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Controlling of Forest Fire using Unmanned Aerial Vehicle

P.Hema [(1)], M.Priyanga [(2)], A.Jagadeesh [(3)], S.Murugaraj [(4)], M.Malarvizhi [(5)]

[(1)] Assistant Professor, Dept. of Electrical and Electronics Engineering, Jay Shriram Group of Institutions, Tirupur, Tamilnadu, India

[(2)(3)(4) & (5)] UG Scholar, Dept. of Electrical and Electronics Engineering, Jay Shriram Group of Institutions, Tirupur, Tamilnadu, India

ABSTRACT*:* Wireless Sensor Networks (WSNs) are used for different uses such as habitat supervising, automation, farming, and security. Since many sensors are usually send out used on remote and unable to be used places, the deployment and maintenance should be easy and scalable. Wireless sensor network consists of large number of small nodes. The nodes then sense surrounding conditions changes and report them to other nodes over flexible network design. Sensor nodes are great for deployment in hateful surrounding conditions or over large geographical areas. These sensor nodes are used for detection of temperature, humidity, smoke and wind direction to prevent a disaster (forest fire) that could lead to loss of a lot of valuable things from nature. In this project, several tests had been done in order to prove the ability to be done of the system. Test results showed that the reliability of the system in spreading information directly to the base station could be gained excellently in different conditions. Forest fire fighting is a very important issue in which Unmanned Aerial Vehicles (UAVs) can play an important role. The paper presents the use of UAVs as a tool for forest fire controlling. The paper shows how an UAV can automatically get the information and controlled it by means of GPS. Especially, UAVs with floating over abilities like aircraft are very useful, as it move to the particular points of the fire. More than that, it is shown how many UAVs can work together in fire controlling activities, allowing to cover bigger fires or to get matching views of a fire. The software provides functions on processing UAV (unmanned aerial vehicle) from high in the air image data according to the needed things of forestry area application on UAV raised, flat supporting surface. It gives a real-time and remote watch on fire in greater the UAV is flying and getting from high in the air data, helping users quickly master the number and the location of fire points. Supervising software covers function including fire source detection module, fire location module, fire range guess module and report generation module. This module helps to improve operational efficiency and detection reliability of the system.

KEYWORDS: Forest fire supervising systems, unmanned aerial vehicle, temperature sensor, humidity sensor, smoke sensor, flame sensor, wind direction sensor and RF module.

I.INTRODUCTION

Several million areas of forest are destroyed every year due to forest fire. Forest fire not only destroys many valuable trees but also destroys the green plants in that area. The fire will burn the trees and also the soil is burnt and so many areas of land become water repellant. Forest fire is one of the major causes of worldwide warming as tones of pollutions are given off into the atmosphere. Now the detection methods used in watching towers, satellite imaging, long distance video recording, etc.

But these do not provide quicker response which is most important in forest fire detection. Video secretly recording is a low cost system but it produces false alarm due to surrounding condition like fog, clouds, dust and human activities.

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Another method uses visual camera to take snapshot of the forest. This camera is placed on tower so that a maximum area of the forest is covered.

A motor is used to rotate the camera 360^0 so that we get a full view of the forest. The images got using these cameras are processed using a program or a MATLAB code. These images are used to find forest fire by comparing it with the usual images. The advantage of this method is that the system can be programmed to take carefully thinking about something of the surrounding conditions and the effect of fog or clouds can be eliminated. The serious disadvantage is that it may sometime do not describe a possible the fire thinking about the signals is due to surrounding conditions. We also need to build towers to place the camera at a higher position and this may increase the cost of the system. A good and effective method is the use of wireless sensor network. In this method the sensor module is send out and used in the forest manually or through a helicopter. The sensor module consists of many sensors like temperature sensor, humidity sensor, smoke sensor, flame sensor, wind direction sensor.

They collect the target surrounding condition information and continuously move from one place to another it to the control center where the necessary process is carried out. Sensor nodes are less expensive and even if it gets damaged in fire it won't be a great loss. Using GPS the exact location of the fire can be easily got and the controlling can be easy using GSM. Accidental causes such as lightning, short circuit, high temperature etc., can cause fires that would lead to disaster.

