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Semi Autonomous Unmanned Aerial Vehicle RC Quadcopter

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ABSTRACT

It is a semi-autonomous unmanned aerial vehicle designed to get aerial views and it is most suitable for surveillance can be used by military and local police easily because of its simple and compact design. It can be used in other fields also like agriculture, industries, railway track inspection, transportation, etc.. It is a combination of electronics and mechanical components. It works on the principle of Newton's second and third law and Bernoulli's principle.

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INTRODUCTION

Humans are fascinated by levitation, the explanation is maybe that the globe, we tend to reside in is three-dimensional. However, kith and kin live and move chiefly in 2 dimensions. It appears that humans have an awfully sturdy drive to beat their biological limits. This results in building of machines that change them to maneuver in three-dimensional area, e.g., airplanes and helicopters. In spite of however sophisticated the geographical feature is, it doesn't become a hassle if it flies within the air. What a lot of, it's doable to use it even in an exceedingly significantly severe region. And it may be controlled remotely to hold out a good variety of investigations. Unmanned Aerial Vehicles are capable of flight while not associate on-board pilot, they are controlled remotely by associate operator or may be controlled autonomously via pre-programmed flight ways.

A quadcopter is a multirotor whirlybird that's raised and propelled by four rotors. Quadcopters are classified as rotorcraft, as against fixed-wing craft, as a result of their raise is generated by a collection of rotors (vertically destined propellers). In contrast to most helicopters, quadcopters use 2 sets of identical fastened pitched propellers; 2 clockwise and 2 counter-clockwise. These uses variation of rev to manage raise and force. Management of auto motion is achieved by sterilization the rotation rate of 1 or additional rotor discs, thereby ever-changing its force load and thrust/lift characteristics. Early within the history of flight, quadcopter (referred to as 'quadrotor') configurations were seen as potential solutions to a number of the persistent issues in vertical flight; torque-induced management problems (as well as potential problems originating from the rotor, that generates no helpful lift) may be eliminated by counter-rotation and also the comparatively short blades are a lot of easier to construct. Variety of manned styles appeared within the Nineteen Twenties and Nineteen Thirties. These vehicles were among the primary in heavy vertical take-off and landing vehicles. However, early prototypes suffered from poor performance, and latter prototypes needed an excessive amount of pilot workload, as a result of the poor stability augmentation and restricted management authority. Additional recently quadcopter styles became well-liked in unmanned aerial vehicle (UAV) analysis. These vehicles use AN electronic system and electronic sensors to stabilize the craft. With their tiny size and agile mobility, these quadcopters may be flown inside also as outdoors.

1.1 Application of Quadcopter:

- Quadcopters are a useful tool for university researchers to test and evaluate new ideas in a number of different fields, including flight control theory, navigation, real time systems, and robotics.
- Quadcopter unmanned aerial vehicles are used for police investigation and intelligence operation by military and enforcement agencies, in addition, as search and rescue missions in urban environments. One such example is that the Aeryon Scout, created by Canadian company Aeryon Labs.
- Quadcopter can be used in other fields like for transportation, agriculture field, inspection, etc..

2. History Of Quadcopter:

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In early 1920s quadcopter comes into play because of its simple design an wide range of applications, but they were heavy, less fight time and four propellers controlled by only one motor. Later in the mid 19th century (1956) some advancement has been made and independent motors used for each rotor. But now lots of changes have been made in the design, materials and advance electronic components used for better PID control.

3. Design and Development:

Model of the quadcopter made by me using aluminium for arms, glass fibre for cover plate and CF for propeller**.**

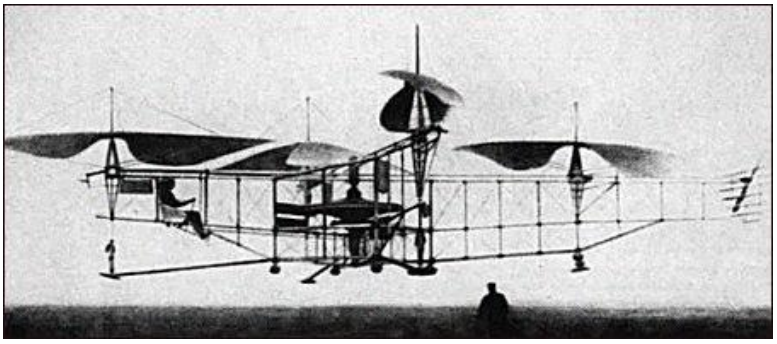

Fig. 1: 1920 model.

