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Google Earth Engine based Forest Fire Detection System

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Abstract:- Forest fires represent a constant threat to ecological systems and human lives. Past has witnessed various instances of forest and wild land fires.

Especially in Amazon Forest. Fires play a remarkable role in determining landscape structure, pattern and eventually the species composition of ecosystems. Fires are considered as a significant environmental issue because they cause prominent economic and ecological damage despite endangering the human lives. So here we are going to develop the system which detects the fire on the earth by using Google earth engine and image processing algorithm with Raspberry pi and Temperature and Humidity Sensor, we instantly inform the forest department about this and immediately action will be taken.

Keywords:- *Google Earth engine, Raspberry pi, Temperature and Humidity sensor.*

I. INTRODUCTION

According to the research, by year 2030 forest fire will halve the worlds forest. Every year over 10,000 acres of forest burns. It has to be dealt with great attention as it's a fact that more than 20% of complete world CO2 emission comes for such forest fires. Also because of global warming, climate changes occurrence rate of forest fire has been increased. There are so many wildfire incidents were recorded for past few years. Every year in USA and Russia over 100.000km2 of forest is burnt while for Europe it's over 10.000 km2.

II. LITERATURE SURVEY

Traditionally fire detection methods include sensors, mechanical devices or human to monitor the surrounding. There are many algorithms which were introduced for fire detection, most frequently used fire detection techniques are usually based on smoke properties which includes particle sampling, temperature sampling, and air transparency testing. An alarm system will not be activated unless smoke properties or particles reach the sensing system and activate them.

Researchers have proposed several fire detection algorithms in past years. Thou-Ho et al. proposed a fire detection algorithm, where he combines the saturation channel of the HSV color and the RGB color. Determination of the two thresholds RT and ST is required for three rules (R≥G>B), (R≥RT), and (S≥ ((255-R)ST/RT) of this algorithm. Threshold range for RT is from 115 to 135 and for ST is from 55 to 65 based on many investigational research done by the authors.

Compared to other algorithms this method is computationally simple; however, in case of fire-like objects it has higher possibility of giving false-positive alarms [1]. Dios et al. proposed an optical model for forest fire detection and measure the properties of the fire such as flame height, flame inclination angle fire front and base width. This system is very good as false alarm rates are low but it becomes very expensive due to the use of infrared cameras, GPS and telemetry sensors [2]. Yinglian et al. proposed image processing based fire disaster prevention algorithm. This algorithm uses color properties of fire and smoke to identify fire but the smoke mainly depends on the burning material it has different color according to it and it spreads quickly; thus, the false alarm rate rises [3].

In this paper, a forest fire detection algorithm is presented by using google earth engine. The final results show that the proposed system has good detection rates and fewer false alarms, which are the main crucial problems of the most existing algorithms.

III. PROPOSED SYSTEM

In our proposed system, Google earth engine plays a very crucial role. Using satellite Google earth engine is continuously monitoring the earth and the location of specific area to detect the forest fire.

Normally the Google earth shows land in green color and water in blue color. The fire which is mostly red in color, and sometimes the fault in detection may occur such that there can be a rally having numerous flag which are also red in color. The next step in our system is to detect the location of land where the fire is detected and also the temperature and humidity sensor(DHT11) detect the temperature and if the temperature rises above the predefined level, then this data goes to the cloud. And thus the objective of our system is to capture the image of a particular location where fire is detected using Google Earth Engine images and the rise in temperature at that particular location where the hardware system is installed. And if both systems are indicating that there is a fire then the condition will be satisfied which indicates that there no fault in fire detection and it will convey that information to the respective forest department.

