On-Board Rechargeable QUADCOPTER

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Abstract- Quadcopter, or commonly known as drone, is a type of aircraft without a human pilot on board, as the name suggested, but controlled autonomously by computers or taking commands from remote stations. The quadcopter are perfect candidates for tasks that are tedious or dangerous for human. Most hobby and commercial drones can fly for only about 20-30 minutes maximum. That's because batteries eventually die. And the larger and more powerful the battery, the heavier the craft, which in turn needs more battery power to fly. The flight time of the quadcopter can be extended by using solar energy along with the batteries, which can be effectively used by recharging the batteries on board. Solar panels can be used for collecting the solar energy which in turn will be converted to electrical energy and is supplied to the batteries for charging which runs the motors and help in extending the flight time of the quadcopter.

Keywords- Quadcopter, solar energy, Flight time, solar panels

I. INTRODUCTION

The Unmanned Aerial Vehicles have four arms and fixed pitch propellers which are set in an X or + configuration with X being the preferred configuration. In the standard format two propellers will spin in a clockwise direction with the other two spinning in an anticlockwise direction allowing the craft to vertically ascend, hover in the air and fly in a designated direction. By adding four motors and four propellers to a lightweight frame constructed of light wood, carbon fibre, or fibre glass then connecting it to a remote control transmitter via a small control board fitted with a gyroscopic stabilization system and connected to a Li-Po battery these craft were relatively simple to construct. The rapid advances in computing power, the efficiency of the coreless or brushless motors, smaller microprocessors the development of batteries and gyroscopic and accelerometer technology has all led to a proliferation of Quadcopter designs.

By using all these advanced components a solar powered quadcopter can be designed. This can be done by designing a quadcopter by using the required hardware components and then placing the solar panels of required specifications on to the frames of the quadcopter, which can be used to convert the solar energy to electrical energy which is given to the charging circuit for the purpose of recharging the batteries on board which in turn runs the motor and hence increases the flight time.

II. LITERATURE SURVEY

In the last few decades, small-scale unmanned aerial vehicles have been used for many applications. The need for aircraft with greater maneuverability and hovering ability has led to a rise in quadcopter research. The four-rotor design allows quadcopters to be relatively simple in design yet highly reliable and maneuverable. Research is continuing to increase the abilities of quadcopters by making advances in multi-craft communication, environment exploration, and maneuverability. If these developing qualities can be combined, quadcopters would be capable of advanced autonomous missions that are currently not possible with other vehicles.

Until 2013, drone or UAV technology was mainly the domain of the defense industry. However the past few years we've seen small private companies, large tech- and aviation companies jump into this new market. According to ABI Research, the drone industry is going to be worth a whopping $8.4 billion by 2019**.** It's not just the sales of the hardware, it's mainly the applications and services where most growth is expected. And the most exciting part: solar energy is playing an increasingly important role in the development of UAV technology. Right now there are over a dozen of tech and aviation companies working intensely on the development of solar powered drones.

III. DESIGN DESCRIPTION

Firstly the motors which we used have an obvious purpose: to spin the propellers. Motors are rated by kilovolts, the higher the kV rating, the faster the motor spins at a constant voltage. Next the Electric Speed controller or ESC is what tells the motors how fast to spin at any given time. We need four ESCs for a quadcopter, one connected to each motor. The ESCs are then connected directly to the battery through either a wiring harness or power distribution board. Many ESC1s come with a built in battery eliminator circuit (BEC), which allows you to power things like your flight control board and radio receiver without connecting them directly to the battery. Because the motors on a quadcopter must all spin at precise speeds to achieve accurate flight, the ESC is very important.

