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GPS Based Fully Ardupilot Drone Using APM Flight Controller and Sensors

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ABSTRACT

The project goal was to design a semi-autonomous Quad copter capable of self-sustained flight via wireless communications. The Quad copter was designed to be small enough so that costs would be minimized. Drones can significantly accelerate delivery times and reduce the human cost associated with the delivery. This report examines the value chain and opportunities in the delivery drones market. It also discusses the barriers for adoption. It concludes with our case for drones to handle the last mile of delivery of most lightweight packages. The drone cameras are operated above 500 meters and covered a radius of three kilometers. The cameras were also operated in the lanes and by lanes of the town to check the movement of people. This project also used to detect obstructs and alerts form collision occurrence. It also used to detect the fire, temperature, humidity and sends an alert message to our mobile.

Keywords : APM Flight Controller, Arduino Nano, Telemetry, FPV Camera, Humidity and Temperature Sensor, Fire Sensor, Ultrasonic Sensor, Motors, ECSs, GPS and Compass.

I. INTRODUCTION

A quadcopter, also called a quadrotor helicopter or quadrotor, is multirotor helicopter that is lifted and propelled by four rotors. Quadcopter are classified as rotorcraft. A quadcopter, also called a quadrotor helicopter or quadrotor, is a multirotor helicopter that is lifted and propelled by four rotors. Quadcopter are classified as rotorcraft. In the last few decades, small-scale unmanned aerial vehicles have been used for many applications. The need for aircraft with greater maneuverability and hovering ability has led to a rise in quadcopter research. The four-rotor design allows quadcopter to be relatively simple in design yet highly reliable and maneuverable. Research is continuing to increase the abilities of quadcopter by making advances in multi-craft communication, environment exploration, and maneuverability. If these developing qualities can be combined, quadcopter would be capable of advanced autonomous missions that are currently not possible with other vehicles.

In 2014 The Guardian reported that major media outlets have started to put serious effort into exploring the use of drones for reporting and verifying news on events that include floods, protests and wars. In December 2013, the Deutsche Post gathered international media attention with the project Parcel copter, in which the company tested the shipment of medical products by drone delivery. The FAA allow registration on a voluntary basis, as well as requiring it for commercial use, but states that it is not required if "flying under the Special Rule for Model Aircraft" (recreational hobby use).

Because they can follow very precise flight patterns, as well as hover in a fixed position (assuming GPS or optical flow), it was inevitable that one of the most popular-use cases for multi-rotors would be imaging.

II. BLOCK DIAGRAM AND SCHEMATIC DIAGRAM

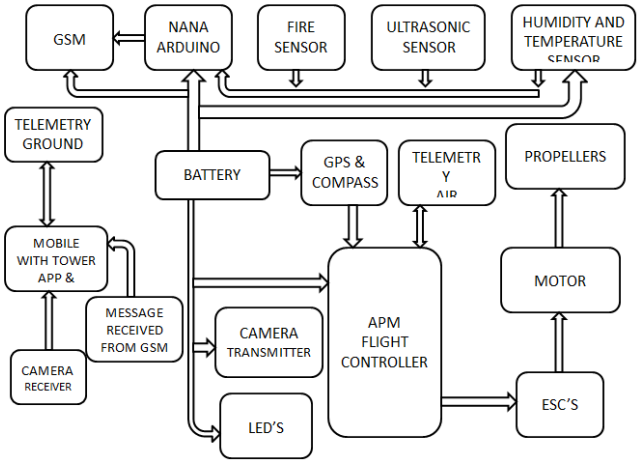


Fig: Block Diagram of the Project

Block diagram consist of a transmission and a receiving part. Computer or mobile is used to control it with a pair of telemetry (ground and air). We have another pair of Tx and Rx of signals for camera. Extra batteries are used to increase the flying life. APM flight controller is used to interconnect all hardware components as shown in block diagram. Telemetry with 2Km range is used for data transmitting and receiving. Brushless dc motors are used for as they have more efficiency. Gps with inbuilt compass is connected to APM flight controller. To have better stabile and control over quad copter we have 2 clock wise and 2 counter clock wise suitable propellers. We are using led's for night visibility. To interact with external sensors a Arduino Nano is used. Ultra sonic sensor is used for collision detection. Humidity and fire sensors are used to calculate the corresponding values. GSM module is used to send the calculated data from Arduino Nano to given mobile number.

