FIRE DETECTION SYSTEM USING WSN

A Project Work

Submitted in the partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

IN

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DECLARATION

I, **'Vanshita Manral'**, student of **'Bachelor of Engineering in CSE (IoT)'**, **session: 2018-2022**, Department of Computer Science and Engineering, Apex Institute of Technology, Chandigarh University, Punjab, hereby declare that the work presented in this Project Work entitled '**Fire Detection System using WSN'** is the outcome of our own bona fide work and is correct to the best of our knowledge and this work has been undertaken taking care of Engineering Ethics. It contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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ABSTRACT

Forest fires are threat to human lives as well as the ecological system and apparently the earth. Apart from causing a tragic loss of lives, natural resources and thousands of hectares of lands and hundreds of houses, forest fires are a great destruction to the environment. Every year thousand of forest fire across the globe caused enormous destruction to the property and lives. For this problem many commercial solutions exist with lots of sensor but all of them are difficult to implement because of their high cost and high maintenance ordered by the system which makes it tedious to use.

In this Report a forest fire detection system using wireless sensor network is proposed stating the fact of “NO MORE FOREST FIRES” with a bunch of advantages.

ACKNOWLEDGEMENT

I would like to express my gratitude and appreciation to all who gave me this responsibility to complete this report. A special thanks to our project supervisor Mr. Nikhil Aggarwal whose help, stimulating suggestions helped me to coordinate my project.
A special thanks to my team members who helped me in the developing this project

Table of Contents

1. INTRODUCTION

Forest fires are threat to human lives as well as the ecological system and apparently the earth. Apart from causing a tragic loss of lives, natural resources and thousands of hectares of lands and hundreds of houses, forest fires are a great destruction to the environment. Every year thousand of forest fire across the globe caused enormous destruction to the property and lives. For this problem many commercial solutions exist with lots of sensor but all of them are difficult to implement because of their high cost and high maintenance ordered by the system which makes it tedious to use.

1.1 Problem Definition:

Forest fire detection systems are gaining a lot of attention because of the continual threat from fire to both economic properties and public safety. Hundreds of millions of hectares are destroyed by wildfires each year and over 200,000 forest fires happen every year in the world. Forest fires destroy a total area of 3.5 to 4.5 million km^2.Increase in forest fires in forest areas around the world has resulted in an increased motivation for developing fire warning systems for the early detection of wildfires.

1.2Project Overview/Specifications:

Due to the wide spread of IoT, Sensor technology has been widely used in fire detection too, usually depending on sensing physical parameters such as changes in pressure, humidity, and temperature, as well as chemical parameters such as carbon dioxide, carbon monoxide, and nitrogen dioxide. However, it is hard to apply these systems in large open areas for a variety of reasons such as high cost, energy usage by the sensors, and the necessary proximity of the sensor to the fire for accurate sensing resulting in physical damage to the sensors.

1.3 Hardware Specification:

- **Nodemcu Esp8266:** -The Nodemcu ESP8266 is a **low-cost Wi-Fi module** built by Express if Systems. Its popularity has been growing among the hardware community thanks to its nice features and stability, to the point that it can be easily programmed using your Arduino IDE. For using it we need Arduino IDE version 1.7 or higher.

- **Dht11 sensor (temp, humidity):** - DHT11 is a Humidity and Temperature Sensor, which **generates calibrated digital output**. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low cost humidity and temperature sensor which provides high reliability and long term stability.

- **MQ-2: -** The ***MQ-2*** Gas sensor can detect or measure gasses like LPG, Alcohol, Propane, Hydrogen, CO and even methane.

- **Flame sensor: -** This Flame Sensor can be used to detect fire source or other light sources of the wave length in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation. Sensor can be a great addition in a fire fighting robot, it can be used as a robot eyes to find the fire source. When the sensor detects

flame the Signal LED will light up and the D0 pin goes LOW

- **TP-4056: -** The TP4056 is a complete constant-current/constant-voltage linear charger for single cell lithium-ion batteries.

- **Solar cells: -** These are used to covert sun light into electricity.

1

1.4 Software Specification:

- **C++ code: -** This code will be uploaded to the nodemcu using Arduino IDE.

- **Node red flow: -** This flow will run in the edge computer and manage all the incoming and outgoing data. It will also synchronize the sensor node. It will also provide basic features.

