ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

An ISO 3297: 2007 Certified Organization *Vol. 5, Special Issue 3, March 2016*

National Conference on Recent Advances in Electrical & Electronics Engineering (NCREEE'16)

Organized by

Dept. of EEE, Mar Baselios Institute of Technology & Science (MBITS), Kothamangalam, Kerala-686693, India

On 17th & 18th March 2016

Solar Empowered Quad-Copter with Smartphone Control

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ABSTRACT: The quad-copter hasimmense applicationin the area of surveillance and emergency rescue. Twenty first century is already marked in names of mobile application development and its uses so such a quad copter with an android application may have immense reach in the digitalized world. The goal of this project is to develop a quad copter that can becontrolled using an android powered Smartphone. The main problems regarding a typical unmanned aerial vehicle (UAV) are its energy sources. Thispaper aims to fabricate and test fly a UAV aided with combination of rechargeable Lithium Polymer battery and wafer based mono-crystalline resin coated solar panels for its power source.

KEYWORDS: Quad copter**,** UAV, Lithium Polymer battery.

I.INTRODUCTION

As the name suggested quad means four and quad-copter is an unmanned aerial vehicle made up of four motors which are fixed in a frame structure. The craft is in shape of English alphabet 'X' and these rotors are rotating clock wise and anti-clock wise adjacent to one another for to balance the torque produced, now this balanced torque advances the safe thrust level for the flight lift.Some helpful considerations when making a quad copter are size, weight, built material, battery size, motor and propellers etc. The weight needs to be low enough so the Quad copter's upward thrust creates a force great enough for flight to occur. The software side is much different from hardware, there are various things that need to done in software; for example, controlling the motor, interpreting controller inputs, communication with the quad copter and various other algorithms required to fly. Schematic diagram of Quad copter with four rotor arrangement and its rotation scheme is shown in Fig: 1

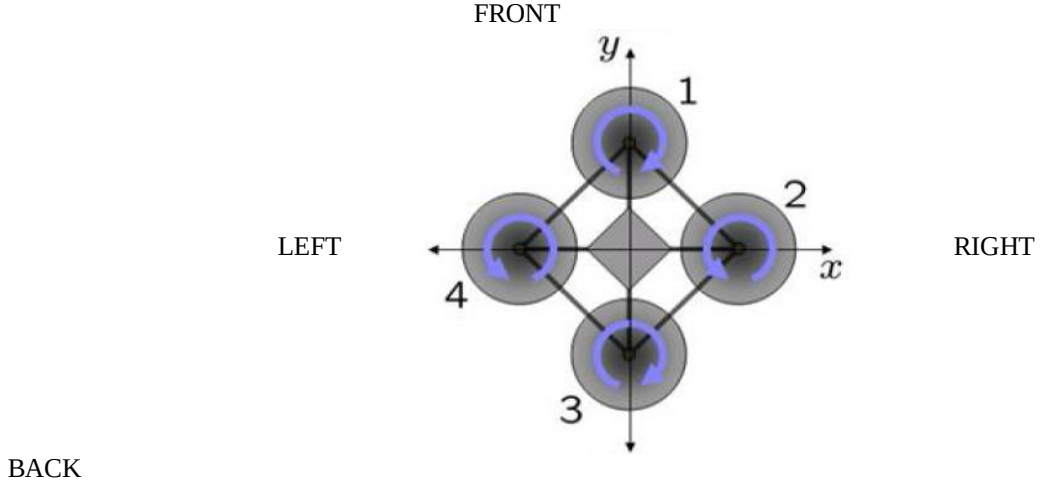

Fig: 1 schematic arrangement of quad copter

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II. DATA COLLECTION AND IMPLEMENTATION

Here discuss about the data collection and implementation of UAV.It includes electrical components, fabrication materials, Battery parameters, solar panels etc.

