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# Automatic Fire Detection in Forest by Enabling IOT

*Jyoshana Y S, Pooja M P, Arpitha, S Manjunatha Chari, Farheen Saba N*

*Department of Electornics and Communication Engineering ,Sai Vidya Institute of Technology,*Bengaluru,INDIA

ABSTRACT

It is difficult to protect environment in the digital age. The main environmental issue is wildfire. The forest fire is provoking by natural disaster and also human action because of this many animals and plants lost their habitat. Once fire catches in the forest it burns and destroys the whole forest. To reduce forest fire wireless sensor networks, continuous monitoring and temperature, humidity, gaseous sensor, smoke sensor, and fire detection system are used to recognize the forest fire and conservation wildlife. The forest fire reduction can be done by monitoring by using software techniques like cloud, Arduino and python coding where can track the fire in the forest and reduce forest fire by IoT. Due to forest fire, only animals and plants can't suffer the event's effects the humans where humans depend on the environment for needs. Wildlife protection is also important nowadays as forest maintains the climate conditions according to the season it rains and does not takes place an ecological imbalance in the environment as a flood (heavy rain), fire catching. As we need to maintain the causing the fire in the forest we use the wireless sensors networks (WSN) the WSN gives the signal to the base station. As we get information early and reduce the fire by not attacking the entire forest. In 2019 amazon rain forest wildfire destroyed lots of hectares of the forest. It is possible to develop a well-organized forest tracking system. This device is entirely based on the latest IoT and Image Processing technology. These technologies are used in conjunction with a Wi-Fi sensor network in our system (WSN). This equipment captures the environmental parameters in a wooded area continuously. Using this in our work helps us to stumble on hearth depth which allow water send out for extinguishing fireplace whilst the Situations emerge as unfavorable. This method could help control wildfire

Keywords— Internet of Things, Cloud Blynk, Smart Phone

## Introduction

The effects of forest fires on the environment over the last few years have attracted researchers to detect forest fires. About 5 billion hectares of damages are registered every passing year, and 1000's of additional wild or forest fires have registered. Because of the wildfires each year, there is an increase in risk and damage. Wildfires are instantaneous in the wild. Once out of control, it will expand and expand, resulting in significant loss of life and property. Automatic Fire Detection in Forest By Enabling IoT One Many forest fires originate from natural causes like lightning, which ignites trees and shrubs. However, the rain smothers those fires without causing a great deal of damage. High atmospheric temperatures, and low atmospheric temperatures, provide favorable circumstances for a fire to start. Fire occurs when a source of fires like cigarettes, open flame, electric spark, or any source of inflammation comes into contact with trees and flammable materials. Prevention of wildfires is the reduction of the risk of fires and spread. Obstruction techniques aim to administer air quality, maintain ecological equilibrium, protect resources, and protect lives. Wildfire has immediate and long-term ecological equilibrium, protect resources, and protect lives. Wildfire has immediate and long-term effects on air quality. When a forest burns, large quantities of smoke enter the atmosphere. These smoke particles are generally small particles composed of gas and stream. Forest fires cause air pollution, which travels longer distances and constitutes a threat to human health. These small particles are embedded deep into our lungs, making it hard to breathe and putting extra stress on our hearts. Besides, forest fires produce an increased amount of carbon monoxide, which causes various health problems. Climate change has been key to raising the risk of forest fires. The risk of wildfires depends on several factors, such as soil moisture, such as temperature, and the presence of trees and other potential fuels. All of these factors may have powerful direct or indirect associations with climate variability and change. Atmospheric change results in drier forest fuel. Forests play a crucial part in maintaining the terrestrial ecosystem's equilibrium. For the past two decades, wildfires triggered by human actions against nature and natural catastrophes have been on the rise. It produces an ecological imbalance, which leads to air pollution and climate change. Forest fires, according to the 2014 Global Warming Report, are one of the primary causes of global warming, releasing massive amounts of greenhouse gases into the atmosphere. Forest trees are extremely combustible and may quickly catch fire when moisture levels are low. Aerial surveillance , satellite surveillance, surveillance towers, and human monitoring are all part of the traditional detection and surveillance system. Forests are typically found in isolated places, making it difficult to identify forest fires as quickly as feasible. The outcome is environmental catastrophe and irreversible ecological harm Land-based fire occurs through the deposition of buried roots and other organic materials. This kind of fuel is responsible for inflammation caused by stains. Land fires burn mainly by smoking and can burn slowly for days or months. Surface fire occurs due to low-elevation vegetation over forest floods, such as leaves, grass, debris, and low -elevation shrubs. Scale fires consume substance between low-level green spaces like small trees. Forest or wildfires are deadly events, destroying infrastructures, international inheritance websites, natural world territories, and timber, and additionally liberating $CO_2$ within the environment. The outcomes derived from huge as well as recurrent fires in mixture with incorrect put-up-fire control routines are stunning for each surrounding and communities of humans. Early detection might help to avoid a scenario that could turn into a catastrophe. Make sure to inform family and friends about the need of installing fireplace alarm systems. Another issue to consider is how people are interfering with the earth's ecological stability through a range of deforestation projects aimed at improving communities and industry. This artificial advancement has had negative consequences on the environment, and the number of herbal disasters is on the rise. According to a nationwide weather report published in May of 2018, a wide range of storms and floods have occurred in recent years.