Most accidental fire in this first part can be controlled with water, but in a more advanced phase needs the use of a chemical retardant, which is mixed with water and is spread by helicopters. It's for these reasons that fire detection systems play an very important role in fighting against forest fires. Recently, new technologies have been applied to fire fighting. However, many of these technologies still have different practical problems for their use in operational conditions, such as low reliability, high costs and others. Unmanned aerial vehicles (UAVs) can play an important role for forest fire response.

Among the most important guidelines for firefighting management are: the shape and position of the fire front, its rate of spread. In this paper an automatic system that makes long use of UAVs and computer vision is proposed for online fire supervising, measurement and controlling. The extension of a forest fire can be very large, so the system can combine information from several UAVs that can work together to cover the fire from matching point of view. The main goal of our system is to the guess and control in real-time, of the evolution of the fire front in geographical co-ordinates. The paper begins with a description of some current automatic approaches in the book. Then, it presents the system for multi UAV fire controlling. Results from experiments involving controlled forest fire are described at the end of the paper before the end results.

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1.1 Block Diagram:

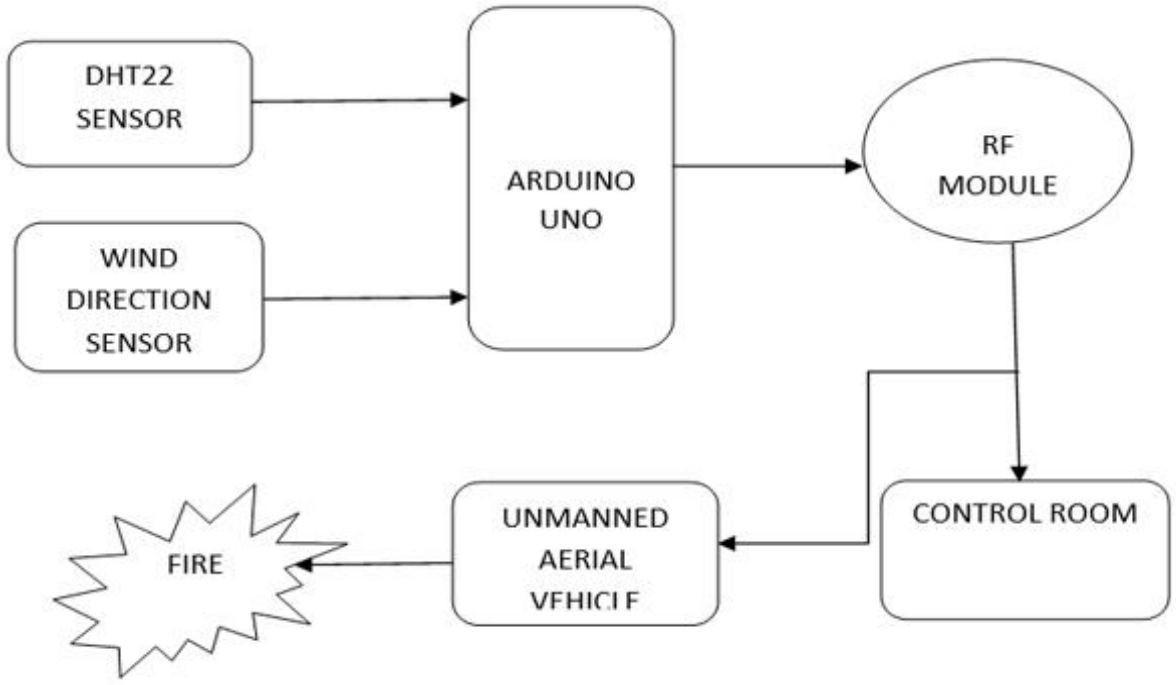

Fig 1: Block Diagram of Forest Fire Control

This block diagram is used to understand the project easily. When the forest fire is detected by sensors in the cluster area, it sends the information through RF technology. The unmanned aerial vehicle should reach the particular fired area after the fire detection message received to this vehicle and control station also. The vehicle should spray fire things that put out fires when it reach the exact position and this vehicle send the information about it like things that put out fires level, energy storage level and travelling distance from the first position of the vehicle to the control station.

