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Fire Detection and Management System for Industries Based on IoT

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ABSTRACT

Fire Detection Systems are now widely used in various safety and security applications. The major amount of fire starts due to the electric short circuit. It leads to damage to property and also loss of life. To avoid that or to minimize the damage caused by fire outbreaks due to electric short circuits an IoT technology is used to control such a kind of risk. Traditional fire detection systems are not that effective and quick to alert the owner about fire, in case no one is present on the location. To overcome this problem in this paper we present the design and development of IoT based Fire Detection System. A system that combines qualities for fire, temperature and smoke detection, sending alert Text Message about the fire to the user along with onsite alarm(buzzer), updating temperature, humidity and smoke on ThingSpeak cloud every 15 seconds, and it also moves manually with the help of Android Application. This Fire Detection system can be used in college, school, office, and industry for safety purposes.

Keywords:Arduino uno, Node MCU, DHT11 sensor, Flame sensor, MIT app inventor, Google firebase

1. INTRODUCTION

The term IoT, or Internet of Things is a relatively new technology that brings together devices in a network for communication between devices and the cloud. Internet is the base of the IoT concept, and it is portable to cover a whole group of things. This IoT technology power extends beyond telephones and computers. Connected devices can be used to establish a federation for information sharing and authentication [1].

A safe environment is necessary for businesses and people. It is the utmost priority for the workplace to be safe for the employees, therefore, IoT gives an opportunity to enhance existing fire alarm systems. It can help to make the workplace safer for people. This paper proposes an intelligent fire alarm system that uses the IoT to accelerate building evacuation, control/prevent the spread of fire, connect people to rapid and safe escape routes, and provide direct contact between building and security administrators/authorities [2].

In contrast to the two existing worldwide IoT-based smart fire alarm systems; a sealed detector with a fan system that captures air samples to identify potential

dangers, and a sensor-based solution; the MUC node sensor, we propose an IoT-based fire alarm system that maintains protocol in a WSN this gives a significant advantage over reconstructing a new topology to meet the requisite strength. We tested the proposed system in a large-scale simulation scenario, the used algorithms produce a new version of the old one every time, so they acquire information from its neighbors. The topology creation protocol is used during the first phase of node connection. When the currently linked topology is no longer ideal, develop a new version of the prior topology based on the data acquired from the nearby topology maintenance method, inserting nodes optimally. It conserves node energy by maintaining critical network features such as coverage and connection during its lifetime. The network begins to fulfill its assigned functions after establishing a minimum topology. Each of the activities is linked to each other, which creates a new one based on past data and assigns the fewest resources possible resulting in minimal network cost. The reason being not all nodes engage in data collection, their energy is conserved by putting them to sleep, which is the goal of this research. The major goal of this study is to combine an IoT-based maintenance protocol with an existing topology construction protocol as an enhanced technique for conserving node energy and extending the lifetime of the monitoring system.

2. LITERATURE REVIEW

Forest fires are as old as the forests themselves. when there is no rain for months during summer, the forests become littered with dry leaves and twinges, which could burst into flames initiated by even the slight spark They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region, also there is a danger for wild life, domestic crops and to the nearest people..So there is a necessary to avoid the excess of losses due to forest fire by controlling the fire in its early stages. In the present technologies like ruled base image processing and MODIS systemsthere are many drawbacks like having high false alarm rate where alarm notification may not give a proper and exact notification at emergencies, also response time is quite big as they use robots to extinguish the fire accidents and temporal representation of the affected area. The main drawback is there is no facility of getting direct notifications to the mobile app immediately at the time of fire burst, all these drawbacks may leads to the rapid spread of the forest fire throughout the larger area of the forest leading to major damage and loss. It requires human force in big number which is a risky process.In the proposed system we have used high sensitive sensors which reduces the false alarm rate by enhanced data collection. Thesensors and micro controller will continuously monitor and sends the data to the database (cloud) as value due to which minimization of the false alarm is achieved also response time is minimized . This system is user friendly as we have introduced mobile application where direct pop up alert message can be received through the mobile app by more than one device at the same time and also this message can be received being at any corner of the globe which has internet access and linked with our cloud. Cost is affordable and minimized the human efforts. The main aim of our project is detection and monitoring the forest fire and to minimize the effect of fire breakout by controlling in its early stage also to protect wild life and domestic crops by informing about the fire breakout to the respective forest department as early as possible. We have implemented the IOT technology to achieve our objective. This method includes the combination of software coding in Arduinouno platform using c programming, mobile app (application) development, which is developed based on the algorithm of the project using MIT app inventor platform , cloud computing where it is created in the google firebase to fetch the data from the microcontroller hence the name database (cloud) and hardware components. Where the hardware components includes two different sensors and microcontroller which is also a WiFi module. Two sensors are used in this project to monitor the flame, temperature and humidity rates in a specific location by DHT11 sensor and flame sensor. These sensors are connected to a NodeMCU microcontroller where this act as a wifi module. The NodeMCU will continuously sends the data from the sensors to a database that is to the cloud which we have created. In case of fire outbreak the temperature will increase and the humidity will decrease, these abnormal changes in the rates will be detected by the DHT 11 sensor and if there is a fire breakout the flame sensor will sense it, the NodeMCU then will receive these changes as a data from the sensors and send it to the database or cloud which will be stored there as a values, these values

