Forest Fire Alarm System Using IoT

Kanthi Vivek, Kondepati Ayyappa, Karnati Vinayaka,
Keerthi Rishika and Kishori Shekokar

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1st Kanthi Vivek

Computer Science and Engineering(AI) Department
Parul Institute of Engineering and Technology
Vadodara, Gujarat, India
kanthivivek18@gmail.com

2nd Kondepati Ayyappa

Computer Science and Engineering(AI) Department
Parul Institue Of Engineering and Technology
Vadodara, Gujarat, India
kondeoatiayyappa@gmail.com

3rd Karnati Vinayaka

Computer Science and Engineering(AI) Department
Parul Institute Of Engineering and Technology
Vadodara, Gujarat, India
vinaychowdarykarnati@gmail.com

4th Keerthi Rishika

Computer Science and Engineering(AI) Department
Parul Institute of Engineering and Technology
Vadodara, Gujarat, India
rishikakeerthi550@gmail.com

5th prof.Kishori shekokar,
Assitant Professor

Computer Science and Engineering(AI) Department
Parul Institute of Engineering and Technology
Vadodara, Gujarat, India
kishori.shekokar20174@paruluniversity.ac.in

Abstract—Forest fires are a major threat to our environment and can cause significant damage to forests, wildlife, and nearby communities. One way to mitigate the impact of forest fires is by detecting them early and taking appropriate action. In recent years, the Internet of Things (IoT) has emerged as a powerful tool for monitoring environmental conditions in real-time. In this context, an IoT-based forest fire alarm system can be an effective solution to detect forest fires at an early stage and alert the authorities to take timely action. The proposed forest fire alarm system uses a combination of sensors, wireless communication, and cloud computing technologies to monitor and detect forest fires. The system consists of multiple sensor nodes deployed in the forest area, which are connected wirelessly to a central node or gateway. These sensor nodes can be equipped with various sensors such as temperature, humidity, and smoke detectors, which can detect changes in the environment that may indicate the occurrence of a forest fire.The sensor data collected by the sensor nodes is transmitted wirelessly to the central node, which processes the data and sends an alarm signal to the cloud server if a forest fire is detected. The cloud server can then send an alert message to the authorities or other stakeholders via email, SMS, or other communication channels. The proposed system has several advantages over traditional forest fire alarm systems. Firstly, it can detect forest fires at an early stage, which can help prevent or minimize the damage caused by the fire. Secondly, the system is highly scalable, and multiple sensor nodes can be deployed in a large area to provide better coverage. Finally, the system is highly cost-effective as it eliminates the need for human intervention in monitoring the forest area continuously.In conclusion, the proposed IoT-based forest fire alarm system is a promising solution to mitigate the impact of forest fires. By leveraging IoT technologies, the system can provide real-time monitoring and early detection of forest fires, which can help authorities take timely action and reduce the damage caused by the fire.

Index Terms—component, formatting, style, styling, insert

I. INTRODUCTION

This system tries to prevent fires in forests and fields, where a disaster of this type can generate large economic losses, significant material damage, destruction of the flora and fauna of the place causing an ecological damage of great magnitude, but the most important thing is saving human lives . The principle of operation is as follows, when detecting fire by the flame sensor, it will send an analog signal to the arduino, which depending on its value, will activate the sending of a text message with the GPS coordinates where the fire is taking place . For this project we will need a flame sensor, an arduino uno, a sim800A module, a battery, cables. ATMEGA328 Introduction The Atmel ATmega328/P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328/P achieves throughputs close to 1MIPS per MHz. This empowers system designer to optimize the device for power consumption versus processing speed. An Arduino board is a one type of microcontroller based kit. The first Arduino technology was developed in the year 2005 by David Cuartielles and Massimo Banzi. The designers thought to provide easy and low cost board for

students, hobbyists and professionals to build devices. Arduino board can be purchased from the seller or directly we can make at home using various basic components. The best examples of Arduino for beginners and hobbyists includes motor detectors and thermostats, and simple robots. In the year 2011, Adafruit industries expected that over 3lakhs Arduino boards had been produced. But, 7lakhs boards were in user's hands in the year 2013. Arduino technology is used in many operating devices like communication or controlling