II.SENSORS

Sensors are combining into structures, machinery and surrounding condition connected with the efficient delivery of sensed information, could provide huge benefits to society. Long wire bundles represent a significant installation and long term maintenance cost, limiting the number of sensors that may be send out used , and therefore reducing the overall quality of the data reported. Wireless sensing networks can eliminate these costs, easing installation and eliminating connectors. The ideal wireless sensors are networked and scalable, uses very little power is smart and software programmable, capable of fast data getting, reliable and true number over the long term, costs little to buy and install and needs no real maintenance. Electrical storage device life, sensor update rates and size are all major design things to carefully think about. Example of low data rate sensors include temperature, humidity and peak strain recorded on a camera passively.

Recent advances have resulted in the ability to integrate sensors, radio communications and digital electronics into a single integrated circuit (IC) package. This ability is enabling networks of very low cost sensors that are able to communicate with each other using low power wireless data routing rules of conduct. A wireless sensor network (WSN) generally consists of base stations that are able to communicate with number of wireless sensors via a radio link.

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Data is collected at the wireless sensor node, smaller space and transmitted to the gateway directly or if needed uses other wireless sensor nodes to forward data to the gateway. The transmitted data is then presented to the system by the gateway connection. The system construction of the forest fire detection and control system is presented from the sensor node hardware in the bottom to management sub-system in the top and figured out the worth in the real-deployment.

2.1 Temperature sensor:

The LM35 series are precision integrated circuit temperature device with an output voltage linearly fair in amount to the centigrade temperature. The LM35 device is rated t operate over a -55^{0}C to 150^{0}C temperature range, while the LM35 DEVICE IS RATED FOR A -40^{0}C to 110^{0}C range (-10^0 with improved true number). It is able to operate the voltage range from 4V to 30V and current drain is less than 60µA.

2.2 Smoke sensor:

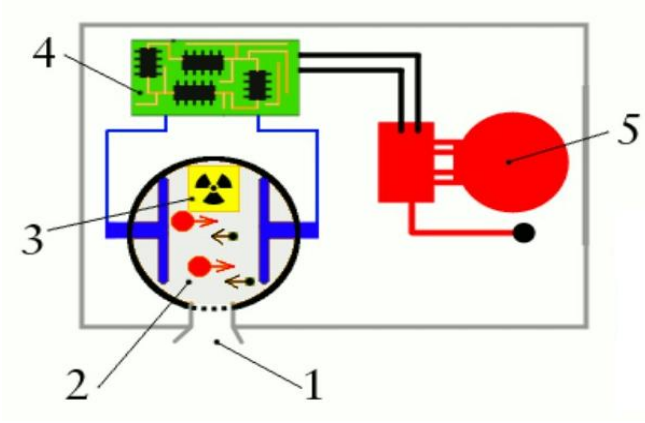

Fig 3: Before smoke detection

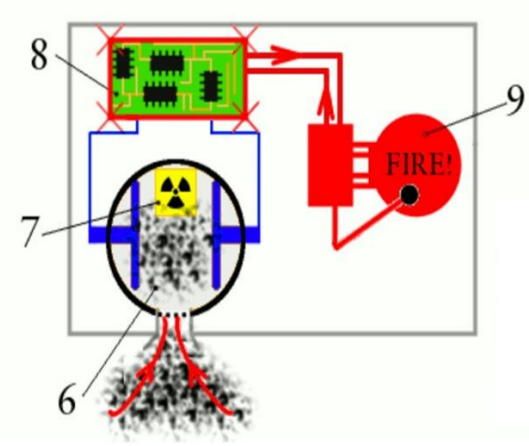

Fig 4: After smoke detection

A smoke sensor is a device that senses smoke, usually as an indicator of fire. This sensor may be interconnected either as a part of an alarm system. Smoke sensor is a device which is used to predetect the fire and it helps to reduce the loss of significant a valuable things from nature.

2.3 Flame sensor:

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire. Responses to a detected flame depend on the installation, but can include sounding an alarm, turning off a fuel line (such as a propane or a natural gas line), and activating a fire preventing system. When used in uses such as industrial furnaces, their role is to provide confirmation that the furnace is properly lit; in these cases they take no direct action beyond telling the operator or control system. A flame detector can often respond faster and more true number than a smoke or heat detector due to the methods it uses to detect the flame.

