Designing and Implementation of Multipurpose Dronefor Aerial Surveillance

1[st]Dhanashree Gade
*Students, Department of Electronicsand Telecommunication Engineering, Dr. D.Y. Patil Institute of Engineering Management & Research, Akurdi*Pune, India – 411044
gadedhanashri24@gmail.com

4[th]B. Lakshmiprabha *Assistant Professor, Department of Electronics and TelecommunicationEngineering, Dr. D.Y. Patil Institute of Engineering Management &Research, Akurdi*
Pune, India – 411044 lakshmiprabap@yahoo.com

2[nd]Ekta Prasad *Students, Department ofElectronics and Telecommunication Engineering,Dr. D.Y. Patil Institute of Engineering Management & Research, Akurdi*
Pune, India – 411044 ektaprasad66@gmail.com

3[rd] Shruti Dhawade *Students, Department of Electronics and TelecommunicationEngineering, Dr. D.Y. Patil Institute of Engineering Management & Research, Akurdi*
Pune, India – 411044shrutidhawade8899@gmail.*com*

***Abstract*—Quadcopter or UAVs have come to the limelight in the contemporary world. This technology is capable of providing services in domains like photography, security, disaster management, etc. at a low cost. The advancement in drone technology is at its high in recent times. Here we propose a more efficient system that can help in surveillance of any area.**

For this, we have an onboard camera that is connected with Raspberry Pi which helps in live streaming of video of the area under surveillance, as well as a GPS module that provides us with the real-time location of the UAV. The sensors mounted on UAV provide us with the real-time atmospheric details of a particular location which can be further used to monitor and predict the climate. All this information collected by the UAV can be accessed remotely on a single website including the live video streaming and current GPS location. The availability of data that can be remotely accessed onto a single system and webpage makes monitoring easy and effective.

Furthermore, this system is also capable of carrying some amount of payload which can be used for medicine and food package delivery during the disaster to the unreachable areas. This helps to bridge the gap and establish communication with the areas or locations that were affected by disasters.

***IndexTerms*—Aerial Surveillance, Drone, Live VideoStreaming Raspberry Pi, UAV.**

I. INTRODUCTION

In today's world, there is an upsurge in surveillance for monitoring of behavior, activities, or information for the purpose of data gathering, influencing, managing, or directing. An aerial surveillance system proves to be advantageous in this regard. Aerial surveillance implies the gathering of data/information, usually an image or video, from an aerial vehicle— such as an unmanned aerial vehicle, helicopter, or spy plane.

Talking about quadcopters, quadcopters are formally known as unmanned aircraft systems (UAVs) or drones. A drone is a

flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded system working in union with onboard sensors and GPS. Drones hold the ability of vertical take-offs, landings, and hovering at a desired location. It has four motors, with a pair of motors rotating in the clockwise direction while the adjacent pair of motors rotating in the anticlockwise direction. Thus, the resultant torque acting on the frame structure is zero, allowing the copter to fly.

A quadcopter is a technology with an intense mixture of electronics, mechanical, and mainly based on the principle of aviation. It can be customized and sized according to our convenience. Drones have most often been used in the field of military, search and rescue, surveillance, traffic monitoring, weather monitoring, firefighting, research applications in the scientific community, fire detection, and some other important areas. The advancement in drone technology is at its peak during the recent times.

II. IDENTIFIED PROBLEM

During a natural calamity, riots, or emergencysituation following problems are faced

- Loss of civilian and military life.
- Communication with a particular area getsdisconnected.
- Transport of essential goods gets interrupted.
- Real-time data of the weather cannot be procureddue to damaged caused to infrastructure.
- Use of high-cost equipment like helicopters.
- Surveillance of an area by traditional means is noteconomical.

Although there is a high amount of increase in demand fordrones. Indigenous drone technology has not evolved up

tothe expectations. Also, during recent times government isshowing great interest in smart surveillance technology.
Hence, we came with the idea of a multipurpose drone foraerial surveillance.

III. OBJECTIVE AND PURPOSE

Objectives:

I. To Live Stream the video of the area which is set under surveillance.

II. To track the live location of the UAV specifying it latitudes and longitudes in order to identify the actual location.

