



e-ISSN: 2278-8875  
p-ISSN: 2320-3765

# International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 10, Issue 3, March 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 7.122**

9940 572 462

6381 907 438

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# Distributed Sensor Network for Detection of Forest Fire Using MATLAB

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**ABSTRACT:** Forest fire causes tragic loss of lives to valuable natural and individual properties including thousands of hectares of forest and hundreds of houses. It is mostly an unplanned fire caused by human activities or a natural phenomenon such as volcanic eruption or lightning. It has become a concern as the flora and fauna are affected. In order to overcome this the only solution can be detecting and preventing at an early stage. The objective of our project is to design an IoT based real-time system that can predict fire using sensors that are placed in series with a logic to go ON using MATLAB code. We integrated our circuit with sensor components, wireless Zigbee module, microcontroller board and a buzzer to produce sound on the event of fire. This system proves to be of great accuracy and conversion of analog input to digital output is done by the coding mechanism. Further process of prevention like sprinklers with water circulated from nearby pond or artificially created pit can be innovated.

**KEYWORDS:** MATLAB, Zigbee controls, sensors, IoT network, microcontroller.

## INTRODUCTION

The most common hazard in a forest is wildfire. They seriously affect the biodiversity and the ecology. High atmospheric temperatures and dryness favor fire to start, however rain extinguishes without causing much damage when not widespread. Similarly, 80% of the wildfire is through human causes. Unfortunately forest fire spread very fast than on land. Adapting small methods seek more time and hence it become unstoppable to control fire. This paper clearly shows a real-time system that prevents this massive destruction.

The main objective is initial stage prevention that is through the distributed sensor network. The collection of sensors makes it easy to sense and transfer the analog output to the zigbee that consists of code to convert to digital output. Transfer of information is done by the IoT i.e. Low Power Wide Area Network (LPWAN). A message or mail can be sent to the official to alert the fire department also a ranges that change on the display at the field. Similarly an alarm sound with LCD display as "FIRE DETECTED" will be seen in the forest. Zigbee transmitter and receiver are used as a main part and the microcontroller interfaces the information. Experiments show that it is capable of achieving best accuracy and less false alarms on different types of scenarios. The MATLAB visualization makes it much easier to see the variations on scale. Also the exact location will be shared by GPS to the officials. This is a low cost prototype that is very flexible and requires less than a minute to send information as the whole process involves internet and new technologies.






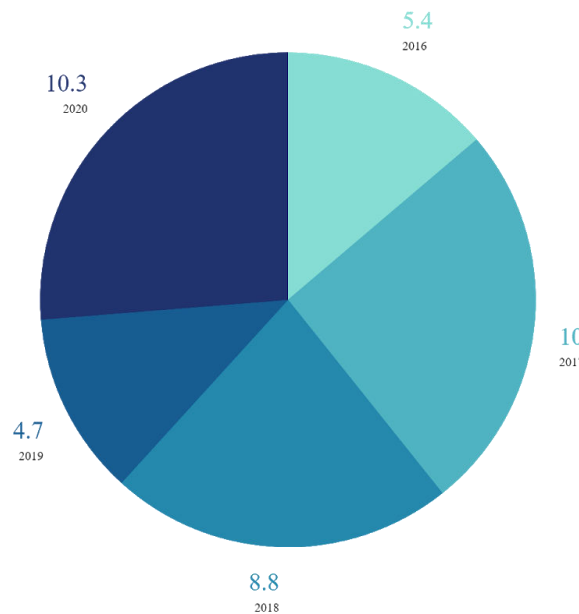
Occurrence of forest fires	Images of forest fire	Existing methods
<p>California</p> <p>Exceeds 4 million acres burned by wildfires in 2020</p>		<p>The technique employs satellite drone technologies to observe wildfires at an early stage and before they grow out of management. Satellites are accustomed pinpoint probably dangerous fires and drones equipped with IR cameras.</p>
<p>Columbia, Canada</p> <p>Exceeds 1.8 million acres burned in 2019.</p>		<p>Drones are helped in a minimum of thirteen fires up to now, being employed primarily for mapping and hotspot detection. Drones square measure able to manufacture maps long which might be utilized by hearth and evacuation crews very first thing within morning and conjointly to try to alternate important work.</p>
<p>Siberia wildfires reached 2,600,000 hectares.</p>		<p>The development combines the work of processor and active operating bodies that considerably increase its potency and scope. Fireproof throwing machine will produce fire proof protecting steps with a breadth of 2 to 8 meter ranges and conjointly extinguish the sting creep hearth at a distance of up to 20m.</p>