**Fig 1:wild fire**

## RELATED WORK

ShivamPareek et al. proposed paper named as "IoT and image processing based forest monitoring and counteracting system", wireless network Thousands of hectors are killed by wildfire all over the world. In this paper, image processing and IoT technologies are combined with WSN to give real-time environmental data. Different sorts of fire can be captured, as well as animal and human movement[1].

Arjun D et al. presented paper named as "Wireless Sensor Network framework for Early detection and Warning of forest fire". Wildfires are a severe concern in the planet, and we see them every year. To reduce the risk of natural disasters, a detection system with gaseous sensors, a WSN framework with RTS detection, and IR camera sensors will be used. WSN topology with MAC synchronisation of time protocols was proposed to improve the efficiency of fire detection in the wild, which is better than conventional approaches[3].

Sandra Sendra et al. presented a paper named as "low cost Lora based network for forest fire detection". This publication proposes that a low-cost long-range (Lora) based network be used to assess risk and identify forest fires. A LoRa node is a collection of temperature, humidity, and CO sensors. They also employ an Arduino Uno, 3D printing, and a network architecture to monitor and cover data per node over a larger area[7].

Damir krstinic et al. Proposed named as "Measuring and controlling cognitive process of visual attention in forest fire monitoring system"[6]. Early fire detection is a benefit of wildfire management in this case. Video surveillance, alarm detection, and the ability to monitor all of these things with the use of visuals could all be more useful in spotting a fire. By analyzing EEG signals, greater periods in forest fires can be detected, and the location can be monitored with the control loop, and the signals will be included in the automatic fire detection system.

Tao Wang et al. presented paper named as " Forest fire detection system based on Fuzzy Kalman filter"[4]. When a fire breaks out unexpectedly in the forest, a method for detecting it can be proposed by collecting preprocessed data from various types of sensors and simulating the data using MATLAB and Kalman filters. As a result, the Kalman filter's output is the likelihood of an open flame and a smoldering fire, and it can only communicate the possibility of a fire. Because of this decision, employing fuzzy reasoning to process the filter's output is significantly easier more grounded in reality.

Benamar kadri et al. presented the paper named as "Early fire detection system using WSN networks[10]".Providing a stand-on Wireless Sensor Network for early wildfire spotting, which is the best utensil for allowing conditions monitoring and remote control because to its portability, integration, and expandability. Tinos, an open-source operating system, is utilized as a programmed for growth. This project's installation of any fire-exposed structure requires ensuring the detection, confinement, and warning of this firestorm to speed up forest guard action, so prototype they expand a sub-system for each mission.

A. Divya et al. proposed the paper named as "IoT enabled forest fire detection and early warning system"[9]. This journal proposed that using a fire sensor, a GSM module with an LCD, and code for a microcontroller, this could be uploaded to a fire detection system. And numerous sensors are connected to the data, which is dispatched in the system via wireless transmission by a small satellite. It is a concept that technological advancement is advantageous in the short term, and that several points of view will diverge, perhaps delaying environmental change.

Jayaram k et al. proposed paper named as "Forest fire alerting system with GPS coordinates using IoT[5]". This technique sent the exact location to the base-station where the forest catches the fire using GPS module in order to recognize and forecast the wild fire. The Wi-Fi module is linked to the Arduino, which is powered by 5 volts. Because supplying power to the complete system in the forest was nearly impossible, they used solar modules to do so.