are compared with the threshold value. This threshold value is setup in the database, it is set depending upon the environment of the area where the detection is needed. If the values received crosses the threshold value then the cloud or database will send the pop up message saying "flame detected" to a mobile phones to inform respective department about the situation, it can beused also to send a notification to the fire stations and hospitals in case of fire outbreak in forests, factories, houses etc. Some of the relevant literary works in this field are briefed below: The one fourth area of Karnataka is covered by forest; the forest and bio-diversity of the India are at the considerable chance and beneath enormous pressure. General causes of forest fire are extreme hot and aired weather, lightning and human carelessness. In order to protect these huge stretches of forest land, there need to be taken early caution measures to control of spreading fire. Usually it requires massive dependency of man power where due to climate situation, transportation facility and lagging to trace true area will leads to delay in taking actions. Through this look up we have come up with the technology where sensing surrounding can be developed with large vast range of wireless sensor nodes, and Node MCU based IOT empowered fire indicator and observing framework is the answer for this issue [8]. The research work performed by Ahmed Imateaj and T Saikumar and Vinay Dubeydescribes the objective of this work is to design a IOT based system that can detect the fire as early as possible before the fire spread over the large area and to prevent poaching. Our system consist of flame sensor which is used for fire detection, PIR sensor for intruder detection with the help of image processing, If any catastrophic event occurs the system will immediately sends the alert message along with picture of the affected region and device location and T saikumar says Implement IOT to monitoring atmospheric CO2 rate using MG811 carbon dioxide sensor and early detection of forest fires using temperature and humidity sensor with Raspberry pi. The main aim of the system is to detect the fire and protect our entire system from fire related calamities. And vinaydubey says. According to a survey, approximately 80% losses are accrued in the forest due to the late detection of fire. So to overcome this problem, we use the Internet of things technology. In this paper, early fire detection model has been proposed with the help of the Raspberry Pi microcontroller and required sensors [11]. In this paper Forest fire detection system using IOT, Early warning and immediate response to a fire breakout are the only ways to avoid great losses and environmental and cultural heritage damages. Hence, the most important goals in fire surveillance are quick and reliable detection and localization of the fire. It is much easier to suppress a fire when the starting location is known, and while it is in its early stages. Information about the progress of fire is also highly valuable for managing the fire during all its stages. Based on this information. In existing system, they use robots to extinguish the fire accidents but robots have its own advantages and disadvantages. In this system we go for detection and Monitoring of forest fires through several sensors and send to IOT cloud, Continuous monitoring and uploading values to cloud can be achieved [12]

3.PROPOSED SYSTEM

Traditional fire alarm systems use a variety of gadgets to notify people through visual and auditory devices in the event of a fire, smoke, carbon monoxide, or another emergency. These alarms are activated manually, such as suction stations, or they can be actuated automatically using smoke and heat detectors. The alarm can come with an electric chime and a horn or wall-mounted speaker that sounds the alarm; for example, you can add an audio evacuation message to warn people about not using the elevator in case of a fire emergency. Fire alarm loudspeakers are always set to a specific sound level with low to high volumes, which is determined by the country and the device's manufacturer. Many researchers have recently identified the major issue with traditional fire alarm systems. Figure 1 shows the block diagram of the proposed system.

