IoT-BASED FOREST FIRE MONITORING AND ALERTING SYSTEM

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Abstract- *Protecting our environment is essential in today's developing world. One such environmental tragedy is forest fires. In recent years, the number of forest fires worldwide has increased. Natural or man-made disasters are to blame for this forest fire. One of the causes of natural forest fires is lightning. It happens as a result of dry fuels like leaves burning in the forest. Man-made fires are more like smoking because they result from several activities. In recent years, significant damage has been caused by forest fires. As many households and communities rely on the forest for food, fuel, and fodder, forest fires can have an adverse economic impact. Small shrubs and grasses are destroyed, causing landslides and soil erosion. Forest fires release toxic gas emissions and smoke that have a serious negative impact on human health. The goal of this effort is to create and implement an IOT-based system that can predict and detect forest fires and transmit alerts to responsible officials via mobile phone, enabling them to assist firefighters in putting out the fire in the area where it first ignites. This would stop the fire from spreading over a large region and allow for the taking of preventative actions to stop any fires that may break out shortly.*

1. INTRODUCTION

Forest fires are a frequent risk in forests and they significantly impact both the environment and wildlife. Forest fires are uncontrolled wildfires that consume everything in their path, including grasslands, animals, plants, and scrublands. The wind hastens the spread of the fire and significantly increases air pollution. Climate change is typically to blame for longer-lasting or more flammable flames. Additionally, there are incidents of lightning, severe drought, and human-caused forest fires. As many nations suffer large losses in terms of lives and property, forest fires have grown to be a global concern. In addition, lung and skin illnesses in people are brought on by the carbon dioxide that forest fires emit into the air. In India, forest fires typically happen between the months of March and April when Dry logs, hay, weeds, trees, and leaves cover the ground. A million acres of woodlands are burned away annually. These forest fires directly affect human lives as well as the devastation of vegetation, air pollution, and other factors. The authorities frequently lack both a fire pre-warning system and an alert system for transmitting and receiving warning messages. As a result, warnings to the general public and the rescue teams frequently arrive too late. It can be prevented if a reliable system is put in place in forest regions to detect fires and notify the appropriate authorities to put them out as soon as possible. Consequently, this project's goal is to develop a fire alert system that offers additional functions in monitoring and forest fire detection. The goal of this project is to create an IOT-based forest fire detection system that can identify fire and transmit an emergency alarm to the appropriate authorities.

2. LITERATURE SURVEY

Jorge Granda Cantuña et al., 2017 proposed an Innovative design and development methods were used to create a Wireless Sensor Network (WSN) prototype for the Ecuadorian capital's Guanguiltagua Park, which is part of the Metropolitan District of Quito (DMQ). The city of Quito has frequent forest fires every year, especially in the summer when the dry soil and high temperatures encourage the spread of fire in regions with thick vegetation. In response to this issue, a WSN technical solution was developed that can identify forest fires in real time and transmit alerts to the user right away. This quick action helps to lessen the effects of forest fires, including the loss of life, the destruction of significant vegetation, financial damage, and environmental degradation. The hardware, software, communication protocols,

topology, and functionality used by the WSN prototype detailed in this document are all geared at improving its final output. The system is based on continually detecting three gases that are involved in combustion, namely CO2, CO, and CH4. Along with these sensors, the environment's temperature and humidity are also provided, along with GPS location data. This data is sent via wireless communications to a graphical interface where the sensors' data will be evaluated and statistical data can be generated. Finally, it is shown through a WSN prototype validation procedure that such a prototype offers an effective and trustworthy technique to detect and monitor forest fires quickly.

S.Anand et al., 2017 proposed a system detecting capacity of the sensor node that is limited when a forest fire is being identified or predicted, which causes a delay in the alert signal or failure to report and makes it challenging to determine when a fire broke out. A Feed Forward Neural Network (FNN) was suggested as a solution to the aforementioned issue and it immediately predicts the occurrence of firestorms. The few false recognitions of firestorms in forests are reduced by the neural networks' low power and improved accuracy. This variant adjusts the alarm delay and more accurately detects flame fires. FNN is built with a few hubs N and conducted an analysis using single and many hidden layers to anticipate greater precision. The RTL schematic was planned using Xilinx ISE 14z, and the recreation result of the suggested framework is verified and actualized using Virtex-5. In a WSN, nodes were placed in a surveillance zone where they worked together to gather all available environmental data. In nature, it's important to notice meteorological conditions. The deployment of nodes in the forest to detect forest fires allowed for the dynamic collection of data on temperature, pressure, and humidity changes related to forest fires [1]. To combine input from multiple sensors in a WSN for the detection process, a fuzzy logic algorithm was created [2]. Each sensor node produced here senses different applications, such as temperature, pressure, and humidity. Utilizing more than one sensor allows for confirmation of the environmental information's states. Fuzzy logic is used to process the signals, create the fusions, group the signals into clusters, and then optimize the energy of the clusters.