## PROPOSED BLOCK DIAGRAM

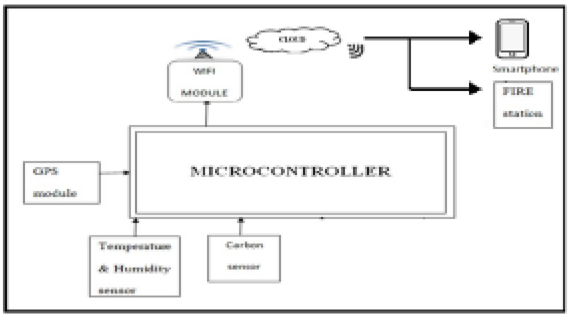


fig 2: block diagram of model

Place a hybrid sensor used to disclose the wildfire in the woodland. The purpose of this system is to alert the authorities. Burning in the wild, according to a forest officer,a microcontroller is used to manage the activities of the company. To pinpoint the exact position of the fire, sensors are used. As a result, the system has reached its completion. The operation of a system in an IoT-based company is constantly monitored, and that information is saved as data that can be seen at any moment. The proposed system the Temperature sensor calculate the relative humidity by measuring electrical resistance and the threshold value is set according to their environmental condition. Temperature value with carbon sensor measure gaseous CO2 level by detecting quantity of IR radiation absorbed by CO2 molecules. And this information is sent to the microcontroller, which activates the GPS module, which identifies a specific position using latitude and longitude values, allowing for a powerful satellite search. Wi-Fi module and microcontroller sends the data to the cloud database, after the threshold voltage reaches microcontroller instantaneously this all information on location of fire is displayed in end station through gateway. The Internet of Things is being utilized to monitor and document data regarding forest fires, and these policing actions are being carried out indefinitely, regardless of whether or not there is a forest fire. The officer can view the intricacies of the system when they are combined with the computer system .

## FLOW CHART

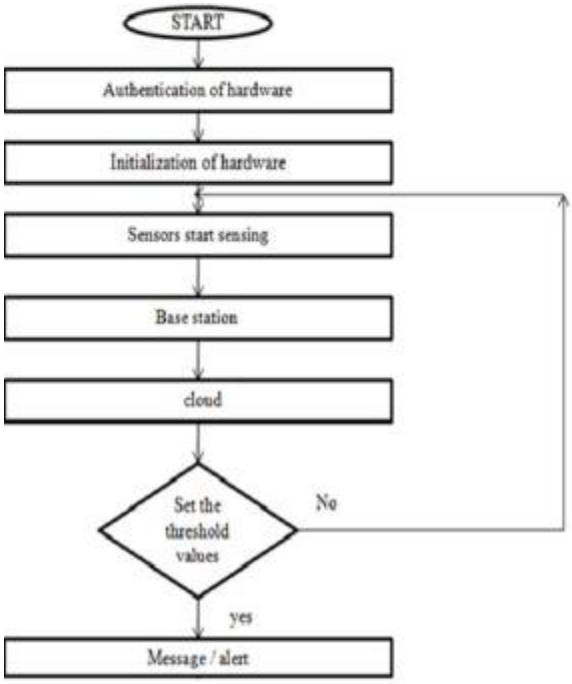


fig 3 : flow chart

The above flowchart shows working of the model it consists of conditions with the flow of control while it follows users authentication process starting with the authentication of hardware, this step gives the users intimation to the hardware like username passwords to execute the programs while implemented in the base station.Secondly, there is an initializing part which initializes the hardware which DHT11 and the carbon monoxide sensors and GPS NEO-6M model. These sensors start sensing environmental parameters like temperature and humidity and carbon monoxide,only when the fire attacks these sensors sends there output data to the base station ESP32, for ESP32 it takes the output value as input value. In base station there is an comparing of input values with the threshold values, where the input values of microcontroller crosses the threshold values then we will get an alert or message through Blynk app . if the input values does not meet the threshold values again the loop will go to sensors start sensing again asking to send the output data of pins to the microcontroller.

***Software requirement***

**Arduino IDE**

IDE stands for "Integrated Development Environment," and it's an Arduino-provided programming environment. It 'soften used to modify, assemble, and shift code in Arduino devices. The Arduino Integrated Development Environment (IDE) is a C and C++-based cross-platform application for Windows, Mac OS X, and Linux. The Arduino IDE includes a software library that includes many common input and output techniques from the wiring project

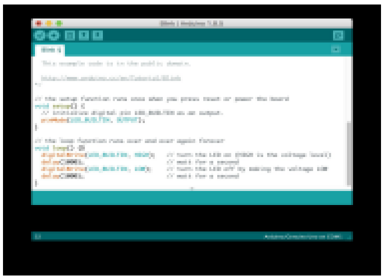

fig 4: Arduino IDE software

**BLYNK APP**

Blynk is a platform that allows you to control Arduino, Raspberry Pi, and other devices via the internet using IOS and Android apps. It's a digital dashboard where you can virtually drag and drop widgets to create a graphic interface for your business.

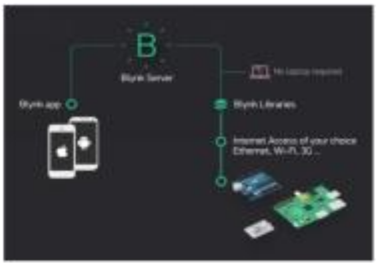

fig 5 : blynk program

***Hardware requiremnts***

GPS MODULE NEO-6M

The NEO-6M module series is a collection of standalone GPS receivers with a high-performance positioning engine. The NEO-6M GPS module is a high-performance full GPS receiver with a built-in 25 x 25 x 4mm ceramic antenna.

