International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 3 Issue: 6 3633 - 3634

Autonomous Navigation of Flying Quadcopter

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Abstract- The goal of the project is to design a semi-autonomous Quadcopter, capable of self-controlled flight with the help of wireless communications. It utilises an Arducopter Version 2.6 having an in-built microcontroller. The size of Quadcopter is designed small enough to take care of expenses, therefore small scale motors and propellers are used in its construction. With the help of APM 2.6, Gyroscope, Accelerometer the Quadcopter maintains control. Raspberry Pie 2 is used as a development board which provides IDE for Python scripts. The design of Quadcopter is in plus '+' configuration. The Quadcopter's movement is controlled by varying the relative thrusts of each rotor. To roll or pitch, one rotor's thrust is decreased and the opposite rotor's thrust is increased by the same amount.

Keywords: *Arducopter V2.6,Raspberry pie 2,ESC,Brushless DC Motor,Propeller.*

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I. INTRODUCTION

A Quadcopter, also called a Quadrotor helicopter, is a multirotor helicopter that is lifted and propelled by four rotors. Unlike most helicopters, Quadcopters use 2 sets of identical fixed pitched propellers, 1st set consists of 2 clockwise (CW) and 2nd set consists of 2 counter-clockwise (CCW). These use variation of Revolutions Per Minute to control lift and torque. To maintain balance the Quadcopter must be continuously taking measurements from the sensors i.e Gyroscope and Accelerometer, and making adjustments to the speed of each rotor to keep the body level. These adjustments are done by a sophisticated control system like Arducopter on the Quadcopter in order to stay perfectly balanced. A Quadcopter has four controllable degrees of freedom: Yaw, Roll, Pitch, and Altitude. Each degree of freedom can be controlled by adjusting the thrusts of each rotor. Quadcopters are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of rotors. Quadcopter configurations were seen as possible solutions to some of the problems in vertical flight. Mostly there are two types of Quadcopter configurations. First configuration is plus '+' and the second configuration is cross. Quadcopters use an electronic control system and electronic sensors like Electronic Speed Controllers to stabilize the aircraft. With their small size, these Quadcopters can be flown indoors as well as outdoors. The use of four rotors allows each individual rotor to have a smaller diameter than the equivalent helicopter rotor. Due to this every motor has to carry 1/4th of the weight of Quadcopter as opposed to Helicopter where the single motor carries the whole weight. This increases the efficiency and life of motors. Some small-scale Quadcopters have frames that enclose the rotors, permitting flights through more challenging environments, with lower risk of damaging the vehicle or its surroundings.

II. MOTIVATION

The Quadcopter, is able to take off without a runway, be able to reach in difficult terrains, take a picture from a particular position and finally maneuver through tight spaces as required. The Quadcopter can also be used for sensing various climatic conditions such as heat, pressure and humidity in a foreign land. The Quadcopter also provides a superior payload capacity when compared to the helicopter and is a more stable platform.

III. METHODOLOGY

Quadcopter changes direction by altering the speed of each rotor and it can be semi autonomously navigate. It is one of the major topic of research in today's world.

A. COMPONENT DESCRIPTION

1) Motor: Motors are a bit similar to normal DC motors in the way that coils and magnets are used to drive the shaft. Though the motors do not have a brush on the shaft which takes care of switching the power direction in the coils, and so it is called as brushless motors. Instead the brushless motors have three coils on the inner of the motor, which is fixed to the mounting. For a small scale Quadcopter the DC Brushless motor used is of 1000 KV rating. It operates at 7.4-14.8 volts.
2) ESC: The brushless motors are multi-phased, normally 3 phases, so direct supply of DC power will not turn the motors on. That is where the Electronic Speed Controllers (ESC) comes into play. The ESC generating three high frequency signals with different but controllable phases continually to keep the motor turning. The ESC is also able to source a lot of current as the motors can draw a lot of power.

3) Propellers: On each of the brushless motors there are

 ISSN: 2321-8169
3633 - 3634

mounted a propeller. The 4 propellers are actually not identical the motor torque of and the law of physics will make the QuadCopter spin around itself if all the propellers were rotating the same way, without any chance of stabilizing it. The larger diameter and pitch the more thrust the propeller can generate. It also requires more power to drive it, but it will be able to lift more weight.

4) Battery: The power source for the whole device. The recommended battery is LiPo (Lithium Polymer) battery because of it is light weighted in nature.

5) Flight Controller: The flight controller consists the Micro Controller, in built Gyroscope, Accelerometer.

6) Raspberry pie 2: The Raspberry Pi primarily uses Linux kernel based operating systems. It is used for providing an IDE for writing Python scripts and hence generating inputs to be fed to the Flight Controller.

IV. ARCHITECTURAL DESIGN

The architectural diagram explains about the working principle of the autonomous navigation for flying robot where in the initial stage is receiving the signal from the Wireless Signal which is connected to the android mobile device and operates based on the directions which is given by the user who is handling the device. The input signals from the device is fed to the flight controller via raspberry pie2. The input signals are in the form of digital signals. The output from the flight controller is directly fed to the motors via the ESC.

V. LITERATURE REVIEW

To know the working principle of the Quadcopter [1] is referred and based on the hardware requirements that are the hardware parts as well as their connectivity and also their working principle of each of the circuits referred to [2]. The explanation for each circuit is known in [3] website. To know their functional requirements [4] is referred. To switch the mode from one angle to another we referred to [5] and to control the flying of robot referred to [6].

VI. CONCLUSION

The project could go in a variety of directions since the platform seems to be as flexible as we initially intended. This flexibility allows changing the functions it performs and also allows integration of any technology that would prove to be useful. The project could be enhanced as per the requirements, resources and the budget. More no of Sensors could be mounted on it thus providing more unique features. The high definitions cameras could also be installed in it. This project has clearly demonstrated the goals of proving that small scale UAVs are useful across a broad range of applications.

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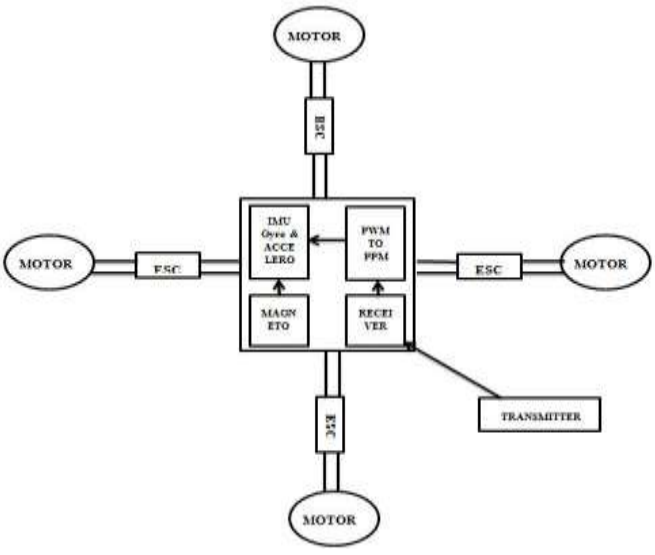

Figure 1. Block Diagram of a Quadcopter.