# Development of Auto Stabilization Algorithm for Uav Using Gyro Sensor

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***Abstract* - Our paper deals with an Unmanned Aerial Vehicle(UAV), a Quadcopter is engaged here. When a external factor such as wind disturbs the quad, the vehicle becomes unstable. So we are providing an algorithm to stabilize the UAV during in motion. Controlling the Quad needs an expert advice or prior training. If an unbalanced situation confronts the vehicle, it can be restored to a stable state with the involvement of the algorithm which is fed through Arduino.**

## INTRODUCTION

Quadcopter plays a vital role in surveying purpose, also used for various other sectors such as in defense, telecommunication, package delivery etc., Normally the quad has four wings. If it is subjected to a wind blown at different velocities at variant times, it becomes a hectic task for the user to control the vehicle. Mostly the Quad gets out of control from the user resulting in a collision or in an unstable position. We are not concentrating in the application part rather we are improving its working functionality. Bringing the four wings to a balanced state simultaneously is difficult.

## LITERATURE SURVEY:

Stabilizing the Quad can be done with the help of many external devices. This makes the Quad heavier as well as those components involved should be controlled instantly. Some methods have brought in a simulation scheme which not engaged in real time. Mathematical equations are also been developed to balance the vehicle during motion without the interference of external factors. These are some of the existing methodologies followed in UAV stabilization. But if a wind or heavy air pressure affects the quad, it gets deviated to an uncontrolled state. The Quad frames can be covered with less weight co-axial cable materials so if the quad crash lands it gets a minimal damage when compared to the quad without these material. Replacement of the Quads parts are costlier. So care must be taken to handle the vehicle with atmost concentration.

## PROPOSED METHOD:

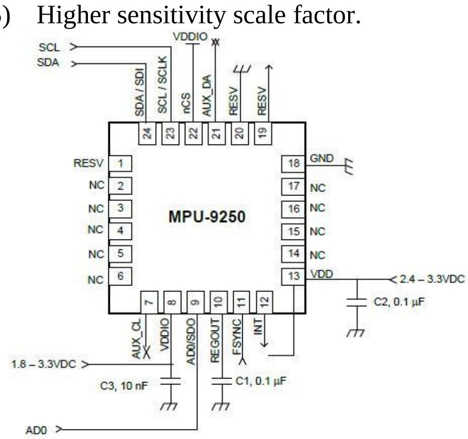
In order to identify the deviations in angle for every individual frame, we are using a Gyro sensor.

This gyroscope sensor has the ability to analyze the axis variations for the Quad. This is fed as an input to the controller where the controller analyses these errors given by the Gyro sensor and proceeds with an instruction according to the error occured to the ESC (Electronic Speed Controller) which controls the motors rpm. As four motors are involved, the motor which is to be controlled is GYRO SENSOR

The Gyro sensor model here used is GY-9250. It is a 9-axis motion tracking device consisting of a 3-axis accelerometer, 3-axis gyroscope and a 3-axis magnetometer. The run time calibration can be done with an instant of time with the help of upgraded digital motion processor.

Gyroscope Features:

1) Angular rate sensors with user programmable full scale range from -250 to =+250 and -2000 to +2000 deg/sec.
2) Digitally programmable low-pass filter.
3) Operating current : 3.2mA
4) Sleep mode current : 8uA
5) Higher sensitivity scale factor.

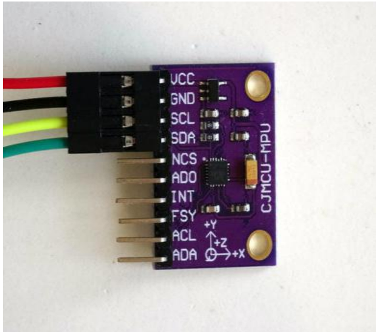



| S.No | PIN Name | PIN Description |
|---|---|---|
| 1 | INT | Interrupt DigitalOutput |
| 2 | VDD | Powersupply Voltage and Digital I/O Voltage |
| 3 | GND | Power supply Ground |
| 4 | FSYNC | Frame Synchronization digital input. Connect to GND if unused. |
| 5 | SCL/SCLK | Serial clock/SPI serial clock |
| 6 | SDA/SDI | Serial data/SPI serial data input |
| 7 | RESV | Reserved |
| 8 | REGOUT | Regular filter capacitor connection |

The Gyro detects the rotational changes of the object to which it is linked. When the Gyro is rotated about any of the roll, pitch and yaw axis, the effect of movement causes a vibration that is detected by the capacitive pick off. The resulting signal is then amplified, demodulated and filtered to produce a voltage which is proportional to the angular rate.

The resulting data can be read from the DMP's registers or can be buffered in a FIFO. The purpose of the DMP is to offload both timing requirements and processing power from the host processor.

