Making of Autonomous Quadcopter Using IoT Sensors and Android Application

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Abstract- *This project aims to infuse the IoT technology to build an autonomous quadcopter. Internet of Things is a wide area comprising of sensors, actuators and cloud platform. The devices that collect the data and exchanges them through the network is termed as IoT. The project is about developing a quadcopter with autonomous feature using IoT sensors mounted on the quadcopter. The term autonomous means that no human intervention is needed to control the quadcopter. The quadcopter can be controlled from both an RC transmitter and an android device. The quadcopter is designed in such a way to provide the users with little or no work in controlling the quadcopter.*

Keywords- Terms **-** Bluetooth, Global Positioning System, and Unmanned autonomous vehicles

I. INTRODUCTION

This project aims to ameliorate the difficulties faced by the users to control the quadcopter by infusing the latest technology in the field of the Internet of Things. The main difficulty a user faces in controlling the quadcopter is its maneuverings. A user must include several safety mechanisms and fail safes to pilot a quadcopter. This project aims at reducing the risks of failure. To achieve this goal, various options were analysed and finally, an autonomous feature was chosen. A quadcopter derives from the family of helicopter. A helicopter is a flying object using only two rotors; whereas the quadcopters use independent motors to provide the thrust for flying [4]. Using these motors, the quadcopter can achieve 6 degrees of freedom. A quadcopter is more agile than any other robot. It can also be used in various terrain.

II. PROPOSED WORK

Initially, quadcopters were not encouraged in any applications because of its instability and difficulty to control. But as these things were rectified, the use of quadcopters has expanded to various applications. The battery used in the project has a capacity of 5200 mah which can power the quadcopter for around 20 minutes. The Power distribution board is used to power the 4 Electronic Speed Controller (ESC'S) which controls the speed, yaw, roll, and pitch of the quadcopter, our quadcopter has wolfpack 20-amp ESC's which is one of the best ESCs available in the market with in-built BEC and fail-safe circuits. The ESC powers the Avionic C2830-850kv motor, the main feature of this brushless motor is that it can produce the thrust of 750 grams on 50% throttle. The maneuvering is quite simple as the motors below 1000kv is easy to control. The propellers paired in this project has the dimension of 10" length and pitch value of 4.5, it can support the motor to achieve the maximum thrust possible. Commonly by knowing the frame size, motors, propeller size is estimated. Motor thrust data is checked to verify the current draw to maintain the safety ratings as propeller size plays vital role in current draw. 3DR 5V power module is used to power the APM 2.6 Flight controller Board, APM 2.6 should have uninterrupted power supply to control the multirotor, as the device might fail or lose control when there is no dedicated power module to APM board. The Radio receiver acts as an input to the APM board, all 6 channel values are continuously sent to APM in 20 millisecond intervals. Processing the inputs from the receiver, concerned values are sent to 4 ESC's to enable flight. The quadcopter can be programmed to include different flight modes such as stabilize, altitude hold, loiter, auto, etc. for efficient flights. The flight controller has the capability to store flight data in form of data logs which include the altitude, horizontal speed, vertical speed, battery drain voltage for better monitoring of flights. Further, this can be converted into telemetry logs for visualization of the flight. The data contains the longitude and latitude values which can be viewed in 3-D in google earth. Further, GSM module can be included in this quadcopter (as shown in figure 1) to simultaneously send the sensor readings to the cloud servers and initiate the data analytics.

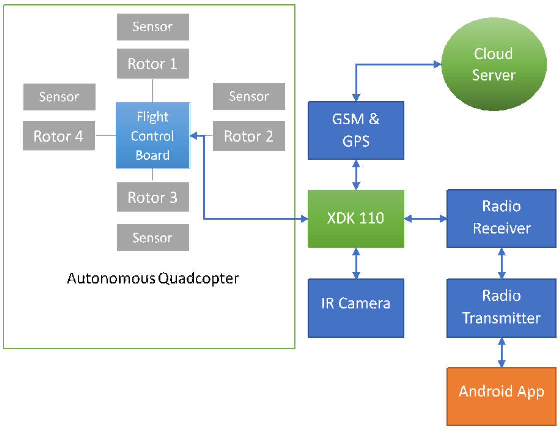

Figure 1. Structural diagram of Quadcopter and its associated component

1. GPS/COMPASS

An external GPS & compass has been mounted on the quadcopter to remove the interference it can cause to the flight control board. The GPS provides the current latitude and longitude of the quadcopter which is crucial for autonomous flight.

