Surveillance Quad-copter

[1] Mr.Adhish Dighe, [2] Ms.Shruti Hande, [3] Mr.Varun Joshi,[4]Prof.S.V.Lohar

[1]Student, [2] Student, [3] Student, [4] Assistant Professor (Guide)
[1]Department Of Electronics and Telecommunication Engineering,
[1]All India Shri Shivaji Memorial Society's Institute of Information Technology, Pune-01, India

Abstract : ***This paper enlightens the basics for building a Quad-copter based on Arduino development board. It explains the various aspects such as auto leveling ,stability and maximum payload as well as the parameters and specifications related to the basic building blocks of the Quad-rotor such as the Motors, ESC's, transmitter and receiver, etc. The quad-rotor is designed to serve as a platform for wide range of applications such as surveillance, 3D mapping, delivering packets, etc. We have demonstrated the application of surveillance in our project.***

IndexTerms- Quad-copter, PID, UAV, Surveillance

I.INTRODUCTION

The enormous potential of the Unmanned Aerial Vehicles (UAVs) has been recognized in the recent years. The applications of drones are increasing day by day from defence to agricultural farms. The cheaper cost of UAVs as compared to airplanes and helicopters makes them the best choice for distinct remote sensing applications.

Surveillance plays a very critical role for military, search as well as rescue operations. Terrorist attacks, growing cases of border illegal crossing highlighted the critical role of video surveillance in tracing criminals and terrorists. Surveillance of wide areas such as borders or large perimeters would require cameras in a very large quantity and thus the price will be astronomic.

A solution to this is integrating cameras into UAV system which will monitor and raise the chances to locate and detect intruders, especially in poor weather conditions. Rotating platform provides more movement freedom and wider view angle. They could be used as a standalone solution instead of stationary multiple cameras.

II. BLOCK DIAGRAM AND WORKING PRINCIPLE

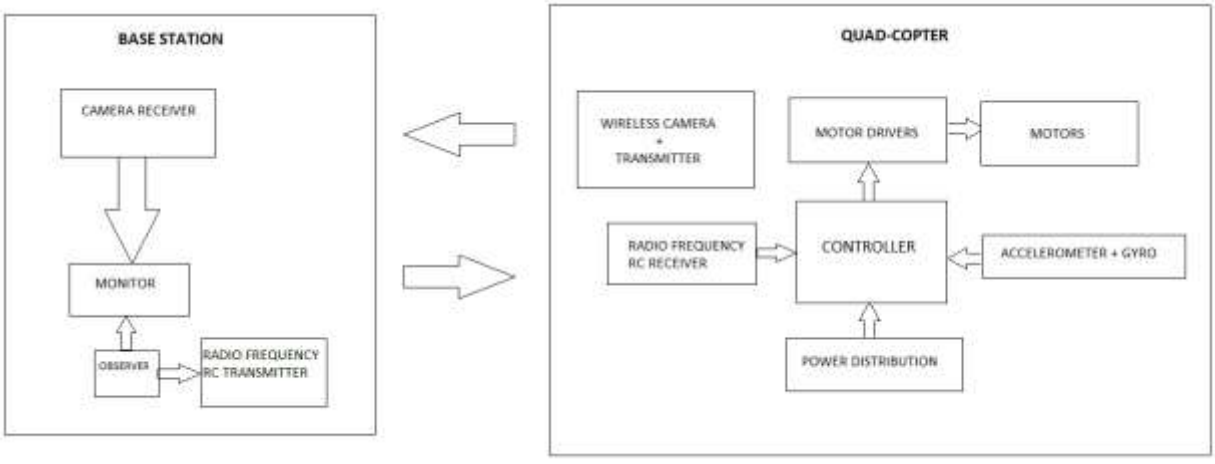

Fig 1. Block Diagram

The above diagram represents the major components of the system. The system is divided into two major blocks:
1) Quad-copter unit
2) The Base station unit

1)Quad-copter unit

The Quad-copter unit comprises of-
A)Controller
The Quad copter houses Arduino nano as the brain of the system which is programmed as the flight controller. The controller is interfaced with sensors and components.
B)Accelerometer and Gyroscope

The accelerometer and gyroscope are used to calculate the angle the quadcopter with respect to x, y, z axis. This accelerometer and gyroscope output is given to the controller which compares it with a pre decided set point and manipulate the pitch, yaw and roll angles to provide stability and control.

