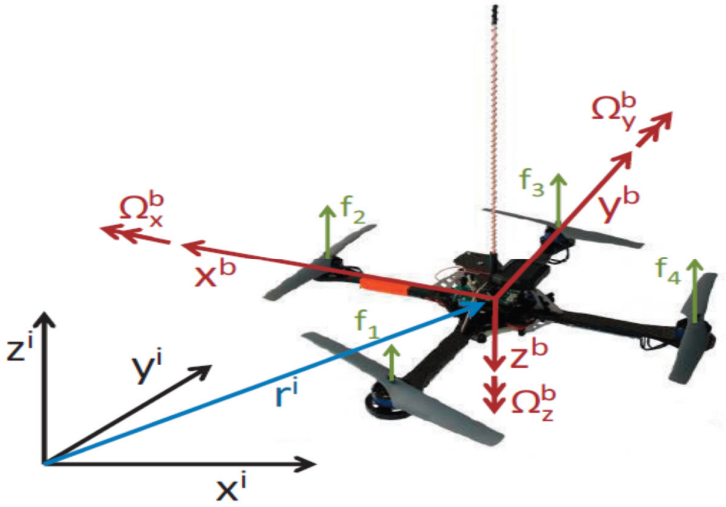

Fig 2: The novel compound Quadcopter configuration

III. Literature Review

Quadcopters had an incredible evolution in 21st century. Universities, students and researchers continuously work to introduce more robust controllers and modelling techniques, so that they can provide detailed and accurate representations of real-life quadrotors. This section introduces some of the work presented in recent years.

IV. Quadcopter CAD Model& Electronics Used

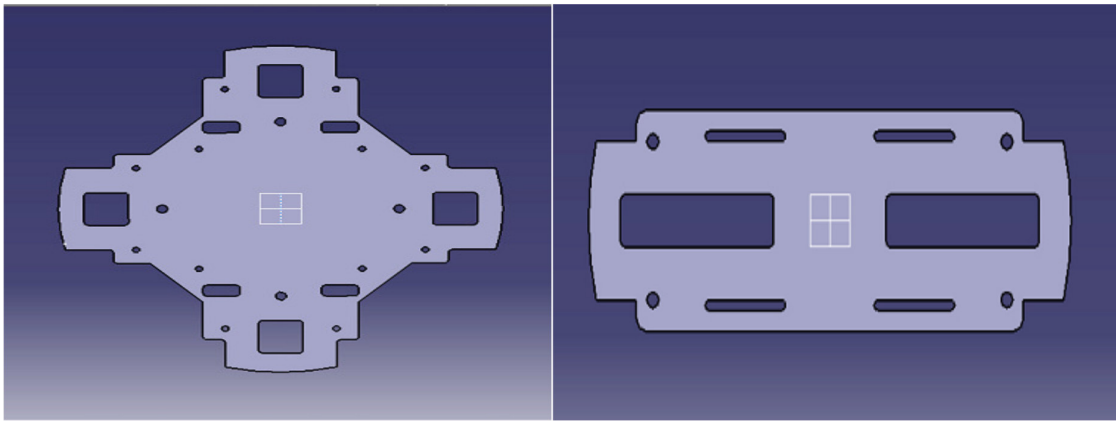

Fig3: CAD model of Top Plate

Fig4: CAD model of bottom Plate

Cite this article as: R Nallappan, CasindraHellanMaxim, P BarathKumar. "Design and Analysis of Quadcopter". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 248-252. Print.

a) **Brushless Motor:** Brushless motors give the 1:1 speed ratio. In quad copter four rotors with brushless motors are used to get high efficiency for less power and low weight. Motor +performances and 1200kv brushless motor used for this paper.performance graph is taken form drive calculator software.