II. LITERATURE REVIEW

A. Forest Fire Alarm System Using IOT

Journal: International Associations of Professionals and Technical Teachers (IAPATT) 2018 Fires play an integral role in human lives, but if uncontrolled, can be disastrous. Burnable materials catch fire easily and spread rapidly degrading the environment. The first stage of fire is called as 'Surface Fire' and the latter stage is known as 'Crown Fire'. Crown fires are uncontrollable and damage the landscape. Although some safety measures have been employed, the accidents related to fire are ineluctable. There are different systems that are used for the detection of domestic and forest fires. Various alarm systems are being used today for fire detection and warning purpose . In this project, we focus on employing various machine learning techniques on a system based on wireless sensor networks. There are a number of advantages of using machine learning algorithms with WSNs. If we can successfully predict the onset of the fire, a lot of damage will be reduced and environmental degradation will be decreased. . Many forest areas do not have fire alarm systems installed. Fire alarms are important because they can alert you before a tragedy happens. You can, therefore, stay prepared, take necessary actions and reduce any kind of loss that might occur. Our goal is to create a technique based on sensors which will help in detecting the forest fires in the early stages. As soon as the fire is detected an alarm will be generated thereby minimizing the loss of environment, property or human life. The machine learning techniques integrated with the sensors help in detection of fire without any human help, therefore no patrolling is required. The major advantage of sensors is that they are fast and accurate. Moreover, machine learning maximizes resource utilization and improves the performance of sensor networks. AIM and methodology: We aim to evaluate the historical data and the natural events, predict the upcoming events based on acquired knowledge. Thus, the model will be capable of generating automatic warning signals whenever a dangerous situation arises, i.e., when fire or smoke is detected. Since this project is based on experimentation, it is constrained by many parameters. Primarily within the stipulated time, the correct response needs to be generated and provided to the user. One of the major issues is noise. Since we are depending on wireless sensors for our data, it is possible that this data might not be clean and may contain noise. Proper and quick preprocessing is required for optimal results. Another issue is accuracy. There is a huge possibility that a false positive

response will be generated and a fake warning may be issued. By parameter optimization, we can reduce these falsepositives but not necessarily eliminate them. Also, the available computing power constraints the working of this system. The training and testing of models are compute-intensive tasks

2. IOT ENABLED FOREST FIRE DETECTION AND EARLY WARNING SYSTEM :

Journal: proceeding of international conference on systems computation automation and networking 2019 With the dawn of the Internet, folks have come increasingly interrelated at a novel separate. However, a seamless interconnection between devices is gradually being make, due to the escalation of inadequate-ramble reticulation and the omnipresence of devices constant to these net. Some of the lacking-order net terminate ZigBee, wireless Fidelity (Wi-Fi), radio frequency identification (RFID) net, Bluetooth, and wireless sensor network (WSNs). It is foreseen that devices will generally be connected collaboratively to construct, converge, and distribute data. These processes mentioned before will involve a series of communication between devices that may or may not need human intervention. These devices are various types of objects or things with embedded intelligence and communication capabilities. Some of those are sensors, cars, smartphones, health care gadgets, home appliances, or RFID tag. proceeding of international conference on systems computation automation and networking 2019. In this project, we focus on employing various machine learning techniques on a system based on wireless sensor networks. There are a number of advantages of using machine learning algorithms with WSNs. If we can successfully predict the onset of the fire, a lot of damage will be reduced and environmental degradation will be decreased. Many forest areas do not have fire alarm systems installed. Fire alarms are important because they can alert you before a tragedy happens. You can, therefore, stay prepared, take necessary actions and reduce any kind of loss that might occur. Our goal is to create a technique based on sensors which will help in detecting the forest fires in the early stages. As soon as the fire is detected an alarm will be generated thereby minimizing the loss of environment, property or human life. The machine learning techniques integrated with the sensors help in detection of fire without any human help, therefore no patrolling is required. The major advantage of sensors is that they are fast and accurate. Moreover, machine learning maximizes resource utilization and improves the performance of sensor networks

