Tinkerers Internship

Final Project Report

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Internship Title: - **IoT based Forest Fire monitoring system.**

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Introduction:

Existing Problem:

Forest fire**,** uncontrolled fire occurring in vegetation more than 6 feet (1.8 m) in height. These fires often reach the proportions of a major conflagration and are sometimes begun by combustion and heat from surface and ground fires. A big forest fire may crown—that is, spread rapidly through the topmost branches of the trees before involving undergrowth or the forest floor. As a result, violent blowups are common in forest fires, and they may assume the characteristics of a firestorm.

A Large destructive fire that spread over a forest or area of woodland which leads to damage in Wildlife, humans, property and Environment. The major Causes Are Lightning. Sparks from Rock falls. Volcanic Eruption or any other manual Ignition from the Humans on purpose which leads to the following disadvantages: A forest fire sets up the potential for soil erosion to occur, Forest fires always bring death to life of humans and animals, Uncontrolled fires can cause localized air pollution, Homes can be destroyed without compensation.

Apart from causing tragic loss of lives and valuable natural and individual properties including thousands of hectares of forest and hundreds of houses, forest fires are a great menace to ecologically healthy grown forests and protection of the environment.

Every year, thousands of forest fires across the globe cause disasters beyond measure and description. This issue has been the research interest for many years; there are a huge amount of very well studied solutions available out there for testing or even ready for use to resolve this problem.

Overview :

We have designed complete solution for ‘Forest Fire’. We have use various sensors and gather their reading on microcontroller. We have written a program in Arduino IDE to read the value from the sensors and from the microcontroller we have uploaded data to the ‘firebase’ which is our central database. For the end consumer we have build one Web app to display readings in graphical format.

Purpose:

To create an affordable and reliable solution for existing problem, by an IoT based approach. The Forest fire conditions like temperature, Humidity and smoke information are transferred to the Firebase. In this way, we are transmitting the real-time environment information. In this way we have manually transmited the real-time forest fire information. Due to uploading in Firebase the information can be viewed from any part of the world. The system will function with tracking and monitoring temperature, humidity and other sensors.

Literature Review :

In the context of the FIRESENSE project [3], an automatic early warning system integrating multiple sensors to remotely monitor areas of archaeological and cultural interest for the risk of fire and extreme weather conditions was developed. The system integrates various sensors including optical cameras, infrared cameras at different wavebands, passive infrared (PIR) sensors, a wireless sensor network of temperature and humidity sensors and local weather stations on the deployment sites. The signals and measurements collected from these sensors are transmitted to the control centre, which employs intelligent computer vision and pattern recognition algorithms as well as data fusion techniques to automatically analyse and combine sensor information and detect the presence of fire or smoke.

A skyline approach for early forest fire detection is proposed in [4] (Pripužic, Belani et al. 2008). Skyline is built using greater values, i.e., those sensor readings with large temperature and high wind speed. Figure 6 shows the proposed skyline. Only data on skyline are sent to a sink to be used for fire detection. Sink processes the data according to the suggested algorithm and results in a fast and energy efficient forest fire detection.

In " IoT based forest fire detection system"[1] Interfacing of Ethernet Shield with Arduino is done The Arduino Ethernet Shield V1 allows an Arduino board to connect to the internet. It is based on the Wiznet W5100 ethernet chip (datasheet). The Wiznet W5100 provides a network (IP) stack capable of both TCP and UDP. It supports up to four simultaneous socket connections. Ethernet Shield allows internet connectivity to Arduino board by using its Ethernet library. We can use

this Ethernet library to write sketches (Arduino program written in IDE) that will help us to configure this shield to connect to internet. This shield is compatible with almost all versions of Arduino boards.

Nowadays, two different types of sensor networks are available for fire detection, camera surveillance and wireless sensor network [2]. The development of sensors, digital camera, image processing, and industrial computers resulted in the development of a system for optical, automated early recognition and warning of forest fires. Different types of detection sensors can be used in terrestrial systems : (i) video-camera, sensitive to visible spectrum of smoke recognisable during the day and a fire recognisable at night, (ii) infrared (IR), thermal imaging cameras based on the detection of heat flow of the fire, (iii) IR spectrometers to identify the spectral characteristics of smoke, (iv) light detection and ranging systems—LIDAR (detection of light and range) that measure laser rays reflected from the smoke particles. Thermal camera or pan tilt zoom cameras can be added to the system. EYEfi does not offer automatic detection of smoke but plans to introduce it sometime in the near future. Simply, EYEfi can provide images for fire agencies whenever the operator notices smoke and can use EYEfi software to use the GIS map and locate the smoke position on the ground. A weather station and lightening detector are included in the system for more accuracy [2]

