

Quad-Copter A Review

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ABSTRACT

This paper is the presentation of design methodology and realization of the Quad-copter. It is a device with an intense mixture of Electronics, Mechanical and mainly works on the principle of aviation. The Quad-copter has 4 motors whose speed of rotation & the direction of rotation changes according to the user's desire to move the device in a particular direction. The rotation of motion changes as per the transmitted signal. Each rotor produces both thrust and torque about its centre of rotation. It can be controlled by radio transmission or operate under the guidance of limited autonomous protocols.

Keyword : - Gyro sensor1, IR sensors2

1.INTRODUCTION

Quad-copter is a helicopter which has four equally spaced motors. It is usually arranged at the corners of the square body. It is a multi-copter helicopter which is lifted and propelled by four rotors. Most Quad-copters use two set of identical fixed propellers; two clockwise and two counter clockwise. These propellers use variation of RPM to control lift and torque. It basically works on various types of sensors like IR and Gyro. IR is used to avoid the obstacle and Gyro is used to change the orientation of the Quad-copter and stability purpose.

1.1 Chassis

It helps to provide to support all components like battery, external sensors, motors & controller board.

1.2 BLDC Motor

Brushless motors have more advantages compared to other motors in terms of comparatively more efficiency, reliability, longer life span, more power, reduce noise factor and overall reduction of Electromagnetic Interference.

1.3 Electronic Speed Controller (ESC)

An ESC is an electronic circuit used to vary ac electric motor speed and also acts as dynamic brakes of the system. An ESC the BLDC motor by converting the supplied DC from battery into AC. We are using 30A brushless speed controllers.

1.4 IR & GYRO SENSORS

IR is used for avoiding obstacles. Gyro is used to change the orientation of the Quad-copter.

1.5 PROPELLERS

Propellers are used to generate lift force. A pair of clockwise rotating and a pair of counter clock wise rotating propellers balance the gyroscopic effect of each motor. We will be using propellers having diameter of 10 inches and pitch of 4.6 inches/revolution.

1.6 BATTERY

Lithium polymer batteries (LiPo) are popular for powering remote control aircraft due to its light weight, energy density, longer run times and ability to be recharged. We selected 2200mah, 11.8 V, 3 cells, 25 C batteries.

1.7 Remote controller

A radio control system needs a transmitter and a receiver. Remote controller is used for multi purposes like steering control, vertical take-off and landing. We are using 6 channel FHSS 2.4GHz Remote Controller.

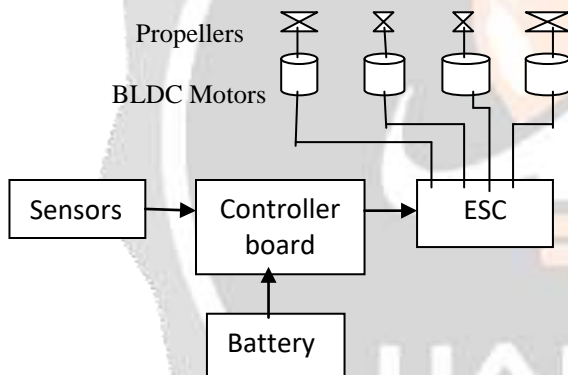
1.8 GPS & GSM

Global positioning system is used to track the system wherever the Quad-copter is and then send the message on mobile through Global system for Mobile communication. A sim card is used for this communication.

1.9 ATmega168

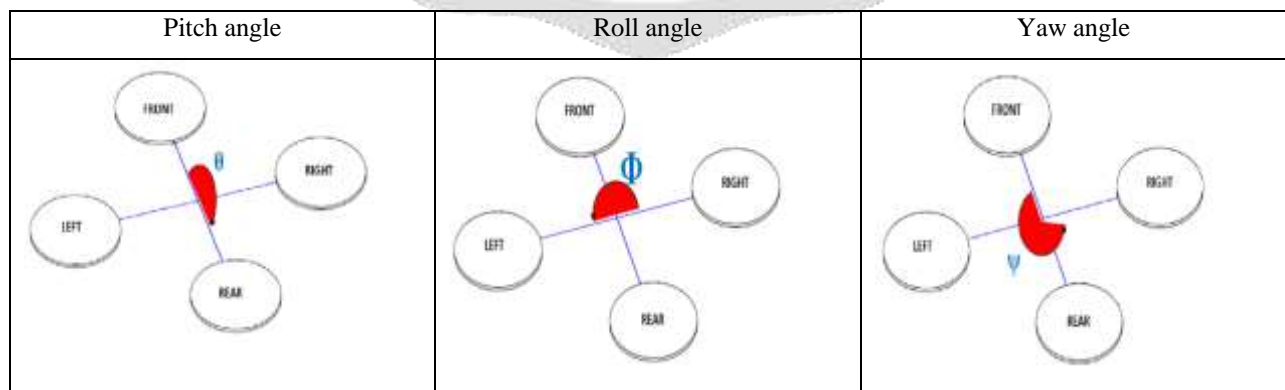
AT mega power consumption is very low. It has advance high RISC architecture. It also has a fully static operation. That's why we choose AT mega processor.

