



# SOLAR POWERED FOREST FIRE PROTECTION AND MITIGATION

Prathmesh Tewari<sup>1</sup>, Vandit Pathak<sup>2</sup>, Vivek Kumar Gupta<sup>3</sup>

<sup>1</sup>Electrical Engineering Department, SRMCEM, Lucknow, India

<sup>2</sup>Electrical Engineering Department SRMCEM, Lucknow, India

<sup>3</sup>Electrical Engineering Department, SRMCEM, Lucknow, India

## ABSTRACT

Forest fires are a regular phenomenon in the world & have increased drastically over the past few years. In this paper, analyzing of the combination of wireless sensor networks to build a smart forest fire early detection sensory system which is solar powered is also done. The process of transmission of data is discussed in detail. Various environmental parameters such as temperature and smoke in the forest region can be monitored & accordingly decision for fire fighting can be made quickly by the officials. The Sensors attached to the Arduino Uno will monitor the temperature and smoke level. If the sensed value is beyond the predefined value given in the program, an alert message would be send via SMS.

**KEYWORDS**—Forest Fire Detection, Temperature and smoke sensors, ARDUINO UNO, Microcontroller, Fire Control.

## I. INTRODUCTION

According to the Global Fire Emissions Database project run by NASA, Fires in the Amazon in 2020 surpassed those of 2019. In fact, 2020's fires have been worst since 2012. The fires burning the Brazilian Amazon increased 28% in July 2020. Despite the surge in forest fires, it has gone unnoticed by the international organizations due to covid-19 pandemic. Yet the degradation of the Amazon rainforests has profound consequences from climate change to global health. Wildfires have drastic effects on ecological, economic factors. This includes- loss of timber resources, loss of biodiversity, extinction of plants and animals, soil erosion affecting productivity of soils and production, ozone layer depletion, loss of livelihood .

Mohamed Hefeeda and Majid Bagheri[1] reported that Forest Fires are like wild fires which are uncontrolled and cause significant damage to natural & human resources. It not only damages the forest habitat but also possess a great threat to the civilization in and around the forests. However , In most cases, forest fire starts from a single point and spread across the areas in no time. Therefore early detection and suppression of the fire can be very crucial in saving the natural habitat & also avoiding the danger to humans.

Junguo Zhang, Wenbin LI, Ning Han, Jiangming Kan[2] Suggested the observation from the watch towers is easy & feasible, but it has several disadvantages as well. In the first place, this method would require many financial & material resources and a trained labor force. Secondly, many problems might occur due to human negligence, carelessness or absence from their respective positions. To conquer these problems, introduction of a system that would sense the early fire and suppress it with the help of various sprinklers. This system is much more reliable than the workforce that would have to be trained for this specific problem. Here the project will be using a natural source of energy to power the entire system which would be solar power. The scope of application of satellite detection

system is also restricted by many factors which reduces its effectiveness in forest fire detection.

Some of the traditional methods for the detection of fire are given below-

- ❖ Fire Watch Towers- In this Humans are made to observe the location throughout but this would also account for human errors or negligence that could lead to drastic losses.
- ❖ Satellite Aerial Monitoring- In this the satellites are used for monitoring large areas but the resolution of the image can be decreased instantly due to weather conditions, due to which it will be more difficult to detect the fires.

In past a lot of research papers have been published but the system to be fully made run on natural source of energy was something that has not been discovered yet. Therefore, It has also taken care of this issue. The Solar power being a clean source does not cause pollution and therefore it is a clean source of energy. This was not implemented previously in any other project, therefore this makes our project even more unique and reliable.

In this project, the use of rainwater efficiently has also been taken care of, to overcome this we have utilised the rainwater by the rainwater harvesting mechanism. This will help in increasing the ground water level and also the water will be utilised to quench the fire produced in the forest. Using this mechanism, the problem of bringing water from a distance can be reduced and timely execution of the project can be done using this mechanism. This System can monitor real time related parameters eg-Temperature, flame & also send data immediately to the monitoring center.

Compared with the normal meteorological information & basic resources data, it can assess the potential fire danger. The analytical results then be sent to the relevant department where the fire propagation will be visualized and relevant actions can be tak

## II. LITERATURE REVIEW

T. Celik and Hasan Demirel[3] proposed a system with fuzzy logic. The Fuzzy logic which used YCBCR color space instead of using RGB which made the classification more robust and effective and achieved up to 99.00% correct fire detection rate with a 9.50% false alarm rate.

