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# Design of a Quadcopter with a Hand Glove Control

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***Abstract:*** *The major objective of this project is to designing a quadcopter which can be controlled by hand glove. The control of a quadcopter can be made by the movement of hand, which in turn maneuvers the quadcopter through radio transmission, fully with the hand. The basic step is to designing and fabricating a quadcopter with accurate flight characteristics. This in turn continued by the assembly of various electronic units on a single right hand glove for the hand movement control. This quadcopter can be controlled both by normal radio control and by hand. This type of quadcopter can able to fly approximately a radial distance of about 1 km.*

***Keywords:*** *Quadcopter, Maneuver, Radio transmission, Radio controller, Fabricate, Radial distance.*

## I. Introduction

Quadcopter is a drone which is the next form of helicopters having more stability than helicopters. It is a small type of unmanned aerial vehicle(UAV). UAVs have most often been used in the field of military but they are also used for search and rescue, surveillance , traffic monitoring, weather monitoring, firefighting, research application in scientific community, fire sensing and some important areas .Quadcopter is device with an intense mixture of electronics, mechanical and mainly on the principle of aviation it can be designed as much small as we want by using the small size components we need to make it. A pair of rotors in one arm facing rotates clockwise direction and another pair of arm rotates anticlockwise direction. The designed vehicle haveability of vertical takeoffs, landing, hovering at a desired location.

## II. Components Used In Quadcopter

**Parts of the Quadcopter**:
X – shaped Frame (Body)
Circular Frame
Brushless motors
Equally balanced Propellers
ESC (Electronic Speed Control)
Microcontroller Board
Receiver
Battery

**Flight control:**It is regarded as the brain of the quadcopter. It controls the motors in a synchronized way. Each rotor produces both a thrust and torque about its center of rotation, as well as a drag force opposite to the vehicle's direction of flight. If all rotors are spinning at the same angular velocity, with rotors one and three rotating clockwise and rotors two and four counterclockwise, the net aerodynamic torque, and hence the angular acceleration about the yaw axis is exactly zero, which implies that the yaw stabilizing rotor of conventional helicopters is not needed. Yaw is induced by mismatching the balance in aerodynamic torques (i.e., by offsetting the cumulative thrust commands between the counter-rotating blade pairs).

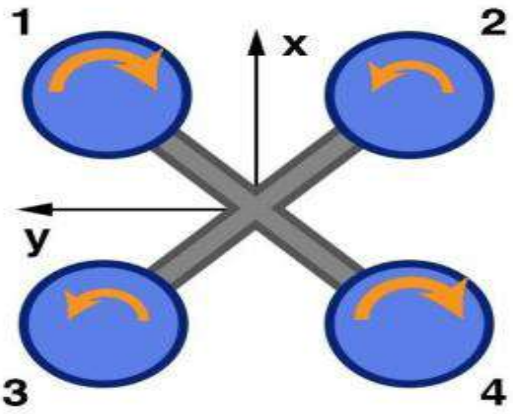



**Fig.1 Flight control diagram**

## III. Fabrication Process Of The Quadcopter

**Frame:** Every quadcopter needs a frame to integrate all the components together. Things to consider here are weight, size, and materials

**ESC:** The electronic speed control or ESC tells the motors how fast to spin at any given time.ESC is often are often used on electrically powered radio controlled models , with the variety most often used for brushless motors essentially providing on electronically generated three phase electric power low voltage source of energy for the motors.An ESC can be a stand – alone unit which plugs into the receiver's throttle control channel or incorporated into the receiver itself, as is the case in most toy – grade R/C manufacturers that install proprietary hobby – grade electronics in their entry – level vehicles, vessels or aircraft use onboard electronics that combine the two on a single circuit board.Regardless of the type used, an ESC interprets control information not as mechanical motion as would be the case of a servo, but rather in a way that varies the switching rate of a network of field transistors, or FETs. The rapid switching rate of a network of field effect transistors is what causes the motor itself to emit its characteristic high – pitched whine, especially noticeable at lower speeds. It also allows much smoother and more precise variation of motor speed in a far more efficient manner than the mechanical type with a resistive coil and moving arm once in common use.