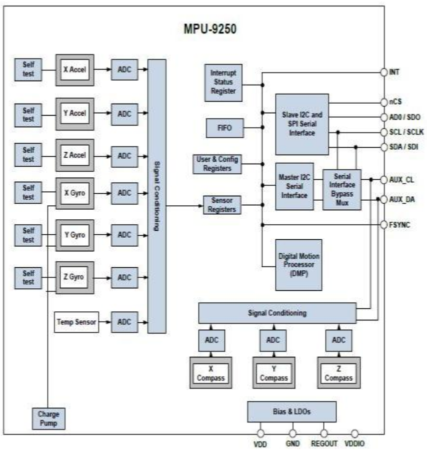
CONNECTION




1. Connect 5V VCC Power(Red wire), Ground(Black wire), SDA(Green wire), and SCL(Yellow wire), to the MPU9250 Module
2. Connect the other end of the Ground wire(Black wire) to Ground pin of the Arduino board
3. Connect the other end of the 5V VCC Power wire(Red wire) to the 5V power pin of the Arduino board
4. Connect the other end of the SDA wire(Green wire) to SDA/Analog pin 4 of the Arduino Nano board
5. Connect the other end of the SCL wire(Yellow wire) to SCL/Analog pin 5 of the Arduino Nano board
6. Picture 3 shows where are the Ground, 5V Power, SDA/ Analog pin 4, and SCL/Analog pin 5, pins of the Arduino Nano

ESC:

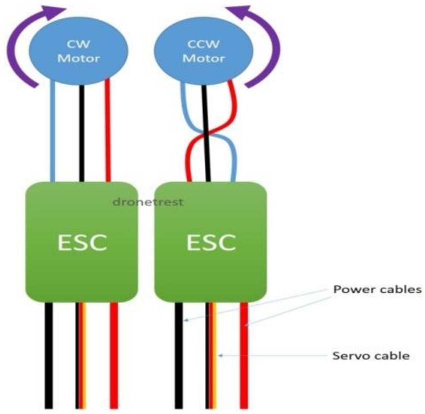
ESC is the short form of Electronic speed controller, firstly the pilot transmit the signal from radio transmitter and that signal is received by radio receiver which is fixed at the Drone and then further that signal is sent to the Flight controller board which generate an Appropriate signal which is forward to the Electronic Speed Controller and according to the strength of that signal Electronic Speed Controller speed up the motors. Most of the ESCs comes with or without BEC which provides supply to the receiver circuitry. Four ESC's are used, a single esc for a single motor.




It has three connections,

1) Power supply
2) To the motors of individual frame
3) To the Controller

All these three connections are to be made mandatory only then control over the motor is feasible.

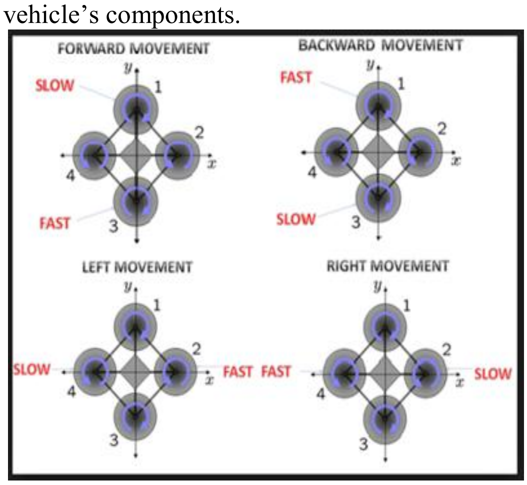



40 Amps or

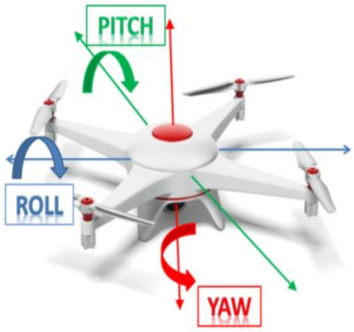
20 Amps ESC are compatible for controlling the motor's RPM in the Quadcopter

WORKING PRINCIPLE

The initial thrust which is given in order to lift the aircraft must be started slowly. Abrupt or sudden increase in the lifting process can lead to overload of power usage leading to internal damages to the vehicle's components.

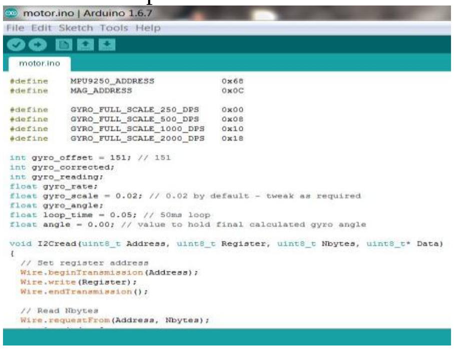



Equal weight distribution has to be maintained. Only then the thrust can act effectively or it results in lifting problem. The three axis-Roll,Pitch and yaw are readily noted for a stipulated interval. The diagonal wings rotate in same direction(clockwise and the other pair in counter .




