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IoT Based Fire Detection System

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Abstract: *As the human technology moved further, the risk of natural and man induced catastrophes increase exponentially. One of the most dangerous disasters is fires. In addition to its direct danger on human's lives, fire consumes forests where trees that provide humans with oxygen are destroyed. The risk of fire has increased due to the problem of global warming which appeared in the 1980s. Forest fires represent a constant threat to ecological systems, infrastructure and environmental aspects of a community. This gives rise to the urgent need to detect forest fires as fast as possible. This paper highlights the powerful feature of wireless sensor networks as a potential solution to the challenge of early detection of forest fires. The device presented makes use of various sensors attached, solar recharging mechanism, and wireless data transmission, to fullfill the task in question. These collected data are transmitted to a near central unit where they are analyzed. This website is accessible by the specific authorities in order to take early actions in case of any alert. It is worth mentioning that this system is efficient and green; thus, enforcing the need for its creation.*

Keywords: Fire detection

I. INTRODUCTION

Forest is a large area were it is dominated by trees and animals. Forest covers an area of around four billion hectares or approximately around 30% of world's land area. Forest is one of the huge support for a countries economic. Forest normally contains various species of trees and animals. Even human beings receive a huge profit from the forest. Some medical materials, house-hold requirements and other human requirements are got from the forest. Forest also has a huge impact on the environment which prevents the earth from overheating. The pollution made by the humans are reduced in a greater extent by the forest. So the fire in the forest causes a great impact in the world. Forest fires are unnoticed and spread very quickly, causing millions of acres in damage and claiming many human lives every year in many countries. These forest fire can lead to a huge disaster in the environment . The losses in the forest fire are huge which affects both animals and trees.

Forest fire in the world is increasing in recent times. This fire in the forest is due to natural or man-made disasters. Lightning is one of the reason for natural forest fire .It occurs due to combustion of dry fuel in the forest like leaves. Fire caused due to man-made are more like smoking , due to any miscellaneous activities. The fire caused due to man-made are more than natural forest fire. But large area damage is caused by natural forest fire because it cannot be predicted. The damage cause due to forest fires are more in recent years. The survey tajen by National Interagency Center says that in 2016, there more than 65,575 wildlife are affected due to forest fire. In 2017, the damage has increased to around 71,499 and around 10 million acres were burned in the fire.

By taking a awareness schemes ,the damage has reduced to 55,911 wildlifes and about 8.6 million acres of were burned which is less compared to the year 2017. The survey also suggests that the forest fire are more in northern countries. USA has a huge number of forest fires. Early detection of hot spots and the initiation of appropriate measures can prevent, or, at least minimize damage and casualties. So from this we can find that the damage in the forest are more and an immediate precautions has to be taken to reduce the forest fires. A possible actions has to be taken by the government and also by the forest department to reduce the fire. Some of the actions taken by the government is restricting the people to enter the forest areas without any permission from the forest officers. Usage of fire causing materials are prohibited inside the forest areas ,in any wild life sanctuaries and also in local forest areas. A regular monitoring activities are taken by the forest department by using cameras in the forest areas. To avoid huge damage of

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forest from the natural fire an precautions are taken by the government and forest departments by having some emergency equipments to reduce the fire like fire extinguisher and some rangers are appointed in the forest areas to give immediate information about the fire in the forest so that immediate necessary actions can be taken. So to reduce the damages in the forest area due to forest fires a device can be used were the device is build with some modern technologies. In the modern world immediate information are send and received in a quick time. Even normal activities are informed through this technologies, it is possible and important to inform this kind of information in a quicker time. This information helps the officials to reduce the damage in the forest by fire.

II. COMPONENTS

A. NODEMCU

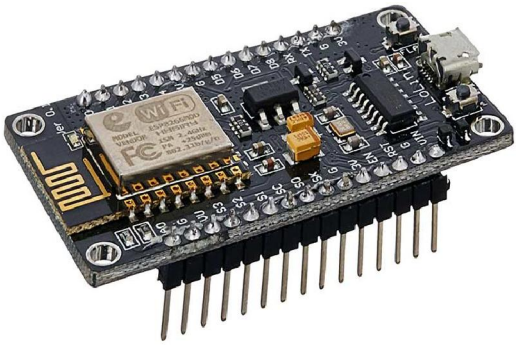

Figure 1 NODEMCU

The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for the Internet of Things (IoT) projects of all kinds..

ESP8266EX has been designed for mobile, wearable electronics and Internet of Things applications with the aim of achieving the lowest power consumption with a combination of several proprietary techniques. The power saving architecture operates mainly in 3 modes: active mode, sleep mode and deep sleep mode. By using advance power management techniques and logic to power-down functions not required and to control switching between sleep and active modes, ESP8266EX consumes about than 60uA in deep sleep mode (with RTC clock still running) and less than 1.0mA (DTIM=3) or less than 0.5mA (DTIM=10) to stay connected to the access point. When in sleep mode, only the calibrated real-time clock and watchdog remains active. The real-time clock can be programmed to wake up the ESP8266EX at any required interval. The ESP8266EX can be programmed to wake up when a specified condition is detected. This minimal wake-up time feature of the ESP8266EX can be utilized by mobile device SOCs, allowing them to remain in the low-power standby mode until WiFi is needed. In order to satisfy the power demand of mobile and wearable electronics, ESP8266EX can be programmed to reduce the output power of the PA to fit various application profiles, by trading off range for power consumption.