Fig 5: Brushless motor

Fig 6: Electric speed controllers

b) Propeller: Propellers are used to generate the thrust for the quad copter hover or lift. These are in different variants which are classified based on their diameter and pitch by which they travel. To create maximum thrust we use to have two "standard rotation" and two "right hand rotation" propellers. The propeller size 8045 is used.

c) Electronic Speed Controllers: Electronic speed controls convert the available 2phase battery current to the 3-phase power and also regulates the speed of brushless motor by taking the signal from the control board.

d) Control Board: Control board is the main system which is connected to the receiver and Electronic Speed Controls which is pre loaded with different set option from single copter to octocopter. This board is used to different operations performed by the quad copter like roll, pitch and yaw. This board is suitable for the 4channel transmitter and one auxiliary port to control such as sensors etc.

e) Receiver and Remote Control: These Quad rotors are controlled by using a 2.4Ghz transmitter and the receiver has been connected to control board.

Fig 7: Receiver and Remote Control

f) Lithium Polymer Battery: It is a constraint of weight so we use a lithium polymer battery in which hi power due to that reason we use these batteries for these micro air vehicles. These are available in different variants from 1000mah to 10000mah.

g) Servo Leads: Servo leads are the connection cables between the receiver - control board and between Electronic speed control - control board these are having three leads which is connect the signal, power(+) and earth(-) connection.The CAD model is prepared.The connection in assembly are connected by using the different connectors.

Material properties

In this model the major components are made using Aluminium.

Aluminium (6061) is light and strong material, which dissipates heat and is inexpensive compared to the other available options. It is malleable and has no sparking capability, so it's ideal for use near flammable substances. Its is also resistant to corrosion, which makes it ideal for outdoor use. Non magnetic, hence it is not affected by electromagnetic forces. Thus Aluminium is a material which is used for arms and the centre plate.

Cite this article as: R Nallappan, CasindraHellanMaxim, P BarathKumar. "Design and Analysis of Quadcopter". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 248-252. Print.

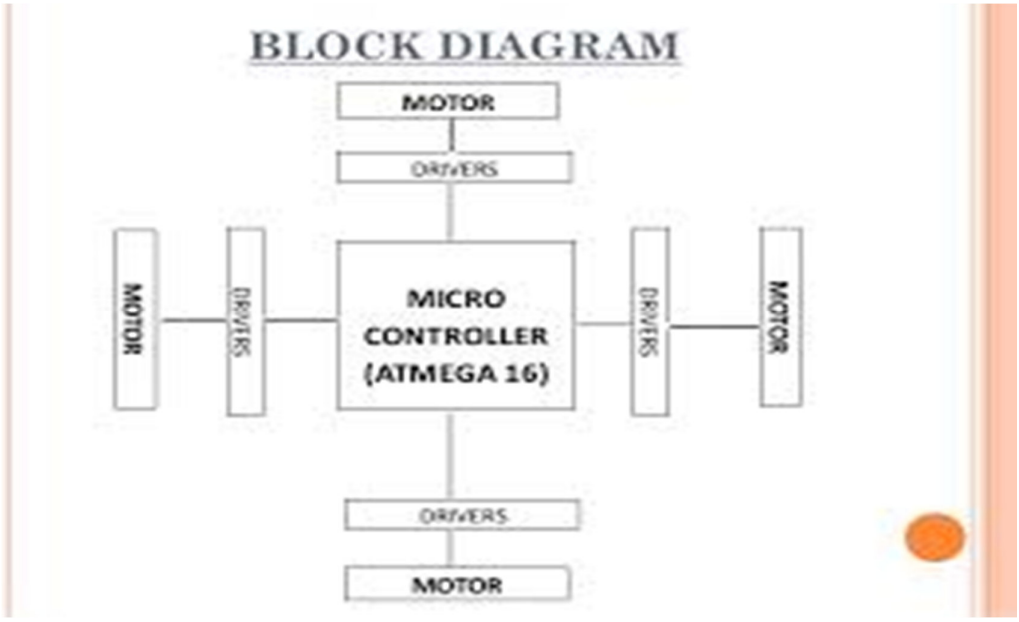

Fig 8: schematic block diagram

Results

Thus we design and development of a novel UAV compact Quadcopter. The prototype consists of a module that can transmit and receive the captured images .The stress analysis at various points and fatigue analysis of the developed UAV compact Quadcopter has been made using ANSYS/CATIA.