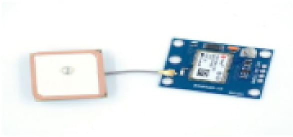

**fig 6 : NEO-6M**

**Carbon Monoxide Sensor MQ7**

A carbon monoxide (CO) sensor is useful for detecting CO levels in the air. CO gasoline concentrations ranging from 10 to 500ppm will be detected by the MQ-7. This sensor offers a high sensitivity as well as a faster response time.

**fig 7 : MQ7 sensor**

**Temperature and Humidity sensor DHT11**

The temperature and humidity sensors are digital temperature and humidity sensors that are primary and low-cost. To measure the surrounding air, it uses a capacitive humidity sensor and a thermistor.

**fig 8: DHT11 sensor**

# ESP32 Microcontroller

The ESP32 is a single-chip that includes a 2.4 GHz Wi-Fi and Bluetooth module. Antenna switches, filters, low noise amplifiers, power amplifiers, and power amplifiers are also integrated. ESP32 is a microcontroller that is used in mobile phones, wearable devices, and the Internet of Things. Espressif System invented and developed the ESP32

**fig 9:ESP32 microcontroller**

## IMPLEMENTATION

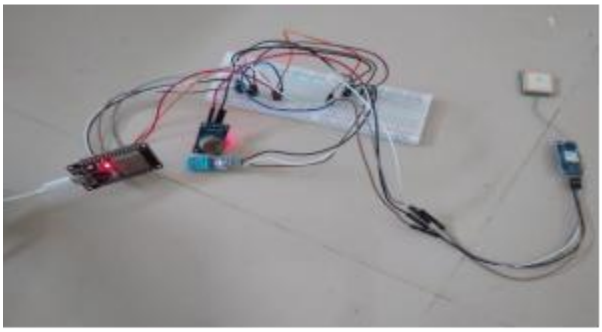

**fig 10: Implementation Model**

place the model in forest with the nodes of cluster, When the fire catches in the forest the model is already starts sensing the surrounding area, when the DHT11 sensor sense the temperature value in digital input to the sensor and sends to the base station. Here the base station is microcontroller i.e., ESP32 when the temperature sensor reads the data then parallelly carbon monoxide sensor where MQ7 ($SnO_2$) is sensitive sensor, with low conductivity in the forest (clean air) it detect the CO in low temperature heated by 1.5V and when high temperature 5V it adsorbs and cleans the air. Senses the values and sends to the ESP32. The program with all the specifications is dumped to the microcontroller when the sensors send the data of temperature and carbon level then microcontroller checks for the threshold valves when the threshold values reach the GPS get initiated and tracks the place where exactly fire catches. if the threshold values do not match then GPS does not initiate to track again the microcontroller takes the values of the sensor the loop will carried out. This microcontroller is connecting to the Blynk software app to android to get notification to the humans to save the forest for more destroying. And we can monitor continuously with the Blynk software. In forest area for network we can use the Zigbee protocol. In the forest we place nodes of cluster that consisting of sensors having connected to the ESP32 microcontroller. The sensors are start sensing the forest area any uncontrolled and unbalanced climate conditions are present means that will notify the sensors, the values will be reached the limit means there will be intimation in the output source base station.

## RESULT

fig 11:output of the Model


fig 12: output in Blynk App

the output of the model in the Blynk software has shown. Which the output consists of temperature range in Celsius, carbon ranges with the GPS location present in the output message.

## CONCLUSION

To avert tremendous catastrophes, natural and social ligancy harms, early warning and quick reaction fire is the primary strategy. As a result, IoT-enabled autonomous forest fire detection is utilized to detect early-stage forest fires as well as to safeguard flora and fauna. In this project IoT base forest fire detection is implemented using microcontroller and sensors, whenever forest fire causes large amount of carbon dioxide releases and amount of temperature is high in surroundings. So, to detect that MQ7 sensor and DHT11 temperature sensors used. Whenever sensors value is more than threshold valve the message is sent through the cloud to a registered and interested people's androids -emails, SMS can get, in order to get exact data location tracking GPS Neo-6M is used. And this project more helpfull as having an advantage is less cost of implementation and this project is integrated. these techniques came to protect the forest, and here we used Blynk app to get notifications. Now we have tested this project in forest like conditions as future work we would like to install this project in real condition like small forest area then only we can get real hard work and success in preventing the huge loss of forest.

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