1) MOTOR AND PROPELLER SELECTION

Due to the advantages of quick acceleration and minimal friction the development ofquad copter can be carried out using BLDC motor (brushless DC motor).The selected motor is type G-Power D2830-11, weighted 50g.These small motors have the capacity of 945 RPM/Volt and maximum efficiency of 80%.Each motor can produce maximum thrust up to 850g, Hence total thrust of the quad is upto 3400g.Fig:2 shows G-Power D2830-11 BLDC motor. With G Power D2830-11 DC motor fiber propeller is used because of its low weight there by increasing the efficiency.

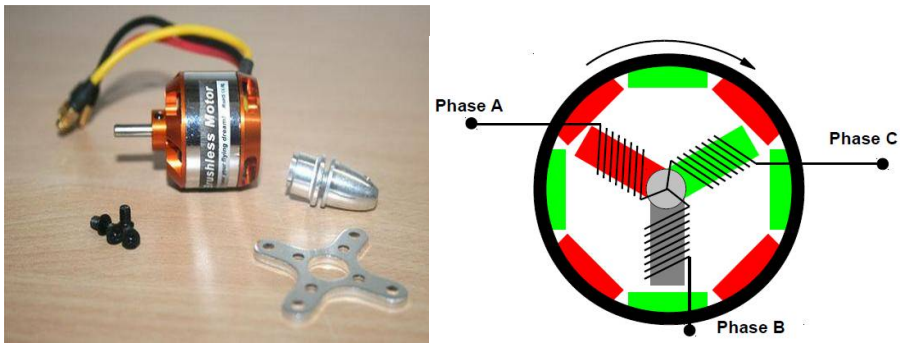

Fig: 2 G-Power D2830-11 BLDC motor

2) ELECTRONICS SPEED CONTROLLER SELECTION

The electronic speed controller (ESC) is a device used to control the DC motor's speed and to provide the motor with three phase electric power from the DC battery source. A sequence of signals is sent to the 3-phase brushless motor which then controls its speed of the DC motor. Specifications of this ESC are having Max Continuous current 30A, burst current 40A upto 10 seconds, using 3s Li-po battery with 11.1V and mainly it is weight less with simonK updated firmware, Hence it doesn't needa separate Battery Elimination Circuit (BEC).It is shown in Fig: 3

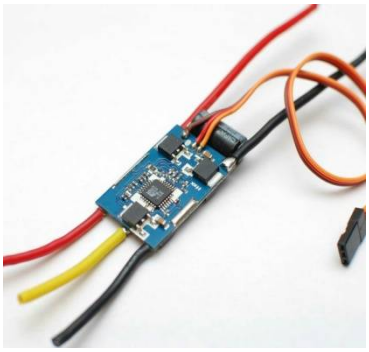

Fig: 3 DYS 30 ESC

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3) TRANSMITTER AND RECEIVER SELECTION

The Transmitter (TX) and Receiver (Rx) system allows the UAV to be remotely controlled through a wireless signal. The aircraft controls would typically include throttle, pitch, roll, yaw, and modesettings. There are two basic types of Transmitter-Receiver systems currently available in themarketnamelythe FM system and the 2.4GHz system. Here 2.4GHz is used for its better performance, because it will not experience signal conflicts from other radio frequency (RF) controllers. TheUAV used utilizes the Fly Sky brand 6C 2.4GHz System. It provides the user with up to 6 individual channel commands that will be employed on the UAV. It is shown in Fig. 4.