- **Flutter app:** - Cross platform application that will allow the user to read the data and show it in a map anywhere.

1. LITERATURE REVIEW

TITLE	YEAR	Author's name	Technology used	Advantage	Disadvantage
A Review on Forest Fire Detection Techniques	2014	Ahmad A. A. Alkhatib	WSN AND 3. Satellite-Based Systems	It uses Earth-orbiting satellites and even air-floating devices have been employed for observation and detection of forest fires.	It is very expensive because of satellite- based system.
Forest Fire Detection Using a Rule-Based Image Processing Algorithm and Temporal Variation	2018	Mubarak A. I. Mahmoud and Honge Ren	digital camera technology and CCD or CMOS digital cameras	It has a rapid increase in image quality and decreased cost of the cameras. The other advantage is that digital cameras can cover large	It uses Yinglian's algorithm which is good, but the smoke spreads quickly and it has many different colors which depend on the burning

				areas with excellent results.	material; thus, the false alarm rate rises.
Forest Fire Detection using Wireless Sensor Network	2015	C. Gomathi , K. Vennila , M. Sathyananth , B. Shriaarthi , S. Selvarasu	Zigbee, PIC microcontroller	It is less expensive. It is flexibility in building the network.	It gives false alarms sometimes.
Monitoring and Wild land Early Fire Detection by a Hierarchical Wireless Sensor Network	2016	Antonio Molina-Pico, David Cuesta-Frau, Alvaro Araujo, Javier Alejandre, and Alba Rozas	WSN	It is used for long range communication.	There are false alarms of fire detection.
Forest Fire Detection System Using IoT and Artificial Neural Network	2019	Vinay Dubey, Prashant Kumar and Naveen Chauhan	IoT, Raspberry Pi microcontroller	The detection and the communication to the authorities can be done with minimum delay	It is expensive.
Forest Fire Prevention , Detection, and Fighting Based on Fuzzy Logic and Wireless Sensor Networks	2018	Pino Caballero-Gil,[1] Nayra Rodríguez-Pérez,[1] Iván Santos-González,[1] Candelaria Hernández-Goya,[1] and Ricardo Aguasca-Colomo	Fuzzy Logic and Wireless Sensor Networks	It paid attention to the implementation of security mechanisms to ensure integrity, confidentiality, and authenticity of communications between WSN nodes and between any WSN node and the Web service.	It is expensive than existing system.
IOT Based Forest Fire Detection And Early Warning	2020	A.Vidya, P.Malini, S.Sathiya	Raspberry Pi And GSM	It is cheaper than existing systems.	It is not efficient for large area.

System Using Raspberry Pi And GSM					
IoT based forest fire detection system	2017	Trinath basu	IOT based , led screen, node mcu etc	Had a visuals led system for detecting fire	It costs high due to the reason everyone can't afford it
Fire monitoring and control based system	2014	Yi Li, Jianjun Yi, Xiaoming Zhu , Zhuoran Wang	IoT based, Rfid ,video recording	It has recording system due to which we can get to know the main cause of fire, also the Rfid tag can tell the exact centre of fire	Sometimes tag detection may also fails
IOT Based Forest Fire Prediction and Detection	2020	N. Saranya, S. Sahana, B. Suganthi, R. K. Vijaynigilesh, T. Vivin	WSN, LCD	It may have a different sensors nodes which will tell us the fire spreading direction	Power failure due to excess heat
IOT Enabled Forest Fire Detection and Altering the Authorities	2019	T. Saikumar, P. Sriramya	MAGNETIC TRANSDUCER, GSM etc	Using gsm we can monitor in that area by using the mobile networks and can capture it In the LCD	Difficult to screen all the woodlands zones in light of the fact that here we are using model we won't have much partition to cover certain area.
An Autonomous IoT Infrastructure for Forest Fire Detection and Alerting System	2014	R. Niranjana	GSM, raspberry pi	The GSM module will be connected with the Raspberry pi 3 and it will send the SMS to the User by using AT command.	Network failure
Fire Detection In Forest Using Wireless Sensor	2020	Diwakar chintha, D.Vishnu vardhan reddy, K.Srilatha	WSN	Nodes getting the data will also tell the line of fire spreading	Nodes deployment are and also nodes may fails