**Brushless Motors:** These are rotary mechanisms that consist of a stator and rotor part used to spin propellers. In drones a stationary core and a rotating out runner is used. Rpm range – 1000rpm/volt. Brushless DC motors (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors which are powered by a DC electric source via an integrated inverter, which produces an AC electric signal to drive the motor; additional sensors and electronics control the inverter output.BLDC motors may be described as stepper motors, however, the term stepper motor tends to be used for motors that are designed specifically to be operated in a mode where they are frequently stopped with the rotor in a defined angular position; this page describes more general BLDC motor principles, though there is overlap.

**Propellers:** Propellers are blades which when rotated generate thrust by pushing the air downwards. These are specified based on diameter and pitch. A quadcopter has four propellers, two propellers that spin counter-clockwise, and two propellers that spin clockwise

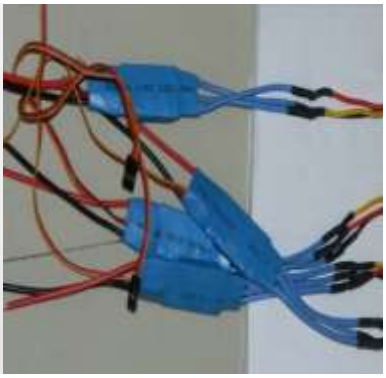
**Receiver-Transmitter:** These are used to control the drones by giving a command signal. The receiver placed on drone receives the signal and transmitter transmits the signal. The antenna intercepts radio waves (electromagnetic waves) and converts them to tiny alternating currents which are applied to the receiver.

**Microcontroller board:** The microcontroller board of the quadcopter is a Hardware PCB board custom designed and with a written source code for the quadrotor application. It also comprises of 3 gyroscopes. The three gyroscopes on the microcontroller board heeds to the roll, pitch and the yaw motion of the quadcopter.

**Battery:** These are portable power units which store electric energy and provide them when load is applied lithium polymer battery is favorable due to its light weight characteristics .type Li-ion battery, capacity 7.4v,25C,1300mah

**Fig.2 Brushless Motors**

**Fig.3 PropellFig.**



**4 ESC (Electronic Speed Control)**

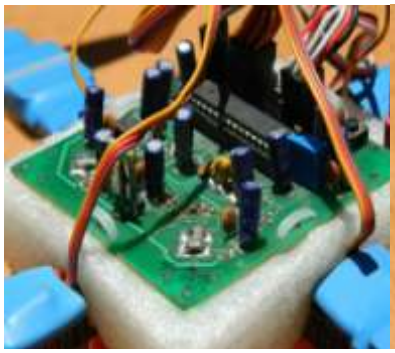


**Fig.5 Microcontroller Board**

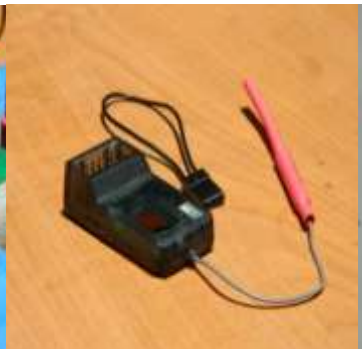


**Fig.6 Receiver**

**Fig.7 Battery**

**Radio controller:** The RC Transmitter sends data to the RC Receiver by generating a modulated radio frequency carrier, while the Receiver is tuned to detect the Transmitter's carrier frequency. The accuracy of sending and receiving frequencies are usually achieved by the use of crystals. The Receiver detects data from the modulated carrier, decodes and deliveries it to the respective Servo.

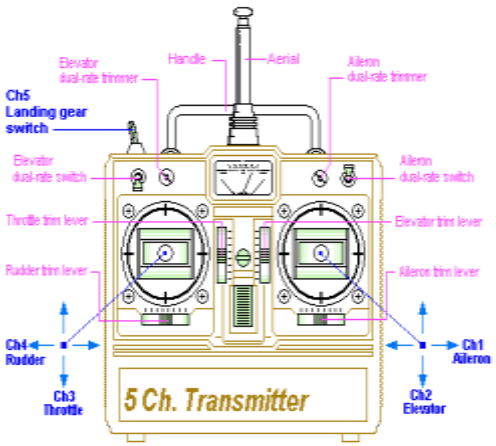



**Fig.8Radio controller**

## IV. Fabrication Of The Hand Movement

**Glove:**For this project, the idea of the usage of a glove was introduced for its capability to suit the hand which helps in free control of the quadcopter and fitting of the microcontroller boards and other electrical units on it.It can be majorly of the type of gloves used in Football or even skiing, as it is the best suiting material for the project


**Fig.9 Skiing glove** **Fig.10 Football glove**

**Hand Glove Controller:**

The hand glove controller mainly consists of the following essential quadcopter controlling components,Accelerometer, Throttle resistive strip, Yaw resistive strip.