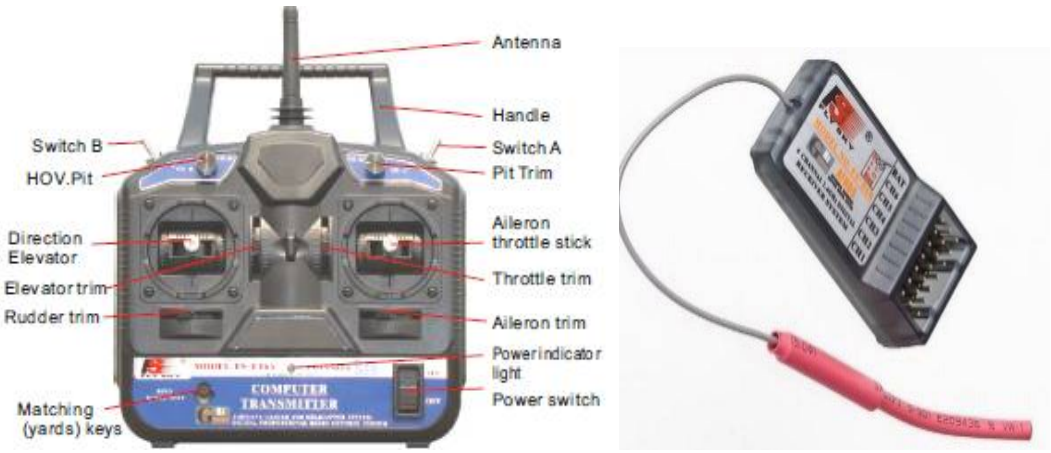

Fig. 4 FS-CT6A Transmitter-Receiver systems

4) FLIGHT CONTROL BOARD SELECTION

Flight Control board is the overall control unit for the UAV's flight performance. The control board is powered by ATMEL Mega 644PA 8 Bit AVR RISC microcontrollers shown in Fig: 5. there is a Piezo buzzer on board for audio warning when activating and deactivating the board. The board has to be loaded with software in order for it to work and subsequently programmed and fine-tuned to allow for stable flight and it doesn't needs separate gyro controller which is inbuilt in the selected flight control board

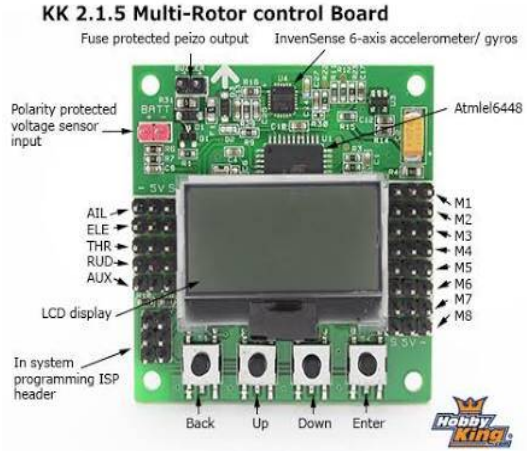

Fig: 5KK Copter Controller

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5) BATTERY SELECTION (PRIMARY POWER SOURCE)

In this section the power source of the UAV is discussed. Here Lithium Polymer (Li-Po) rechargeable battery is selected for UAV's primary power, because it is having low weight and high voltage capacity compare to other types of batteries. It is shown in Fig.6Specifications of the battery selected are 11.1V, 3-cell Li-Po rechargeable battery with 2200mAh. It comes under the Turnigy Nano-Tech brand

Fig.6 Lithium Polymer (Li-Po) battery

6) SOLAR PANEL SELECTION (SECONDARY POWER SOURCE)

Solar modules use light energy (photons) from the sun to generate electricity through the photovoltaic effect. The module used is wafer-based mono crystalline silicon cells. Cells must be protected from mechanical damage and moisture by epoxy resin. It is shown in Fig. 7

Fig. 7 solar panel

7) Wi-Fi MODULE

Embedded Wi-Fi module is based on the universal serial interface network standard within built IP stack. Dissipation power of the module is 600mW and RAM of 16 Mb.Serial communication baud rate upto230.4KBPS.It will support built in on board antenna as well as external antenna and shown in fig: 8

Fig. 8 Wi-Fi Module

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III. SYSTEM OVERVIEW (BLOCK DIAGRAM)