Imteaj et al., 2017 Protecting the safety and ensuring the bare minimum rights of textile workers is a contentious topic. A system to control many Arduino using Raspberry has been proposed. Undoubtedly, one of the mazes that employees at garment factories must traverse is the escape from a fire. Investor interest is declining, and the significance of this industry is fading. The fire's impacted area can be found and detected using the suggested method. The Raspberry Pi 3 has a camera and several sensors built therein. The camera has a 360-degree relay motor installed so it may capture images from any angle when a fire is detected. We have provided validation of the fire suspicion system to avoid any erroneous alarms. The system will immediately transmit a message with a picture of the affected area and the location of the Arduino. The system will immediately raise an alarm and send a message to the neighborhood fire brigade if the administrator believes that a fire is starting. The administrator can confirm or deny the impeachment.

Diwaker Pant et al., 2018 undergone research on various disasters, their identification of them, and their management of them to reduce losses in hilly regions A wireless sensor network can offer better disaster management and search and rescue solutions. There are several situations where WSN can be applied, such as earthquake detection and alert systems, flood detection, landslide detection, forest fire detection, Himalayan River water level monitoring, glacier monitoring, pilgrimage, and tourist management. Multiple parameters are measured by sensors, and early warning systems can be designed to reduce losses based on the measured values.

Evizal Abdul Kadir et al., 2018 developed with the help of WSN technology, data can be collected from the sensors deployed in the forest area to identify forest fires in the Riau province an area that has a high risk of forest fire during the dry season. In this instance, mathematical analysis is employed to calculate the number of sensors that must be deployed as well as the size of the total forest area that represents Riau Province. The creation of WSN sensors increases the viability of resolving present Riau Province forest fire-related problems. WSN technology was heavily utilized in the system's construction for early warning and alerts to representative institutions for action.

George Georgiades et al., 2019 proposed a system that can recognize hazards from forest fires in real-time and can alert authorities and interested parties by sending alerts and critical information (e.g. specific location, environmental conditions, etc.). By combining thermal and optical cameras installed on a (or maybe more) UAS with those at a panoramic, stationary ground site, the suggested system makes use of these complementarities to solve them. Additionally, the system has sensors that monitor and account for ambient factors in the on-the-fly threat assessment. An automated risk assessment is conducted using all of the data. The suggested system has been integrated and is prepared for experimental testing and validation in field fire circumstances that are quite similar to operational conditions in Cyprus' Pano Platres woodland, tests are conducted under carefully monitored safety settings.

Byron Arteaga et al., 2020 Nowadays, Frequently occurring forest fires are mostly brought on by climate change and poor resident behavior. Due to rising temperatures and extended droughts, the "El Nio" weather phenomena have become more intense globally in recent years, increasing the frequency of forest fires. The majority of forest fires are located visually, either from the ground or from an aircraft like a helicopter; however, this method is ineffective since it takes too long to notify the emergency services and calls for well-planned logistics. The recent instances (the last fires) have demonstrated a lack of early detection methods, and it may be inferred that there are insufficient controls in place to address this issue. The system's goal is to assess how well various CNN models function when used to classify photographs of forest fires, which can be used in economic development cards like the Raspberry Pi.

S.Srividhya et al., 2020 presented an IoT-based method for monitoring forest fires. One of the most serious disasters that have been primarily brought on by global warming is forest fires. Environmental pollution increases this hazard because nature has the potential to wipe out both humans and themselves. The department of forest management and wildlife is in charge of several issues, including the rehabilitation of wild animals and the movement of animals into populated areas. The trees' strength has significantly decreased, which has resulted in an unhealthy forest environment. According to the analysis of the yearly study, wildfires are to blame for 85% of the losses in forest disasters. There haven't been many studies done recently on wireless sensor networks for managing forests. With Edge/Fog computing in IOT, issues with bandwidth, latency, and delay in data processing are also

eliminated.

To protect the trees and wildlife, the suggested IOT-based fog-based architecture for a forest fire management system is employed for monitoring and alerting.