2.4 Wind direction sensor:

A sensor for measuring average wind direction in a sampling space. It is designed to be used with Aanderaa sensor scanning units. Data loggers or display units. This sensor consists of a light wind vane spun around on top of a housing a compass is magnetically couple to the vane. The wind direction sensor must be connected to the sensor scanning or display unit by a separate cable.

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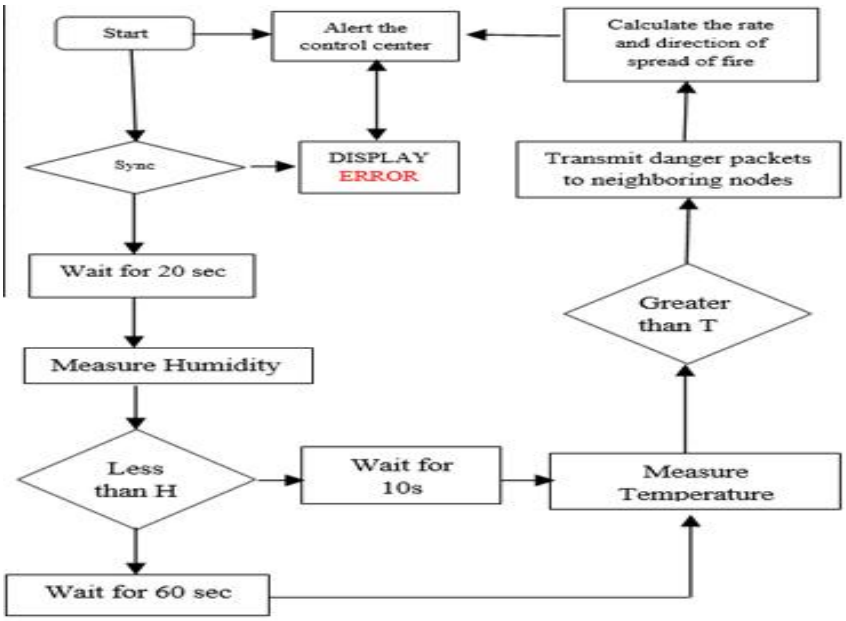

Fig 5: Flow Chart for Forest Fire Detection

III.CONTROL UNIT

Arduino Uno is a microcontroller board on the ATmega3. The Uno is the best board to get started with electronic and coding. Arduino Uno is a microcontroller board based on the ATmega328. Very convenient power management and built in voltage regulation. A button to rest the program on the chip.