Table :Occurence of Fire in Forest



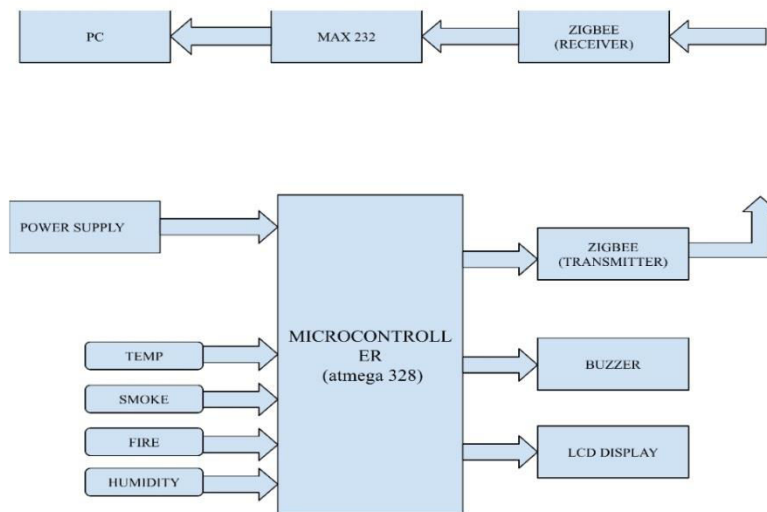
Figure 1: Pie chart on analysis of recent forest fire affected areas

**OCCURANCE OF FOREST FIRE IN YEARS(x-axis) Vs AREA AFFECTED ON ACRES(million) (y-axis)**



The impact of forest fire is represented in the pie chart. It describes the occurrence of forest fires in terms of years versus the area affected in terms of acres. The above details are the analyses of recent years such as 2016, 2017, 2018, 2019, 2020.. Generally forest fire is caused by factors such as logging and forestry operations, transportation and communications, arson, natural factors and other causes.

**ILSYSTEM MODEL AND ASSUMPTIONS**





The voltage regulator is programmed to keep the power constant automatically. The sensors, such as temperature, heat, and smoke, are then attached to the microcontroller (ATmega328), which is a high performance, low power controller from microchip, to detect the specific parameters. A buzzer is attached for the purpose of signalling. A warning such as FIRE DETECTED is shown on the LCD.

The Zigbee protocol is used to transfer data between wireless sensor networks. Additionally, Zigbee is used to receive data that is linked to a computer through the USB port. that sends a mail message to the forest officials The warning includes information such as the location of the area, temperature levels, and a smoke and fire observed message with an alarm. The computer is used to do tasks.