Purposed Solution:

Software and Hardware Requirements –

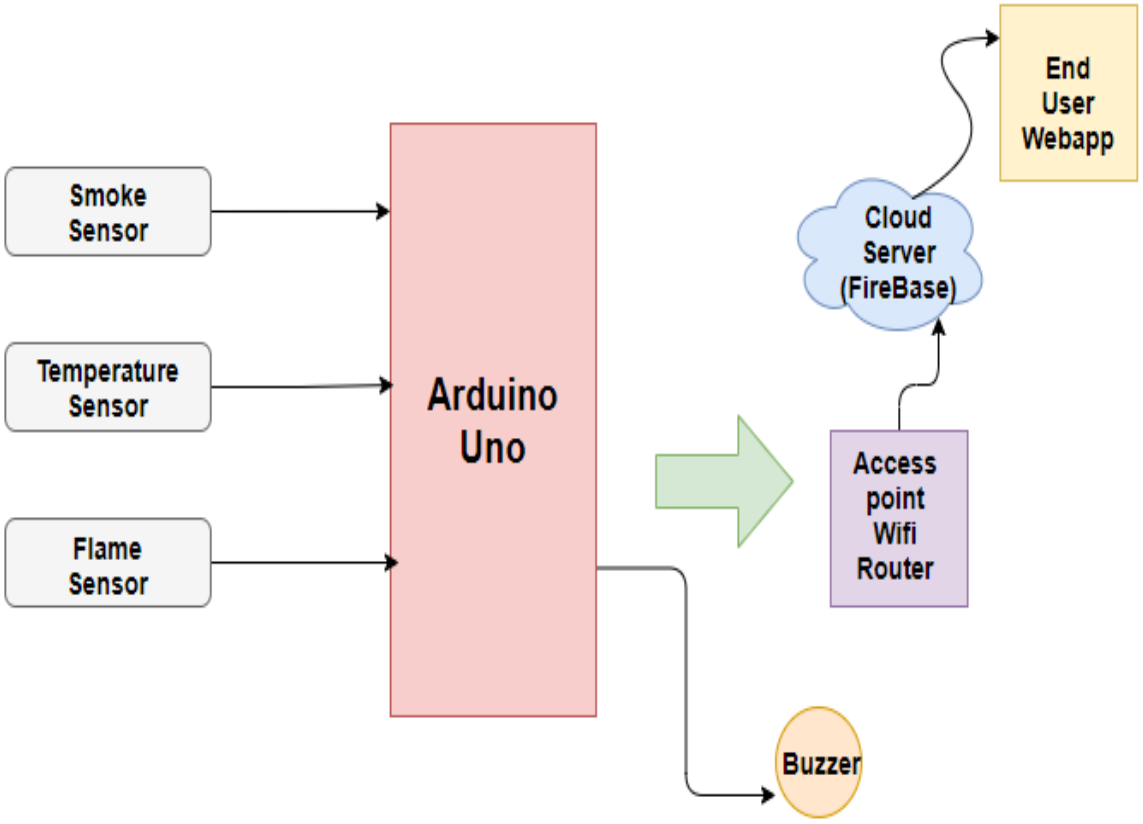
Hardware Components –

Sr. No	Hardware Components
1.	Arduino Uno
2.	Flame Sensor – Range (760 nm to 1100 nm)
3.	Jumper Wires
4.	Buzzer
5.	Temperature Sensor (DHT11) Range – 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy.
6.	Smoke Senor (MQ2) Range - 200 to 10000ppm. (Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide)