We identify the fire in our suggested fire detection system using multiple characteristics and situations. . The flame sensor determines whether or not there is a fire or flame present. It works using an infrared flame flash technology. A photo transistor is used in this explicit flame detector. The infrared spectral band is used by flame detection systems. Carbon dioxide, which is produced by the combustion of organic compound materials, has a resonance frequency in this range. Put anything that can catch fire in front of the flame sensor. The flame sensor is triggered when it detects a fire or flame. This sensing relies on variables such as humidity

and temperature. As temperature increases the temperature sensor will detect and it will trigger the buzzer and buzzer will blow. The water pump is connected to a IC. If a flame is detected, IC activates the dc motor and water pump. The sprinklersconnected tothe pump will sprinkle the water throughout the fire affected area.Figure 2 shows the flow of events in the proposed system.

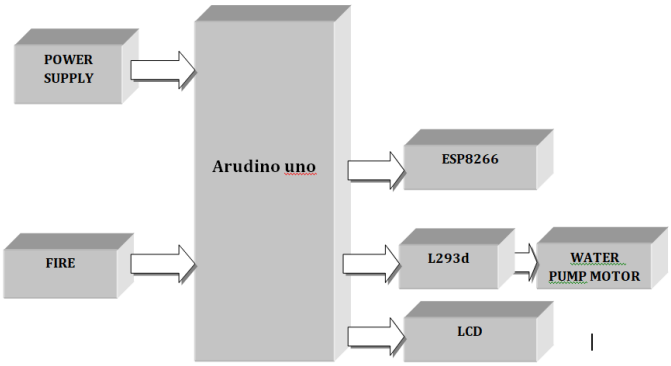

Figure 1: Block diagram of the proposed system

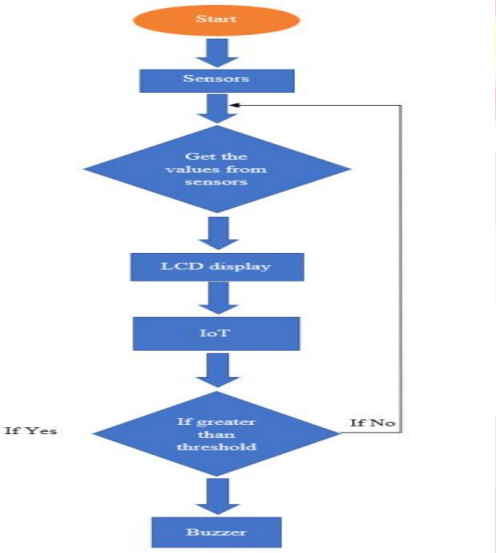

Figure 2: Flowchart of the Proposed system

4. RESULTS& DISCUSSION

The design of hardware components are done and processed by Arduino UNO. The software implementation is by Arduino IDE tool. Here are the figures of the results. In this section, the results & discussions of the mini-project work is presented in a nutshell. It provides an early warning of fire so that people can be evacuated & immediate action can be taken to stop or eliminate of the fire effect as soon as possible. A circuit is designed that will detect the fire by monitoring environmental changes associated with combustion. The Figure 3 shows the designed system for the detection of the fire alarm, whereas gives the photographic view of the developed electronic circuitry for fire detecting using the bread board. Similarly,When the flame sensor data does not detect fire, the value is 0. The same value is then updated to Google Firebase.

