Table of Contents

APPENDIX A

Usage of drones to prevent forest fires

Joy of Engineering Project Report

by

The Earthlings

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BML Munjal University, Gurgaon
December 2017

APPENDIX B

BONAFIDE CERTIFICATE

This is to certify that this project report entitled “Usage of drones to prevent forest fires” submitted to, BML University, Gurgaon is a bonafide record of work done by “Deepak Manchala, Shikshaa Sharma, Yarala Hruthik Reddy, Surya Keesara, Gautam Sontu, Balaji Rao Vavintaparthi” under my supervision from “22 August 2017” to “6 December 2017”

Signature of the Supervisor
(Mr. Sumit Roy-Assistant Professor)

Place: - BML Munjal University, Gurgaon

Date: - 05.12.2017

APPENDIX C

Declaration by Author(s)

This is to declare that this report is an original work by us. No part of the report is plagiarized from other sources. All information included from other sources have been duly acknowledged. We aver that if any part of the report is found to be plagiarized, we shall take complete responsibility for the same.

S.No.	Name Of The Candidates	Signature
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Place: - BML Munjal University, Gurgaon

Date: - 05.12.2017

Acknowledgement

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We would also thank our fellow friends and seniors who helped us in finishing this project within the limited time frame.

Abstract:

One of the biggest dangers to forests is forest fires. It is also a great danger to people who live in forests. Out of all the wildfires caused, majority of them happen due to humans, acts such as negligent discarding of cigarette butts and non-extinguished campfires result in these disasters every year. To rebuild and rehabilitate this, it consumes a lot of resources.

We plan to use drones in this scenario, drones equipped with special sensors like IR or Thermographic cameras can identify wildfires from a long distance. A drone can be made to move around a fixed area and monitor the forests. Using drones entire forest can be covered. The drone would also be equipped with GPS; as soon as the drone detects a forest fire, it will send the co-ordinates back to the forest department who can act fast and control the fire before it spreads.

So, using temperature sensitive drones we can greatly minimize the damages done by forest fires.

Introduction:

Forest fire is a natural phenomenon, but most of them are caused due to careless human acts such as negligent discarding of cigarette butts and non-extinguished campfires. The only natural way of these wildfires erupting is due to lightning strikes. These wildfires cause immense damage to ecosystems and biodiversity, it takes millions every time to stop these wildfires.

The methods to extinguish these fires have not changed in the last 40 years and we have an idea, a modern way to extinguish these fires.

We plan to use drones, equipped with special sensors like IR or Thermographic cameras can identify wildfires from distance. A drone can be made to move around a fixed area and monitor the forests. Using less than 10 drones, an entire forest can be monitored. These drones would be having GPS; as soon as the drone detects a forest fire, it will send the co-ordinates of the wildfire and send it back to the forest department who upon receiving them can act fast and control the fire before it spreads.

Literature Survey:

The subject of forests is in the concurrent list of the Constitution of India. The Central Government and State Governments are both competent to legislate on the issue. The issues relating to policy planning and finance is the primary responsibility of the Government of India. The field administration of the forests is the responsibility of the various state governments. The state Government thus have the direct responsibility of the management of forest resources of the country. The prevention of forest fires and control measures are, therefore, carried out by the state forest departments. Each State and Union Territory has its own separate forest department. The Ministry is implementing a plan scheme "Modern Forest Fire Control Methods" in India under which the state governments are provided financial assistance for fire prevention and control.