Sayantani Bhattacharya et al., 2021 proposed a WSN-based solution with warning generation and visualization techniques. There is a global crisis with forest fires. In rare cases, it even results in the death of forest firefighters. It destroys the green belt, worsens air pollution, harms tree and animal habitats, and increases air pollution. It has caused the nation to suffer significant losses in both the economy and the environment. The traditional satellite-based technology lags in continuous monitoring necessitating extensive processing and does not provide real-time information on the ground. Consequently, a system that can monitor forest fires around-the-clock and send out alerts almost instantly is required. The system has been created and put to the test outside. The sensors in the system keep track of environmental variables when a forest fire starts.

3. SYSTEM REQUIREMENTS

3.1 TEMPERATURE SENSOR

The integrated analog temperature sensor in the LM35 produces an electrical output that is proportional to degrees Celsius. For typical accuracies, the LM35 Sensor doesn't require any additional trimming or calibration. Because of the LM35's low output impedance, a linear output, and precise intrinsic calibration, integrating it with readout or control circuitry is especially straightforward. LM35 can also be directly connected to Arduino. By feeding the LM35 temperature output into a comparator circuit, it can also be used as a temperature controller or an overtemperature indicator.

3.2 ARDUINO MICROCONTROLLER

An integrated circuit (IC) known as the Arduino Microcontroller contains key components of a computer's central processing unit (CPU). It is a clock-driven, register-based, programmable multipurpose silicon device that accepts binary data as input and processes it by memory-stored instructions.

3.3 ATMEGA 328

The Arduino board's ATMEGA 328 microcontroller serves as its processor. There are almost 28 pins in it. By sending and receiving inputs to the external device from these 28 pins, the inputs can be controlled. Additionally, pulse width modulation is included (PWM). These PWM are used to pulse-modulate and convey the whole signal. It uses input power supplies like Vcc and GND. These integrated circuits mostly have analog and digital inputs. Various applications employ these analog and digital inputs to carry out their processes.

3.4 WI-FI MODULE (ESP8266)

The ESP8266 WiFi Module is an integrated TCP/IP protocol stack-equipped self-contained SOC that allows any microcontroller access to your WiFi network. The ESP8266 is capable of offloading all Wi-Fi networking tasks from another application processor or hosting an application. Each ESP8266 module has an AT command set firmware that has been pre-programmed, so all you have to do is connect it to your Arduino device to get nearly the same amount of WiFi functionality as a WiFi Shield (and that's right out of the box)! The ESP8266 module is a very affordable board with a sizable and expanding community.

3.5 POWER SUPPLY

DC voltage sources or power supplies are needed by the majority of electronic circuits. One or more batteries are typically required to supply the DC voltage needed by electronic circuits in portable electronic devices. Batteries cannot be recharged and have a finite lifespan. Converting the alternating current loose hold line voltage to a DC voltage source is the solution.