2. FLIGHT CONTROL BOARD

The flight control board used for this project is APM 2.6. APM 2.6 uses an external compass than an internal compass. The APM 2.6 has onboard magnetometer and gyroscope, and is optimized for vehicles where the compass should be placed as far from power and motor sources as possible to avoid magnetic interference. The GPS/Compass module may be mounted far away from other interferences the APM itself. APM 2.6 requires a GPS unit with an onboard compass for full autonomy.

III. WORKING

1. QUADCOPTER

A quadcopter is an unmanned aerial vehicle with four rotors. It has 6 independent axes of freedom. But a quadcopter can be controlled only using four independent inputs. To make these a possibility both the rotational and translational motion are combined. To nullify the angular momentum caused by the rotation of propellers, two motors move in clockwise direction and other two motors move in anticlockwise direction. This method also provides more control over the quadcopter

Figure 2. Top view of the quadcopter

The four inputs in the quadcopter include Throttle, roll, yaw, and pitch. During the throttle phase, all the motors are given equal power to provide the thrust for take-off. Movement around the vertical axis is called the throttle. To adjust a yaw, two opposite motors are given more power. Rotation around the vertical axis is called the yaw. To adjust a roll or a pitch, only one motor is given more power. Rotation around the front to back axis and side to side axis is called the roll and pitch respectively.

Our quadcopter is x configured (as shown in figure 4 and 5). We chose the x configuration because two motors are aligned in the pitch and roll directions, this configuration is inherently more stable and agile when required. Also, we could easily mount a camera in the front and keep the blades out of the camera view.

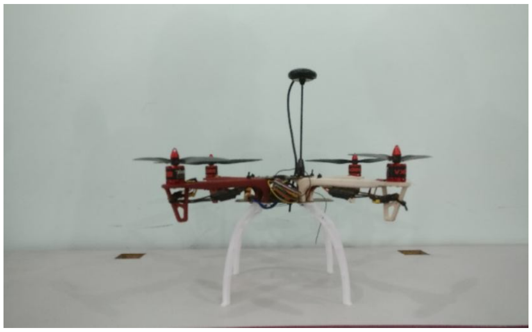

Figure 3. Side view of the quadcopter

There are two major modes of operation for the quadcopter. First, it can be controlled using a RC Controller which has a range of 2.5kms. Second, it can be made completely autonomous so that it would go on pre-planned missions at required time without any human intervention [1]. During autonomous mode (as shown in figure 6), one can set the waypoints, the path to cover, the altitude and the speed between two waypoints. Also, it can be configured to move in required direction and alt in required locations. These missions can be sent to the flight control board either through a PC or Android mobile via USB or Bluetooth. During these flights, the IoT sensors mounted on the quadcopter records the environmental parameters at a time interval of one second.

Hence the quadcopter is flown in such a way to achieve the perfect readings.

Figure 4. Quadcopter during flight

2. ANDROID APPLICATION:

To set the waypoints for autonomous navigation (as shown in figure 7) an Android application is developed. This communicates through Bluetooth for data transfer. Bluetooth module HC-05 is interfaced with Telemetry port for this purpose. This short-range device can interface APM and Smart phones to identify the flight modes, device status, and reading sensor values from the Flight Controller board. Further android application can be used for arming and disarming the quadcopter along with land, follow and RTL features. Further by connecting a telemetry device (3DR) the range of the mobile station and quadcopter can be enhanced to kilometres.

Figure 5. Setting waypoints in Android Application.

3. WEB APPLICATION:

A web application is developed to store the flight data for further analysis. The application stores the values of sensor data from the flight controller such as gyroscope, accelerometer, humidity which can be viewed as a graph.

4. ULTRASONIC SENSOR

An ultrasonic sensor is mounted at the four sides and base of the quadcopter for avoiding obstacles. Initially, the sensor takes reading of an empty space available in its position. Then as these readings are manipulated in the microcontroller, obstacles can be identified. The ultrasonic sensor measures the gap by the amount of distance it records. the altitude of the quadcopter can be found out using these readings.

V. CONCLUSION

In this paper, it shows the working of quadcopter along with some of the important components to make it work. The use of android and web application is clearly outlined. Finally, IoT sensors used in the project is explained.

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