Software Components –

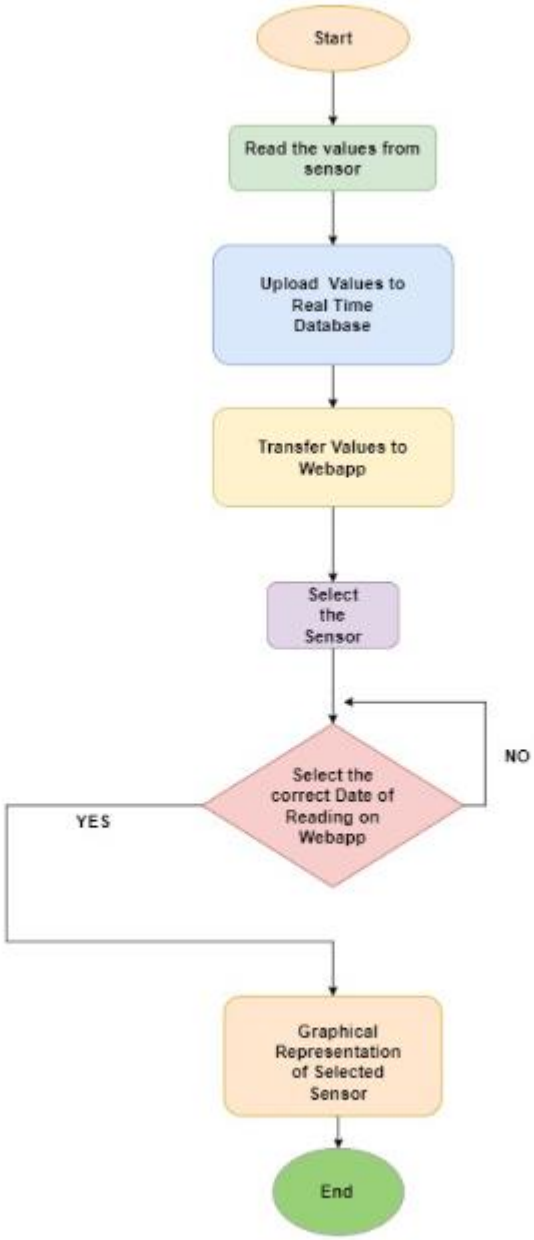
Sr. No	Software Components
1.	Proteus Software
2.	Arduino IDE
3.	Firebase

Block Diagram :



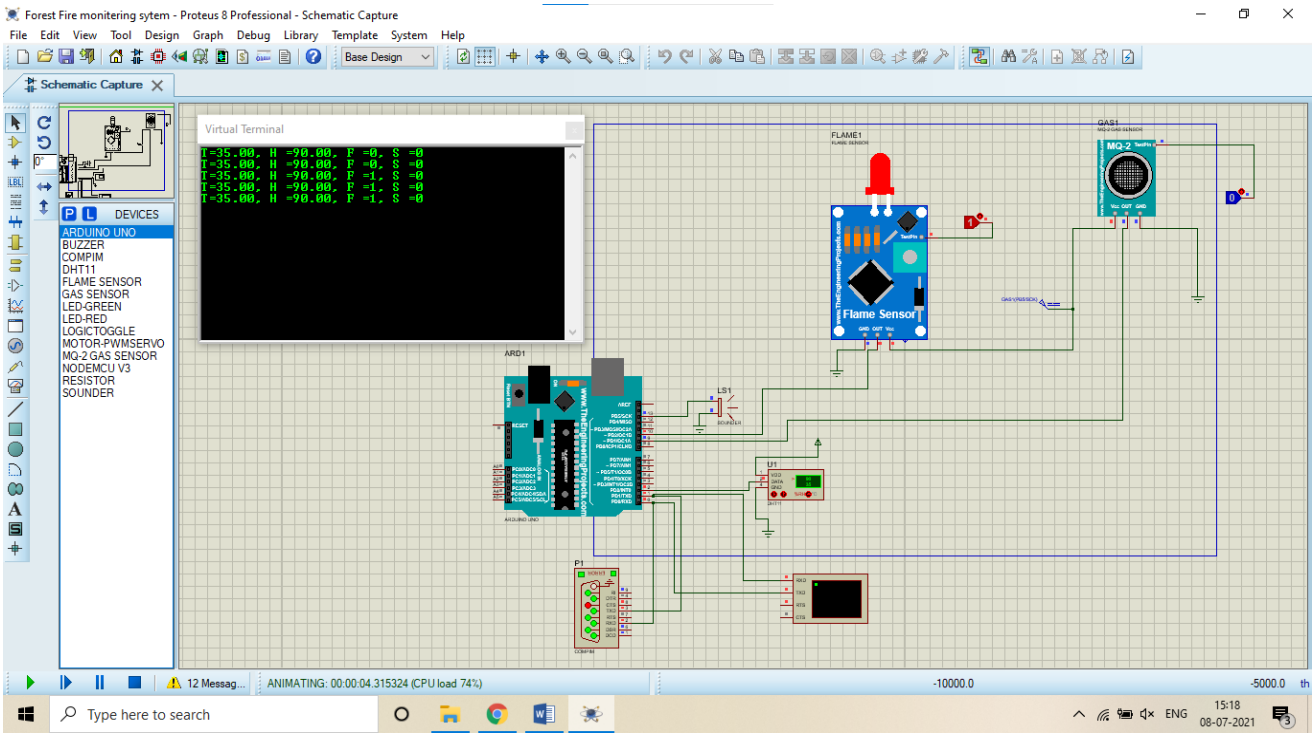
The Aurdino will read all the values from the sensor. We will transfer the values to Firebase and then the End user will be able to see plotted Graph of sensor values on Webapp.