B. DHT11 Temperature Sensor

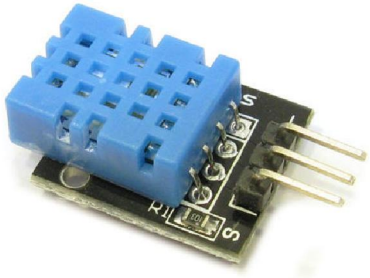

Figure 2 DHT11 TEMPERATURE SENSOR

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Temperature sensor is normally used to measure the temperature at a particular area in a range. The temperature sensor used in this system is DHT11 sensor. Here with the help of this sensor the humidity and temperature can be measures. This sensor generates calibrated digital output. It can be interface with any microcontroller like NodeMCU, Arduino, Raspberry Pi, etc. and get instantaneous results. It is a low cost humidity and temperature sensor which provides high reliability and long term stability.

Here the temperature sensor is connected with NodeMCU and a program is coded in the NodeMCU were the system should give an alert system beyond a certain temperature. Since it is connected with the NodeMCU it does not require an external power supply. Its work is to measure the temperature continuously , the sensor also has a humidity sensing part in it. So the humidity level in the area is also measured and monitored.

C. MQ2 Smoke Sensor

Figure 3MQ2 GAS SENSOR

A gas detector is a sensor that detects gas and smoke as the primary indication of fire. It an easy tool to detect any type of gases or smoke occurred in the forest. The type of smoke sensor used is MQ2. Its coverage is of 112m² per device, which is usually approximated to 100m². With heat detectors it has an area of coverage of 56m² per device which is rounded down to 50m². It has high sensitive and has a high responding time so that the measurement can be done quicker. Smoke sensor is also connected with the NodeMCU board were the smoke level in the forest is measured. Since during fire large amount of smoke is produced a value is initially set in the NodeMCU for the smoke sensor and when the sensor senses the value beyond the limit value an alert is given about the fire in the forest.

D. GPS Module

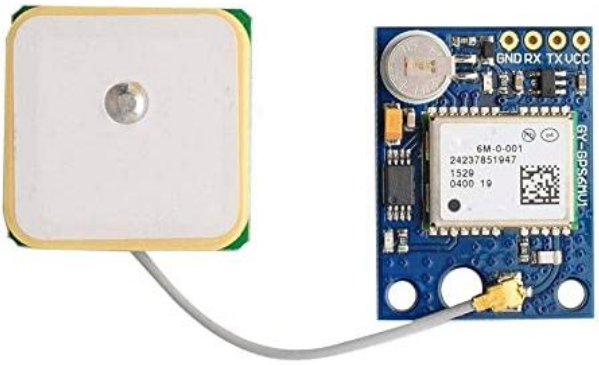

Figure 4 GPS MODULE

GPS module is used to track and located the exact location of the fire in the forest. It is capable of locating the location at a high speed rate. It requires power of 3-5 V and transmits the data at 9600 bps. It also has a backup stored battery which can store the data during power failure. This module is connected with the arduino module, when the arduino notices that the fire has occurred with the help of temperature and smoke sensor it gives the information to the nearby area through Wi-Fi module along with the latitude and longitude values from the GPS module. By receiving the

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longitude and latitude values the exact location can be located. Here GPS is integrated with an antenna which is used to find the values of the place.

E. Solar Module

Solar module is used to provide supply to the entire system. Since the system is designed to implement in the forest it is difficult to have a transmission line for the supply. So the system itself has to provide a power supply in the forest area it is best to have a solar panel and a battery to supply power to the system. The solar module contains a solar panel and a battery. The solar panel contains more number of solar cells which absorbs the sun light and converts it into electricity. This power is stored in a battery.Here during day time the power is supplied directly from the solar panel and during night times the power stored in the battery is used as a power supply. Since the system requires only less power supply, it is enough to have a medium rated solar panel and a battery. Here the power supply is given to arduino and GPS module. Since GPS require only less power than arduino it is not possible for it to supply power to GPS hence a separate line is connected to the GPS module from the solar panel.