3. IoT Based Forest Fire Detection System Using Raspberry PI and GSM :

Journal: proceeding of international conference on systems computation automation and networking 2019 Fire is one of the most fateful threaten for mankind. Fire can be determined by light, smoke and temperature. We may resort to power failure, water spraying for alarming. However fire alarm is still a difficult problem for large space. Because there are many factors such as the height of the space, the heat barrier,

the coverage, the signal transmission and so, it is difficult to control. To detect fire, only using colour information may produce false so colour and temporal variation information should be used to get good performance of the fire detection system. Sensors are used to measure the desired parameters in most of the methods. In this project, IOT based early warning fire detection framework senses the fire as quickly as possible and save valuable lives. Detection of fire based on colour information results in false prediction Therefore, not only humans are being interconnected, but devices also are being interconnected. The cause of the IoT (Internet of Things) has been come by the pattern chemise enumerate. The IoT is an underived course of the grant Internet, which has been chance from supply man interconnection into a body of interrelated devices. These devices have an interaction with the human world with the help of Internet standards and protocols for collecting information from the environment. The IoT will amend sensed or gathered information into intelligent data, thus combining

4. IOT BASED AUTOMATIC FOREST FIRE DETECTION BASED ON MACHINE LEARNING APPROACH :
Journal: ANNALS OF FOREST RESEARCH https://www.e-afr.org/2019 An overview of the worldwide context for forest fires is provided in this section. Studying forest fires is crucial to understanding their causes and establishing the need for further research. The most uncontrolled occurrence that seriously disturbs the whole ecosystem is a forest fire, which must be dealt with by using WSN technology. The motivation for this research's endeavour is to 1793 Ann. For. Res. 65(1): 1792-1809, 2022 ISSN: 18448135, 20652445 ANNALS OF FOREST RESEARCH https://www.e-afr.org/ © ICAS 2022 stop forest fires, and the following justification serves as that motivation. Because of these and other issues, human civilization severely degrades biological variety by negatively affecting biological resources. For the preservation of biological variety, it is crucial to plan forest management using effective instruments. India is a nation with a diverse array of plants and animals . It has been a worry that the destruction of forests brought on by forest fires and other activities impacts animals and threatens their habitat. In order to guarantee the nation's biological and environmental security, a law (the Wildlife Protection Act, 1972) for the protection of wildlife, animals, birds, plants, and items related to wildlife has been established. Article 8 of the CBD addresses the creation and management of protected areas with a focus on resource conservation and ecological restoration (Convention on biological diversity). The value and importance of a nation's protected areas for the preser

4.Implementation of Wireless Sensor Network and IOT for Real Time Forest Fire Warning System :
- Journal: Student, Instrumentation and Controls Engineering, St. Joseph's College Of Engineering, Chennai, India. As we all know, the forest is considered as one of the most important and indispensable resources, theprevention and detection of the forest fire, have been researched hotly in

worldwide Forest Fire Prevention Departments. Forests are the protectors of earth's ecological balance. Unfortunately, the forest fire is usually only observed when it has already spread over a large area, making its control and stoppage arduous and even impossible at times. The result is devastating loss and irreparable damage to the environment and atmosphere (30atmosphere comes from forest fires), in addition to irreparable damage to the tecology (huge amounts of smoke and carbon dioxide ($CO2$) in the atmosphere) Among other terrible consequences of forest fires are long-term disastrous effects such as impacts on local weather patterns, global warming, and extinction of rare species of the flora and fauna. Based on the deficiencies of conventional forest fire detection on real time andmonitoring accuracy, the wireless sensor network technique for forest fire detection is being implemented here. The problem with forest fires is that the forests are usually remote, abandoned/unmanaged areas filled with trees,dry and parching wood, leaves, and so forth that act as a fuel source.

5. Remote multi-function fire alarm system based on Internet of things Journal: School of hai, nan University, Danzhou 571737, China2018. Fire is one of the most common natural disasters in the world today. It caused devastating damage to life, property and natural environment [1]. According to statistics, a large number of fires happen every day in the whole country and the whole world. Thousands of people are killed every day. Forest fires are up to about 200 thousand times a year [2], which brings immeasurable losses to forests. Recent years, there have been too many unpleasant fires around us. For example, the recent micro-blog heat launched accident the Greentown fire. Four fresh lives are passed away including three children Try to think, If our alarm device is a little more advanced, a little more accurate, a little faster, how many lives we can save and how many families we can save. This firmed my faith to contribute in the fire alarm The remote multi-function fire alarm system based on the Internet of things realizes the networking fire alarm, which is, deployable and family, and can also be deployed with large office buildings, and can also be deployed and used in the field for forest fire alarm. The nodes designed by the system are completely low power, and the two nodes 7 batteries can maintain the wireless node for one year. Using a packet jump transmission, the gateway can control all wireless nodes within one kilometer range