Flowchart :

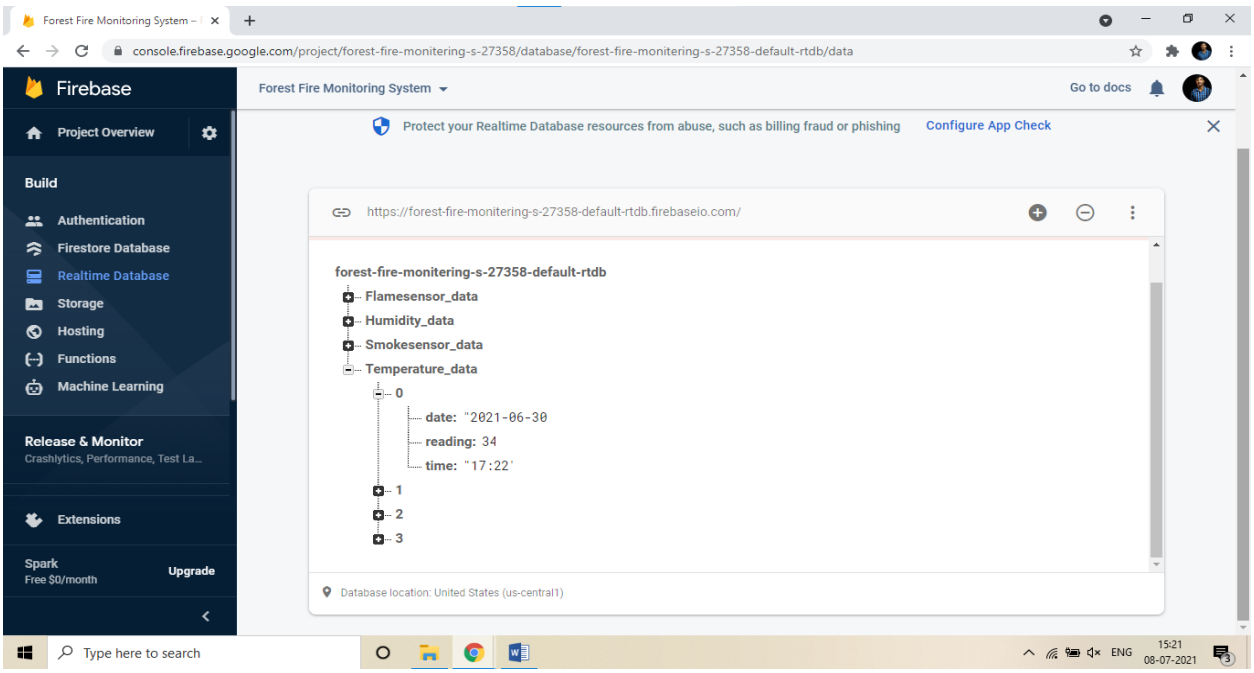

Start
Read the values from sensor
Upload Values to Real Time Database
Transfer Values to Webapp
Select the Sensor
Select the correct Date of Reading on Webapp
NO
YES
Graphical Representation of Selected Sensor
End

RESULT:

Circuit Simulation on Proteus:

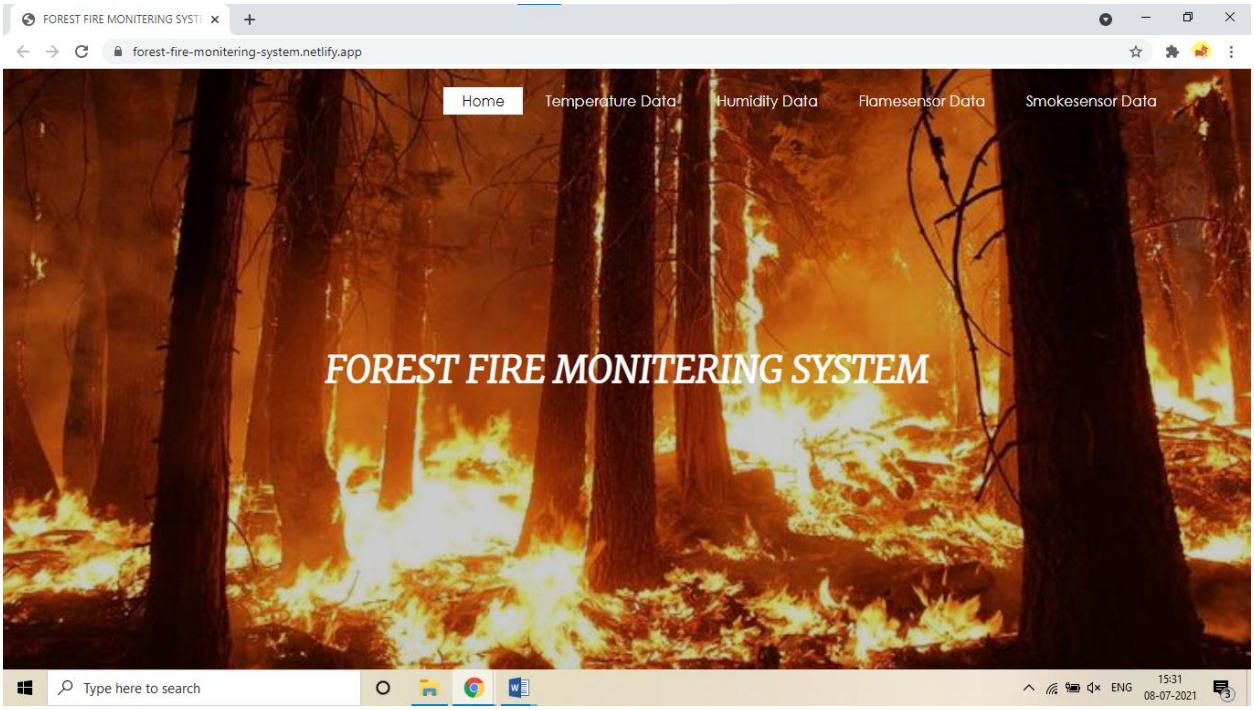


Firebase Realtime Database:

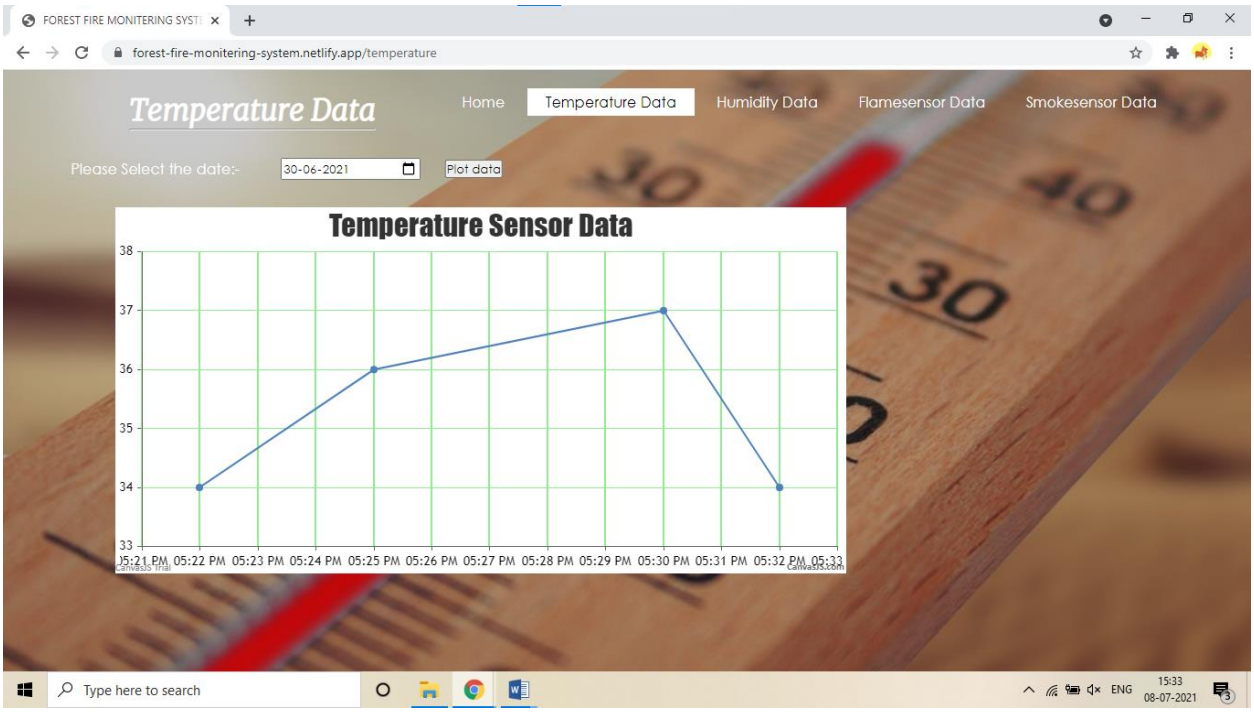


Plotted Graph on Deployed HTML Web Page :