C)Motor driver

Electronic speed controllers (ESCs) are used as motor controllers. The ESC control the motors by varying the voltage and current corresponding to the control signal from the controller.

D)Motors

The Brushless DC motor (BLDC) are used in the quad-copter as they provide greater efficiency and better performance than DC motor. These motors are used to spin the propellers which in turn provide the up thrust to lift the quad-copter of the ground.

E)Power distribution

On board power supply is used to provide power to all components. A rechargeable Li Po battery which is connected in parallel to all components to provide constant voltage of 11.1V.

F)Wireless Camera

A wireless AV camera with an inbuilt transmitter is used to provide a live feed to the base station for surveillance purposes.

2) Base Station Unit

The base station unit comprises of

A)Radio Frequency RC Transmitter

The Transmitter used is Fly Sky CT6B, it is a 6 channel transmitter and has a corresponding 6 channel receiver which is placed on quad copter. The working frequency for transmitter and receiver is 2.4GHz and uses GMSK modulation.

B)Camera receiver and monitor

The camera receiver unit comprises of RF receiver which operates at 2.4GHz. The output of the receiver is given to the monitor which is observed for surveillance and giving control signals via the RC transmitter.

Working of Quad-copter -

Quad-copter consists of two pairs of identical fixed pitched propellers; two clockwise (CW) and two counterclockwise (CCW).The motors having the same orientation i.e. clockwise or counterclockwise are diagonally placed.

The quad-copter must take off and land vertically, maintain a stable flight as well as perform flight attributes such as yaw, pitch and roll.

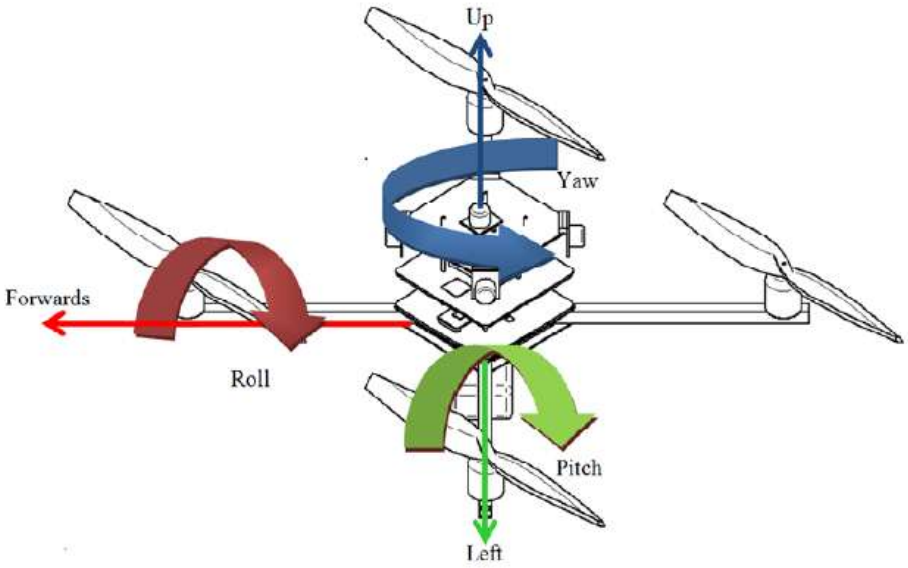

Fig 2. Motions of Quad-copter

For stability and performing flight attributes PID controller is used-

Proportional-Integral-Derivative controller is a type of feedback based control system that is most widely used in automation processed. The algorithm of a PID controller revolves around the three separate constant parameters and is sometimes referred as three term control.