2. BLOCK DIAGRAM



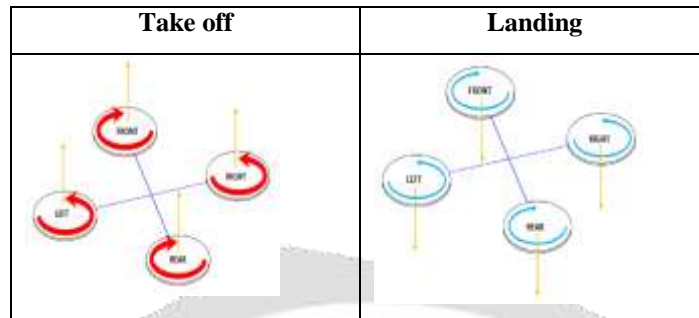
3. Quad-copter movement mechanism

This aim for control the Quad-copter motion. The speed of these four rotors are independent. By independent, pitch, roll and yaw attitude of the Quad-copter can be control easily.



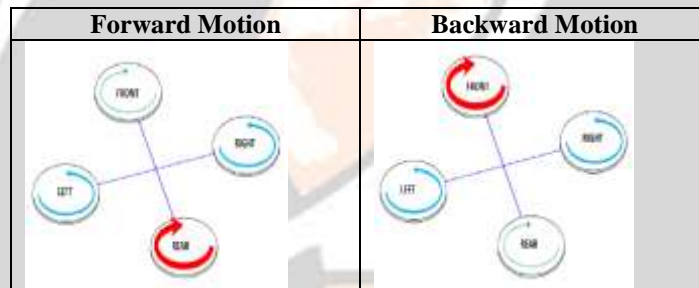
a) Take off and Landing Position

Take-off is the movement of Quad-copter that lift up from a certain height from ground and Landing position is versa of take-off position. Take-off motion is control by increasing the speed of four rotors simultaneously and landing motion is control by decreasing the speed of four motors.



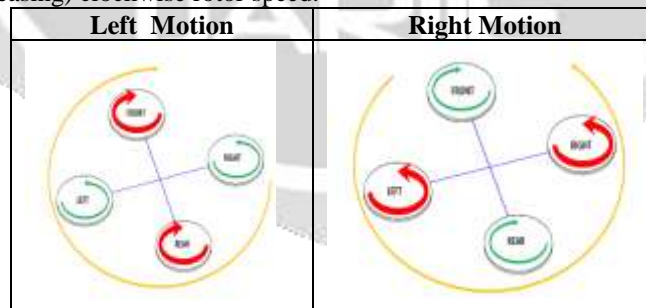
b) Forward and Backward Motion

Forward (backward) motion is control by increasing (decreasing) speed of rear (front) rotor. Decreasing (increasing) rear (front) rotor speed simultaneously will affect the Pitch angle of the Quad-copter.



c) Left and Right Motion

For left and right motion, it can control by changing the yaw angle of Quad-copter. Yaw Angle can control by increasing (decreasing) counter-clockwise rotors speed while decreasing (increasing) clockwise rotor speed.



4. CALCULATION

- Required thrust = $(\text{weight} \times 2) / 4$
- Maximum rpm = $K_v \text{ rating} \times \text{max. Voltage} \times \text{propeller efficiency } (\eta)$
Where, propeller efficiency $(\eta) = 0.9$
Max. Voltage = voltage of battery
- Maximum thrust = $\text{maximum rpm} \times (\text{diagonal})^2 \times \text{pitch angle of propeller}$
Where, M=diagonal distance

Pitch angle=4.5

- Motor spacing formula= $M/\sqrt{2}$, Where M= diagonal distance.

5. Application

- In Military & Defense.
- For surveillance.
- For civil purpose like contour planning of Dam.
- In emergency like fire, flood etc.
- In remote areas for providing mandatory objects.
- For Data measurement.

6. CONCLUSION

The quad-copter is now able to takeoff and reach at height, but some small corrections are still needed to keep the quad-copter in one spot. Better settings of controller, for example with using another method to use a better control method it may help for a better stabilization. Also it possible to refine the positioning in space by adding extra sophisticated filters. On the time of flight the quad-copter acts also the wind effect; therefore it is needed to include this effect into the overall stabilization.

One of the advantages of the quad-copter is ability to fly on the places, where human can't reach so quickly. with the help of a camera it is possible to explore inaccessible locations. With added new devices like GPS & GSM we can determine a flight path or track some objects.

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