4 PROPOSED WORK

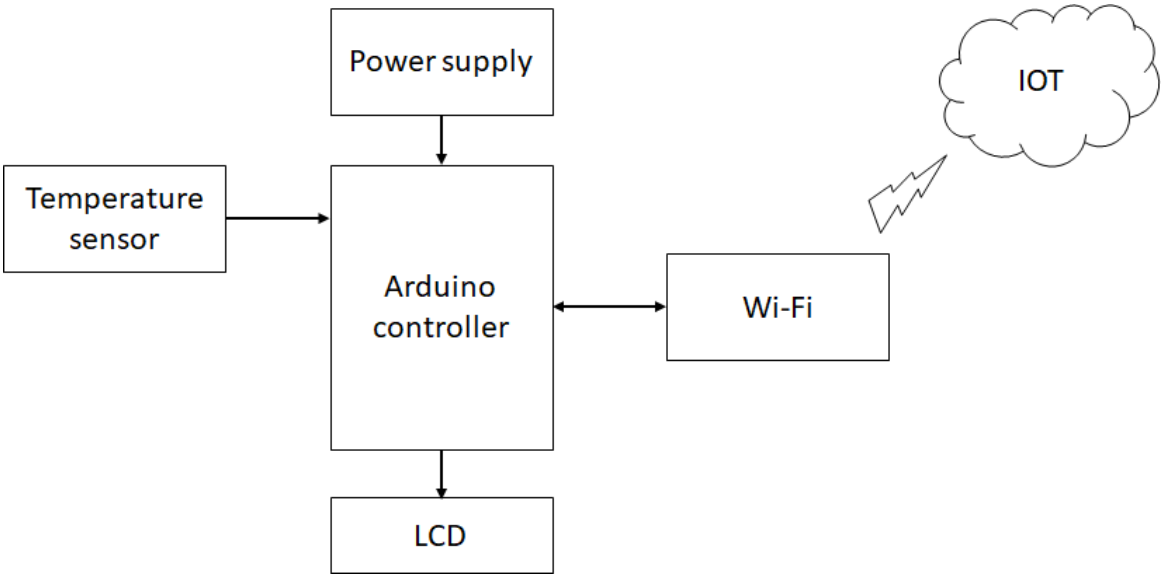

Figure 1: Block diagram

Using IOT technology connected to a remote server so that the user can get messages from the server, an Arduino microcontroller is utilized in this study to detect fires in forests. If there is a sudden change in the sensor values, the user is sent an emergency alert. In the system we've proposed, a microcontroller is connected to a temperature sensor and a smoke sensor that measure the temperature of the area around a fire. The sensor used for temperature is an LM35. The Arduino controller receives the detected values and analyses them before sending the data to the LCD and the Wi-Fi. This system is linked to the distant server via Wi-Fi**.** We have access to the sensed data on the distant server. If the temperature changes or suddenly rises, the remote server will give the user a message via an app. The suggested system is powered by a single power unit. The LCD is utilized to show both warning messages and the live readout of the sensed readings**.**