Our Quadcopter uses four propellers, each controlled by its own motor and electronic speed controller. Using accelerometers we are able to measure the angle of the Quadcopter in terms of X<Y and Z and accordingly adjust the RPM of each motor in order to self-stabilize itself. The Quadcopter platform provides stability as a result of the counter rotating motors. For designing the on-board rechargeable quadcopter, solar panels is placed on to all four arms of the quadcopter and also on the center. For charging the Li-Po battery solar panel with rating 12 volt and 200mA is used. Figure 1 shows the solar panel that can be used. This is a high quality 2.4 watt 200mA module of size 4.5in*7in. 5 solar panels of this type is used because for charging the 2200mA Li-Po battery we need a voltage of around 12V which cannot

be provided by a single panel, hence we are using 5 panels which provides nearest voltage which later is amplified to get the required voltage for charging the battery

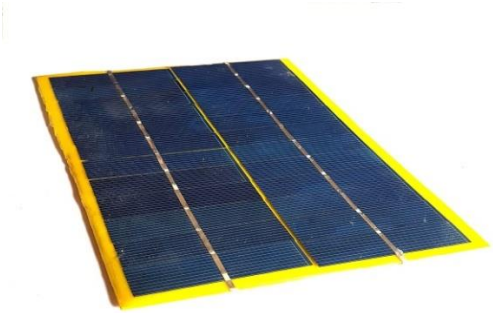

Fig.1: Solar panel

The electrical output from the solar panel is given to the charging circuit for the purpose of recharging the Li-Po battery.

The CN6009 regulator is a wide input range, current mode, DC/DC converter shown in figure 3 which is capable of generating either positive or negative output voltages. It can be configured as a boost, flyback, SEPIC or inverting converter. The CN6009 built in N-channel power MOSFET and fixed frequency oscillator, current-mode architecture results in stable operation over a wide range of supply and output voltages. The CN6009 regulator is special design for portable electronic equipment applications. This is thus helpful in amplifying the output voltage from the solar panel.

Fig.3: CN6009 module

The output from the charging circuit is given directly to the battery for charging it which further runs the motor. Further the charging circuit is explained using figure 2.

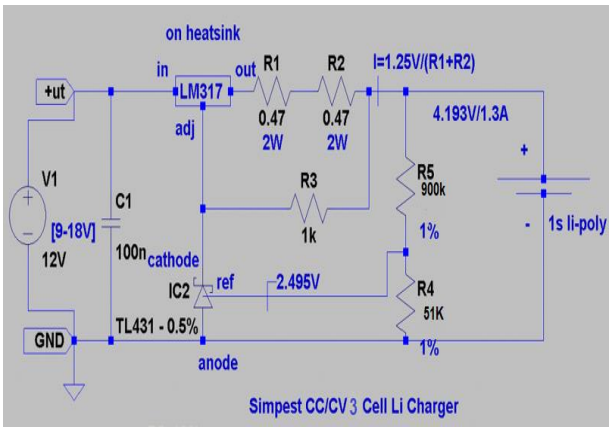

Fig.2: Three cell Li-Po battery charging circuit

This is a Lithium-ion charger for Li-Po batteries. Circuit schematic shows configuration for charging three cell Li-Po battery but voltage can be set to charge several batteries in series. Li-Po charger sets a current limit with the LM317, and 1 resistor, and the voltage limit with the TL431, and 2 resistors. 1K resistor is needed to let the TL431 decrease the LM317 current, and to provide the necessary current to the TL431. The optional Schottky diode at the output will prevent current flowing back from battery to the charger circuit when power is disconnected, and reverse biasing of the LM317. Power supply with more than 3V above output voltage is required.

IV. FLIGHT RESULT

During the challenging 2 months of design and development, a total of 21 hours flight testing has been done. The design of on-board recharging of the quadcopter battery has yielded an extension of flight time up to 17 minutes. The flight conditions are summarized in Table 1.

The first day it showed excellent flight time with clear sky and high intensity of sunlight. The second and third day also went well, but had to land the drone early due to overheating of the charging circuit. Furthermore heating may cause damage to the electronic speed controller, and the drone may fall down

Table 1: Summarized flight conditions

Day and Weather	Flight Time	
	Without Charging Circuit	With Charging Circuit
Day 1: Clear sky	11 minutes 32 seconds	16 minutes 42 seconds
Day 2:Clear sky	10 minutes 37 seconds	15 minutes 40 seconds
Day 3:Clear sky	10 minutes 39 seconds	16 minutes 29 seconds

V. CONCLUSION

This paper has presented development efforts behind the on-board rechargeable quadcopter. This paper brings technology to establish flight performance of solar powered quadcopter. More specifically, we have introduced a conceptual design and analysis frame work to analysis solar powered UAVs. The vehicle is not based on the most energy dense battery technology publically available and uses efficient yet affordable solar modules.

VI. REFERENCES

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