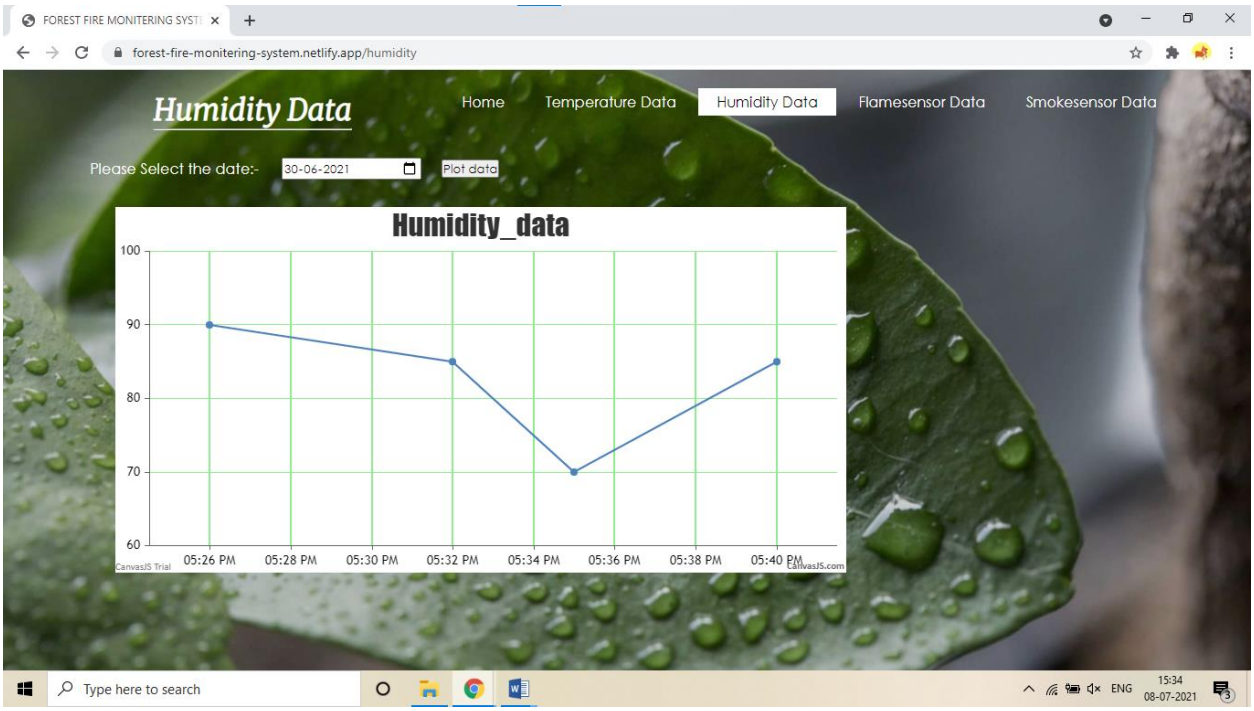
Deloyed app -



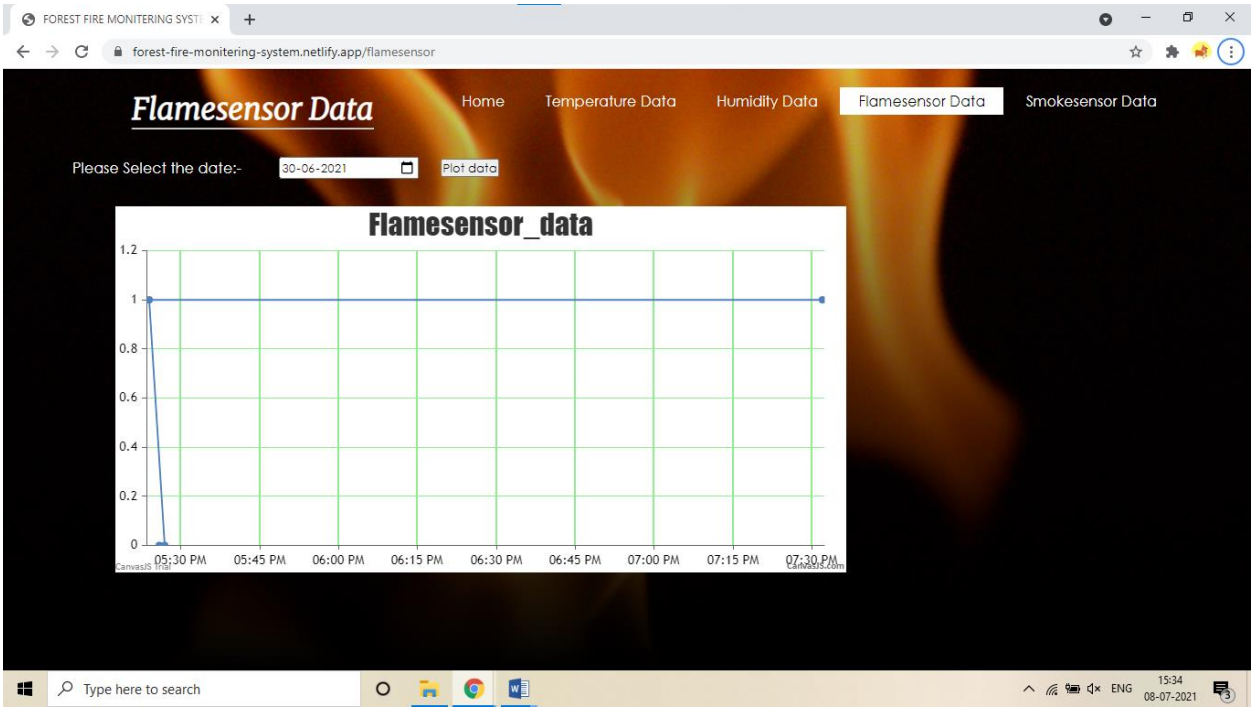
