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Forest Fire Detection Using IoT Devices

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***Abstract*: In the advancing world, it is very crucial to protect our environment. Many incidents of man-made and natural disasters are occurring around the world. Forest fires are one such catastrophe for environment. Once the fire inside the deep forest starts, it burns and destroys the complete forest region. Such disasters should be curbed. The objective of this work is to design and implement an IoT based system which is self-sustaining and would predict and detect the forest fires and send the exact location to concerned officials which would help firefighting personals to extinguish the fire in the location when it is in its initial stages. The developed system uses different IoT sensors to communicate and transmit data.**

***Keywords*: WSN, ESP8266, Things Speak, Forest fire.**

1. Introduction

Forest is a large area where it is dominated by trees and animals. It is an essential element of the biodiversity. Therefore, any major threat posed to the essential component of the environment should be identified, studied and fought through the most efficient and modern technological means. Forest covers an area of around four billion hectares or approximately around 30% of world's land area. The profits we obtain from forest are huge namely the medical materials, house-hold requirements and other huge profits. Forest fire is an evil disaster that affects a vast land-field which in-turn affects both flora and fauna. Different reasons that cause the fire include lightning (natural forest fire) caused due to the combustion of dry fuel like leaves, fire caused due to man-made activities like smoking and miscellaneous actions. Forest fire detection has become one of the main issues in the environment. In this paper, we have built fire detector system using NodeMCU along with this the hardware components interfaced are a DTH11 sensor, methane sensor, soil-moisture sensor, flame sensor and a buzzer. The software includes Thingspeak platform which gives the timely update of data through graphs. In literature study, includes theoretical contribution also investigation of different methodologies and technologies. Also discusses the research and development methodology of the device in which we present our architectonic and design modules, the data transmitted in them, Existing examples of how our system operates and the statistics of efficiency. Also finally, concludes the paper.

2. Literature Survey

The Previous work done in this domain involves reviewing the already present methods & understanding the most effective and reliable methods. The amount of data required for the placing of sensors can be obtained using satellite tools. But the study reveals that the time required to find the location of fire occurred is inefficient to reduce the damages caused by it in its initial stages.

A. Application of WSN's for detection land and forest fire in Riau Province Indonesia

Eyizal Abdul Kadir, Sri Listia Rosa, Ana Yulianti. In this paper, they proposed a system using development of WSN for detection of forest fire. Mathematical analysis was done for modeling the number of sensors that had to be used to cover the region. The system had different sensors to collect the data from the surroundings in which it was placed. The WSN hub sensor node collects the data and the same is forwarded to its base station. The system makes use of the Zig-Bee-WSN based system. Though the system had advantages like its high reliability and installation cost, it had a few limitations. The system had only one gate access to the server and if there was any problem in the server the entire data would be ruined and in-turn would result in improper monitoring of the system.

B. Smart Forests: fire detection service.

Guilherme Borba Neumann, Vitor Pinheiro de Almeida and Markus Endler. This paper aimed to introduce the idea of implementing a low-cost infrastructure for Smart Forests using mobile objects and mobile hubs to detect fire. The goal of this work is to propose a solution focused on Edge Computing, using the concept of Mobile Hubs (M-Hubs). The developed Fire Detection IoT prototype application is based on the Context Net middleware, and uses Event Processing Agents (EPAs), running on smart phones carried by forest guards. Scalability tests up to 10,000 remote sensors connected per M-Hub were performed.

C. SAMRAKSHA: Developing a real-time and automatic early warning system for forest fire

A. Sai Chand, K. Sai Bhargavi, R. Sai Kiran, M.K. Kaushik, D. Raghavi Prashanthi, S. Siva Kumar. The solution proposed by this paper recommends of making use of stand-alone boxes

which are deployed throughout the forest. These boxes contain different type of sensors and a radio module to transmit data received from these sensors. Each sensor in the project was tested individually and XBee modules are configured and paired using XCTU software. The sensor data obtained in the coordinator is saved and graph is plotted by using PLX-DAQ software. By using programmable Arduino, the data can be transferred to Excel sheets where the plot can be drawn for occurring forest fires. By analyzing the plots forest fires can be predicted.