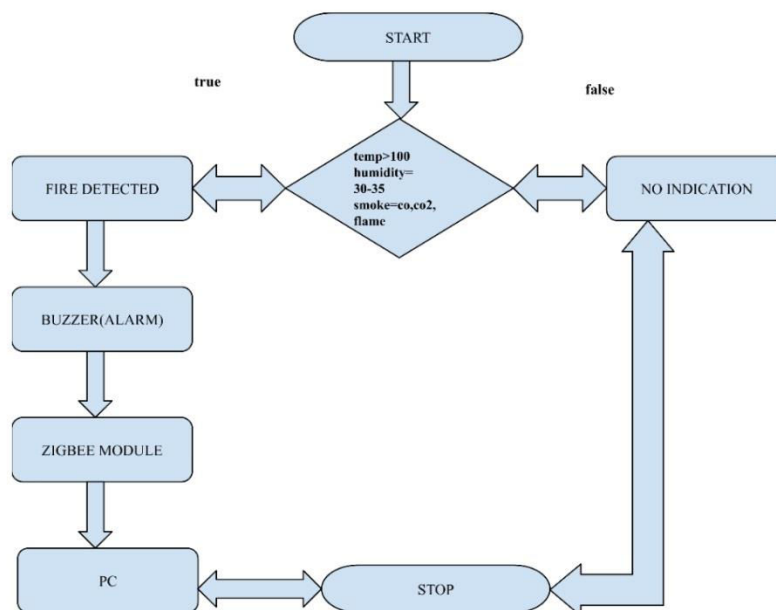
The temperature sensor (LM35) and the fire sensor each have three pins. Vcc is connected to pin 1, output is connected to pin 2, and land is connected to pin 3. The gas sensor (MQ135) has four pins. Vcc is connected to pin 1, land is connected to pin 2, and optical and analogue outputs are connected to pin 3. The Arduino Nano is a microcontroller based on the ATmega328 that is lightweight, full, and breadboard compatible. The LCD is attached to ATmega pins. 4 and 5 are bound by D2 and D3.

The fire sensor is connected to Arduino pin A0, the temperature sensor is connected to Arduino pin A1, and the smoke sensor is connected to Arduino pin A2. The pins on the LCD are attached to the Arduino. The LCD is wired to a preset resistor. A preset resistor is a smaller version of a potentiometer that is fixed on a PCB. It may be used to fine-tune or configure a circuit. When there are n components in a circuit, a preset resistor is used.

Forest fires are widespread as a consequence of unregulated anthropogenic behaviour and abnormal natural conditions. Land fire control and surveillance has become a national problem for forest fire management organisations. Sensor technology has long been used in fire detection, with physical parameters such as friction, humidity, and temperature being commonly sensed. Carbon dioxide, carbon monoxide, and nitrogen dioxide are examples of chemical parameters.

MATLAB is interface with MAX232. Coding part is done in MATLAB. The arduino takes gas, temperature and fire analog inputs through already written code. These values are converted with a formula in comparison with the reference values and displayed as an output in both LCD and pop up window on pc with corresponding ranges. By selecting the particular DO port the interfacing mechanism shows an alert to the officials. The code is written in such a way that a count can be given for the sensors to be ON so that even due to any technical delay the information will wait and then be received to the particular centre.

### III. METHODOLOGY





When the power is turned on, the machine checks for parameters such as humidity, temperature, flame, and smoke. The condition will be valid and the protocol will proceed to the next stage if the parameter value changes above the range. It will reveal that a fire has been observed on the LCD panel, as well as a warning signal. An IoT setup is generated in which data is sent to a system using Zigbee module communication, and the parameter value is sent to a computer for display. If the condition check is incorrect, the programme will be terminated immediately. This is a Low-Power Wide-Area Network (LPWAN) that performs extremely well. As a result, MATLAB visualisation for alarm and warning settings based on sensor data stops fire from spreading.

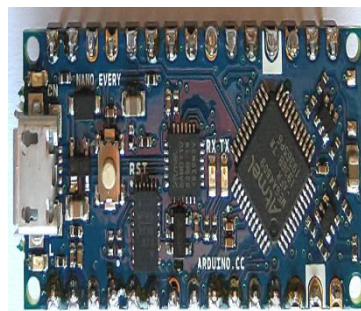
#### IV. HARDWARE DESCRIPTION

##### MICROCONTROLLER



A microcontroller contains one or additional CPUs along side memory and programmable input/output peripherals. ATMEGA328P is high performance, low power controller from semiconductor device. The ATMEGA328P could be a single-chip microcontroller created by Atmel within the mega AVR family (later semiconductor device Technology non heritable Atmel in 2016). It has a changed Harvard design 8-bit RISC processor core. It is the foremost common of all AVR controller because it is often employed in several comes and autonomous systems. It is most typically enforced on the favored arduino development platform, specifically the Arduino UNO and Arduino NANO. In order to maximise performance and correspondence, the AVR uses Harvard architecture-with separate recollections and buses for program and information.