Independently P denotes the present error, I denotes accumulation of past errors and D is the prediction of future errors. The weighted sum that is generated from these terms is then used to adjust the deviation in the process. Thus PID controller is an error based system which works by minimizing the error between measured process and a desired set point.

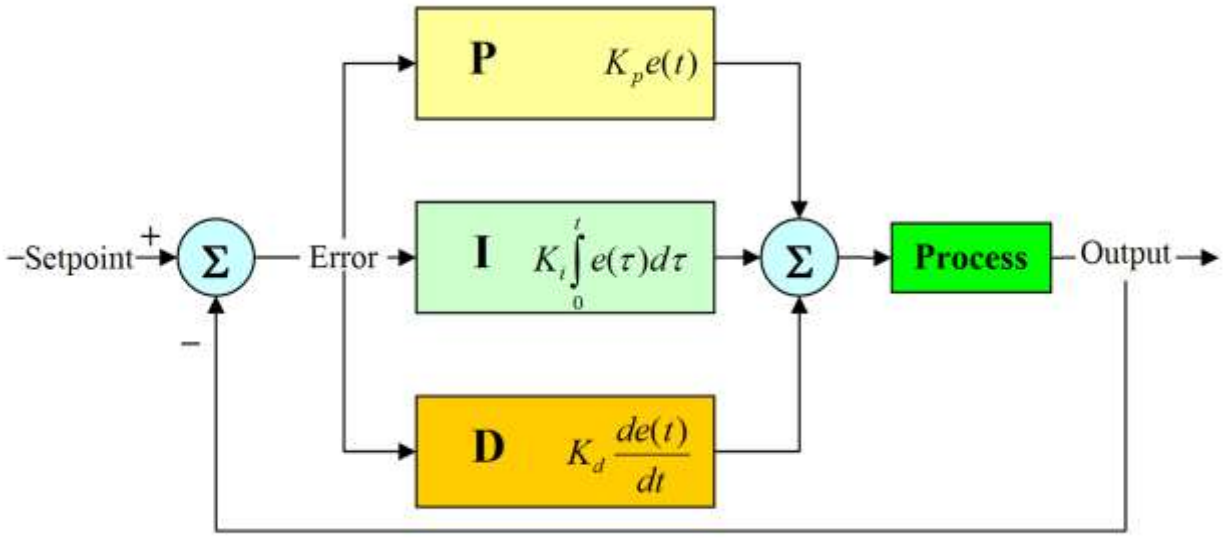

Fig 3. PID Process control

The process is controlled by manipulating the 'manipulated variable' (MV) using the three terms of PID. The output of each i.e. proportional, integral and derivative component is added to find the final output.

