

# Design and Experimentation of Hexacopter

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**Abstract-** Hexacopter is a flying robot capable of flying without pilot. It is controlled either manually or autonomously. UAVC Unmanned aerial vehicle is being suggested for application like difficult mapping, border surveillance and monitoring the forest. Maintaining of the forest through officers is not complete surveillance due to the nature factor of human being may be the error occur in the monitoring. Animal activities and large forest area coverage is difficult task to handle in forest region monitoring so a normal UAV is not suitable for this process, hence hexacopter is better solution for this monitoring because have its unique characteristics like more stability, high speed.

**Keywords** —UAV, Hexacopter, Aerodynamics, Electronics, frame, cad model

## I. INTRODUCTION

Unmanned aerial vehicle (UAV) is a type of aircraft which has no pilot or passenger on board UAVS include both autonomously controlled and remotely piloted vehicle controlled via transmitter one of the early practices of UAVS was the aerial torpedoes designed and built during world war first later due to the complication in control part and work load for pilot replaced by an aircraft with single rotor which is known as helicopter today.[6] but multirotor UAV have once again gain popularity among us due to its multiple application and structural integrated circuit led to UAVS that can be controlled via electronic autopilots modern UAVS controlled with both manual controlled and autopilots. Th is allowed safe flights under their own controlled and fly under the command of human pilot during complicated phases of the mission. the controlling of the hexacopter depends upon the six propeller air downward, since the foundation of the upward force is suited exterior center of gravity differential upward force can be used to rotted the UAV. [4] the rotation of motors and propellers also generate a reaction twisting force which are acts opposite direction so net torque when all rotors have equal speed is zero. the speed of every entity rotor is the sum of six contolled signals involvement to that particular rotor.

## II. NEED OF PROJECT

To design an implement a portable aerial autonomous surveillance robot to assist in observation of large area, by attaching a live feed camera to remote control unmanned aerial vehicle UAV which is capable of vertical take off and vertical landing(VTOL). [3]

The military use of unmanned aerial vehicle has grown because of their ability to operate in dangerous location while keeping their human's operators at the safe distance along with this we are going to make it is possible for blind people to operate the hexacopter although there are many

enhancements that we could do to the design, we have proven that it is possible to produce a small scale UAV that performs function of interest to the military as well as commercial application.[2]

## III. OBJECTIVES:

- 1.To study hexacopter flight dynamics.
- 2.To determine suitable hexacopter RC UAV design.
- 3.Analysis of frame and trial conduct.
- 4.Design and code control system for the hexacopter (move up, avoid this, etc)
- 5.Design and code a sensor fusion algorithm for keeping the copter stable.
- 6.Select a camera system to mount on hexacopter.
- 7.Design and build a frame.
- 8.To reduce a cost.

## IV. SELECTION OF COMPONENTS

### Selection of Propulsion system

1. Battery operated six rotor driven systems

### Design of Frame

1. Hexagon-frame

### Selection of control system components

- 1.Microcontroller
- 2.Electronic speed controller
- 3.Transmitting and Receiving Modules
- 4.Voltage Regulator
- 5.Wireless Camera module
- 6.Matrix keyboard

### Selection and Testing of materials

- 1.Frame-Aluminum, Balsa wood.
- 2.Propeller-Carbon fiber
- 3.Battery- Lipo, 11.1 V, 2600mAh, 20C,3 cell, discharge current of 66 amps.
4. Motor- Electric Brushless DC motor (BLDC), Trust-1100 gms
- 5.Weight-60gms, RPM/V-1300

### Selection of electronic components for Hexacopter

**Motors:** Brushless DC motors also called as BLDC motors are used in Hexacopter. These motor consist of a permanent magnet which rotate around a fix armature.[3]

**Motor calculations:** The motors follows thrust to weight relationship.

$$\begin{aligned} \text{Ratio} &= (\text{Thrust} / \text{weight}) \\ &= (ma / mg) \\ &= (a / g) \end{aligned}$$

Thus, vertical take off and vertical landing (VTOL) is possible only when, (a / g) greater than 1. In other words, The total thrust to total weight ratio should be greater than 1 so that the hexacopter can accelerate in the upward direction. In this case, we assumed that,

$$\text{Total Thrust} = 2(\text{Total weight of Hexacopter})$$

Thrust provided by each motor= total thrust/6  
**Propellers:** Propeller is a like fan that converts rotational motion into the thrust. [7] Generally, propellers are classified according to the pitch and diameter and are represented in terms of product of diameter and pitch.