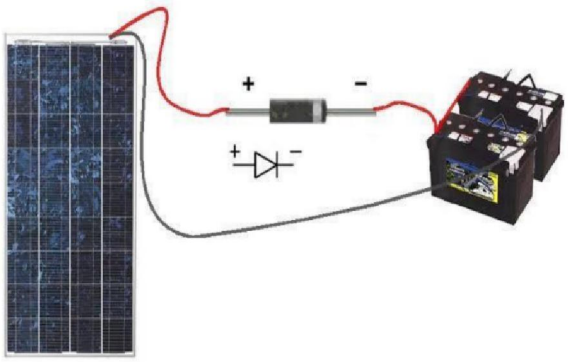

Figure 5 SOLAR MODULE

III. SIMULATION

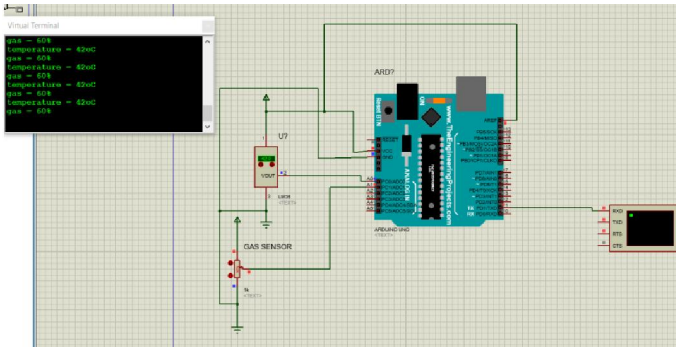

Figure 6 SIMULATION

IV. RESULT & DISCUSSION

The IOT based fire detection system works in such a way that if the smoke detects above a temperature of 33oC “FIRE DETECTED” message was sent to the monitoring station (here it is in thingspeak cloud) using wi-fi module in the NodeMcu by uploading the value to the cloud. The real time temperature is continuously monitored after every 20 seconds and are shown in a graphical manner. When the temperature reaches 38oC or above and the gas or smoke is detected “FIRE DETECTED FAST SPREADING” message is shown in the monitoring station. Though the smoke is not detected on higher temperatures a alert is sent to the monitoring station saying that there is high chances of fire in the area. This is how this system works.

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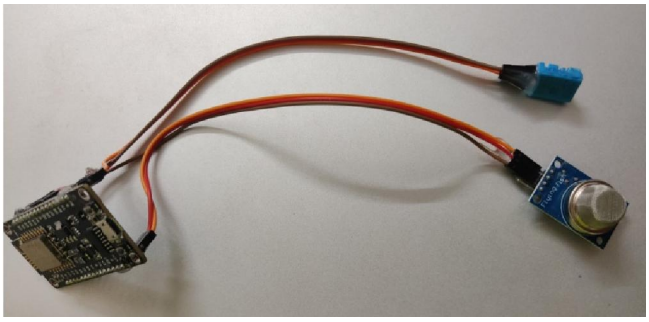

Figure 7 CONNECTION

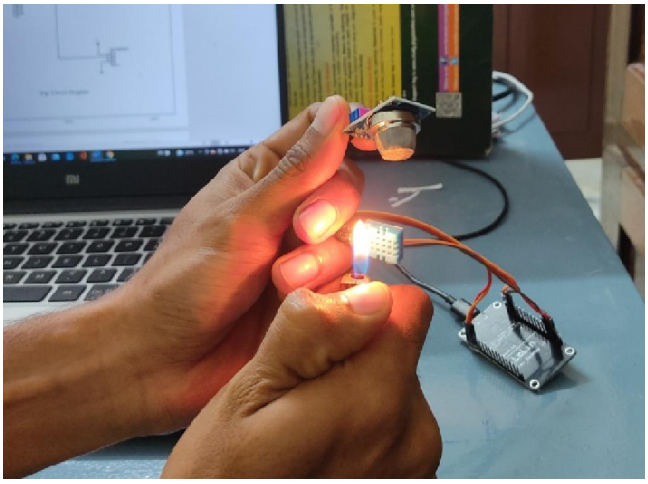

Figure 8 TESTING

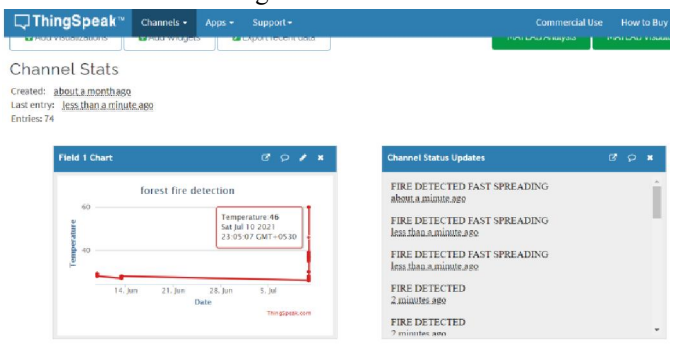

Figure 9 DISPLAY

V. CONCLUSION

Science and technology is panacea for all our growing problems. Predicting the natural processes are highly complex and our system needs to be tested against real time conditions. Though our system is self- sustaining and standalone, other factors which would affect the hardware were tested against time. It shall be implemented in small forest areas where chances of occurrence of forest fires were high. The system needs to be robust to withstand all the climate changes which may affect its functioning. However, our system will play a crucial role in curbing the forest fires which would prevent loss of huge resources and financial losses. We have tested in forest like conditions, but real hardship which we may face is during implementation in large area in real time..

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