III. To monitor the climate of the area in which thedrone is placed.

IV. To make available all the data of the location under surveillance onto a single website.

Purpose:

I. Live streaming using an onboard camera makessurveillance efficient.

II. Getting live geo location makes the task easier toidentify the location with high accuracy.

III. Procurement of real-time weather through onboard sensors reduces the reliance on the available infrastructure and the onboard sensors are more resilient.

IV. Delivery of essential goods weighing up to 0.5 kg is also possible.

IV. METHODOLOGY

For the purpose of designing and implementing our quadcopter model we followed the following methodology:

1) Recognize the objective for the model.

2) Surveying the existing work models and propose our model.

3) Study about working dynamics of quadcopter along with parts(components) identifications.

4) Selection of parts/components by market surveying in order to minimize the cost and mitigate the possible risk of damaging the copter.

5) Assembling the parts and testing the drone for a stable flight.

6) Work on the software part so as to get the final product to accomplish the desired results.

Quadcopter dynamics:

We choose the quadcopter model because of its simple design characteristics, easy manufacturing and the power provided by four motors allows for quick and fast movement. Also, the quadcopters are easy to repair and cost less than their counterparts.

Drones have motors that are used for propulsion and control. Spinning the blades of propellers pushes air down which in turn pushes up the motor. The fast-spinning of the motors results in a greater lift, and vice-versa. For Hovering in the mid-air, the net thrust of the four motors lifting up the drone must be equal to the gravitational force pulling it downwards. Easy. For moving the drone further up, increase the thrust (speed) of the four motors. This results in a non-zero upward force that is greater than the weight of the drone. For descending, simply decrease the motor thrust (speed) so that the net force is downward.

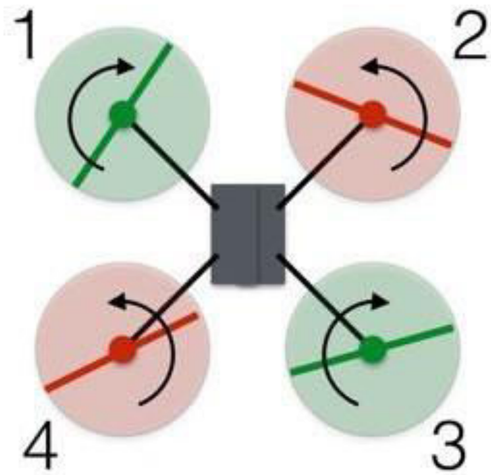

Figure 1

In the above figure, the red motors represent counterclockwiserotation and the green represents clockwise rotation. With the two sets of motors rotating in opposite directions, the total angular momentum is zero. The angular momentum is based on how fast the motors spin. For rotating the drone, we need to decrease the spin of motors 1 and 3 and increase the spin for motors 2 and 4. Thus, the angular momentum of the motors still doesn't add up to zero, so the drone rotates. Also, the total force remains equal to the gravitational force, thus the drone continues to hover. Since the lower thrust motors are diagonally opposite from each other, the drone is balanced.

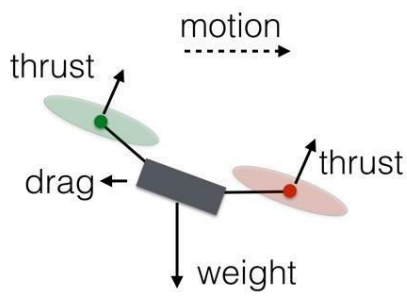

Figure 2

For flying forward, a forward component of thrust from the motors is needed. To do this, increase the rotation of motors 3 and 4 (rear ones) and decrease the rotation of motors 1 and 2. The drone will stay at the same vertical level as the total thrust force remains equal to the weight. Also, since one of the rear motors is spinning counterclockwise and the other clockwise, the increased rotation of those rotors will still produce zero angular momentum. The same holds true for the front motors, and so the drone does not rotate. However, the drone will tilt forward when there is a greater force in the back of the drone. Now a slight increase in thrust will produce a net thrust force that will balance the weight along with a forward motion component.

For selecting the motors,

Thrust on each motor = (Total weight of the drone × 2) / 4
= (2 kg) / 4 = 1 kg
Thus, we selected 2300 KV which provides 1024gm of thrust. Hence, total thrust provided by the 4 motors is = 1024 4 = 4096gm i.e., 4 kg approx.