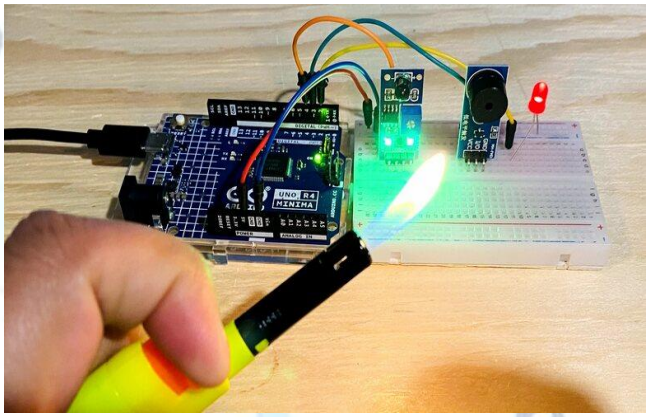

Figure 3: Forest Fire Detection and Management System

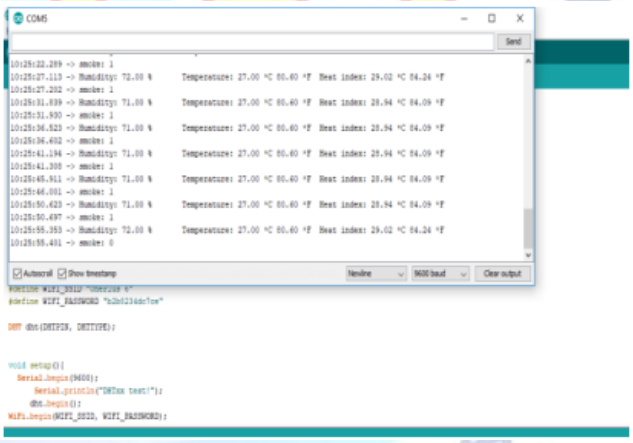

Figure 4: Screenshot of Serial Monitor where values are recorded continuously

As discussed earlier we can observe the changes in the app continuously. When the value crosses the set threshold value then automatically the user or nearest forest officials will be notified which will help them to take necessary actions immediately so that much loss doesn't occur. The app notifies the user with a message that fire is detected. pump can be added so that it automatically sends water when there is a fire breakout. Figure 4 shows the screenshot of the serial monitor. Figure 5 shows the message when fire is detected.

Figure 5: Fire can be detected

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5. CONCLUSIONS

This system consists of various sensors to monitor the safety while operating in coal mines. This system consists of devices that monitor the conditions such as temperature, humidity, water, fire and gas inside the coal mine and alerts the workers. Implementation of Coal mine safety system is implemented using Fire sensor, Gas sensor, DHT11 sensor to increase the safety of the workers in the coal mine and to prevent them from danger, It also has applications to view the readings remotely. This system is wireless hence it has the advantages that wireless systems have such as being economical and having low maintenance. By using this system constant checking of the coalmine and alerting the worker is done by using Thinger IoT. The system is cost-effective and efficient.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] [Zhang, Lan, Bing Wang, Weilong Peng, Chao Li, Zeping Lu, and Yan Guo. "Forest fire detection solution based on UAV aerial data." International Journal of Smart Home 9, no. 8 (2015): 239-250.

[2] Nakau, Koji, Masami Fukuda, KeijiKushida, Hiroshi Hayasaka, Keiji Kimura, and Hiroshi Tani. "Forest fire detection based on MODIS satellite imagery, and Comparison of NOAA satellite imagery with fire fighters' Information." In IARC/JAXA terrestrial team workshop, pp. 18-

[3] Mahmoud, Mubarak AI, and Honge Ren. "Forest fire detection using a rule-based image processing algorithm and temporal variation." Mathematical Problems in Engineering "2018 (2018).

[4] D.Sathya "Forest Fire Detection System" Volume-8, Issue-6S3, September 2019.

[5] Toledo-Castro, Josué, Pino Caballero-Gil, Nayra Rodríguez-Pérez, Iván Santos-González, Candelaria Hernández-Goya, and Ricardo Aguasca-Colomo. "Forest fire prevention, detection, and fighting based on fuzzy logic and wireless sensornetworks." Complexity 2018

[6] Molina-Pico, Antonio, David Cuesta-Frau, Alvaro Araujo, Javier Alejandre, and Alba Rozas. "Forest monitoring and wildland early fire detection by a hierarchical wireless sensor network." Journal of Sensors 2016 (2016).

[7] V.Parthipan, D.Dhanasekaran "Preventing and Monitoring of Framework for Forest Fire Detection Using Internet of Things (IoT)" February 2019.

[8] Imteaj, Ahmed, Tanveer Rahman, Muhammad Kamrul Hossain, Mohammed ShamsulAlam, and Saad Ahmad Rahat. "An IoT based fire alarming and authentication system for workhouse using Raspberry Pi 3." In 2017 International conference on electrical, computer and communication engineering (ECCE), pp. 899-904. IEEE, 2017.

[9] T Saikumar "IOT enabled forest fire detection and alerting the authorities", 2019 IEEE.

[10] Dubey, Vinay, Prashant Kumar, and Naveen Chauhan. "Forest fire detection system using IoT and artificial neural network." In International Conference on Innovative Computing and Communications, pp. 323-337. Springer, Singapore, 2019.

[11] Sruthi, M. S., M. NewlinRajkumar, and V. Venkatesa Kumar. "Smart IoT Based System for CO2 Monitoring and Forest Fire Detection with

[12] Niranjana, R., and T. HemaLatha. "An autonomous IoT infrastructure for forest fire detection and alerting system." Int. J. Pure Appl.

[13] Math 119 (2018): 16295-16302. [17] Singh, DigVijay, Neetika Sharma, Mehak Gupta, and Shubham Sharma. "Development of system for early fire detection using Arduino UNO." International Journal of Engineering Science 10857 (2017).