##### ARDUINO NANO



The Arduino Nano could be a tiny, complete and board friendly board supported the ATMEGA328P. This board will be supercharged through a type-b micro-USB cable, or through a 9v battery. It is a tiny low size board and conjointly versatile with a good style of applications.

##### ZIGBEE

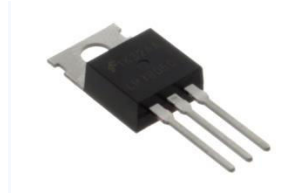


Zigbee could be a wireless technology developed as an open world customary to deal with the distinctive wards of affordable, low-power wireless IoT networks. Zigbee is easier and fewer expensive than alternative wireless



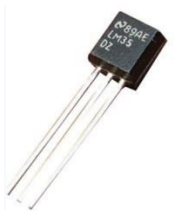
personal space network. Zigbee is especially liable for aggregation and transporting the special atmosphere parameters of the forest together with temperature, humidity, fire, smoke and then on. Zigbee act as each receiver and transmitter.

### REGULATOR



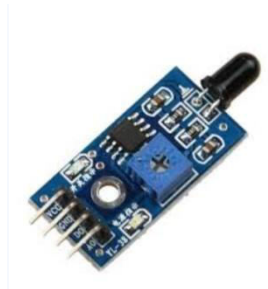
A transformer may be a system designed to mechanically maintain a relentless voltage. Depending on the look, it may be wont to regulate one or additional AC or DC voltages. Feedback transformer operates by scrutinizing the particular output voltage to some mounted reference voltage.

### SENSOR TEMPERATURE SENSOR:



A temperature device is associated device that measures the temperature of its atmosphere and converts the information into electronic data to record, monitor, or signal temperature changes.

### FIRE SENSOR:



Fire detector works by police investigation heat. These devices answer the presence of extraordinarily high temperatures that square measure gift with a hearth. A hearth warning device features a range of devices operating along to find and warn folks through visual and audio appliances once fire or different emergencies square measure gift.

### SMOKE SENSOR:



A smoke device may be a device that senses smoke, typically as associate indicator of fireplace. Smoke is detected either by optically or by physical method.



### MAX232



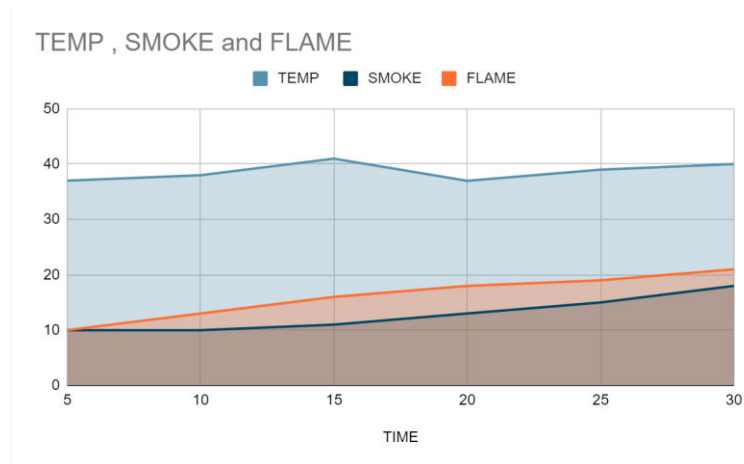
MAX232 is associate degree computer circuit that converts signals from a TIA -232 interface to signals appropriate to be used in TTL-compatible digital logic circuits.The MAX232 could be a twin transmitter/dual receiver that usually is employed to convert the RX,TX,CTS,RTS signals.