The country has a history of forest management for more than 100 years. Many practices have been developed for different forests all over the country. Yet another practice is being supplemented to the project by bringing the village forest protection committees constituted under the Joint Forest Management (JFM) programme. The JFM programme is being implemented in 22 states through 35,000 village forest protection committees over an area of

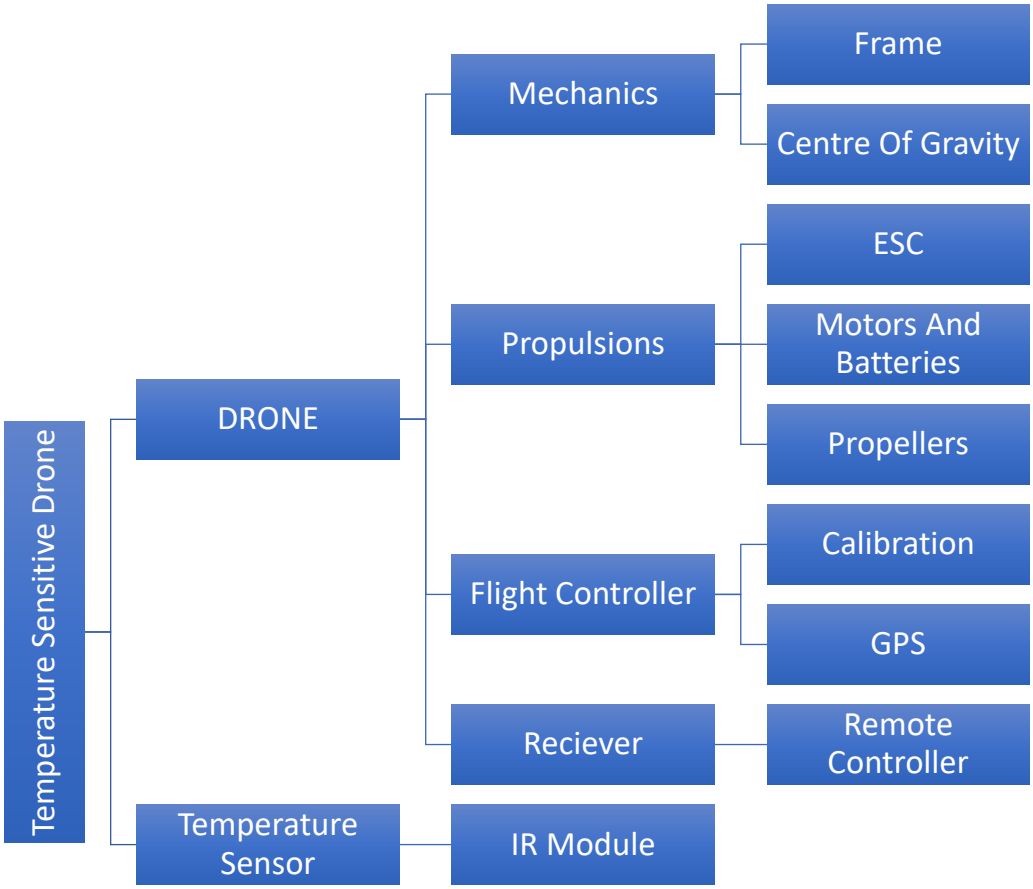
7 million ha. It is proposed to invoke the people's interest and enlist their support for fire prevention and firefighting operations. The Government is considering setting up of a National Institute of Forest Fire Management with satellite centres in different parts of India to bring the latest forest fire fighting technologies to India through proper research, training of personnel and technology transfer on a long-term basis.

In the event of a wildfire, information is critical for proper management and suppression. The scientists at the Ljungberg lab at the Swedish University of Agricultural Sciences in Umea did a two-day field test using thermal cameras in drones.

At present there are tests happening on the same project of using drones in fighting wildfires, very recently Spain's Ministry of Agriculture and Fisheries, Food and Environment proposed a strategy to prevent wildfires. They plan to use utmost four drones for this surveillance.

Also, a team of researchers led by Carlton Pennypacker, an astrophysicist at UC Berkeley are using early location and identification of fires using drones, planes and satellites equipped with special infrared cameras. They call it the Fire Urgency Estimator In Geosynchronous Orbit or 'FUEGO', once fully operational the system could spot new wildfires barely three minutes after they start. But this is still in the very early stages of development and could take another 7-10 years to be operational.

