AN IOT BASED FOREST FIRE DETECTION AND PREVENTION SYSTEM USING RASPBERRY PI 3

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Abstract - *Uncontrolled blazes occurred by weather, wind, and dry underbrush, can burn acres of land and consume everything in their paths which cause significant damage to natural and human resource. The objective of this work is to design a IoT based system that can detect the fire as early as possible before the fire spread over the large area and to prevent poaching. In our proposed system Raspberry pi is integrated with couple of sensors and camera. Our system consist of fire sensor which is used for fire detection, pir sensor for intruder detection with the help of image processing and humidity sensor for temperature detection. If any catastrophic event occurs the system will immediately sends the alert message along with picture of the affected region and device location.*

Key Words: IOT, RASPBERRY PI, SENSORS, CAMERA, NOTIFICATION, GSM MODULE, GPS MODULE.

I. INTRODUCTION:

Wildfire is an uncontrolled fire which cause significant damage to natural and human resources. Once the fire starts ignited it rapidly spreads all over the forest and results in massive destruction. Some of the reason for wildfire are lightning, extreme hot and arid weather, severe drought, and human unawareness. Over the past decade there is a enormous destruction in forest, in which the majority of those accidents were caused by forest fire. Based on the Forest Survey of India's data on forest fire it is stated that around 50% of the forest areas as fire prone. Based on the forest inventory records, 54.40% of forests in India are exposed to occasional fires, 7.49% to moderately frequent fires and 2.405 to high incidence levels while 35.71% of India's forests have not yet been exposed to fires of any real significance. Between January 1, 2019, and February 26, 2019, a count of 558 forest fire occurred in India. This incidents shows that forest do not have proper fire prevention system.

In this project, we designed an IOT Infrastructure for forest fire detection system to help detect fire as soon as possible, before the fire spread over the large area. The system will be integrated with several sensors to detect fire and motion. The device will be placed on proper places after doing surveys. The data collected by sensors will be sent to Raspberry pi placed on various places. Then the system will process the data and at the same time the system will send SMS using GSM module to the nearby fire service station with the location of the fire using GPS module. Several types of sensors used in the system are Humidity sensor, pir sensor and flame sensor

II. RELATED WORK

An Autonomous IoT Infrastructure for Forest Fire Detection and Alerting System [1] - In this paper, they have built fire detector using Arduino which is interfaced with a temperature sensor, a smoke sensor and buzzer. With the help of IoT technology, they have tried to make it smarter by connecting the whole monitoring process to the webpage created by the PHP tool and controlled by the Arduino programming. In this paper the system is designed and evaluated for its effectiveness as well as scalability due to the improvement of sensor technology. In this paper, the latest technology can help to reduce catastrophic accidents caused due to fire. With the improvement of IoT sensor technology, the system is more efficient and useful.

IoT Enabled Forest fire detection and online monitoring system [2] - The objective of this project was to detect the forest fire as early as possible by measuring the level of temperature and CO2 level. They have used Temperature and smoke sensor to detect the ignition alarming temperature and the level of carbon dioxide gas (CO2).

Early alerting and immediate response to a Wildfire is the only way to avoid great losses. Hence, the most important goals in fire surveillance are early and reliable detection and localization of the fire. It is much easier to extinguish a fire when the starting location is known, and while it is in its early stages. Information about the progress of fire is also highly valuable for handling the fire during all its stages. Based on this information, the firefighting s can be guided on target to suppress fire.

An IOT based fire alarming and authentication system for workhouse using raspberry pi3 [3] -In this paper, they have designed and implemented a fire detection system for factories using Raspberry pi3.They used temperature, flame and smoke sensors for sensing fire and PIR sensor & camera for Intruder detection i.e. Authentication. They have provided a confirmation of the fire suspecting system to avoid any false alarm and System will start firing

suppression system, like opening fire extinguishing water valves when fire occurs.

Forest fire detection using optimized solar–powered ZigBee wireless sensor networks [4] - In this paper, they have developed an system for Forest Fire Detection which overcomes the demerits of the Existing technologies of Forest Fire Detection. It can be ensured that the system developed can be implemented on a large scale with its promising results. The system is provided with low-power elements, higher versions of Zigbee , Maximum power point tracking Algorithm is used in order to make the system run for longer periods efficiently.