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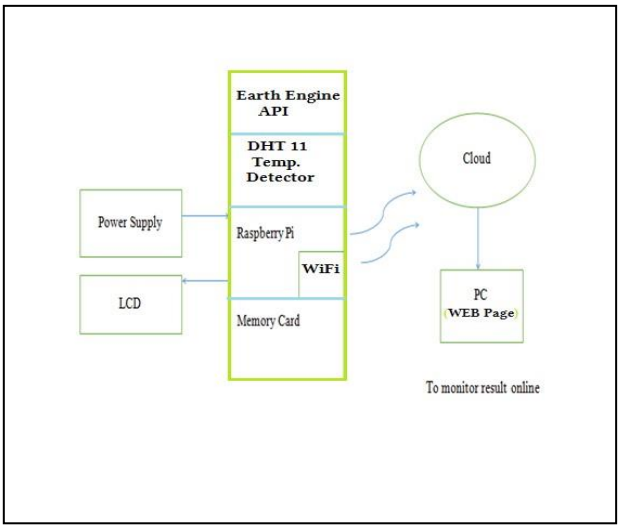

Fig. 1: Block diagram of system

From the Google Earth Engine images of the area are captured And using image processing algorithm the fire is detected. On The other hand, the Hardware system which includes Temperature and Humidity sensor is installed in the area of Which we have captured the images through Google earth engine. DHT11 sensor, LCD Display, buzzer is interfaced with Raspberry pi. The result of both these systems are uploaded on the Cloud. These both results are compared, and if the fire is detected by both the systems the we can conclude that the fire is actually present in that area then the message will be send to the respective forest department so that further actions will be taken. And if any one of the system does not shows fire then we will conclude that there is no fire present.

IV. EQUIPMENT

A. Hardware requirement

a) Raspberry Pi4 - Raspberry Pi 4 model B is used to interface the sensor, LCD display and Buzzer.

Fig. 2: Raspberry Pi 4

b) Temperature and Humidity sensor - The DHT11 is a digital temperature and humidity sensor. This sensor takes input from surroundings and gives digital signal as output.

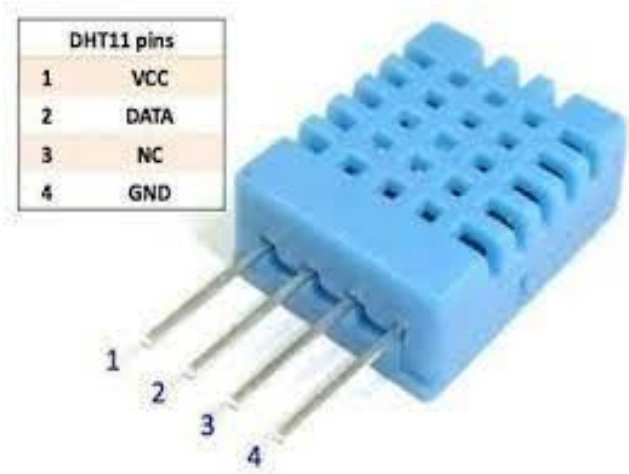

Fig. 3: DHT11 Temperature and humidity sensor

As the sensor is of small size and consumes less power. It's temperature range is in between 0^0 to 50^0 c and humidity range is between 20% to 90%.

c) LCD Display – Liquid crystal display(LCD) is a 16 columns 2 rows display. It is a user-friendly electronic display module. It uses liquid crystal for producing character and number.

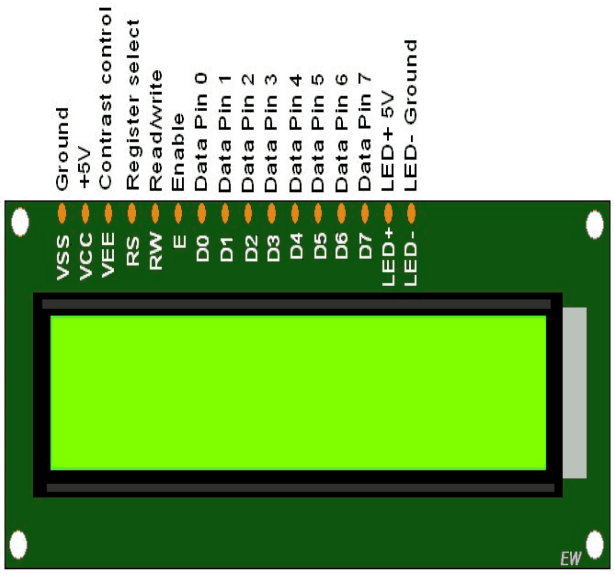

Fig. 4: LCD Display

It is used to display status about fire detection. LCD is a thin, flat display device made up of a number of color of monochrome pixel arrayed in front of light source or reflector. It uses very small amount of electric power.