[14] Mohindru, Parul, and Rajdeep Singh. "Multi-sensor based forest fire detection system." International Journal of Soft Computing and Engineering (IJSCE) ISSN (2013): 2231-2307.

[15] Vijayalakshmi, S. R., and S. Muruganand. "A survey of Internet of Things in fire detection and fire industries." In 2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), pp. 703-707. IEEE, 2017.

[16] Parameshachari B D et. Al Optimized Neighbor Discovery in Internet of Things (IoT), 2017 International Conference on Electrical, Electronics, Communication, Computer and Optimization Techniques (ICEECCOT), PP 594-598, 978-1-5386-2361-9/17/$31.00 ©2017 IEEE.

[17] Ravikiran, D. N., & Dethe, C. G. (2018). Improvements in Routing Algorithms to Enhance Lifetime of Wireless Sensor Networks. International Journal of Computer Networks & Communications (IJCNC), 10(2), 23-32.

[18] Ravikiran, D. N., & Dethe, C. G. Fuzzy Rule Selection using LEACH Algorithm to Enhance Life Time in Wireless Sensor Networks. Advances in Wireless and Mobile Communications. ISSN, 0973-6972.

[19] Rajesh, G., Thommandru, R., & Subhani, S. M. DESIGN AND IMPLEMENTATION OF 16-BIT HIGH SPEED CARRY SELECT PARALLEL PREFIX ADDER.

[20] Polanki, K., Purimetla, N. R., Roja, D., Thommandru, R., & Javvadi, S. Predictions of Tesla Stock Price based on Machine Learning Model.

[21] Thommandru, R. A PROSPECTIVE FORECAST OF BRAIN STROKE USING MACHINE LEARNING TECHNIQUES.

[22] Rajesh, G., Raja, A., & Thommandru, R. OPTIMIZATION OF MINIATURIZED MICROSTRIP PATCH ANTENNAS WITH GA.

[23] Vellela, S. S., & Balamanigandan, R. (2022, December). Design of Hybrid Authentication Protocol for High Secure Applications in Cloud Environments. In 2022 International Conference on

Automation, Computing and Renewable Systems (ICACRS) (pp. 408-414). IEEE.

[24] Vellela, S. S., & Balamanigandan, R. (2024). Optimized clustering routing framework to maintain the optimal energy status in the wsn mobile cloud environment. Multimedia Tools and Applications, 83(3), 7919-7938.

[25] Praveen, S. P., Sarala, P., Kumar, T. K. M., Manuri, S. G., Srinivas, V. S., & Swapna, D. (2022, November). An Adaptive Load Balancing Technique for Multi SDN Controllers. In 2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS) (pp. 1403-1409). IEEE.

[26] Priya, S. S., Vellela, S. S., Reddy, V., Javvadi, S., Sk, K. B., & Roja, D. (2023, June). Design And Implementation of An Integrated IOT Blockchain Framework for Drone Communication. In 2023 3rd International Conference on Intelligent Technologies (CONIT) (pp. 1-5). IEEE.

[27] Vellela, S. S., & Balamanigandan, R. An intelligent sleep-awake energy management system for wireless sensor network. Peer-to-Peer Netw. Appl.(2023).

[28] Addepalli, T., Babu, K. J., Beno, A., Potti, B. M. K., Sundari, D. T., & Devana, V. K. R. (2022). Characteristic mode analysis of two port semi-circular arc-shaped multiple-input-multiple-output antenna with high isolation for 5G sub-6 GHz and wireless local area network applications. International Journal of Communication Systems, 35(14), e5257.

[29] Srija, V., & Krishna, P. B. M. (2015). Implementation of agricultural automation system using web & gsm technologies. International Journal of Research in Engineering and Technology, 04 (09), 385-389.

[30] Potti, D. B., MV, D. S., & Kodati, D. S. P. (2015). Hybrid genetic optimization to mitigate starvation in wireless mesh networks. Hybrid Genetic Optimization to Mitigate Starvation in Wireless Mesh Networks, Indian Journal of Science and Technology, 8(23).

[31] Potti, B., Subramanyam, M. V., & Prasad, K. S. (2013). A packet priority approach to mitigate starvation in wireless mesh network with multimedia traffic. International Journal of Computer Applications, 62(14).

[32] Potti, B., Subramanyam, M. V., & Satya Prasad, K. (2016). Adopting Multi-radio Channel Approach in TCP Congestion Control Mechanisms to Mitigate Starvation in Wireless Mesh Networks. In Information Science and Applications (ICISA) 2016 (pp. 85-95). Springer Singapore.