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3D FPV Drone

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ABSTRACT

Drones are unmanned aerial vehicles that are remotely controlled. They range in size from under one pound to several hundred pounds. Drone technology has skyrocketed over the past decade driving costs down and the number of potential applications up, such as in the field of agriculture, shipping and delivery, 3D mapping, Safety Surveillance, Wireless Internet Access, Applications in the field of research and nature science. We present here a drone which is equipped with an onboard camera and various other sensors connected to a Raspberry Pi 3 board which will collect and transmit the video feed and all the necessary data from the sensors connected to the Raspberry Pi and display it on an Android phone or a laptop. This system is equipped onto the drone to add more functionality to it. It will make the drone smarter in better ways.

Keywords: Drone, smart, FPV Drone, Raspberry Pi, VR, 3D

I.INTRODUCTION

Drones are nowadays used for a wide variety of applications. They have gained so much popularity in just a short amount of time since they were made, that they are now being used from surveillance to expensive film making. We have decided to create a drone capable of streaming live video feed with object detection and various other values retrieved from the different sensors equipped onto the drone. The sensors are connected to the Raspberry Pi 3 along with the camera and fixed on the drone which will provide computational power to retrieve the sensor data.

A drone is actually an Unmanned Aerial Vehicle (UAV). They are capable of manual control or even autonomous control and sometimes both. Our drone is a Vertical Take-Off and Landing (VTOL) drone. The body of the drone is made of lightweight but durable materials. It ensures maximum flight time and good immunity to harsh weather conditions, rough landing and sometimes crashes. Higher quality drones based on specific purpose are sometimes made of carbon fiber and similar lightweight but strong materials. The quality of the propeller blades and the speed of the brushless motor also matter. We have used four numbers of 1400KV brushless motor. The motors are controlled by the Electronic Speed Controllers (ESC) which aid in regulating the speed of individual motors. This allows the drone to achieve lift and to be stable while airborne. The ESCs are connected to the flight control board. We are using the KK 2.1.5 flight control board. This board is the one that is responsible for a stable flight of the drone. A receiver is hooked to the flight control board so that the board receives the flight operation instructions from the transmitter. We have used a 6 channeltransmitter. The onboard electronics is powered by a 11.1V Lithium Polymer battery as it provides high power density and long lifetime. It can be charged by a specially designed charger available in the market. On the other hand, Raspberry Pi 3 is responsible for other electronics such as the camera and the sensors.Here, we can use any sensors depending on the purpose of our drone or for any use.The Raspberry Pi 3 is a credit-card-sized low cost small computer which is used in many electronics and computing projects. It is capable of performing many of the things that a general desktop PC can do such as edit spreadsheets, word processing, internetbrowsing and playing games. The programming part for the camera and the sensors equipped to the Raspberry Pi is done on OpenCV. It is known as Open Source Computer Vision. OpenCV is a

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library of programming functions mainly aimed at real-time computing capabilities. This library is cross-platform and free for use. A small power bankin the range of 2000 mAH to 4000 mAH will be used to power the Raspberry Pi and sensor electronics. The complete system will then be equipped onto the drone to make it a single unit.

II. WORKING OF THE DRONE

The drone mounted with a KK 2.1.5 Multi-Rotor LCD Flight Controller. It has a 6050MPU Gyroscope and Accelerometer installed in it. It is capable of receiving 1520us (5 channels) from Receiver, whereas the signal to ESC is 1520us. It has an easy graphical interfacing with receiver andin-built firmware. It is designed to be easy to use for beginners. The size of the KK 2.1.5 board is 50.5mm x 50.5mm x 12mm and the weight is 21 gramsalong with the Power Distribution Board(PDB). The heart of the drone is the flight controller as it communicates with all the other parts of the drone. The 4 numbers of 1400KV Brushless motors are controlled by the ESC which is in turn maneuvered by the flight controller.

The 5 channel transmitter works on a 2.4GHz channel and also has frequency hopping techniques to avoid signal interference. The receiver is in communication with the flight controller via SBUS. Based on the commands received, the speed of the motors is varied and hence the motions of the drone is defined.

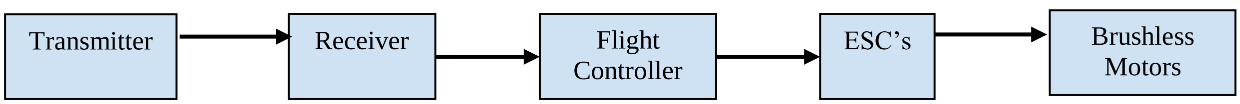

Fig 1: Basic working principle of drone

Here, we provide the details of the components that we have used to create the drone. As we have mentioned above, our flight control board is the KK2.1.5 Flight Controller. It is equipped with a small LCD screen for easy instant setting changes and its very own firmware preinstalled. To the flight controller, we connect 2 pairs of ESC or Electronic Speed Controller. To each of the ESC, we connect a A2212/10T brushless motor having the rating 1400KV. The individual power terminals of the motors are connected to the appropriate terminals of the 2200mAH 11.1V Lithium Polymer battery. We have a Fly Sky R6B receiver connected to the flight control board so that it can receive instructions from the transmitter. The transmitter we have used is a 6CH 2.4GHz Fly Sky FS-CT6B Transmitter.