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d) Buzzer – Buzzer can also be referred as a beeper. It's an audio signaling device used in systems where audio needs to be generated for signaling purpose, which may be of mechanical, electro mechanical or piezo-electric type.

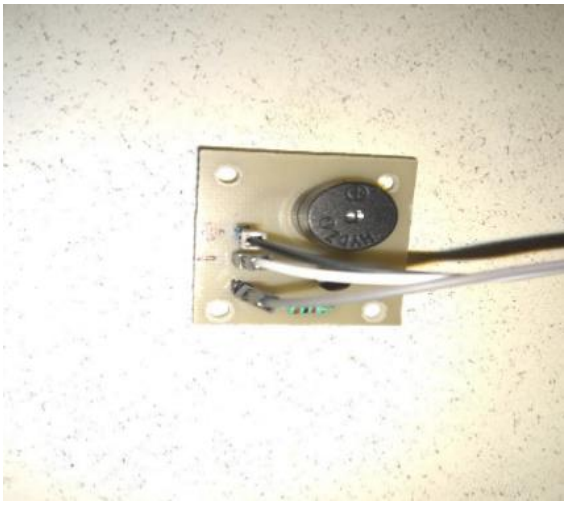

Fig. 5: Buzzer

B. Software Requirement

- Google Earth Engine – The Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with analysis capabilities and makes it available for scientist, researchers and developers to detect the change, map trends and quantify difference on the earth surface. Earth engine data catalog consists of variety of datasets from which we can select any as per requirement.

We have selected FIRMS: Fire Information for Resource Management System.

Dataset provider - NASA / LANCE / EOSDIS

Fire Information for Resource Management System (FIRMS) dataset contains the LANCE fire detection product. This LANCE fire detection product is in rasterized form. The near real-time (NRT) active fire locations are processed by LANCE. For which it uses the standard MODIS MOD14/MYD14 Fire and Thermal Anomalies product. The data are rasterized as follows: for each FIRMS active fire point, a 1km bounding box (BB) is defined; pixels in the MODIS sinusoidal projection that intersect the FIRMS BB are identified; if multiple FIRMS BBs intersect the same pixel, the one with higher confidence is retained; in case of a tie, the brighter one is retained.

- Python – Python is a general purpose and high level programming language. It can be used for developing desktop GUI applications, websites and web applications.