R. Gonzalez- et al [4]. Proposed a method of detecting fire which was based on wavelet. In this process, image processing is done. It involves three steps. In the first step, the image is resized and is transformed into a grayscale image. After this the image is indexed using indexation. The second step involves elimination of high frequencies and reconstruction of image. After this the comparison of image with a non smoke frame is done. The final step included smoke verification algorithm.

Mehdi torabnezhad et[5] also proposed another method which was using image fusion to detect smoke. In this the visual and thermal information was combined to improve the rate of fire decision. Infrared images cannot detect the smoke but the smoke like objects was detected. The IR images and visible images was combined and can later be distinguished. In order to reduce false alarms the PSM is analyzed and the energy calculations have been done.

Yogesh Deshpande, Krishi Savla, Crispin Lobo, Jahnavi Patel et al[6]. Also proposed a paper about monitoring systems of forest using sensors, wireless communication, and image processing. The Project will keep a track of conditions which will be good for the flora and fauna and will also be responsible for collecting data related to temperature, humidity etc.

O. R. Vincent, O. Folorunso, et al.[7] Has proposed a paper in which the emphasis was given on Image edge detection which is a process in which the edge of image is detected. The accuracy of the detection of edge depends on the algorithm. The methods used for detecting edges are the Gradient and Laplacian. It accepts the input image and the the absolute magnitude of the gradient is performed and the edges are given as a result.

Vergin Raja Sarobin M. Simrandeep Singh, Abhay Khera, Lakshay Suri, Chhavi Gupta, Ayush Sharma, et. al [8] proposed that fire outbreak has been very common in the forests from past years. It proposed the detection of fire using drones by image and video processing. The research was divided into two modules. The first module focused on cloud service . The second module focused on video processing captured by the drone .These modules boosted the overall performance and accuracy.

Ranjith E, Padmabalaji D, Sibisubramanian S, Radhika S et al. [9] proposed a design of an IOT based system which could be used to detect forest fire at the earliest before the spreading of the fire. The system would be using Raspberry Pi which will be connected to a camera and two sensors. It will send an alert message which will contain the picture of the region and location of the device.

Anphy Jose, Deepa Merlin Dixon K, Naiji Joseph & Silpa

George E et al. [10] proposed and emphasized on the study of the performance of edge detection operators. The intensity change in an image will be considered as an edge. It would have a comparative study between various operators such as Sobel, Prewitt, Roberts & based on the performance factors.

Miriyala, Trinath & Karthik, Ragipati & Mahitha, J& Reddy, V. et. al[11] proposed the detection through NodeMCU fire indicator and observation through IOT technology. In this the Node mcu is connected to the temperature sensor, a smoke sensor .The android page is portable and user friendly and helps the officials in detecting the minute problems also.

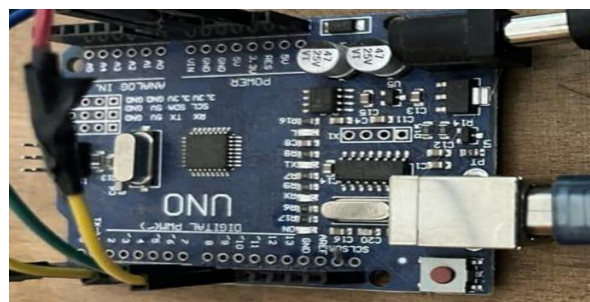
## III. PROPOSED METHODOLOGY

The main aim of the project is to develop early warning system integrating multiple sensors to remotely monitor areas of archaeological and cultural interest for the risk of fire and extreme weather conditions.. The Area will be divided into two equal parts .Both the areas will be covered with flame sensors places at 60 Degrees. As soon as the fire is detected by the flame sensors. The collected information will be transmitted to a monitoring center , which will employ intelligent computer pattern algorithm as well as data fusion techniques to automatically analyze and combine sensor information.

The Control centre will be capable of generating automatic warning signals whenever a dangerous situation would occur i.e. whenever fire is detected. It will also provide real- time information about the evolution of the fire based on wind speed direction and other factors. The warning will then be sent to the control centre and through GSM module , there will be sprinklers and water pumps connected which will be come to use and extinguish fire with high pressure. The warning will be "FIRE DETECTED PUMP ON". This will be sent via GSM module to the phone as a SMS.