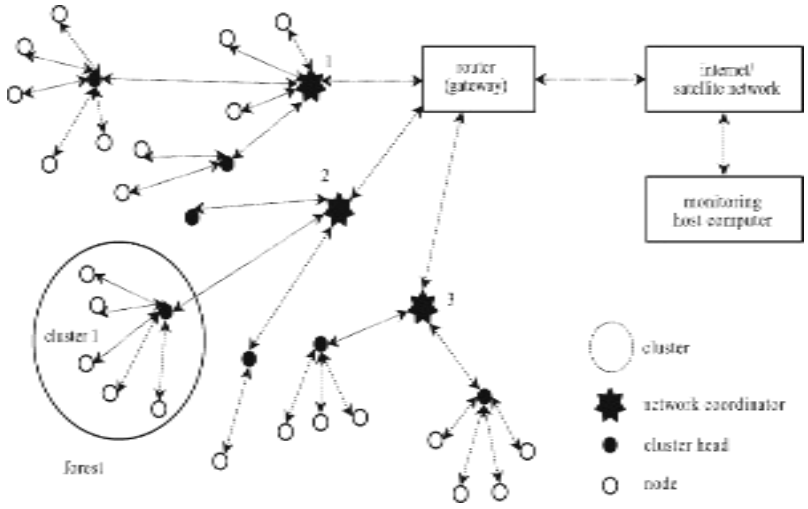

Fig 6: Forest Fire Detection

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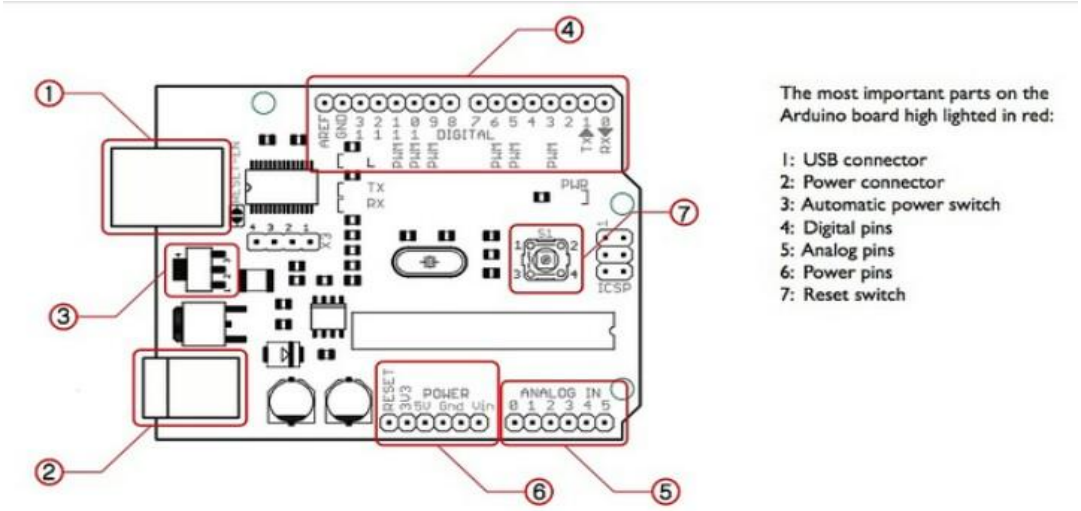

Fig 7: Arduino Pin Operation

3.1 RF Technology

A raddio frequency (RF) signal refers to a wireless electromagnetic signal used as a from of communication. The RF techology is used to pass the informmation from controller to supervising device. The frequency range of RF module from 3Hz to 300 GHz.

IV.POSITION TRACKING

The position was watched and followed by the use of GPS, which is placed on control vehicle. GPS watching and following not only enables to track location of the vehicle but its advance features enables to the vehicle, sound conversation , LCD display on vehicles, automatic door locking, Temperature supervising of vehicles and even ignition control also.

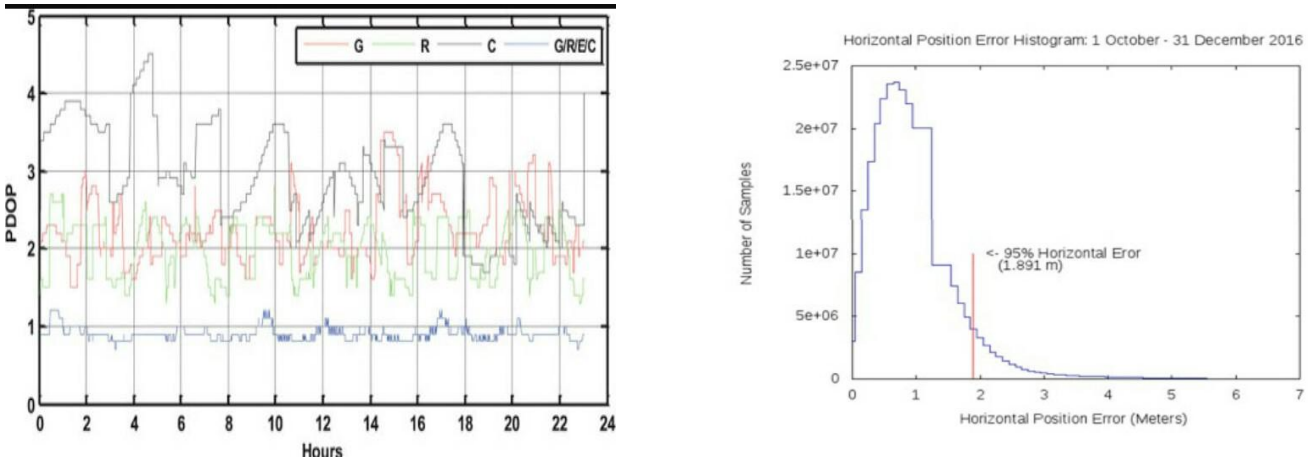

Fig 8: Location Tracking Graphs

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V. UAV

Unmanned aerial vehicle (UAV) is used for the forest fire control process. The vehicle is move when the fire detection is received by the vehicle supervising system from the controller. When the vehicle reaches the particular area of fire then it spray the water is mixed with some chemical reactance. The chemical reactance has the properties of reduce the fire. The unmanned vehicle is carry the GPS which is track the position and it open the value when it the reaches the particular position.