III. RESULTS

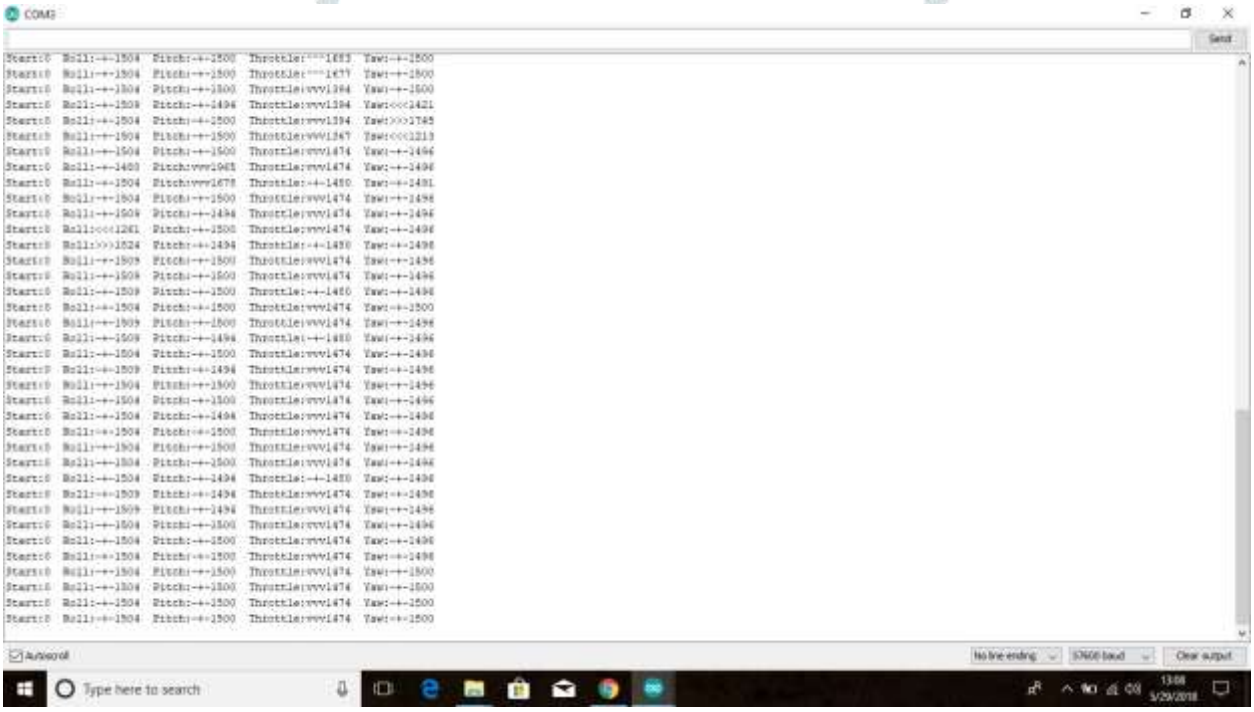

Fig 4. Simulation results for throttle, yaw, pitch, roll values

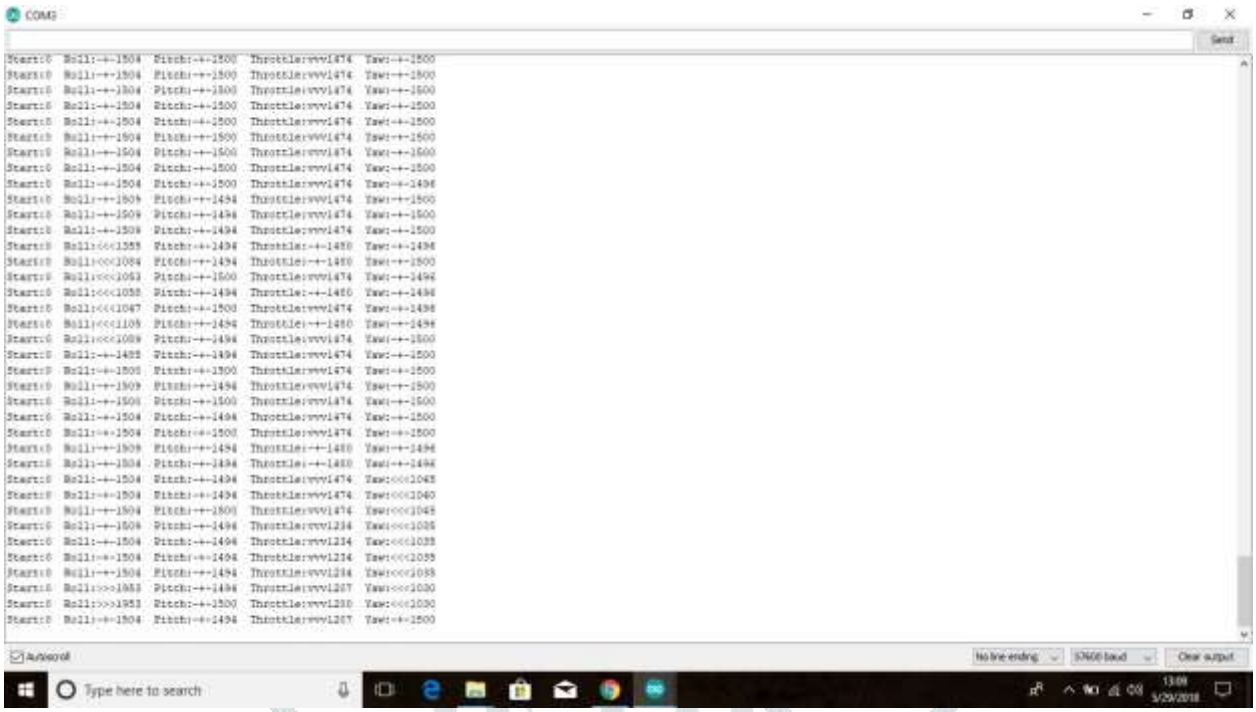

Fig 5. Simulation results for throttle, yaw, pitch, roll values

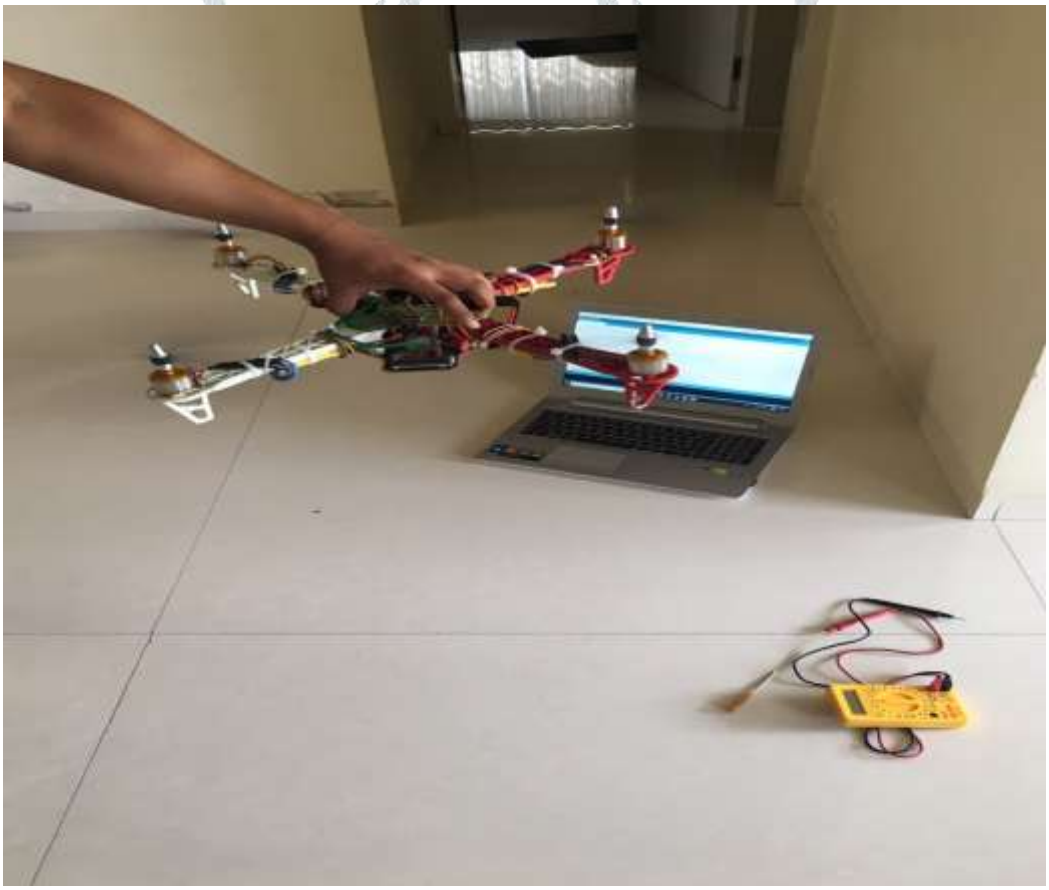

Fig 6. Testing for stability with various PID input values

Fig 7. During flight Quad-copter

IV.CONCLUSION

Through our design and calculations we were able to successfully achieve a stable working Quad-copter with some payload capabilities. The design is simple to implement and also proved to be cost effective.
The system was able to transmit live video feed which was monitored successfully at the base station.

V.REFERENCES

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