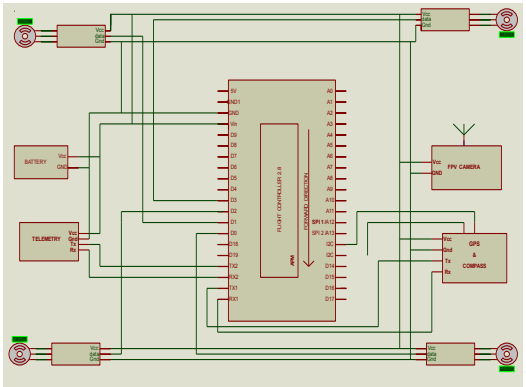


Fig: Schematic Diagram of the Project

A. COMPONENT DESCRIPTION

1) Motor: Motors are a bit similar to normal DC motors in the way that coils and magnets are used to drive the shaft. Though the motors do not have a brush on the shaft which takes care of switching the power direction in the coils, and so it is called as brushless motors. Instead the brushless motors have three coils on the inner of the motor, which is fixed to the mounting. For a small scale Quadcopter the DC Brushless motor used is of 1000 KV rating. It operates at 7.4-14.8 volts.

2) ESC: The brushless motors are multi-phased, normally 3 phases, so direct supply of DC power will not turn the motors on. That is where the Electronic Speed Controllers (ESC) comes into play. The ESC generating three high frequency signals with different but controllable phases continually
to keep the motor turning. The ESC is also able to source a lot of current as the motors can draw a lot of power.

3) Propellers: On each of the brushless motors are mounted with a propeller. The 4 propellers are actually not identical the motor torque of and the law of physics will make the Quad Copter spin around itself if all the propellers were rotating the same way, without any chance of stabilizing it. The larger diameter and pitch the more thrust the propeller can generate. It also requires more power to drive it, but it will be able to lift more weight.

4) Battery: The power source for the whole device. The recommended battery is LiPo (Lithium Polymer) battery because of it is light weighted in nature and the battery with lesser discharge rate is more preferable.

5) Flight Controller: the new APM 2.8 autopilot module, upgraded Version 2.5 2.6. Out of the V2.52 version of the old 1.0mm 6P SM06B GPS interface, I2C interface to external compass DF13-4P, DF13-5P GPS interface and external compass interface is placed together, with more convenient GPS and external compass. The original DF13-5P GPS interface and SM06B GPS interface function reuse, no significance. This revision of the board has onboard compass. V2.8 improved the design, use jumper selection, MAG

markers found on the board pin plug(Near to GPS connector), jumper cap for a built-in compass, unplug the jumper cap for external compass.

6) GPS & Compass: A new generation Ublox GPS NEO-M8N,with low power consumption and high precision, the ultimate accuracy is 0.6 meters, actually almost 0.9 meters, greater than the previous generation NEO-7N 1.4-1.6 meters accuracy.

7) FPV Camera: 5. 8g 48ch 25mw 600tvl fpv camera w transmitter antenna for fpv rc mini drone.

8) Telemetry: 500MW Radio Telemetry 915Mhz Air and Ground Data Transmit Module Set, Small in size, lightweight - 915Mhz frequency band - Receiver sensitivity to -117dBm - Transmit power up to 20dBm(100mW) - Transparent serial link - Air data rates up to 250kbps - Range of approx 1 mile with supplied antennas - Demonstrated range of several kilometers with a small Omni antenna - Can be used with a bi-directional amplifier for even more range .Built in error correcting code(can correct up to 25% data bit errors)

9) Arduino Nano: The Arduino Nano Is A Small, Complete, And Breadboard-Friendly Board Based On The ATmega328 (Arduino Nano 3.X) Or ATmega168 (Arduino Nano 2.X). It Has More Or Less The Same Functionality Of The Arduino Duemilanove, But In A Different Package. It Lacks Only A Dc Power Jack, And Works With A Mini-B Usb Cable Instead Of A Standard One.

10) GSM module: SIM800L is a quad-band GSM/GPRS module. It works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM800 features GPRS multi-slot class 12/ class 10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. SIM800 can meet almost all the space requirements in users' applications, such as M2M, smart phone, PDA and other mobile devices. SIM800 is designed with power saving technique so that the current consumption is as low as 1.2mA in sleep mode. SIM800 integrates TCP/IP protocol and extended TCP/IP AT commands which are very useful for data transfer applications.

11) FIRE SENSOR: A Photodiode is used as the Flame sensor. It is connected in the reverse biased mode with the Cathode to the Positive rail. In the ambient light, it passes only 0.84 V through it to the Emitter of the PNP transistor T1. But when the Photodiode gets light from the Flame, mainly the Infrared light, the Photodiode passes more voltage.

T1 is a PNP transistor, so it conducts only when its base is held low. So here the base of T1 is held low through the 470K resistor. In this state, it can conduct. But the Photodiode is not passing current to the emitter of T1. At this condition, T2 remains off since it is not getting any base current from the collector of T1. So the circuit remains standby.