### LCD



Liquid Crystal show could be a flat panel show technology.Liquid crystal show technology works by block lightweight.It is designed to project on-screen information of a digital computer onto a bigger screen.

## V. RESULT AND DISCUSSION



We used the Fire Weather Index (FWI) Method to measure the fire indices. To produce an alert message, the nodes take into account this index as well as the evolution of the raw measurements, such as odd temperature increments, humidity decrements, or gas detection. In a lab setting, various fire simulations were created to detect actual fires and to see if any false alarms were raised.Based on sensed temperature rising by more than 5 degrees in less than 10 minutes and relative humidity declining by more than 10% in the same time frame, the results showed a 100 percent fire detection accuracy. During the experiments, the gas sensors observed major smoke variations in both situations (concentration changes greater than 3 percent )

## VI. CONCLUSION

Forest fires are a significant problem in many countries, and global warming can exacerbate the problem. Experts believe that investing in advanced innovations and equipment that require a multifaceted approach is crucial to deter these disasters from occurring.

A WSN for early warning of forest fires is defined in this article. This network is simple to set up in high-traffic areas. We believe that this project would identify fires sooner because each node was fitted with multiple sensors to



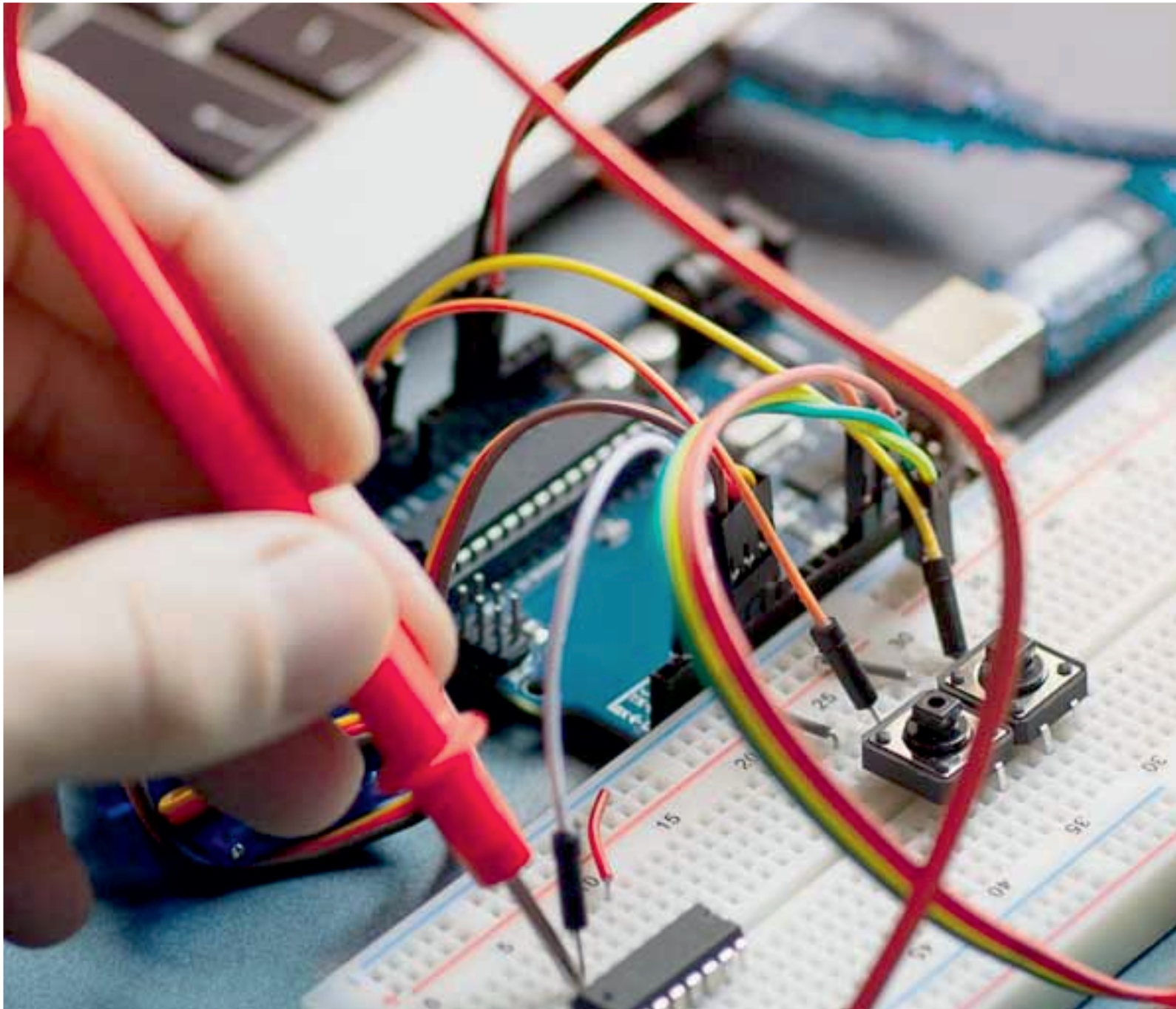


collect data such as temperature, smoke, and fire flickering in order to classify fire incidents in that area. Furthermore, if a fire is observed, a warning will be sent to the incharge officer via mail. It is capable of maintaining the highest level of accuracy and fewer false alarms in a variety of situations.

Automated applications with less manual operations are used to increase reliability and accuracy.