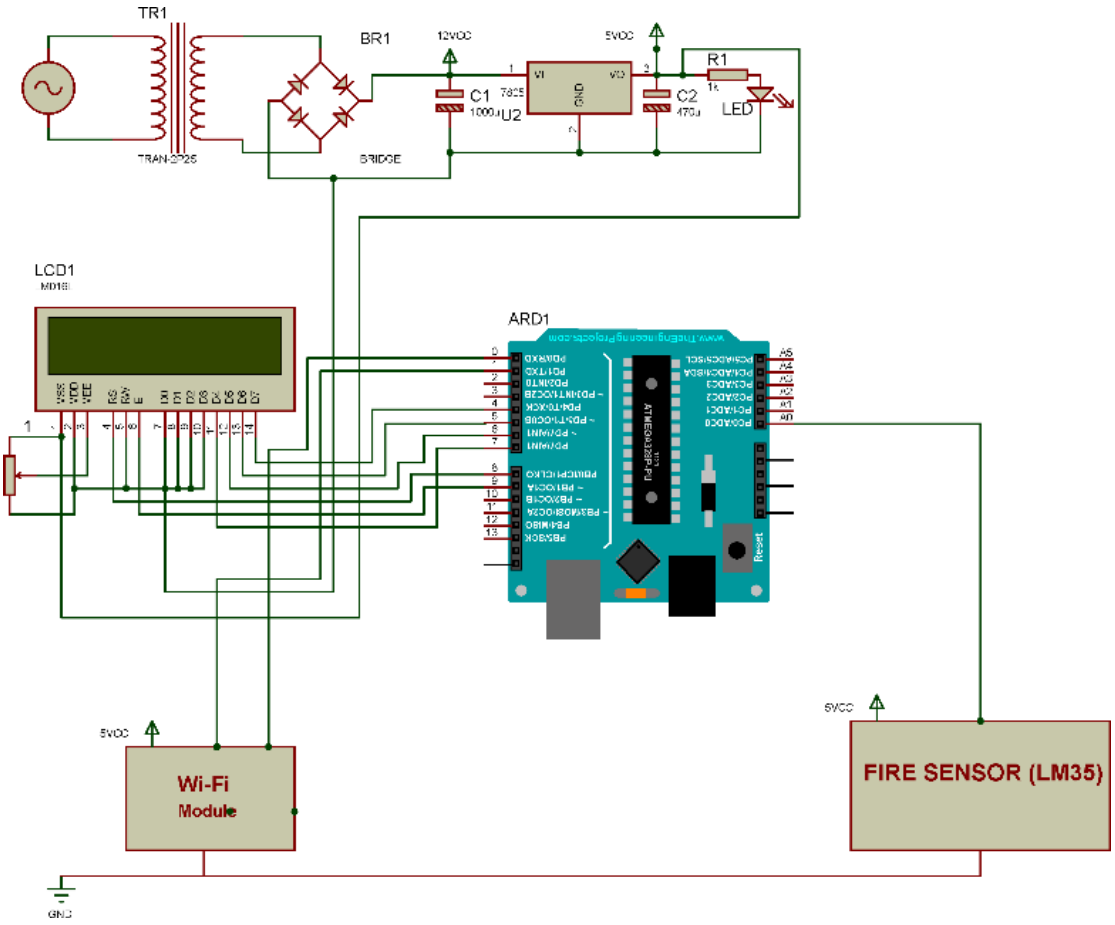

Figure 2: Circuit Diagram

5. RESULT AND DISCUSSION

Figure 3: Result-LCD Display

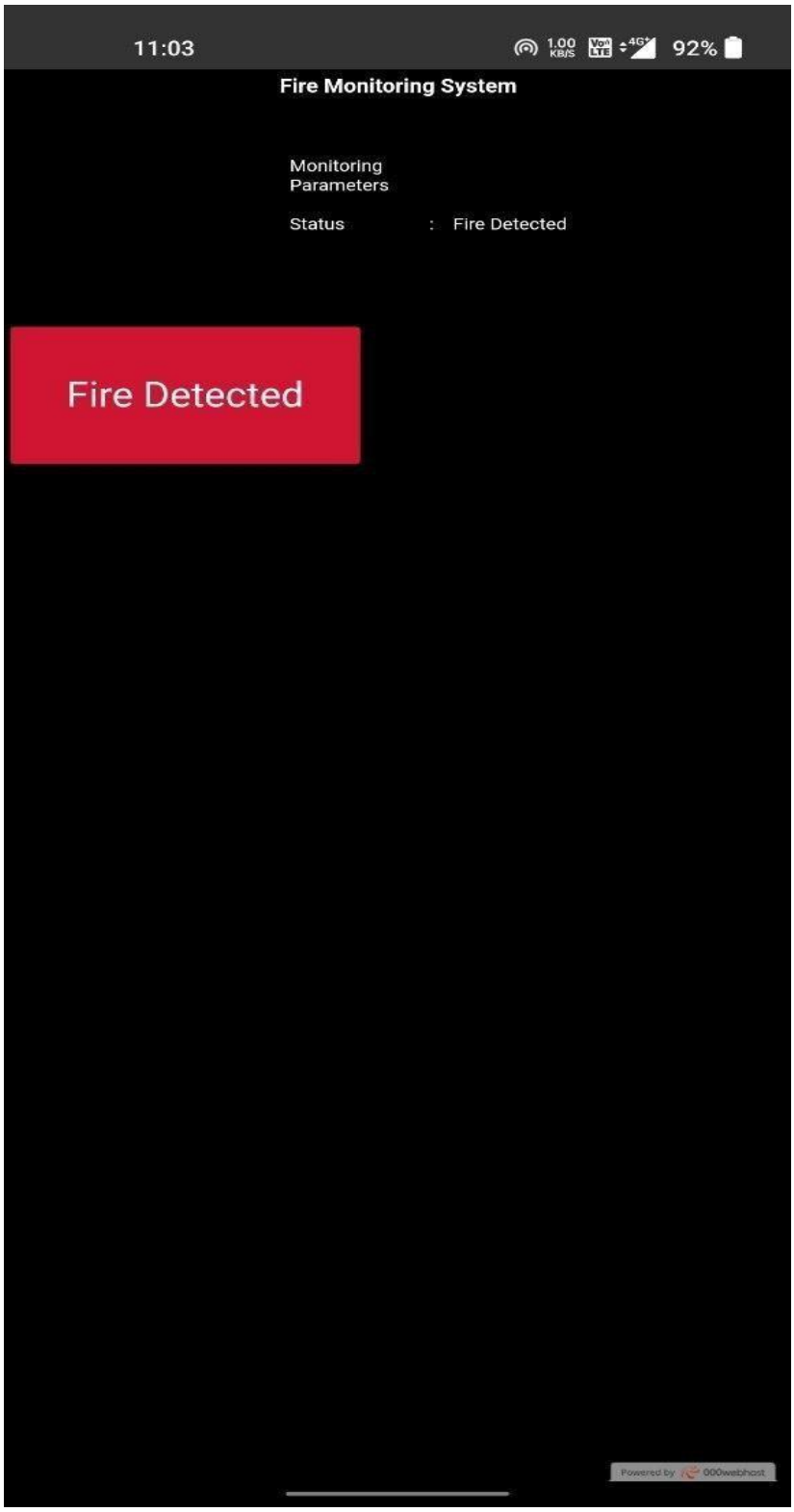

Figure 4: Mobile Phone Display

By quickly and accurately detecting a fire (i.e., without sacrificing speed or producing false alarms)

and disseminating early warning alerts, a fire-detection system might limit the emission of hazardous combustion byproducts as well as the global warming gases created by the fire itself.

CONCLUSION

Forest fire detection was implemented in this project using the Internet of Things. An LCD will provide information when the temperature and smoke levels increase, and an IoT-powered portal will notify the authorities. Small wooded areas where there is a high risk of forest fires should utilize it. We can protect the trees and wildlife by using this technique

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