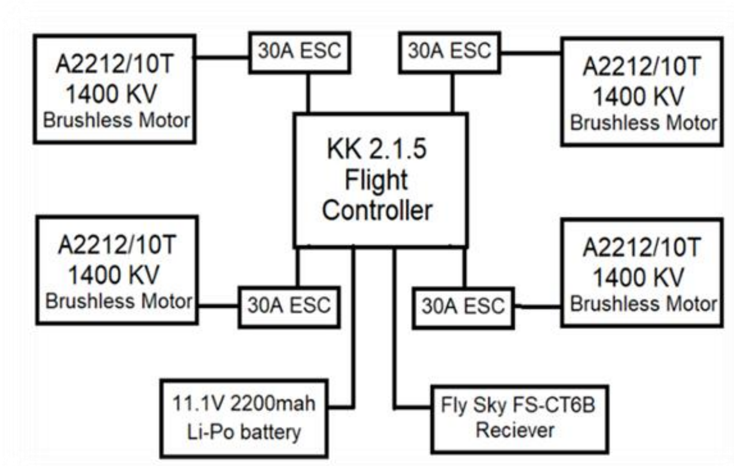

Fig 2: Drone Hardware Setup

In addition to the drone setup, it will also carry a Raspberry Pi 3 and a power bank of the rating 2000-4000 mAH to power the credit-card-sized computer. A Pi camera which will be either VGA or 5MP and above will also be used.

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But since, it will be used for object detection, a 5MP camera sounds more suitable. There will also be other sensors added to get more functionality out of the Raspberry Pi 3 board such as infrared sensors, proximity sensors and more. Moreover, through OpenCV, the Raspberry Pi board will be programmed to provide the video feed and all the sensor data in real time to a laptop or to an android phone. We will also try to provide the video feedback in google VR format. Below is the basic idea where we will follow this.

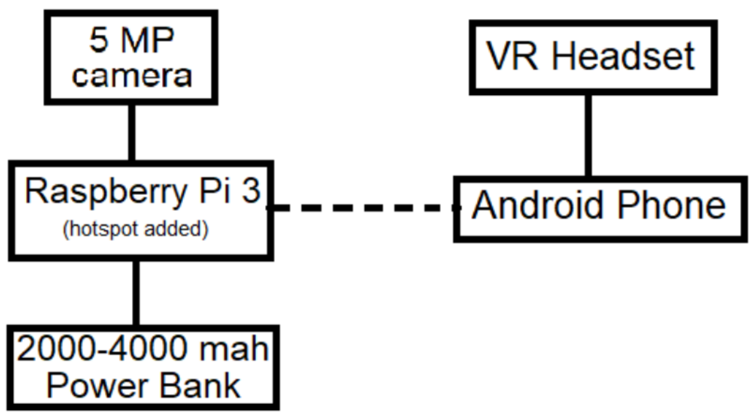

Fig 3: Basic block diagram for the sensor and camera kit of Raspberry Pi 3.

Below are some of the sensors we have chosen to use in our drone with the Raspberry Pi 3 board

(i) Infrared sensor
(ii) Ultrasonic Sensor
(iii) Humidity Sensor

(i) Infrared Sensor

IR Infrared Obstacle Avoidance Sensor Module has a pair of infrared transmitting and receiving tubes. When the transmitted light waves are reflected back, the reflected IR waves will be received by the receiver tube. The onboard comparator circuitry does the processing and the green indicator LED comes to life.

The module features a 3 wire interface with Vcc, GND and an OUTPUT pin on its tail. It works fine with 3.3 to 5V levels. Upon hindrance/reflectance, the output pin gives out a digital signal (a low-level signal). The onboard preset helps to fine tune the range of operation, effective distance range is 2cm to 80cm.

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(ii) Ultrasonic Sensor

We are using HC-SR04 ultrasonic sensor. It emits an ultrasound at 40,000 Hz which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. Its operation is not affected by sunlight or black material although some soft materials like cloth can be difficult to detect. It comes complete with ultrasonic transmitter and receiver module.

(iii) Humidity Sensor

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It is integrated with a high-performance 8-bit microcontroller. Its technology ensures the high reliability and excellent long-term stability. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin. It has excellent quality, fast response, anti-interference ability and high performance.
It’s fairly simple to use, but requires careful timing to grab data. It’s good for 20-80% humidity readings with 5% accuracy and 0-50°C temperature readings with ±2°C accuracy. It has a 1 Hz sampling rate.

III. HARDWARE AND SOFTWARE REQUIREMENTS

Below are the hardware and software requirements that are to be used to make this drone

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HARDWARE REQUIREMENT	SOFTWARE REQUIREMENT
1. Flight Controller (KK 2.1.5). 2. Electronic Speed Controllers (ESCs). 3. 6 Channel RF Transmitter (2.4GHz). 4. RF Receiver (2.4 GHz). 5. Brushless DC Motors (1400KV). 6. 2200 mAH 11.1V Li-Po Battery. 7. Raspberry Pi 3. 8. 2000-4000 mAH Power bank 9. Pi Camera. 10. Various sensors.	1. BetaFlight 2. BSHeli Configurator 3. OpenCV.

Table 3.1 Hardware and Software requirements

IV. CONCLUSION

As we have mentioned above, one of the main applications is video streaming from the camera in VR format and also have object detection functionality. More sensors can be added to increase the functionality of the drone such as humidity sensor, infrared sensor and various other sensors that will provide real time data indicating the environmental conditions of where the drone is airborne. This allows it to be useful in various fields such as agriculture, surveillance, rescue missions. The data acquired from the sensors can be used to assess the conditions of the situation of where human need to operate and need confirmation if it is suitable for human to go there. In some cases, if a certain area needs to assessed and if the environment is not fit for humans, then a drone can be sent to acquire the required data. This data can then be analyzed if the conditions are right for a human being to enter into the designated area. The major drawback is that the drone needs to be operated by a human operator. This disadvantage can be removed by upgrading to an autonomous drone. With help of well-crafted algorithms and a few modifications to the hardware, autonomous feature can also be added to the drone. This will allow even more diverse uses of the drone in a wider range of applications.

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