#### REFERENCES

1. Muthuvaraja, Arun, karthik prabhu “Forest fire detection using-powered AOT networks” International Journal of Advanced Science and Engineering Research, 2018.
2. Chaitali Tikhe, Nimisha Rail Asst. Professor Department of Electronics, Dr.D.Y. Patil college pimpri, pune, India “Solar powered wireless forest fire detection” International Journal of Advanced Research in Computer and Communication Engineering, 2018.
3. Antonio Molina-pico, David Cuesta-Frau, Alvaro Araujo, Javier Alejandro, Alba Rozas polytechnic university of madrid, campus ciudad universitaria, Avenida complutense30, Madrid, spain “Forest monitoring and Wildland early fire detection by a Hierarchical wireless sensor network” Hindawi Publishing Corporation Journal of Sensor, 2016.
4. Guangxue Yang, Zheng Liu, College of Electrical and Electronic Engineering, Harbin University of Science and Technology, Harbin,China “ The Design of forest fire monitoring system based on wireless sensor network” International Forum on Strategic Technology.
5. Giglio, Louis, W. Schroeder and Christopher O. Justice, “The Collection 6 MODIS Active Fire Detection Algorithm and Fire Products.” Remote Sensing of Environment , 2016.
6. L. Millan-Garcia, G. Sanchez-Perez, M. Nakano, K. Toscano-Medina, H. Perez-Meana, and L. Rojas-Cardenas, “An early fire detection algorithm using IP cameras,” Sensors (Switzerland), vol. 12, no. 5, pp. 5670–5686, 2012.
7. M. Trinath Basu, R. Karthik, J. Mahitha, and V. Lokesh Reddy, “IoT based forest fire detection system,” Int. J. Eng. Technol., vol. 7, no. 2, pp. 124–126, 2018.
8. ThingsBoard. Thingsboard - open-source IoT platform (2018), <https://thingsboard.io>.
9. J B. Son, Y. Her, and J. Kim, “A design and implementation of forest fires surveillance system based on wireless sensor networks for South Korea mountains,” Int. J. Comput. Sci. Netw. Secur., vol. 6, no. 9, pp. 124–130, 2006.
10. M. Hefeeda and M. Bagheri, “Forest fire modeling and early detection using wireless sensor networks,” Ad-Hoc and Sensor Wireless Networks, vol. 7, no. 3-4, pp. 169–224, 2009.



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