When the Photodiode gets light from the flame, it passes more voltage as high as that of positive rail. So T2 gets base bias from the collector of T1. T1 then conducts and the buzzer beeps.

12) ULTRASONIC SENSOR: The HC-SR04 ultrasonic sensor uses sonar to measure distance to an object. It offers excellent range accuracy and stable readings in an easy-to-use package. It operation is not affected by sunlight or black material like Sharp rangefinders are (soft materials like cloth can be difficult to detect).

Testing distance = duration of high level*sound velocity (340m/s) / 2 You can use the above calculation to find the distance between the obstacle and the ultrasonic module.

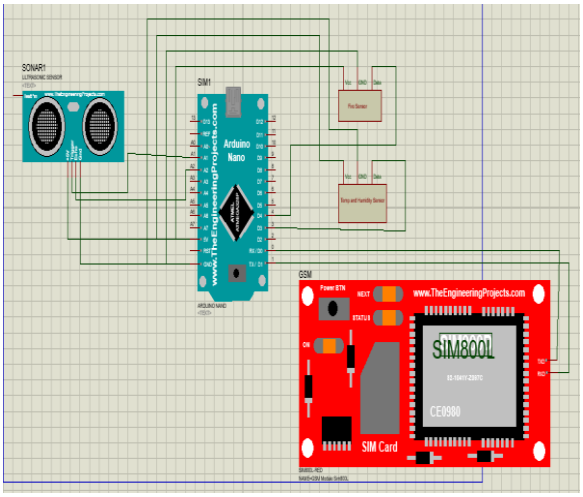


Fig: Schematic Diagram of the sensors

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x). The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply, or 5V regulated external power supply.

Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. The Arduino Nano has 14 digital pins and 8 analog pins, GND, 5V, 3.3V, RST, REF, RxD, TxD, Vin pins on the Arduino Nano board. SIM800 is one of the most commonly used GSM module among hobbyists and Arduino community. Even though AT command reference is available with a quick Google search, it is not very easy for a beginner to properly understand and use Arduino with SIM800.

Here we are using fire sensor, humidity and temperature sensor and ultrasonic sensor along with a GSM module which are connected to Arduino Nano board.

These sensors and GSM module are connected to Arduino Nano board with respect to their pin configurations.

DHT11 is a part of DHTXX series of Humidity sensors. The other sensor in this series is DHT22. Both these sensors are Relative Humidity (RH) Sensor. As a result, they will measure both the humidity and temperature. Although DHT11 Humidity Sensors are cheap and slow, they are very popular among hobbyists and beginners.

We have two digital output pins for fire sensor and humidity with temperature sensor which are connected to digital pin D3 and digital pin D4 of Arduino Nano and the two analog data pins of ultrasonic sensor (i.e. trigger and echo pins) are connected to analog data pin of Arduino Nano board at pin A1 and pin A2 of it.

As we are using GSM module to send the sensors collected data in the form of message to corresponding mobile number, we are connecting only the transmitting (TxD) and receiving (RxD) pins of GSM module to Arduino Nano. Here the TxD of GSM is connected to RxD of Arduino Nano and RxD of GSM is connected to TxD of Arduino Nano board to exchange of data with each other.