**Electronic speed controllers:** Low voltage in micro controller and current is provided by the microcontroller and this is not sufficient to drive motors. To drive the motors as at specific speed, we require a motor driver to supply specific amount of voltage and current required by them and this work is done by Esc.[1]

**ESC calculation**

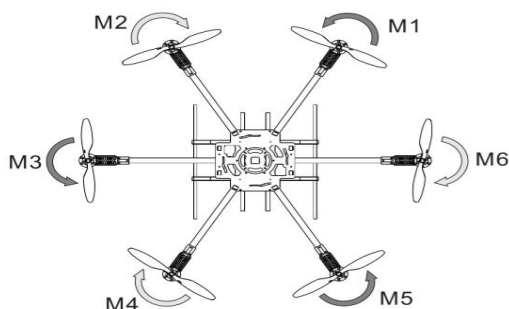
$$\text{ESC rating} = [1.2 \text{ to } 1.5] * (\text{max. ampere rating of motor})$$

**Flight controller:** The Hexacopter should continuously take measurements from the sensors and make adjustment accordingly to the speed of the rotors to keep the body level to maintain balance. We choose Naza-M Lite as a Flight controller. Naza-M Lite is the most cost effective entry level flight controller for light weight multi- rotor, Designed aero model hobbyists. [1]

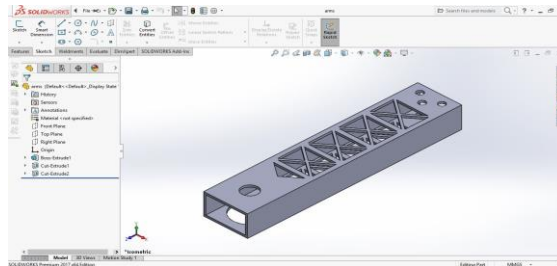
**Transmitter and receiver:** The Receiver (Rx) and Transmitter (Tx) system allows Hexacopter to be remotely controlled through a wireless signal

**V. DESIGN**

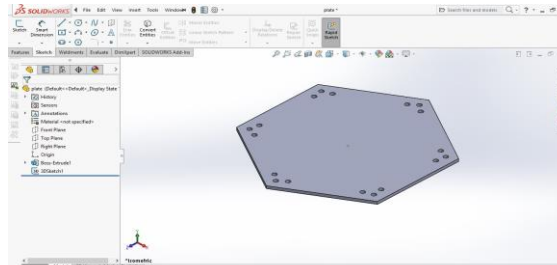
**Line diagram of project set-up**



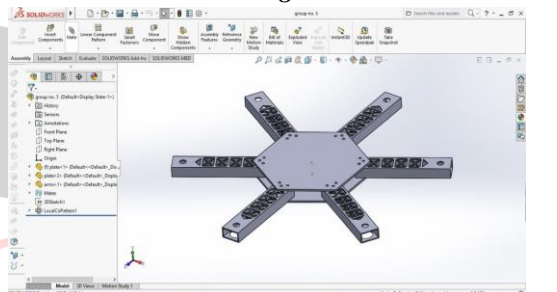
**3D Model**



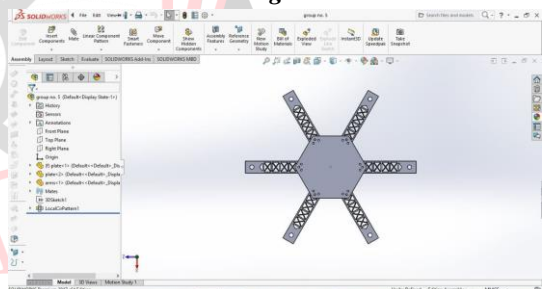
**Fig1. Arm**



**Fig.2 Plate**



**Fig.3. Model**



**Fig.4. Model**

**1.Design considerations-**

- a) Adjacent arms should be at 60 deg. w.r.t. each other.
- b) Motor to motor distance along the axes should be same.
- c) Centre plate should allow for easy removal of battery for charging.

**2. Assumptions-**

- a) Arms are assumed to be (300\*40\*40) mm.
- b) Centre plate is assumed to be (200\*200\* 20) mm.

**VI. SCOPE OF THE PROJECT**

As surveillance is one of the major aim of our project to spot the enemies and to report findings we require a wireless camera module installed and a T.V. to view the camera output directly on it. We are going to make it possible for blind people to operate the Hexacopter [7]

**VII. CONCLUSION**

Design of Hexacopter is mainly depend on design and its material like Aluminium, Balsa wood, carbon fibre Different material is used by considering the application. Propeller are also playing important part in design of

hexacopter, required total thrust gives idea for the selection and design of propeller.

### VIII. PROPOSED RESULT

As per the above calculation following factors are important

**Motor calculations:** The motors should be selected that it follows thrust to weight relationship.

$$\begin{aligned}\text{Ratio} &= (\text{Thrust} / \text{weight}) \\ &= (m_a / m_g) \\ &= (a / g)\end{aligned}$$

$$\text{Total Thrust} = 2 * (\text{Total weight of Hexacopter})$$

**Propellers:** Propeller is a like fan that converts rotational motion into the thrust.

#### ESC calculation

$$\text{ESC rating} = [1.2 \text{ to } 1.5] * (\text{max. ampere rating of motor})$$

**Flight controller:** To maintain balance, the Hexacopter should continuously take measurements from the sensors and make adjustment accordingly to the speed of the rotors to keep the body level.

**Transmitter and receiver:** The Transmitter (Tx) and Receiver (Rx) system allows the Hexacopter to be remotely controlled through a wireless signal.

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