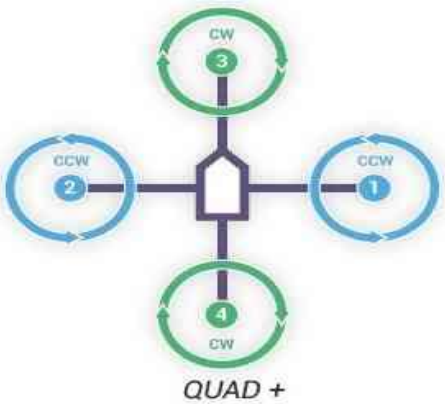
Proposed Project:



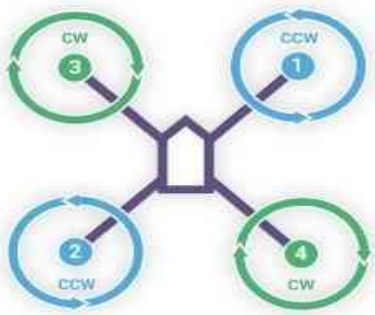
The first part is to make a drone, to make one we need to understand how one works. We categorised working. We categorised working of a drone into four categories:

1. **<u>Mechanics:</u>**

   Mechanics involves two things the frame and the centre of gravity, for a drone to fly properly the centre of mass must be concentrated in the centre. This frame also provides protection. We are using a plastic quadcopter frame with an integrated PCB.



QUAD +



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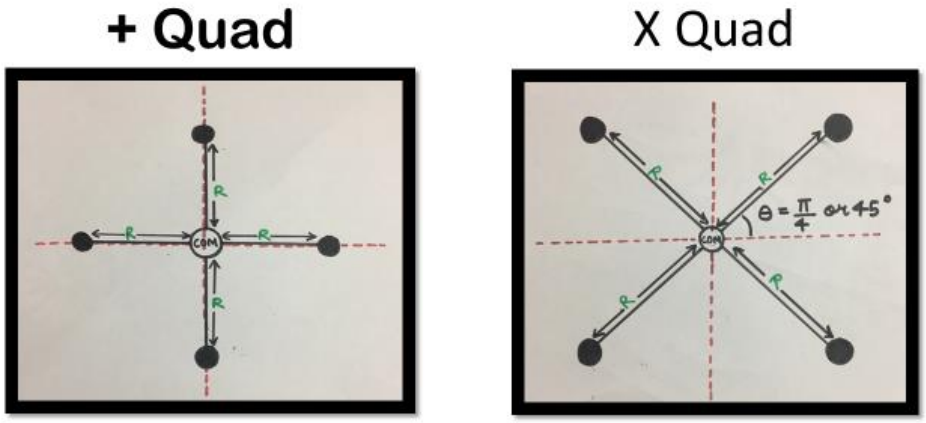


FRAME	THRUST APPLIED AT A DISTANCE
+	r
X	r cos45 = 0.71 r

The distance of motors away from the axis of rotation determines the torque generated by the motors.

In X-Quad frame, we can provide more torque than in +Quad frame, even with the same number of motors and their equal capacities.

2. Propulsions:

A drone must have a propulsion system to fly, since we are making a quadcopter drone, we use four brushless motors with an ESC (electronic speed controller, helps in mediating the speed by which motors rotate) each for propulsion system. Finally, the ESC's are connected to the LI-PO battery (Lithium Polymer, universal battery type used to power RC drones, they're lightweight and can release a lot of current).

The math behind a brushless motor is a bit confusing, but they work on the principle of motor induction to cause frictionless rotation. If we look inside a motor, we will see copper coils and neodymium magnets arranged in circles. When currents pass through the coils, a magnetic field is generated, which interacts with the magnetic field of the magnets. When they interact, a magnetic force is exerted on the coils. An equal and opposite force is exerted on the magnets on the outer ring, causing the shaft and casing of the motor to spin rapidly. Brushless motors have three connectors, or 'phase leads'; each phase lead is required to control the 3 axes of rotation of the quad: pitch, roll, and yaw. The amount of current entering the motor is equal to the thrust.

The propellers are connected to the motors, to be noted that the propellers should be in the proper direction. The motor connections to the ESCs and the ESC connections to the flight controller must be carefully made.