III. FLOW CHART

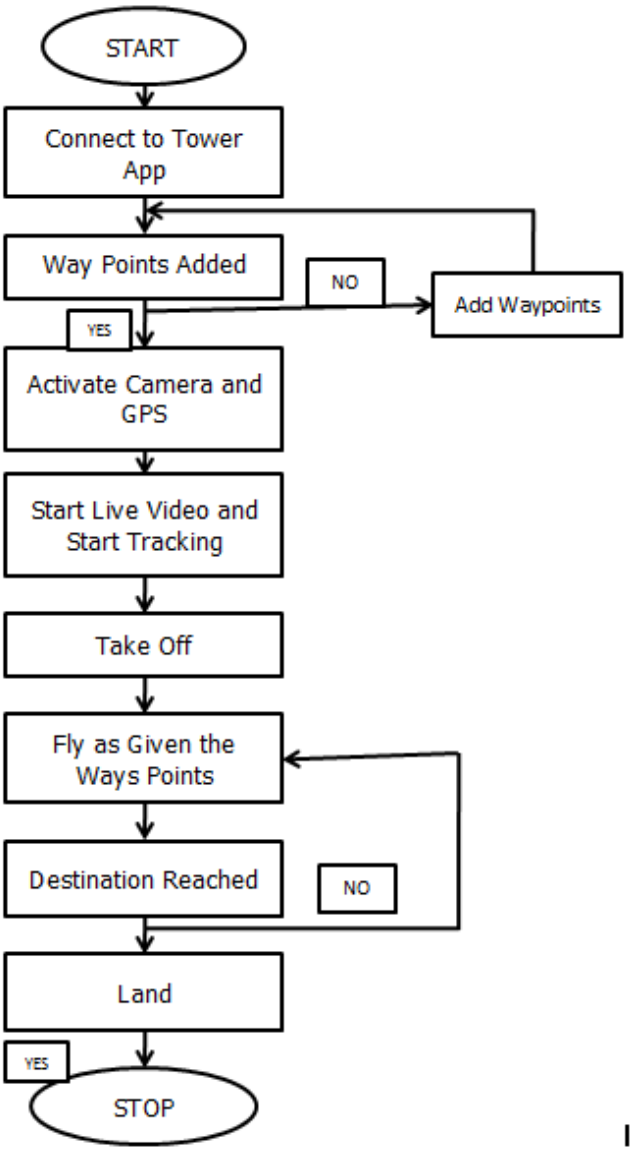
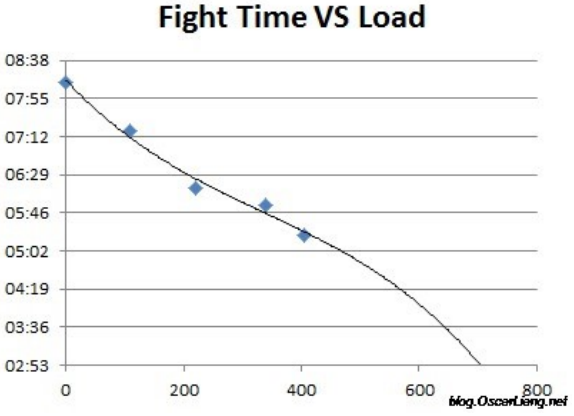


Fig: Flow Chart of the project



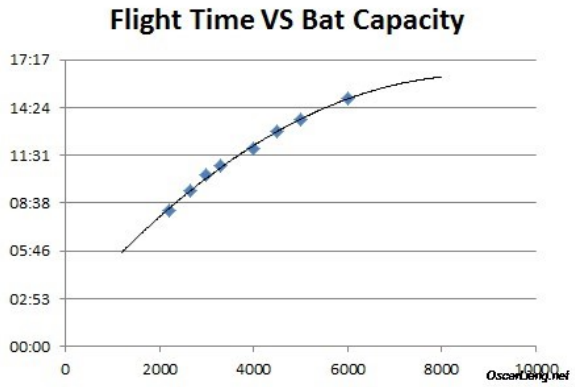


Fig: Battery Utilization

IV. LITERATURE REVIEW

To know the working principle of the Quadcopter [1] is referred and based on the hardware requirements that are the hardware parts as well as their connectivity and also their working principle of each of the circuits referred to [2]. The explanation for each circuit is known in [3] website. To know their functional requirements [4] is referred. To switch the mode from one angle to another and to control the flying of robot referred to [5].

V. RESULT

We can observe that our quadcopter is working as per the given commands and send the calculated temperature and humidity value and also sends an alert message if any fire or collision is detected through GSM.

- Initially when quadcopter is connected to battery, the power is supplied to all the components.
- Telemetry shows the stable green light as soon as it gets connected to ground telemetry.

Fig: Kit in OFF condition

Fig: Kit in ON & Armed condition

- The below fig shows when the waypoints are added and set to armed. Where the motor starts rotating with normal speed.
- The next image shows the quadcopter when it is tack off with front view of FPV camera.
- The remaining images show the screenshots of the sensors output data which were detected and send to our mobile through GSM module while quadcopter is in air.

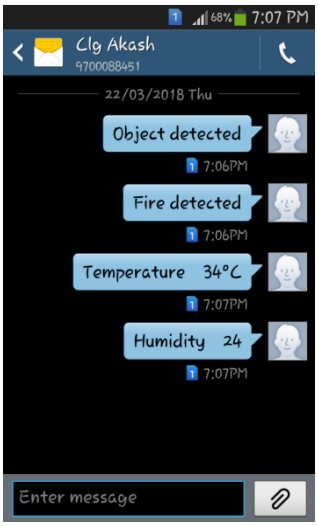


Fig: Sensors results

VI. CONCLUSION

The project could go in a variety of directions since the platform seems to be as flexible as we initially intended. This flexibility allows changing the functions it performs and also allows integration of any technology that would prove to be useful. The project could be enhanced as per the requirements, resources and the budget. More no of Sensors could be mounted on it thus providing more unique features. The high definitions cameras could also be installed in it. This project has clearly demonstrated the goals of proving that small scale UAVs are useful across a broad range of applications.

VII. REFERENCES

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BIOGRAPHY

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