Tinkerers Internship

Task-1: Research of problem statement

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Problem Statement Understanding –

Problem Definition –

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.

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]

Our Approach–

We will be designing complete solution for 'Forest Fire'. We will use various sensors and gather their reading on microcontroller. We will write a program in Arduino IDE to read the value from the sensors and from the microcontroller we will upload data to the 'firebase' which is our central database.

For the end consumer we will build some Web app to display readings in graphical format.

The Forest fire conditions like temperature, Humidity and smoke information are transferred to the cloud server. In this way we will be manually transmit the real-time forest fire information. Due to uploading in cloud server the information can be viewed from any part of the world. The system will function with tracking and monitoring temperature, humidity with sensors.

Software and Hardware Requirements –

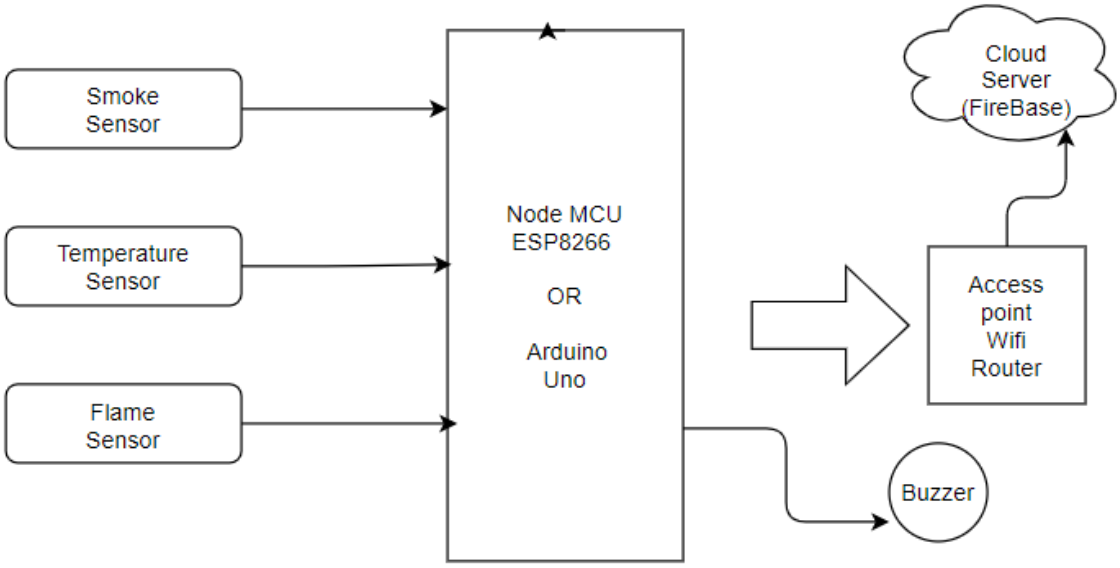
Hardware Components –

Sr. No	Hardware Components
1.	NodeMCU ESP8266 / 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 (MQ135) Range - 10～1000ppm(ammonia gas, toluene, Hydrogen, smoke)

Software Components –

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

Block Diagram –



Addition and Updates –

In this project we have interfaced Temperature and Humidity sensor (DHT11) with microcontroller in order to get data of temperature and humidity. Main addition is to measure humidity because when the relative humidity is 40 percent, it means that the atmosphere contains 40 percent of the moisture that it could contain at that same temperature. The lower the relative humidity, the more readily a fire will start and burn; the more vigorously a fire will burn. So it is necessary to measure humidity.

In Future we can add -

MWIR infrared (IR) cameras can be used to detect heat and with particular algorithms can detect hot-spots within a scene as well as flames for both detection and prevention of fire and risks of fire.

Applications –

a) The forest fire is detected by the temperature sensors, Flame sensor and smoke sensor. The buzzer associated with gives us an alert sign.
b) This project help us to detect forest fire so it can also help to save habitat.
c) 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.

Advantages –

a) Low cost
b) High speed
c) Easy to understand
d) Reduce man power
e) Reduce Death Rate
f) Fast response

Challenges –

a) Data transmission during Forest Fire is extremely difficult and challenging.
b) Technical challenges in fire IoT include government regulations with regards to spectrum allocation, security

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.

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

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[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