Networks					
An IOT based forest fire detection and prevention system using raspberry pi 3	2019	RANJITH E, PADMABALAJI D, SIBISUBRAMANIAN S, Ms. RADHIKA S	Raspberry pi	Iot infrastructure will be used, may be cost efficient	Less number of sensors detection used
IOT Enabled Forest Fire Detection and Management	2018	Shushma G Krishna	Node MCU, DHT11 sensor, Flame sensor, MIT app inventor, Google firebase.	The proposed system detects the forest fire at a faster rate compared to existing system. It has enhanced data collection feature. The major aspect is that it reduces false alarm and also has accuracy due to various sensors present. It minimizes the human effort as it works automatically.	The electrical interference diminishes the effectiveness of radio receiver. The main drawback is that it has less coverage range areas.
smart forest fire detection system based on optimized solar energy using Arduino with source of tank water	2020	Mrs.P.Malarvizhi | G.Gajendran | R.Mahalakshmi | S.Sarathkumar | K.Vigneshwaran	Arduino UNO	It is used for long range communication	Sensor failure may occur
Image processing based system for fire detection system	2020	Mohammad Syamirza Mohd Najib	Rfid, infrared cameras	Segmentation of fires can be shown	High processing time ,

2. PROBLEM FORMULATION

Fire spreads in forests very fast and it is difficult to detect in the early stages where it is easy to contain and handle. The current solutions are not practical or cost effective and do not provide such features.
From the literature review, it is observed that studies highlight the need of efficient and scalable approach for detecting code clones having software vulnerability. The existing techniques are not able to detect all types of vulnerable code clones. Different approaches suffer from high false negative rate and not scalable to large software systems due to high time complexity.

3. RESEARCH OBJECTIVES

The sensor node will get the readings from the different sensors then send it through the repeaters to the base station which will check if there is fire or not then reflect the data in the map. It will also show the fire direction according to the wind.
The fire will be detected in case of flame, smoke or difference in either humidity or temperature.

The system will contain mainly three parts

1. WSN: A wireless sensor networks that contains sensor nodes which acts as repeaters and send the readings
2. Base station: It will run a node red program that will handle the data, error detection, synchronization.
3. Interfaces: which are calls, messages, emails, apps and a dashboard?

WSN

The sensor nodes will be deployed in lines and between these lines a sensor nodes act as access points to extend the range.

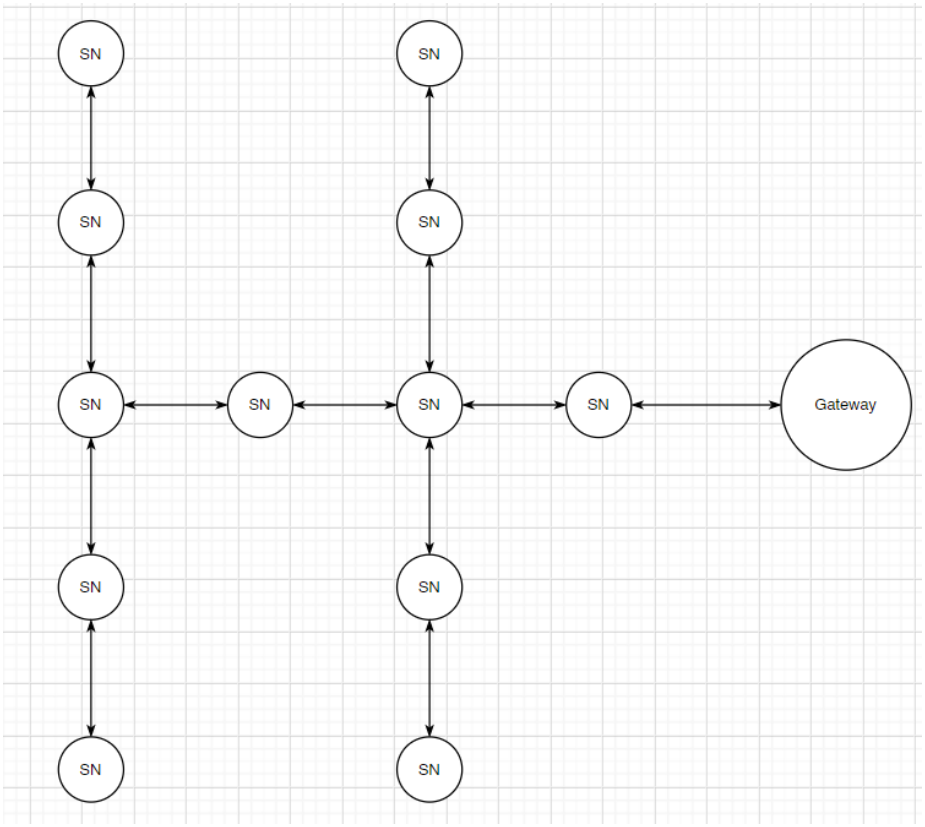


Figure 1 WSN

Sensor node

The sensor node acts as a repeater and sends the readings of the sensors. It is power independent and uses solar energy.