D. Insight of Forest Fire Detection technique using Wireless Sensor Networks.

Pradeep Kumar Singh, Amit Sharma, The Sensor mode collects the data and the information from devices are collected and the information from devices are collected and then forwarded to gateways. Information is further carried out to LAN (internet). The system makes use of Infrared detections and cameras which are positioned at top of tower for detection purpose. Sensor nodes in WSN can operate for a long time with the help of small batteries and provides regular monitoring. LEACH objective is to improve the lifetime of WSN.

E. Low-cost system for early detection and deployment of counter measures against wild fires

Warinthorn, Kiadtikornthaweeyot, Chnika Sukawattanavijit, Anusorn Rungsipanich. The main objective of this paper was to develop a low-cost modular system with a Master-Slave topology in order to allow the addition of as many Slave nodes as needed. The Slave nodes are responsible for reading and pre-processing data from their integrated flame sensors in order to provide the Master node with temperature readings of the surroundings. The Master node, being connected to the Internet, is responsible for real-time monitoring and for sending alarms, by receiving and processing data from the Slave nodes. When an approaching fire is detected a sprinkler system is actuated using electric valves. Instead of the commonly used normally closed/opened solenoid valves, latching valves are used as they require less power and maintain their status even during a power loss. Pressure sensors have also been installed to check if there is enough water pressure in the sprinkler system. Each of the sensors has been placed in a strategic position to detect leaks in the system or missing water from the source (e.g. a water pump).

3. Methodology

We are using two standalone wireless sensor connected systems. The standalone systems are kept at a specific distance from each other so that a certain area is covered. Stages of design for the entire outlining of this IOT empowered forest fire detection system has been for the most part classified into 4 sections:

- Interfacing and programming of LCD with NodeMCU.
- Interfacing and programming of collector and transmitter with NodeMCU.
- Interfacing of Ethernet shield with NodeMCU and making test conditions by programming.
- Interfacing of sensors with transmitter.

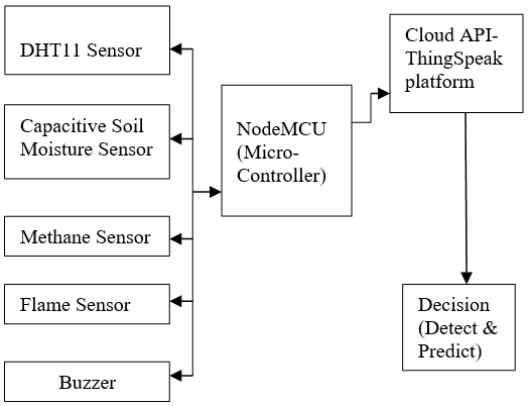

Fig. 1. Block diagram

Employing sensors serving as data acquisition center methane sensor and flame sensor are utilized that should be set at specific separations with the goal that a look can be kept on the whole forest territory keeping in mind the end goal to distinguish temperature and the level of carbon dioxide gas (CO2). These sensors will send the flag or the data to the microcontroller. These will all detect changes in the earth and respond naturally in case of a crisis. Number of terminate sensors are to be utilized in handy circumstances that should be set at specific separations with the goal that a look can be kept on the whole forest region.

1. Gathering of information by the IC installed in the NodeMCU of the transmitter circuit is done in this stage. The controller plays the customized activity to pass them to the transmitter for transmitting the information to the accepting station.
2. Transmission of the information by the transmitter: On getting the information from the controller, transmitter transmits the information to a specific range where the station is enhanced to be utilized.
3. Accepting of the information by the getting station: On accepting the information from the transmitter circuit, the recipient sensor sends the information to the controller IC of the appended NodeMCU installed in the beneficiary circuit in computerized frame making the controller conceivable to do the modified activities for the checking of temperature level and CO2 level for the flame identification.
4. The result output-At this point when the information in regards to the temperature and the humidity level are prepared in the IC of the recipient circuit NodeMCU which is modified with various library elements interfacing the thingspeak page.

The following flow chart gives the description about the working of the system.