Temperature Sensor :



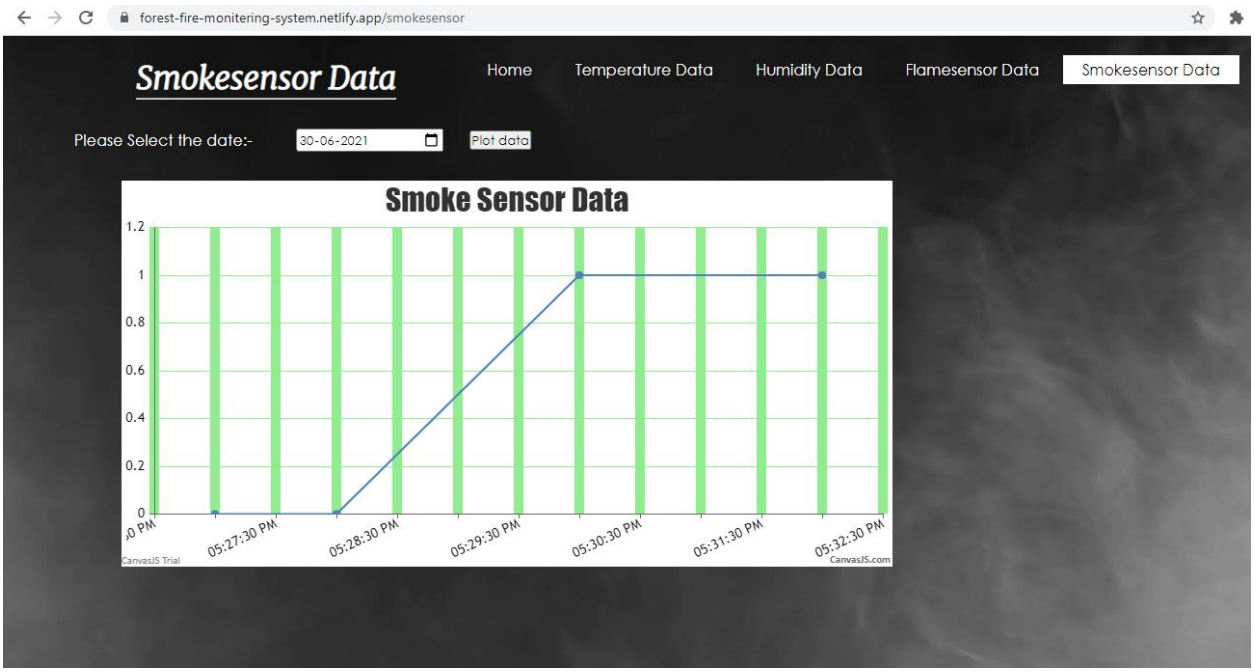
Humidity Sensor:



Flame Sensor :



Smoke Senor:



URL of Deployed Web App:

https://forest-fire-monitering-system.netlify.app/

Advantages :

1. IoT Forest Fire monitoring system project using Arduino UNO which is fully automated, and doesn't require human attention.
2. Low power consumption, highly accurate, faster response time, and much more efficient.
3. Easy to understand and build.
4. Low cost of build and maintenance.
5. Real-time data transfer, via cloud server, to any place on earth.
6. Easy to use, end user web app, displaying data in graphically.

Disadvantages :

1. Difficult to transmit real-time data, to end user in cases of extreme Forest Fire.
2. In case of network disturbances, real-time data may not get transmitted.
3. Chances of failure of the sensor, if maintenance of the sensors are not done.
4. Work for small and particular area.

Applications:

1. The forest fire is detected by the temperature sensors, Flame sensor and smoke sensor. The buzzer associated with gives us an alert sign.
2. This project help us to detect forest fire so it can also help to save habitat.
3. Forests provide us a large number of commercial goods which include timber, firewood, pulpwood by using this project we can detect the forest fire early and can take needed action and save other trees.

Learning Outcomes:

1. IoT circuit design simulation on Proteus.
2. Transferring real-time data, to Firebase real-time database using python programming.
3. Extracting real time data, from Firebase real-time database, and plotting it graphically using HTML, JavaScript and CSS.
4. Web app designing, using HTML, JavaScript and CSS.
5. Web app deployment.

Conclusion :

The Forest Fire is a serious issue as it has caused loss of huge amount of land, property and lives of people as well as animals. The project has huge scope in the future where we will be able to use GPS system and we can know exact location where the forest is burning . The connectivity of the Wi-Fi in forest areas still remains a technical challenge as using high frequency waves for connectivity may lead to disturbance in birds and animal's life and low frequency may not respond properly, Alternate methods are either too expensive or not effective. The future scope of the project lies in the areas like Connectivity of Network and Range of sensors. Forest still remain an important resource to balance the climate and a possible solution to global warming. Thus when a forest fire occurs not only the valuable forest resource meets damage but the fire tears of the surrounding causing enough pollution by the very source that prevents it. The model proposed has been tested and working properly. It will monitor each and every aspect related to forest fire.

References :

[1] M. Tarinath Basu, Ragipati Karthik, J. Mahitha and V. Lokesh Reddy, March 2018. – " IoT based forest fire detection system", 4 Department of Electronics and Computer Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India – 522502, Accessed June 2021. https://www.researchgate.net/publication/324054113_IoT_based_forest_fire_detection_system

[2] - Ahmad A. A. Alkhatib, November 2014, "Review Article on Forest Fire Detection Technique" The University of South Wales UK, Accessed June 2021, https://www.researchgate.net/publication/260792296_A_Review_on_Forest_Fire_Detection_Techniques

[3] - Dr Nikos Grammalidis, Researcher Grade B, Centre for Research and Technology Hellas (CERTH) The project started on December 1, 2009, and finished on February 28, 2013. FIRESENSE "Fire Detection and Management through a Multi-Sensor Network for the Protection of Cultural Heritage Areas from the Risk of Fire and Extreme Weather Conditions" (FP7-ENV2009-1-244088-FIRESENSE), Is a Specific Targeted Research Project of the European Union's 7th Framework Programme Environment (including Climate Change), Accessed on June 2021. https://cordis.europa.eu/docs/results/244088/final1-firesense-final-report-v5-public.pdf

[4] - Majid Bahrepour, Nirvana Meratnia, Paul Havinga, AUTOMATIC FIRE DETECTION: A SURVEY FROM WIRELESS SENSOR NETWORK PERSPECTIVE, Pervasive Systems Group, University of Twente, Accessed on June 2021. https://research.utwente.nl

Appendix:

Source Code (Web app) - https://github.com/Tinkerers-Lab-VESIT-ETRX/IoT-based-forest-fire-monitoring-system-11/tree/main/Webapp

Source code (Arduino Code) - https://github.com/Tinkerers-Lab-VESIT-ETRX/IoT-based-forest-fire-monitoring-system-11/blob/main/Forest_fire.ino

Source code (Python data upload) - https://github.com/Tinkerers-Lab-VESIT-ETRX/IoT-based-forest-fire-monitoring-system-11/blob/main/main.py