Specifications

1. It will run for at least 4 years.
2. It will use solar energy and batteries
3. It will have two different modes which are normal mode and emergency mode.
4. It will be power efficient.

Design

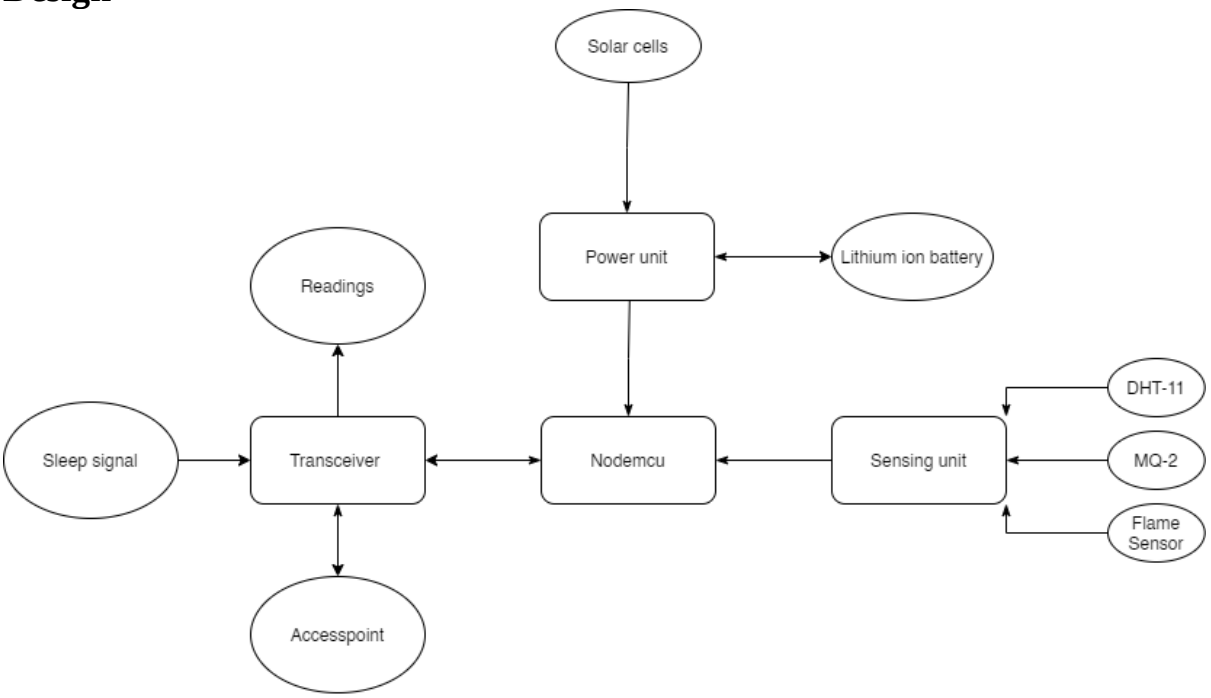


Figure 2 Sensor node design

Sensing unit

It will consist of

a) DHT-11: Humidity and temperature sensor
b) MQ-2: gas sensor to detect smoke
c) Flame sensor

Power unit

TP-4056 will be used to charge LG 2600 ma battery and protect it from over discharging or charging. Solar cells of 300 ma will be used to charge the battery.