**Micro-machined Accelerometer:**

The MMA7341L is a low power, low profile capacitive micro-machined accelerometer featuring signal conditioning, a 1-pole low pass filter, temperature compensation, self-test, and g-Select which allows for the selection between 2 sensitivities. Accelerometers are good for measuring tilt angles of your airframe relative to gravity (technically, this is referred to as "pitch" and "roll").The MMA7341L includes a Sleep Mode that makes it ideal for handheld battery powered electronics.

**FLEX SENSOR (Bend Resistor Strip):**

The Flex Sensor is a unique component that changes resistance when bent. The Flex sensor has a normal resistance of 10 K ohms at 0 degrees. As the flex sensor is bent in either direction the resistance gradually decreases. ( 1 K ohm to 20 K ohm). The Bend Resistor Strip can also be called as the Bend-Flex Sensor Strip. The throttle bend resistor strip is used to increase and decrease the throttle by the action of bending these resistor strips with the help of the middle finger.The yaw bend resistor strip is used to produce yaw motion towards the right or the left side by the action of bending these strips with the help of the thumb.

**FABRICATION PROCESS OF THE HAND MOVEMENT CONTROL:**

The glove consists of a microcontroller board on which the quadcopter controlling units are attached.There are three controlling units which are connected to the microcontroller board.Throttle flex sensor, Yaw flex sensor,Accelerometer.

The throttle and the yaw flex sensor are connected to a potentiometer.There is a need for amplification for the throttle output, a transistor (SL100) is interconnected in order to change the small swings in $V_{in}$ and produce large changes in $V_{out}$.For throttle, there just a single strip the variance is only from 0 to 5 volt.Whereas, for the yaw motion, there are two strips which are placed back to back, as there is a variance of 2.5 to 0volt and 2.5 to 5volt, with 2.5volt being the mid-center. The micro-machined accelerometer (MMA7341L) which operates at about 3.4V consists of a regulator which regulates the incoming 5volt.Two push type button switches are also provided for the purpose of arming and disarming the quadcopter.

**The Arm Section:**

The arm section consists of one of the microcontroller board from the RC, a radio frequency transmitter board and an antenna fitted on an arm pad used in the game of cricket by the batsman. The microcontroller board was taken from the RC as it required the corresponding throttle, yaw, roll and pitch conditions of the receiver of the quadcopter and the transmitter of the hand movement control.It is also required for other binding operations between different transmitters and the receiver.An Analog to Digital converter is also used here in order to produce the PPM (Pulse Position Modulation) signals.The arm section also consists of the Radio Frequency Transmitter board which is connected to the former. Finally, an antenna is connected to transmit the radio frequency signals to the receiver of the quadcopter.

**Procedure of Flight by the Hand Movement Control:**

The Hand Movement Control is first switched ON. After synchronization at proper zero conditions, the quadcopter is to be armed by pushing the arm button.Now, the quadcopter can be given some throttle by moving the forefinger down gradually until the required height is reached.The yaw motion can be controlled by moving the thumb towards and away from the palm.The roll and pitch motion can be controlled by tilting the palm or the hand in any way.

i.e.,

| | | |
|---|---|---|
| Forward tilt | – | pitch down |
| Backward tilt | – | pitch up |
| Leftward tilt | – | roll left |
| Rightward tilt | – | roll right |

**Future Additional Enhancements:**

GPS (Global Positioning System)
External Body Cover for protection,
Robotic arm, etc.

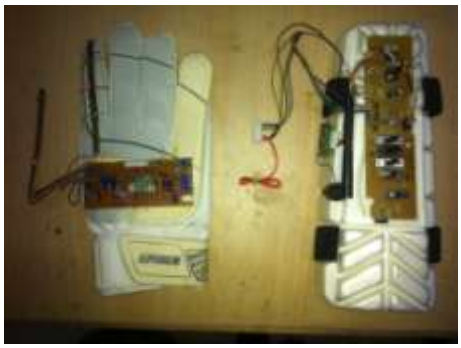


**Fig.11Entire Hand Movement Control Apparatus**

## V. Conclusion

The Fabrication of the Quadcopter and its Hand Movement Control has been carried out meticulously and has also passed through a series of repeated flight tests. This project will thus aid through major areas of varying application.

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