The overall idea can be explained using a block diagram (Fig: 9, 10) description. Supply for both microcontroller and Wi-Fi module are fed from a step down transformer and a 7805 regulator IC, while supply for the DAC (digital to analog converter) is fed using 7812 regulator IC.A smartphone with developed application is the main controller. The mobile application is developed using eclipse android development kit, working concept of the app is such that the manual joystick has a variable resistance inside that and by manual controlling the value of resistance will changes and thereby the transmitted analog signal will varies and motor control become possible

But here using an android app ASCII valueswill be generated equal to that of manual joystick resistance variations value during the move of the sticks. Using a Wi-Fi module serially transmit the data to PIC microcontroller (PIC16F877A).Microcontroller is already programmed to decode and output the digital data to different ports. Using a digital to analog converter convert the digital signal into analog signal and using a differential amplifier the change in parameters with reference is extracted and transmitted through RF transmitter.

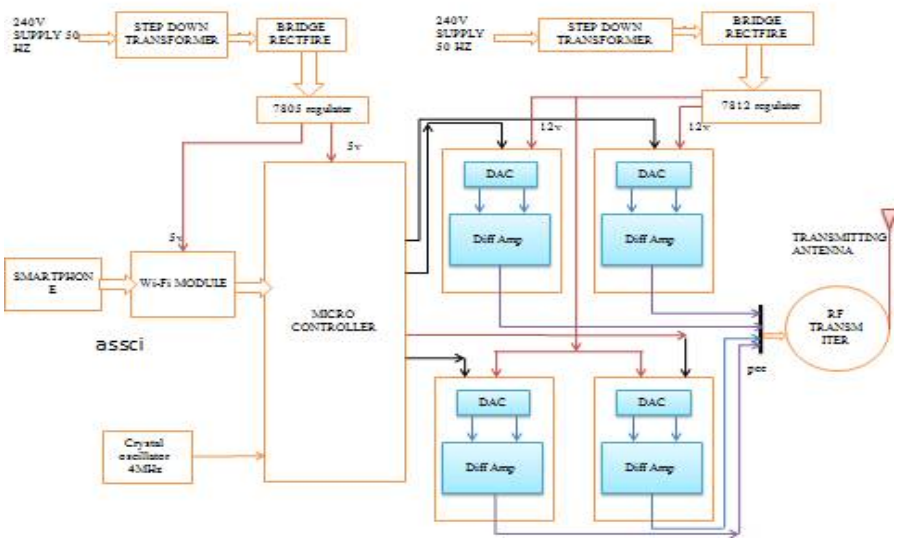

Fig.9Main circuit boardlayout

The receiver in the quad copter will receives the signal and using the main quad controller, electronics speed controller speed of each motor is controlled. The quad controller also monitors the battery level, and as a secondary power source, battery is charged using a solar panel placed on the top of thecontroller.

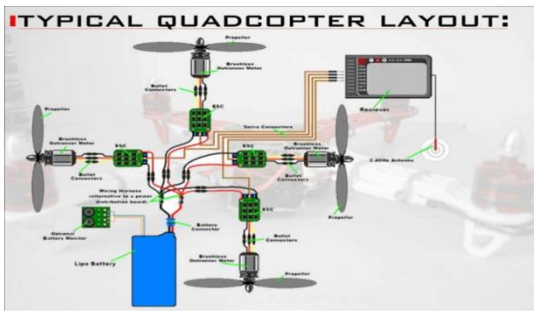

Fig.10 Layout of quad copter

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IV RESULT AND DISCUSSIONS

Fig11, fig 12 shows the photo of finalprototype and flying tests of UAV. By the use of mentioned specification components the quad copter can be liftedupto 20m range. The use of solar panel helps to save 20% of battery. By precisely and accurately spinning these four propellers at different speeds, all the common directional movements like forward/backward movement, left/right movement, and yaw (turn rate) movement of a standard helicopter are attained