Transceiver

ESP-8266 will be used with an external antenna to extend the range. It will send the readings in the format sensorId, temperature, humidity, flame, smoke, longitude and latitude. It will also receive the sleep signal in the format isSleeping, mode, and sensorId.
It will also have access point with the following setting
SSID: nofire_sensorId
Password:

Base station:

The base station will receive all the data and pre-process it

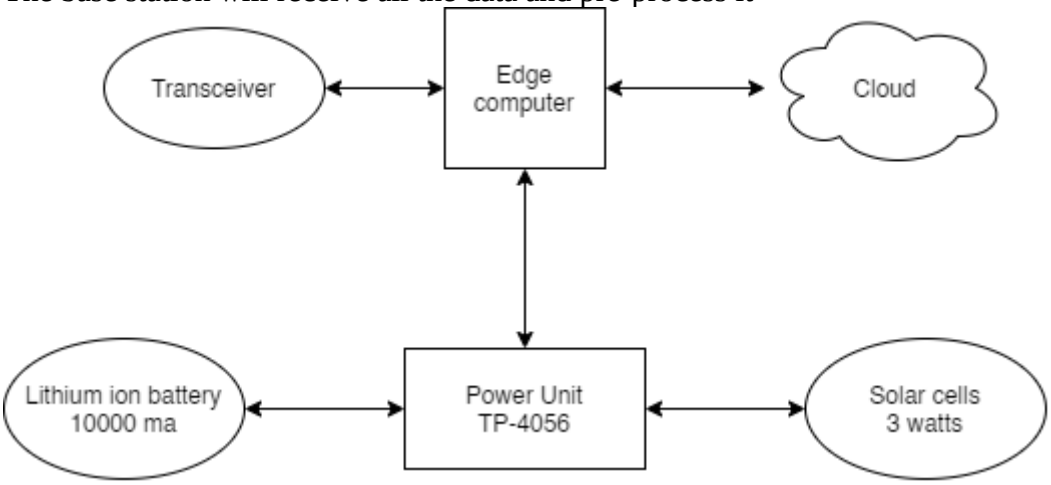


Figure 3 Base station designs

It will run on solar energy and will use node red to manage all the data.

Broker:

The broker will be in node red that is capable of getting the data from the WSN pre process and providing an interface to the user. It will also send it to the cloud so it can be accessed using different types of applications.

4. METHODOLOGY

The following methodology will be used to achieve the project objectives:

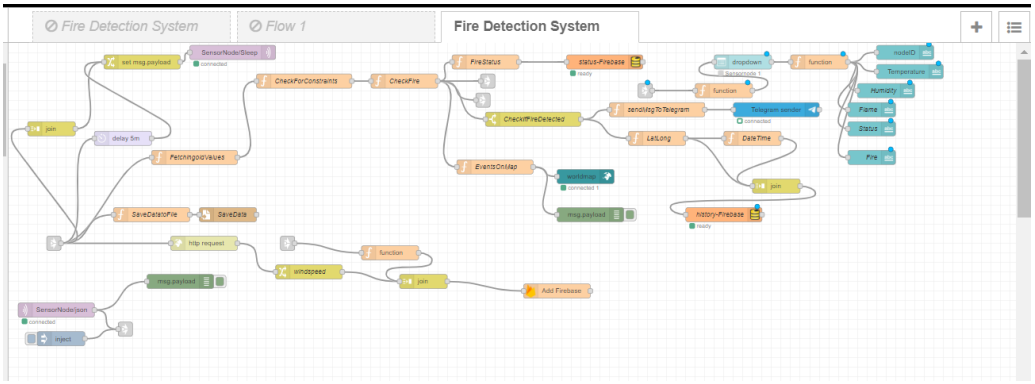
1. Planning and Requirement Analysis.
2. Designing the project architecture.
3. Building the project according to the design.
4. Testing the project in controlled environment
5. Deploying the project for further testing.