Proposed system components:

1. Quadcopter Frame: The goal of the frame is to provide the physical structure for the entire aircraft and house all of the other components. The frame should be of suitable size so as all the four propellers spin without collision. We used glass fiber frames for their low weight, high strength, and low cost.
2. Speed Controllers: Electronic speed controller (ESC) are required for every motor individually. The ESCs accept commands in the form of PWM signals and output the appropriate motor speed. Appropriate ESCs must be chosen to make sure that they will provide enough current for the motors. Thus, we choose ESC of 40 amp.
3. Motors and Propellers: The motors work is to spin the propellers to provide the quadcopter with lifting thrust. We used brushless DC motors, as they provide thrust-to-weight ratios superior to brushed DC motors.

Propellers are available in many sizes and materials. Propellers must be selected so as to yield appropriate thrust and not overheat the motors. We selected 10x4.5 carbon fiber props.

4. Flight Controller: The flight controller can be regarded as the brain of the quadcopter, as it performs all the necessary operations to keep the quadcopter stable and controllable during its flight. Its operation is to accept the user control commands from the Rx, combine them with the readings from the attitude sensor(s), and calculate the necessary motor output. This project uses APM 2.8 flight controller.
5. Battery: The purpose of the battery is to provide electrical power to the motors and all electronic components of the copter. Lithium Polymer (LiPo) batteries were selected because they have high specific energy and have a capacity rating and discharge rating.
6. Transmitters (TX) and Receivers (RX): The transmitter module is in charge of the transmission of the radio signals from the controller to the drone for issuing the commands of flight and directions. The receiver module is in charge of the reception of the radio signals sent to the drone through the controller. Here, the FlySky FS-i6, a great low-cost entry-level 6-channel
2.4 GHz Transmitter and Receiver are being used.
7. GPS Module: The GPS module is used for retrieving and displaying the exact location of the area. GPS module used is NEO-M8N.
8. Raspberry Pi: The version of raspberry used here is version 3 model B. It was selected due to its higher performance.
9. Raspberry pi camera: The Raspberry Pi Camera delivers a crystal clear 5MP resolution image or 1080p HD video recording at 30fps. It is fully compatible with Model B and has small size and lightweight.
10. Sensors: The sensors such as temperature sensor (LM35), MQ6 for smoke, MQ135 for CO_2, are used to provides the real- time atmospheric of an area.

Working Procedure:

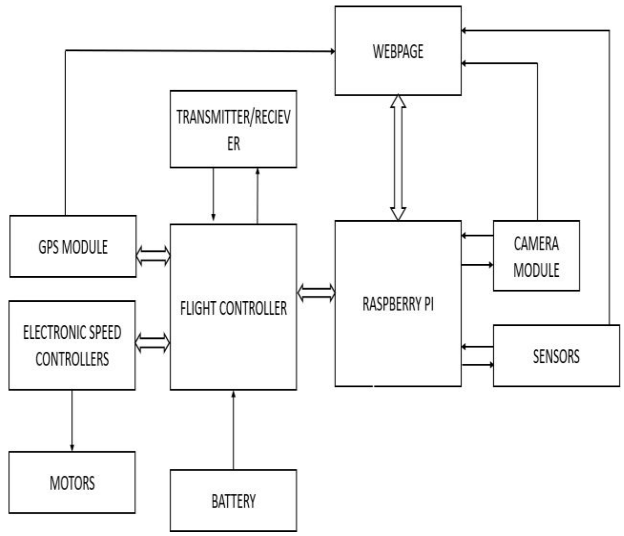

Figure 3: Block diagram of quadcopter

Above is the block diagram of the proposed quadcopter system, which shows the connection between various components.

This quadcopter is mainly designed for surveillance. The very first step is to integrate all the system components in order to prepare the quadcopter hardware. After developing the hardware, the next step is calibration. Calibration is the process of configuring an instrument so that it can measure something accurately. Calibration aims to minimize measurement uncertainly. Mistakes in calibration can result in flying issues or crashing of the quadcopter. For the calibration purpose, we used software named Mission Planner. After calibration of the drone next comes the software part.