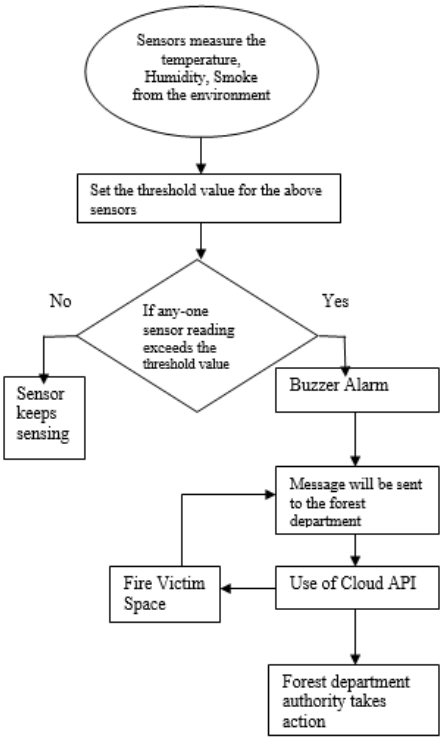

Fig. 2. Control flow diagram

ThingSpeak cloud is an IoT analytics platform that allows you to aggregate, visualize and analyze live data streams in the cloud. The data collected by the sensors is timely updated to the cloud. The depiction of the values collected by the sensors are visualized in the following snapshots.

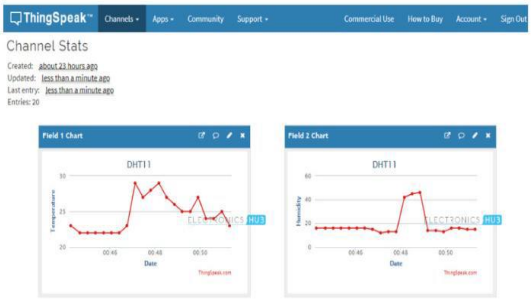

Fig. 3. Temperature and Humidity sensor values represented in graphs on ThingSpeak

Fig. 4. Soil Moisture sensor value represented in graph on ThingSpeak

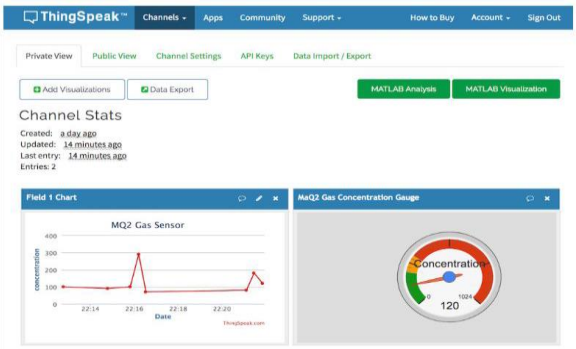

Fig. 5. Gas sensor value represented in graph and gauge on ThingSpeak

Along with thingspeak, we are making use of python-anywhere and IFTTT to keep track of the location and temperature data to alert the person allotted the duty. Python Anywhere is a web hosting company which offers hosting solution for python web applications. One can use it to host python web apps and scripts. In our project it is used to track the location where the fire has occurred. IFTTT, also known as if, then, this, that is a freeware web-based service that creates chain samples of simple conditional statements, called applets. In our project we are using it to trigger a call if there are changes in the web service i.e., any changes more than the threshold value. IFTTT can automate web-application tasks when any changes trigger in the values recorded by the sensors.

4. Future Enhancement

This study firstly reveals that IoT technology is a very promising green technology for the future in detecting efficiently the forest fires in our country. Secondly, and through the real experiments performed in the field, we conclude the effectiveness of the project and it's suitability to the context of our country mainly during summer seasons. The more data recovered by IOT about forest fires means the more effective fire management by forest authorities.

Hence, introducing the paradigm of multi-modal detection of forest fires seems to be a good solution for the future in which scalar data and multi-media data can be collected by heterogeneous sensors. Such IOT based multi-modal detection systems can resolve efficiently some outstanding problems such as more precision of detection and reducing false alarm rate and also the avoidance of the destruction of motes by the fire.

5. Conclusion

Early cautioning and quick reaction to a fire breakout are the main approaches to dodge incredible misfortunes and natural and social legacy harms. Hence, the most critical objectives in flame observation are fast and solid identification and restriction of the fire. It is substantially less demanding to stifle a fire when the beginning area is known, and keeping in mind that it is in its beginning periods. Data about the advance of flame is likewise profoundly profitable for dealing with the fire amid every one of its stages. In light of this data, the fire battling

staff can be guided on focus to hinder the fire before it achieves social legacy destinations and to smother it rapidly by using the required putting out fires hardware.

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