3. **Flight Controller:**

Every flying drone must have a control system. This electronic control system allows the drone to be stable in the air while flying and processes all the shifts and changes in direction and wind. The flight controller is the part which tells the drone how to fly, even if the centre of mass is not at the geometric centre; we can configure the flight controller to fly it properly.

It takes inputs from the transmitter and outputs signals to the ESC's to get the desired response. Everything from hovering the quad to doing simple turns requires a lot of math specific to the drone. The FC performs these calculations hundreds of times a second.

This is where the mathematics of the FC comes into play, to modulate drone in desired manner about the three axes we use. PID Loops are a set-point variable-based feedback system used in manufacturing industries. There is a lot of math involved here.

P-Proportional:

This value determines the drone's stabilisation.

I-Integral:

'P' value determines the amount of stabilisation done, while 'I' value determines the time it takes to reach that amount.

D-Derivative:

This is not that important, but it is more of a finishing touch.

The FC we used has these pre-set, so we didn't have much trouble in stabilising the drone. The FC we are using is an Ardupilot Mega 2.8 APM, this has all the sensors like accelerometer, gyroscope, GPS and compass these are used to maintain the drone in equilibrium as centre of mass will not always coincide with the geometric centre. The calibration of the FC is done using Mission Planner, an open source programme. All the ESC's are connected to this.