To live-stream the video of the area which is set under surveillance, to track the live location of UAV specifying its latitudes and longitudes in order to identify the actual location, to monitor the atmospheric details of the area in which the drone is placed, we developed a website. All the data collected by the drone is made available on a single website. To develop the website HTML and JavaScript was used and coding was done with the help of Python Language.

Since we are using raspberry pi, we were needed to install the Raspbian operating system on our desktop.

V. RESULT

After the successful completion of the project, we get a quadcopter with a stable flight, controlled by an RC controller. And accessing the website which displays the data collected by the quadcopter on the desktop.

Below is the drone devolved, which can be controlled using RC controller and perform is the task of surveillance.

Figure 4: Drone hardware

The screenshot of the website, that is live streaming usingthe raspberry pi camera module is presented below.

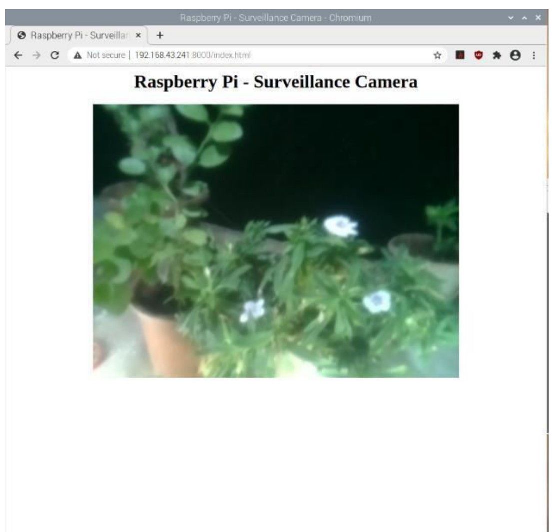

Figure 5: Live streaming on the website

VI. CONCLUSIONS

This paper presents a quadcopter model which can provide efficient surveillance in an area. The Quadcopter can be controlled using a remote controller (RC) and is capable of a stable flight. It has a camera module installed for live video streaming of the area under surveillance, on a self-made website. The website displays details of the copter along with the latitude and longitude of the drone's current location, which is captured using the GPS module. The drone also has some sensors integrated for providing the current atmospheric details. Furthermore, it is also capable of carrying a small amount of payload, which proves useful in situations like disaster relief operations (by carrying first aids or food packets). All the data collected by the quadcopter can be accessed remotely on a single website. Thus, this model of the drone makes monitoring of an area easier and effective, thus achieving our goal of a surveillance.

VII. FURTHER WORK

There are few changes possible in the quadcopter for future implementation:

- The quadcopter controls can be brought onto the website for control instead of using RC flight controller.
- Implementation of image processing can help to identify the calamities like floods, fire etc.
- The quadcopter can be designed to fly automatically by giving the location of the destination.
- The payload attached to the quad copter can be increased by changing the specification of the currentsystem.
- The shortest route to reach a desired place can be figured out by an algorithm.

ACKNOWLEDGMENT

The Authors would like to thank Prof. B. Lakshmiprabha E&TC Department in D. Y. Patil Institute of Engineering Management and Research, Akurdi for her valuable guidance.

REFERENCES

[1] Zainab Zaheer, Atiya Usmani, Ekram Khan, Mohammed.
[2] A. Qadeer, “Aerial Surveillance System using UAV” 978- 1-4673-8975- 4/16/$31.00 ©2016 IEEE.
[3] Dr. G . G Sivasankari and Prerana G Joshi, Live Video Streaming using Raspberry Pi in IOT Devices. International Journal of Engineering Research & Technology (IJERT). ICPCN - 2017 Conference Proceedings.
[4] RameeshaTariq ,”A smart Human Detection drone for Rescue.” Conference Paper - October 2018.
[5] Munmum Ghosal, Ankur Bobade, PreetiVerma , “A Quadcopter based Environmental Health Monitoring System”, Proceedings of second International Conference on Trends in Electronics and Information (ICOEI 2018).
[6] .MohdKhan,”Quadcopter Flight Dynamics” International Journal of Scientific & Technology Research.
[7] Nadia Nowshin, Sumaiya Jannat Hossain, Md. Ahsanul Kabir and KanizFatem,”Designing and Implementation of a Multi-purpose Quadcopter”, International Conference on Information , Communication, Engineering and Technology (ICICET).