- Static structural analysis
- Modal analysis
- Harmonic analysis

Total deformation analysis
Deformation result

Minimum	0.03 m
Maximum	1.3176e-006

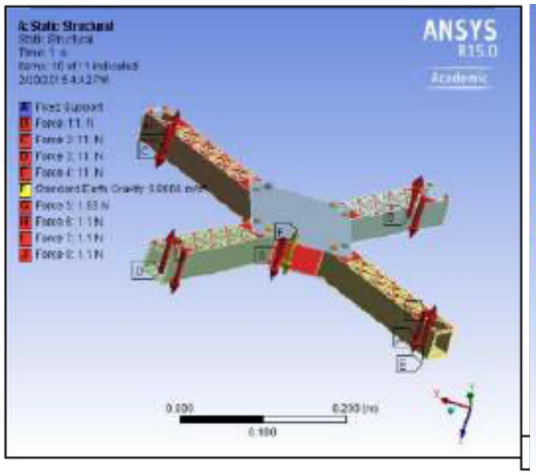

Fig 9: Static structural analysis

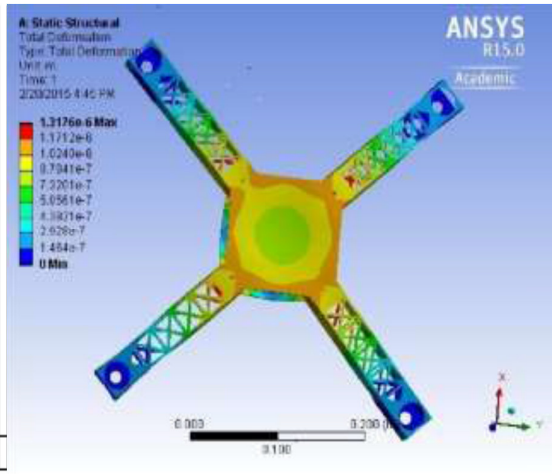

fig 10: Modal analysis

Cite this article as: R Nallappan, CasindraHellanMaxim, P BarathKumar. "Design and Analysis of Quadcopter". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 248-252. Print.

Conclusion

Through experimental results and simulations, this works proves that it is possible to develop a heterogeneous prototype that contains all the mentioned instruments and technologies. This is able to autonomously navigate in between narrow corridors, best suited for inspection through orchids and vineyards and other outdoor conditions for a longer duration. Despite its limited width the configuration achieves high agility, longer endurance and responsive to control inputs.

References

1. Bernard Tat meng Leong et al, *Journal of International Symposium on Robotics and intelligent sensors* 2012(IRIS2012)
2. Corey Russel et al, *Journal of Design and Realization of intelligent portable Aerial surveillance system 43, pp.1923*-1930*(2010)*
3. Swee King Phang, Kun Li, Kok Hwa Yu, Ben M. Chen, Tong Heng Lee "Systematic Design and Implementation of a Micro Unmanned Quad rotor System" pp1-21, World Scientific Publishing Company,Vol. 2, No. 2 (2014)
4. Antonio DiCesare, Kyle Gustafson, Paul Lindenfelzer "Design Optimization of a Quad-Rotor Capable of Autonomous Flight" Worcester Polytechnic Institute; 2012.
5. Mr. Kalpesh N. Shah1, Mr. Bala J. Dutt2, Hardik Modh3 "Quadrotor – An Unmanned Aerial Vehicle"Volume 2, Issue 1 | ISSN: 2321-9939 adamone.rchomepage.com/calc_thrust.htm

Cite this article as: R Nallappan, CasindraHellanMaxim, P BarathKumar. "Design and Analysis of Quadcopter". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 248-252. Print.