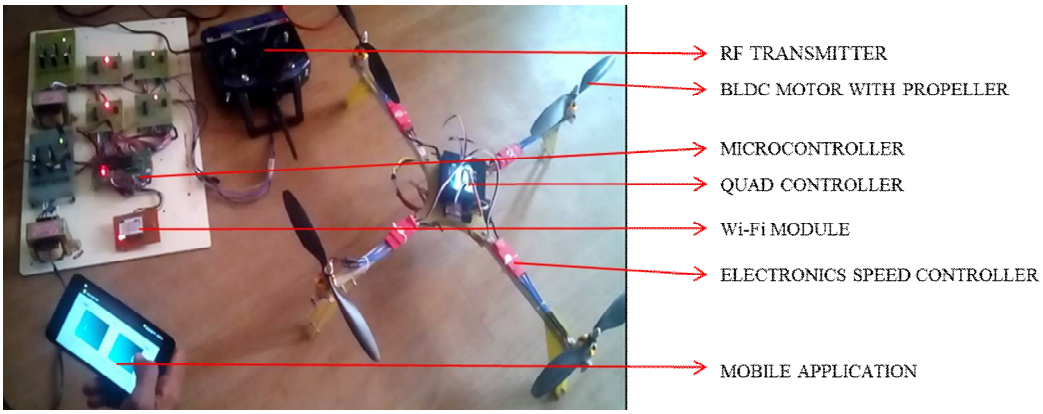

Fig.11 Final prototype

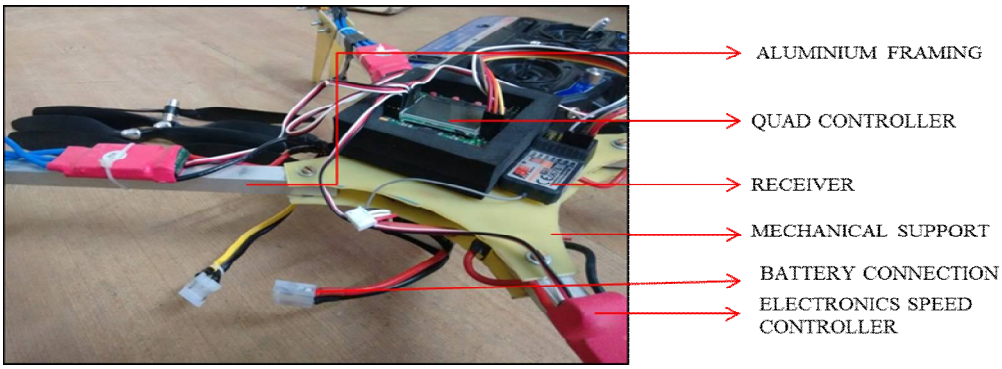

Fig.12 Quad copter prototype

The main ground circuit board is shown in fig: 13.Using the preinstalled application in smartphone the smooth take off and hovering of quad is achieved

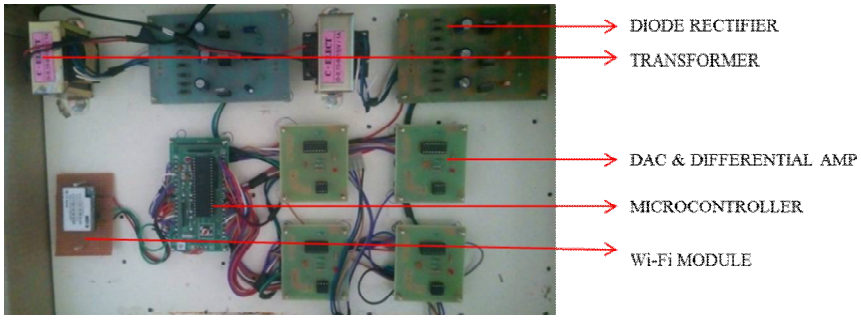

Fig.13 Main Board prototype

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V. CONCLUSION

The fabrication and test fly of a UAV aided with rechargeable batteries and solar panels areachieved.Using quad copter, risky security tasks can be completed easily and use of smartphone based control system make it more convenient to use,Future expansion and innovative ideas can be implemented later.

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