5.1 Pumping Circuit:

The motor gets automatically switched on when water in the overhead tank (OHT) falls below the lower limit. Similarly, it gets switched off when the tank is filled up. Build around only one NAND gate IC (CD4011), the circuit is simple, compact and money saving. It works off a 12V DC power supply and consumes very little power. The circuit consists of 5 LEDs which glow to show the level of in the overhead tank. The water level of the tank, which gives the hint to the control station.

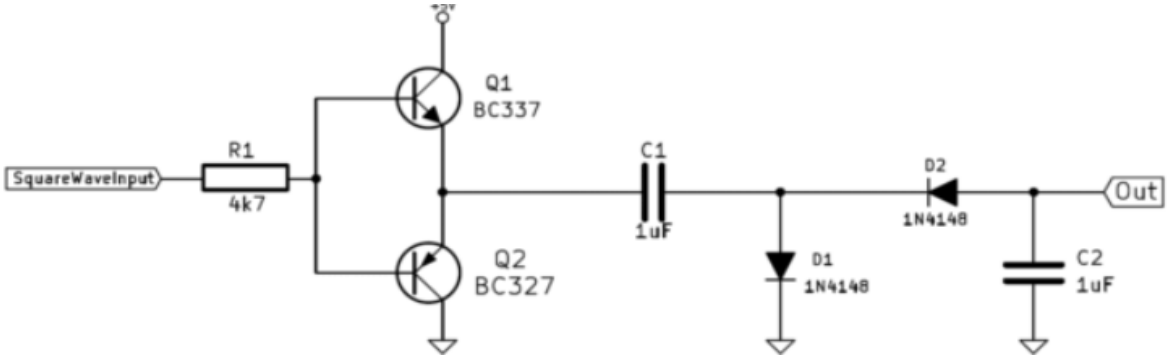

Fig 9: Pumping Circuit Diagram

5.2 Renewable Energy Use:

The renewable energy is very important for today's world as in near future the nonrenewable sources that we are using are going to get exhausted. The solar vehicle is a step in saving these nonrenewable sources of energy.

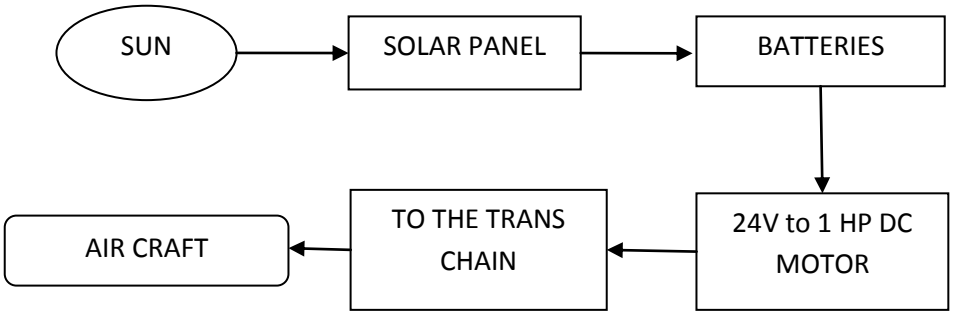

Fig 10: Vehicle Move by Solar Energy

The basic rule of solar car is to use energy that is stored in an electrical storage device during and after charging it from a solar panel. The charged electrical storage devices are used to drive the motor which serves here as an engine and moves

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the vehicle in reverse or forward direction. The electrical tapping rheostat is given to control the motor speed. This avoids excess flow of current when the vehicle is supposed to be stopped suddenly as it is in usual cars with regards to fuel. This idea, in future, may help protect our fuels from getting put out a fire.

VI. CONCLUSION

The very best theme of this paper is to control the forest fire using wireless network. In the existing system, different ways of doing things are used only to detect the forest fire. No methods are put into use to control the forest fire. In this paper, the controlling of the forest fire is very skillful using RF technology and UAVs. UAV used here gets the signal through the RF technology and with the help of GPS it traces the location and automatically moves to that place and control the fire. By using renewable energy to run the vehicles which helps to protect fuels and also avoid pollution.

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