## IV. EQUIPMENTS USED

### ➤ Arduino Uno Microcontroller



### ➤ Flame Sensor



➤ **Water P**



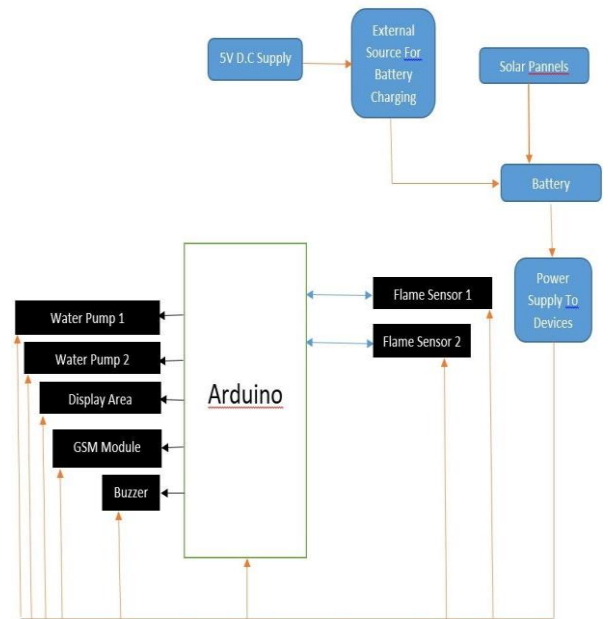
➤ **Solar Panels**



➤ **GSM Module**



**V.BLOCK DIAGRAM**



**Fig.1. Block Diagram of the Module**

**VI.OBJECTIVES**

The main objectives of the project includes-

- The transmission of useful information which helps in early detection of the fire and to avoid the impacts it might cause on the environment.
- Fire Detection is very accurate and false SMS alerts are very rare if any.
- The help can be sent immediately to the fire detected area and avoid any kind of casualties in the area.
- Use of rainwater for extinguishing of fire by rain water harvesting method which would also reduce the wastage of rain water and can be used efficiently.

**VII.CONCLUSION**

Forest fire can cause damage only when they are undetected. When this problem is analyzed and immediate alert will be sent to the forest departments, a huge environment loss can be avoided. We have obtained very promising results on experimenting of our system. We believe this technology can be the turning point in the protection of the forests. Our system is well equipped to distinguish forest fire scenarios accurately.

The system is effective and provides a solid basis in terms of hardware. To extend the potential of the system, we have focused on using solar panels for powering our system, which would in turn limit the energy consumption. Our System is able to distinguish different forest fire scenarios, from base case to detection of fire accurately. It will also help in early stages of fire detection and help to confine fire to limited areas before much damage occurs. Use of water harvesting has also been a key point of the project. This could limit the wastage of water and the rightful consumption can be done. There are some of remaining problem areas to be considered, before the level of forest fire monitoring can be improved and made more efficient.





## REFERENCES

1. Mohamed Hefeeda and Majid Bagheri, "Wireless Sensor Networks for early detection of forest fire" School of Computing Science. Simon Fraser University.
2. Junguo Zhang, Wenbin LI, Ning Han, Jiangming Kan. "Forest fire detection system based on a ZigBee wireless sensor network", front for China 2008.
3. T. Celik and Hasan Demirel, "Statistical Color Model With Fuzzy Logic". Feb 2015.
4. R. Gonzalez- et, "Smoke detection based on wavelets". May 2021
5. Mehdi torabnezhad et, "Image Fusion Technique to detect Smoke". May 2021
6. Y. Deshpande, K. Savla, C. Lobo, and J. Patel, "Forest Monitoring System Using Sensors, Wireless Communication, and Image Processing," Fourth International Conference on Computing Communication Control and Automation Pune, India 2018
7. Vincent, Olufunke & Folorunso, Oluegun. "A descriptive Algorithm for Sobel Image Edge Detection". 2009
8. Vergin Raja Sarobin M. Simrandeep Singh, Abhay Khera, Lakshay Suri, Chhavi Gupta, Ayush Sharma, et. al "Forest Fire Detection using IOT enabled Drone", International Journal of Pure and applied Mathematics. 2020.
9. Ranjith E, Padmabalaji D, Sibisubramanian S, Radhika S et al. "An IOT based forest fire detection and prevention system using raspberry Pi 3" International Research Journal of Engineering and Technology. 03 March 2019.
10. Anphy Jose, Deepa Merlin Dixon K, Naiji Joseph & Silpa George E, "Performance and study of edge detection operators". 2014
11. Miriyala, Trinath & Karthik, Ragipati & Mahitha, J& Reddy, V, "The NodeMCU fire detector And IOT based technology for observation". 2018