5. CONCLUSION & FUTURE SCOPE

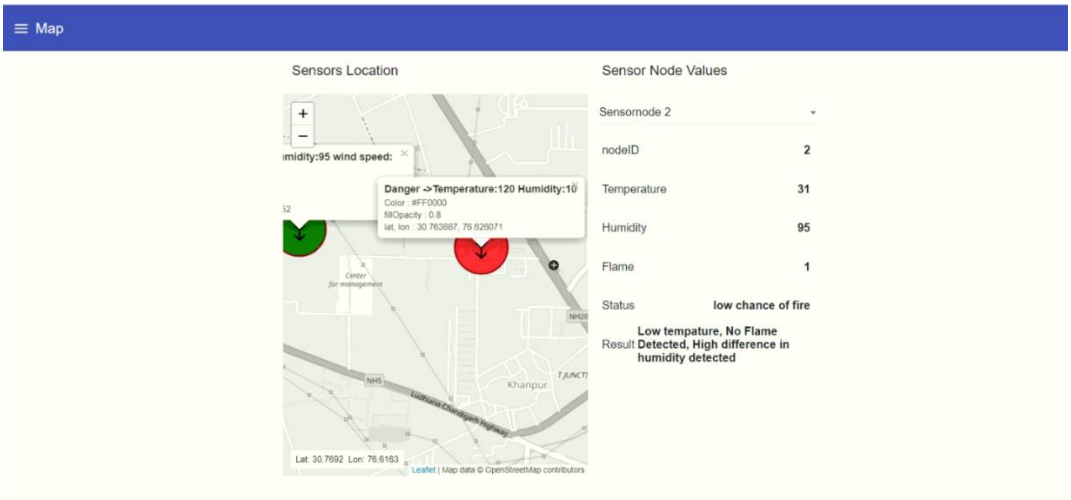
Conclusion

1. Detected fire using multiple sensor nodes.
2. It shows the sensor node location in map.
3. Shows the direction where the fire is possible to spread.
4. It was able to cover large areas.
5. Power efficient

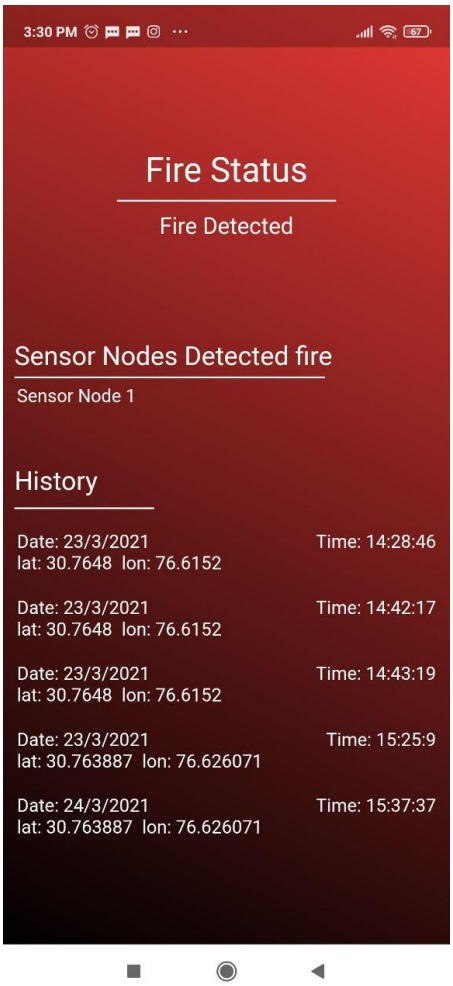
Base station

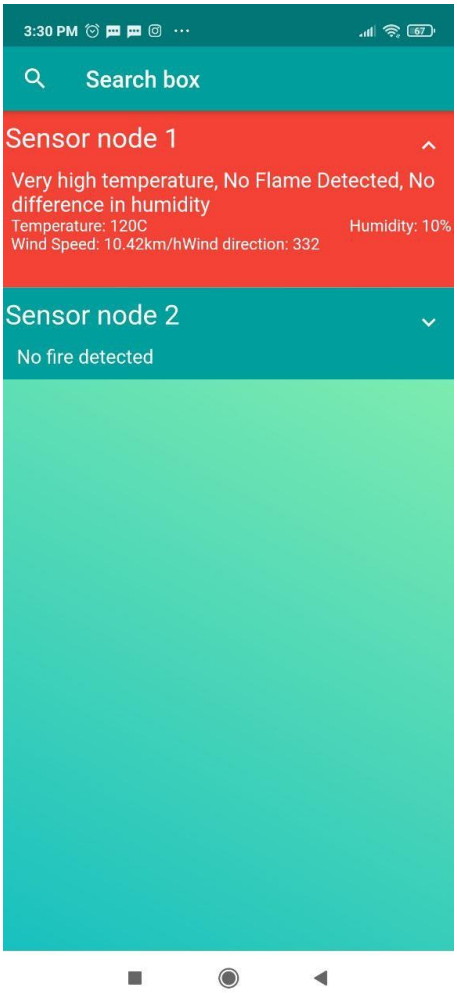


Dashboard



Flutter Application





Future scope

1. Making the WSN insulted.
2. Adding more features into the flutter app to increase the user experience.

6. REFERENCES

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