SYNCHRONIZATION:

The components linkage should be connected and a proper synchronization has to be established. Gyro's feedback is given to the controller and then the instruction which is generated is given to the ESC. A proper time delay has to be provided, so that at regular intervals the gyro senses the deviation in angle. As ESC needs some time to increase or decrease the rpm of the motors.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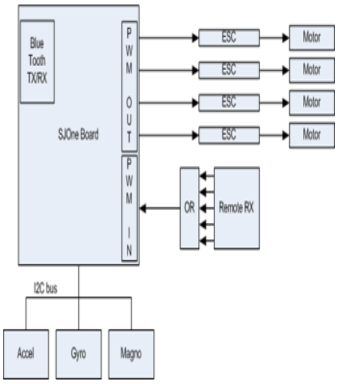
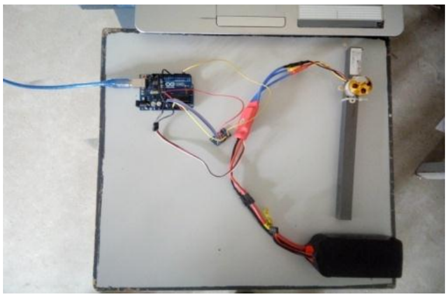
```
#define     MPU9250_ADDRESS            0x68
#define     MAG_ADDRESS                0x0C

#define     GYRO_FULL_SCALE_250_DPS    0x00
#define     GYRO_FULL_SCALE_500_DPS    0x08
#define     GYRO_FULL_SCALE_1000_DPS   0x10
#define     GYRO_FULL_SCALE_2000_DPS   0x18

int gyro_offset = 151; // 151
int gyro_corrected;
int gyro_reading;
float gyro_rate;
float gyro_scale = 0.02; // 0.02 by default - tweak as required
float gyro_angle;
float loop_time = 0.05; // 50ms loop
float angle = 0.00; // value to hold final calculated gyro angle

void I2Cread(uint8_t Address, uint8_t Register, uint8_t Nbytes, uint8_t* Data)
{
  // Set register address
  Wire.beginTransmission(Address);
  Wire.write(Register);
  Wire.endTransmission();

  // Read Nbytes
  Wire.requestFrom(Address, Nbytes);
```

The code development factor comes out with a needed configuration for the controller to analyze and produce an instruction to the ESC whether to increase or decrease the speed of the motor in that particular frame.

BLOCK DIAGRAM




WORKING MODEL:

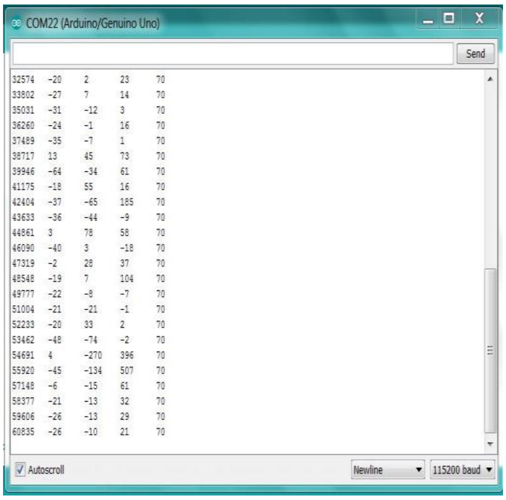


PERFORMANCE COMPARISON:

| METHOD | ACCURACY | PARAMETER |
|---|---|---|
| Manual | 20-60% | X and Y axis |
| Ultrasonic | 60-75% | Altitude |
| Gyroscope | 75-90% | Angle detection of Yaw,Pitch & Roll |

Out of various methods for the stability of the UAV(Quadcopter) the usage of gyroscope to control the Quad during abrupt climatic situations is found to be efficient. The analysation of variation in angle deviation of the vehicle is identified momentarily and it can be adjusted to the required needs.

OUTPUT:




## CONCLUSION:

The components interface are done effectively with gyrosensor along with Unmanned Aerial Vehicle (Quadcopter).The Stablization is enhanced by controlling the motors individually with the help of Electronic Speed Controller(ESC). We succeeded in stabilizing the quadcopter in seven degrees of freedom.

## REFERENCE

[1] Mark W. Mueller and Raffaello D'Andrea, "Stability and control of quadrocopter despite the complete loss of one, two, or three propellers", May-June 2014 IEEE International Conference on Robotics & Automation (ICRA).

[2] J. Fink, N. Michael, S. Kim, V. Kumar, "Planning and control for cooperative manipulation and transportation with aerial robots," The International Journal of Robotics Research, vol. 30, no. 3, pp.324–334, 2011.

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