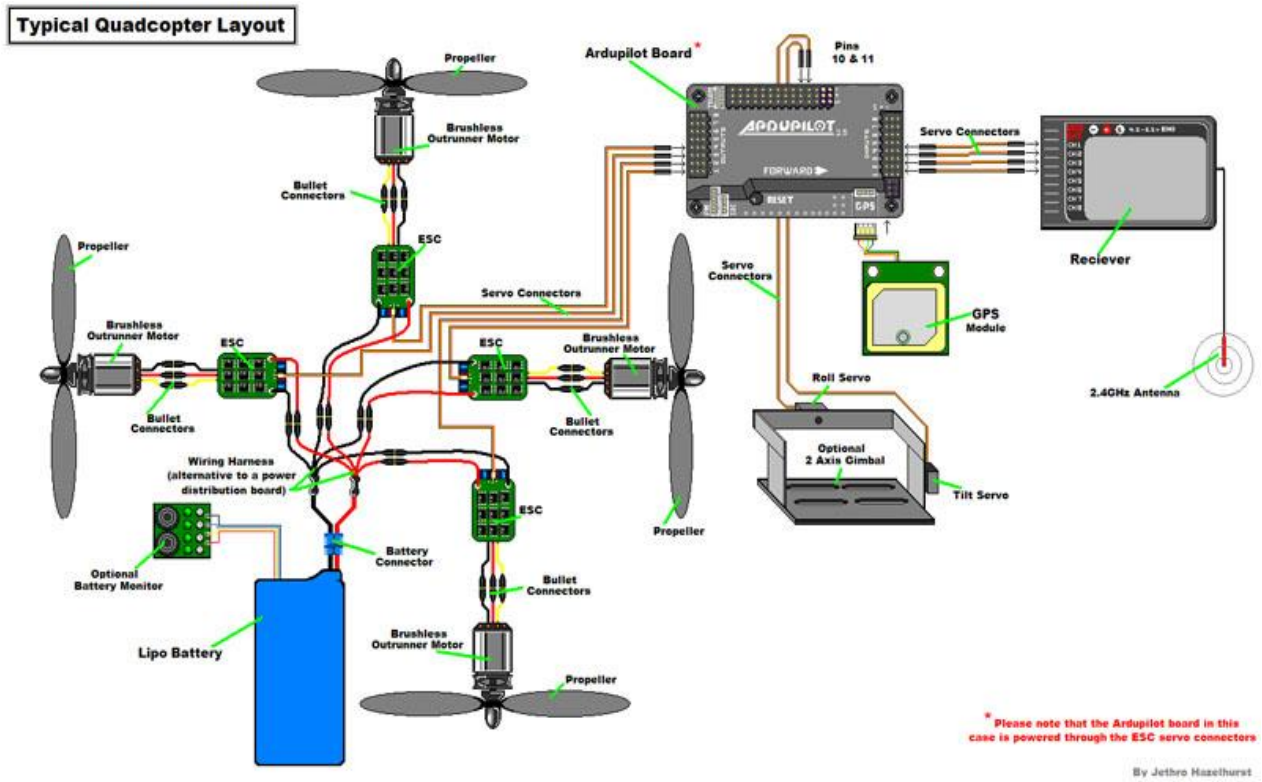
4. **Receiver:**

The flight controller is connected to a receiver which receives the inputs from the FC. The throttle, yaw, pitch, roll and flight modes can be changed using this controller. We

are using a six-channel receiver, the receiver is binded to the transmitter. This process of binding requires a key called binding key.

The next part after making the drone is the temperature sensor, we are using an LM-35 sensor for our flight controller. This can detect temperature ranging more than 100^0C since fires have even higher temperatures, this can detect it easily, but the fire must be very close to be detected but using higher equipment like thermographic camera the detection distance can be greatly increased to 100 metres or more. Our prototype drone would include an LM-35 sensor.

Circuit Diagram:



The circuit diagram shows how the connections are to be made. As shown, the motors are connected to the ESC's with a three-pin bullet connector. The ESC's are connected to the battery and the flight controller, the black wire is the ground, the red wire is the voltage supply, the orange wire is the signal wire.

Connecting the three wires in any way we like results the motor to spin in certain direction, if you need to change the direction just swap the two wires. The FC is connected to the receiver, the receiver is configured to the remote control, the servo connectors are used to connect the receiver and the FC. This complete setup is mounted onto the drone frame.

The Arduino code:

```
int val;
int tempPin = 1;
void setup()
{
Serial.begin(9600);
}
void loop()
{
val = analogRead(tempPin);
float mv = ( val/1024.0)*5000;
float cel = mv/10;
float farh = (cel*9)/5 + 32;
Serial.print("TEMPRATURE = ");
Serial.print(cel);
Serial.print("*C");
Serial.println();
delay(1000);}
```

Components Required:

S. No	Material	Specification	PRICE	VENDOR
1	The Frame	Q450 Quadcopter Frame with integrated PCB	Rs.900	robu.in or amazon.in
2	Motors	Brushless DC Motor 1000KV	Rs.600 for each = Rs.2400 for 4	robu.in or amazon.in
3	ESCs	Standard 30A ESC (with connectors)	Rs.450 for each = Rs.1800 for 4	robu.in or amazon.in
4	Propellers	1045 SF Props 1CW+1CCW	RS.100 for 1 pair = Rs.800 for 8 pair	robu.in or amazon.in
5	Connectors	Deans Connectors	Rs.200 for each = Rs.800 for 4	robu.in or amazon.in
6	Flight Controller Board	Ardupilot Mega 2.8 Flight controller board	Rs.3500	robu.in or amazon.in
7	Batteries	1800MAH 3S 40C (11.1V) Lithium Polymer Battery	Rs.1800	robu.in or amazon.in
8	BEC	-	-	-
9	Controller	Flysky 6 Channel RC Transmitter and Controller	Rs.4700	robu.in or amazon.in
10	RC Receiver			
11	Camera	-	-	-
12	IR	IR module	Rs.1500	Amazon.in
TOTAL COST IS Rs.18200				

Result Analysis:

- Improper calibration of the ESCs will not start the motors at the same time.
- Once the voltage across the battery drops below 10 volts, it cannot be recharged again.
- The Flight Controller is highly sensitive, so proper calibration is required.
- The propellers must be fitted tight enough and in the correct direction so that they don't go off mid-air.

Hence from the above results, we can tell that it is necessary to analyse the working of each and every component.

Conclusion:

In this project, we were able to make a prototype of a temperature sensitive drone, which can give us temperature readings and when advanced using an IR Thermographic camera and set path to follow we could detect forest fires at their early stages and alert us.

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