III. IMPLIMENTATION

This system tries to prevent fires in forests and fields, where a disaster of this type can generate large economic losses, significant material damage, destruction of the flora and fauna of the place causing an ecological damage of great magnitude, but the most important thing is saving human lives . The principle of operation is as follows, when detecting fire by the flame sensor, it will send an analog signal to the arduino, which depending on its value, will activate the sending of a text message with the GPS coordinates where

the fire is taking place . For this project we will need a flame sensor, an arduino uno, a sim800A module, a battery, cables

IV. PROPOSED SYSTEM

To This project requires training to be done before deploying. Using historical data, various machine learning techniques are applied for Model learning and validation. Accordingly, the model classifies the real-time data, predicting the chances of fire. 1.3.1 The Modules involved in Fire Detection System are as follows: Pre-processing module: The data acquired from sensors is sent to the pre-processing module. Itperforms thresholding, cleaning, transformation and any specific enhancements required for lateremployed algorithms. Classification module: Pre-processed data is then classified using machine learning algorithms using the classification module. According to the result, alerting and alarming is done to the respective authorities. User Interface module: A user interface for monitoring and supervision purposes is provided.
• It shows real-time statistics and reports.A wireless sensor network (WSN) is a wireless network
consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions
• A WSN system incorporates a gateway that provides wireless connectivity back to the wired world and distributed nodes. Energy, memory, computation, and bandwidth are the main constraints of WSN. They are widely used in fields like Air Pollution Monitoring, Forest Fire Detection, Landslide Detection, Water Quality Monitoring etc. Machine learning can be used to teach the computers to act like human beings without being hardcoded.
• Supervised, unsupervised, and reinforcement learning. Form the three categories of machine learning. In supervised learning, class label is present for a certain data (training data) and needs to be predicted for unknown instances
• In unsupervised learning, there is no class label present and implicit relationships within given data need to be discovered.

FUTURE WORK

Designing a forest fire alarm system using IoT technology involves several software requirements. • Some of the essential software requirements for a forest fire alarm system using IoT are • IoT Hardware and Sensors:The system requires IoT hardware and sensors that can detect temperature, humidity, smoke, and other environmental factors that may indicate a fire. The hardware should be capable of communicating with the IoT software. • Data Collection and Analysis: The IoT software should be capable of collecting and analyzing data from the sensors in real-time. The system should be able to detect patterns that indicate a potential fire and alert authorities. • Cloud Connectivity: The software should have cloud connectivity to enable real-time monitoring of the system's status and receive alerts from the sensors. • Data Storage: The system should have a database to store all the data collected

from the sensors for future analysis and reporting. • Alarm and Notification: The software should be capable of sending alerts and notifications to authorities, emergency responders, and people in the affected area. The notification can be in the form of SMS, email, or push notifications to the user's mobile device. • System Management: The software should provide a user interface for managing the system, such as adding or removing sensors, configuring the alarm thresholds, and monitoring the system's status

CONCLUSION

In conclusion, a forest fire alarm system using IoT technology is an efficient and effective way to detect potential forest fires and prevent their spread. The system requires a combination of hardware and software components, including IoT sensors, data collection and analysis software, cloud connectivity, data storage, alarm and notification systems, system management, security, and maintenance and support. The software requirements for the forest fire alarm system using IoT technology are crucial to its overall functionality and reliability. The system should be designed to collect and analyze data in real-time, alerting authorities and emergency responders as soon as a potential fire is detected. Additionally, the software should be secure and easy to use, allowing for straightforward system management and maintenance. Overall, a well-designed forest fire alarm system using IoT technology can help reduce the damage caused by forest fires, protect the environment, and potentially save lives. Using IoT technology in the design of a forest fire alarm system offers a viable way to identify wildfires early and respond quickly. The goal of this project is to construct a reliable and effective monitoring system by integrating many sensors, communication protocols, and data processing techniques.

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