III. SYSTEM DESIGN:

In our proposed system we are providing an integrated system which is capable of detecting intruders and fire and sends alert message to the fire station as well as sends the captured picture to email via Wi-Fi. Raspberry Pi 3 has 1.4GHz processor with 1GB memory. Depending on the budget, any webcam or Pi camera which is compatible with the Raspberry Pi can be used, here we have used a normal webcam to keep the overall cost low. The picture is captured in the event of a fire or an intruder and is sent to the registered email id via Wi-Fi and activates buzzer.

A. Block Diagram

The block diagram of the paper is quite simple which has a few basic components but it is quite efficient in producing the result as required.
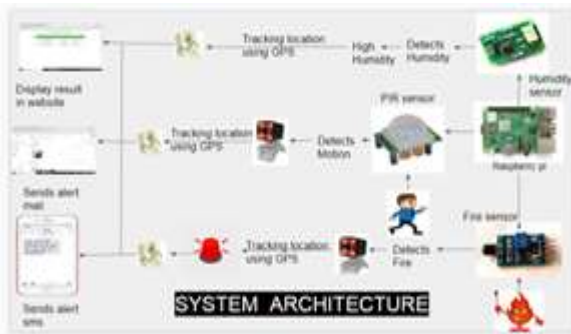

Fig. 1 Block diagram of the system

1) RASPBERRY PI :The Raspberry Pi 3 Model B is the third generation Raspberry Pi and it is a powerful credit-card sized single board computer which consist of ARM Cortex-A53 1.4GHz,64bit quad-core ARMv8 CPU can be used for many applications and supersedes the original Raspberry Pi Model B+. Raspberry pi has a 1GB memory and additional memory is provided by using a micro SD card. It has 4 USB ports, 40 GPIO pins and a Full HDMI port is used to connect to a display.

Fig. 2 Raspberry pi

2) GSM modem: It just looks like a mobile phone using the transmission and reception pins, gsm modem can receive and send the message. Gsm modem could be interfaced with the pc or microcontroller. Gsm modem detects the signals from all the sensors integrated with an RPI, so that if there is any sudden increase in value of sensor it will send alert notification to the forest department.

Fig. 3 GSM modem

3) GPS module: GPS is a device that is capable of receiving information from global navigation satellite system (GNSS) about the device's geographical position. GNSS made up of a network of 30 Satellites placed in the orbit by the U.S. Department of Defense.

Fig. 4 GPS module

4) PIR SENSOR (Passive Infrared Sensor): The PIR Sensor is a pyroelectric device that detects motion by measuring changes in the level of infrared emitted by surrounding objects. Object that generate heat also generate Infrared radiation and those objects includes animals and humans

Fig. 5 PIR sensor

5) FLAME SENSOR: The flame detector is a sensor which is designed to detect and respond to the presence of a fire. Allows your device to detect fire from upto 10m away. When the sensor senses fire it will activate the buzzer

Fig. 6 FLAME sensor

6) HUMIDITY SENSOR: The humidity sensor detects both moisture and air temperature. Humidity is defined as the level of water present in the surrounding air. The device which is used to measure the humidity of the atmosphere is called Hygrometer. If it senses any abnormal situation then the alert message will be sent to the Forest department.

Fig.7 HUMIDITY sensor
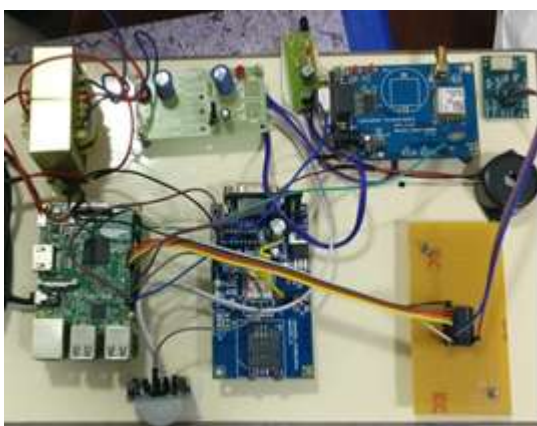
Fig. 8 Hardware Module of the Proposed System.
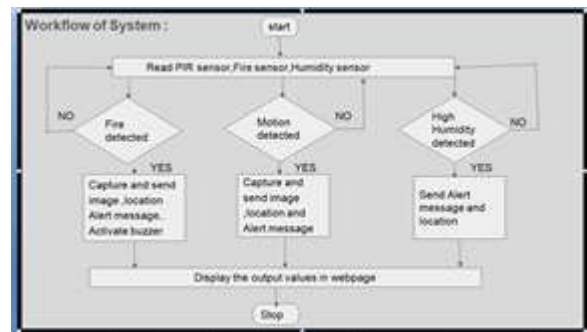
B. FLOWCHART:

Fig. 9 Flowchart of the System

The overall working of the system can be explained with the help of a flowchart. The sensors integrated with the system record the data continuously and send signals to the Raspberry Pi 3 as inputs via the GPIO pins. The Raspberry Pi processes all the received data and responds based on the values of the sensor outputs. The system capture and send the image via mail, alert message via sms with the location whenever the PIR sensor and flame sensor output is TRUE and the system sends alert message via sms with the location whenever the HUMIDITY sensor output is TRUE. The system activates buzzer only when fire is detected. After the alert message is sent, the result will be gets updated to the web page.

C. WORKING PRINCIPLE:

The overall working of the system can be explained with the help of a flowchart. In the proposed system, the sensors record the data continuously and send signals to the Raspberry Pi 3 as inputs through the GPIO pins. The Raspberry Pi processes all the received data and responds based on the output values generated by the sensor. The system is programmed with the necessary condition. If fire occurs the flame sensor senses it and send High value to raspberry pi ,when it receive high value it will send alert message via sms and capture the image and send it to the fire station via mail , activates the buzzer and updates result in the web page. If motion occurs the pir sensor senses it and send HIGH value to raspberry pi, when it receives high value it will send alert message via sms and capture the image and send it to the fire station via mail and updates result in the web page. If abnormal temperature occurs the Humidity sensor senses it and sends High value to raspberry pi ,when it receive high value it will send alert message via sms and updates result in the web page.

D. RESULT:

The system is designed and executed. The inputs flame sensor, PIR sensor and Humidity sensor are used to detect fire, and intruder and measure temperature levels respectively. When abnormal situation occurs it will send alert message and the Web Camera is used to capture the

picture and the captured picture is sent to email via Wi-Fi. Buzzer is activated when the fire is detected.
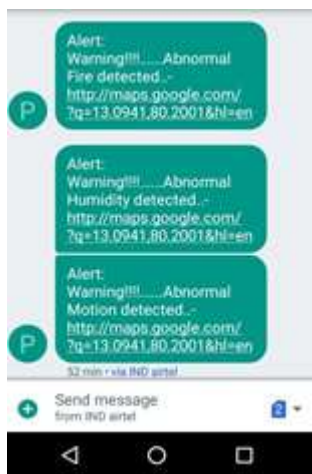

Fig. 10 SMS Alert

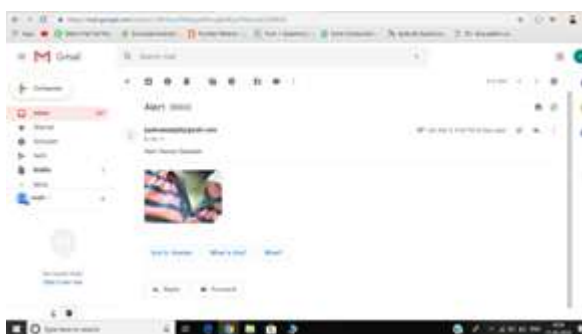Sample SMS alert generated by the system in abnormal situation

Fig. 11 Mail Alert

Sample Mail alert generated by the system in abnormal situation

Fig. 12 Updates result to web page

System updates result to web page if abnormal situation occurs.

IV.CONCLUSION:

We have designed a system for Forest Fire Detection which overcomes the limitation of the Existing technologies of Forest Fire Detection. In this work, we have developed a system which can reduce catastrophic events caused due to fire. This system detects the Wildfire as early as possible before the fire spreads over a large area and prevents poaching.

V. FUTURE SCOPE:

In future, we will be updating the system with additional features like increase the range of sensing of the sensor, monitoring the count of animals present in the forest and can be prevented from being endangered

VI. REFERENCES

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