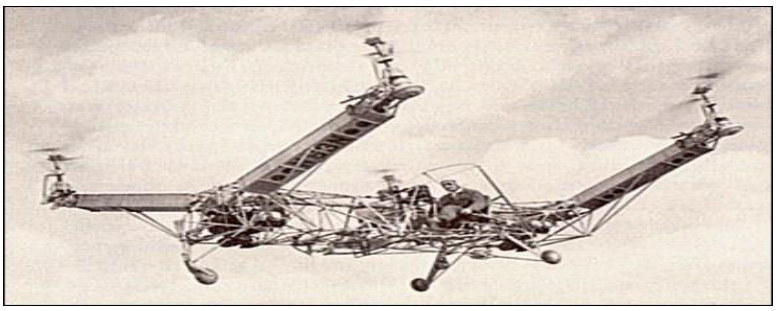

Fig. 2: 1956 model.

Fig. 3: Small Quadcopters

Newton's 2nd law of motion-"for every action there is an equal and opposite reaction". This law is used for levitation of quadcopter.For hovering i.e. maintaining stability of quadcopter principle used is that "one pair of propeller rotates in anticlockwise direction and another rotates in clockwise direction. Design of quad copter has been made using designing software and drafted.

4. Design Calculation:

4.1 Thrust Calculation:

Thrust produced by one motor, T1= ρAv2
Where, =density of air (1.16kg/)
A=0.041m^2
v=velocity of air (3.64m/s)
Hence, T1=6.1842N
Total thrust T = 4XT1 =24.7368N

4.2 Stress Calculation:

a) Centrifugal force (Fc) = m²rω Newton

b) Arm length=21cm
c) Here m=mass of propeller in 'kg' (0.003 kg)
d) r=Radius of the propellers in 'm' (0.1143m)
e) rpm produced by motor= kv X volt=1400 X 10=14000rpm
f) Fc=0.736KN
g) Moment= Fc*(Perpendicular distance b/w prop centre and rod surface) in Newton
h) M =0.736X0.054
i) M =39.744Nm
j) Bending force F=F1+F2+F3
k) F1= Weight due to motor (50g)
l) F2=Weight due to Al arm (15g)
m) F3=Thrust produced by motor1 (0.6304kgf)
n) F=6.8218N
o) Bending moment, M= FXL=1.4325Nm
p) Bending stress, $\sigma=(M * Y)/I$
q) I=area moment of inertia
r) y=fibre distance from neutral axis (0.006m)
s) h=1.2cm&h1=0.8cm
t) I=1.216m
u) σ=7.06MPa
v) Tensile stress acting on arm,σt=Fc/A=5.11Mpa

4.3 Advantages:

a) This type of aerial vehicle has more stability
b) It is to construct and needs less maintainance.
c) It provides vertical take-off and landing.
d) Ecofriendly vehicle.

Conclusion:

As per the design specifications, the quad copter self stabilizes using the array of sensors integrated on it. It attains an appropriate lift and provides surveillance of the terrain through the camera mounted on it. It acts appropriately to the user specified commands given via a remote controller. Its purpose is to provide real time audio/video transmission from areas which are physically inaccessible by humans. Thus, its functionality is monitored under human supervision, henceforth being beneficial towards military applications. It is easy to maneuver, thereby providing flexibility in its movement. It can be used to provide surveillance at night through the usage of infrared cameras. Now it can lift 1.2kg with ease. The system can further be enhanced for future prospects.

Future Advancement:

In future robotic arms will be added with proximity sensors for the Railtrack defect sensing purpose and can be used as pick and place quadcopter.