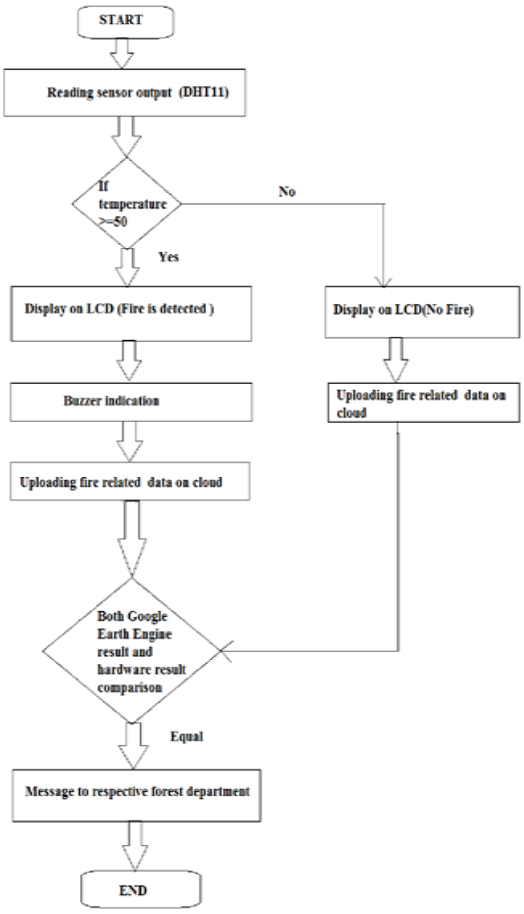

Fig. 6: System flowchart

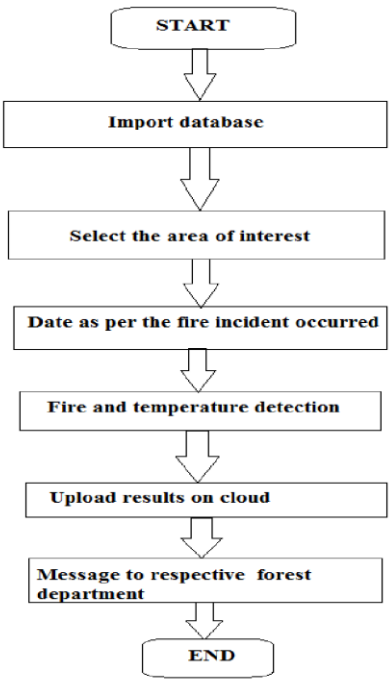

Fig. 7: Flowchart of the Google Earth Engine based system

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V. RESULT

Image before fire:

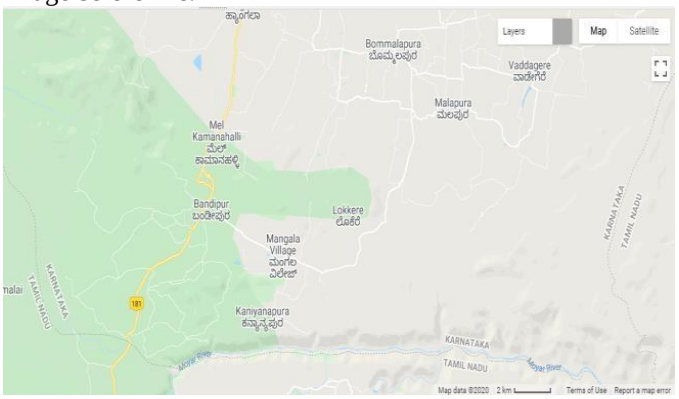

Fig. 8: Image before fire

Image after fire:

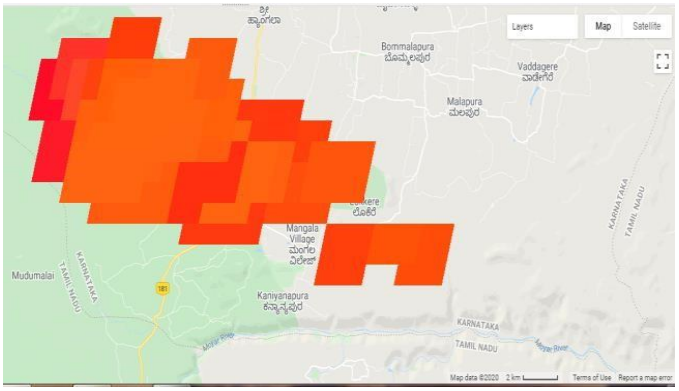

Fig. 9: Image after fire

VI. APPLICATIONS

- To detect forest fire in early stage so that it will reduce the possibility of huge disaster.
- Can be used in public places.
- Can be used in industrial area.

VII. FUTURE SCOPE

- With further analysis and research, it is possible to improve the efficiency of proposed system. We can completely eliminate the sensor based system and make it completely dependent on Google earth engine cloud based detection. Even further improving and developing the algorithm we can reduce the margin of false alarms.

VIII. CONCLUSION

Forest fires break out in India every year during November-May due to various natural and anthropogenic reasons including accumulation of materials such as dry leaves, twigs, pine needles. Based on the records from forest inventory, occasional fires occur in 54.40% of forests in India, 7.49% to moderately frequent fires and 2.40% to high incidence levels while 35.71% of India's forests is not yet exposed to fires of any real significance so it is important to protect forests from possible fire.

Not only the wildlife but also the entire ecosystem gets affected because of forest fire and it is important to detect fire early to avoid major harm to ecosystem with the help of datasets available in Google Earth engine. The overarching goal of Google Earth Engine is to make progress on forest fire detection which is the biggest challenge by making it not just possible, but easy, to monitor, track and manage the Earth's environment and resources.

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