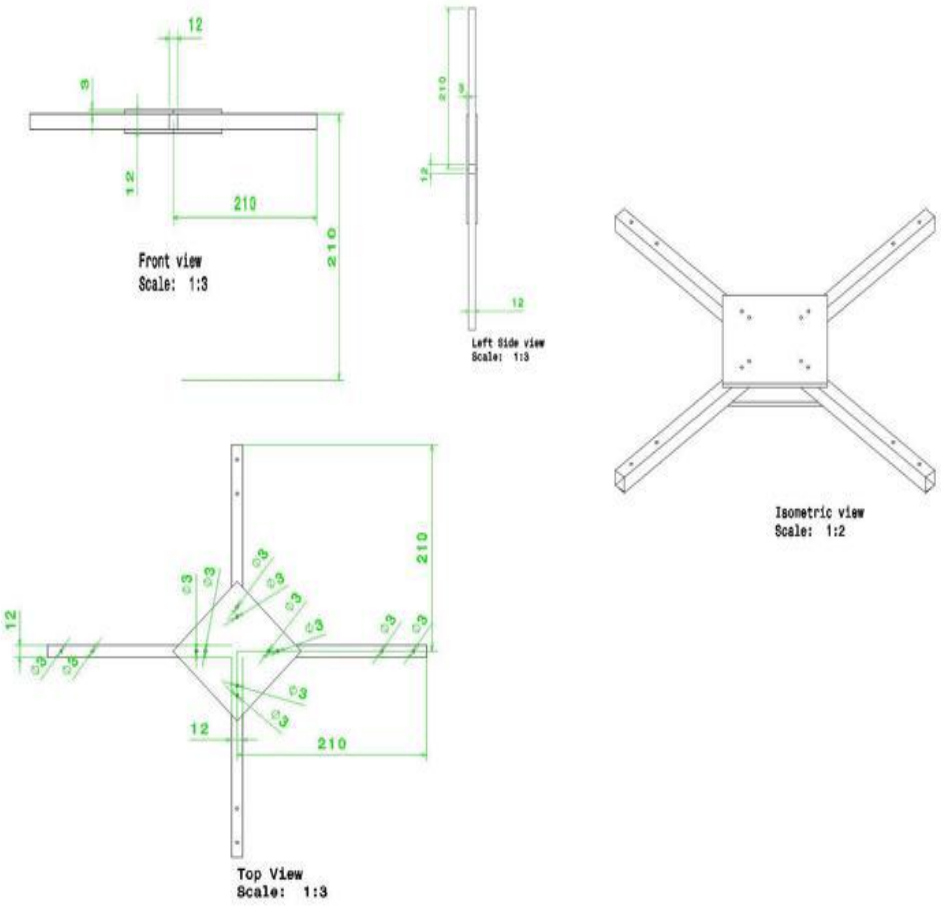

Fig. 4: Desin of Quadcopters.

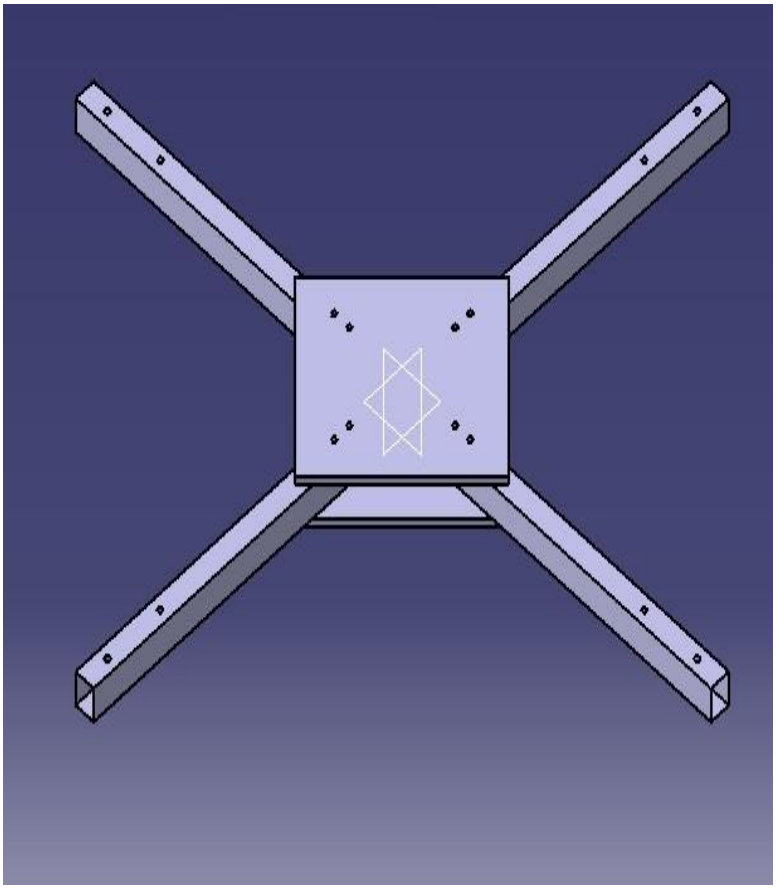

Fig. 5: Assemply Desin of Quadcopters.

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