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IoT based Forest Surveillance

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ABSTRACT: IoT is one of the dominant position all over the world in technological development. It is another information industry following computer, Internet and mobile communication. In Internet of Things technology the fire-fighting, fire monitoring and safety management system are an important applications[1]. Forest play very important role in the nature cycle so it is necessary to protect it in each and possible way. Arduino platform based IoT enabled fire detector and monitoring system is the solution to this problem. In this project, we have built fire detector using Arduino Uno which is interfaced with a ultrasonic sensor, LDR, humidity/ temperature sensor DHT11, a smoke sensor, Accelerometer sensor and buzzer. The temperature sensor senses the heat and smoke sensor senses any smoke generated due to burning or fire. Buzzer connected to Arduino gives us an alarm indication. Whenever fire triggered, it burns objects nearby and produces smoke. A fire alarm can also be triggered due to small smoke from candlelight or oil lamps used in a household. Also, whenever heat intensity is high then also the alarm goes on. Buzzer or alarm is turned off whenever the temperature goes to normal room temperature and smoke level reduces. We have also interfaced LCD display to the Arduino board with the help of IoT technology, we have tried to make it smarter by connecting the whole monitoring process to the webpage naming created by the PHP tool and controlled by the Arduino programming done in the software- Arduino . Arduino fire monitoring system serves for industrial purpose as well as for household purpose. Whenever it detects fire or smoke then it instantly alerts the user about the fire through the ethernet module. For this purpose, we are using Arduino Uno which is from Arduino family. Also, the Arduino interfacing with LCD display is done to display the status of the system whether the Smoke and Overheat is detected or not. And Arduino interfacing with Ethernet module is done so that user get to know about the prevailing condition message. It intimates the user about the fire detection. This system is really useful whenever the user is not in the proximity of control centre. Whenever a fire occurs, the system automatically senses and alerts the user by sending an alert to an app installed on user's Android mobile or webpage accessible through internet.

KEYWORDS: Forest, ARDUINO, SENSORS, IoT.

I. INTRODUCTION

Forests are the protectors of earth's ecological balance. Unfortunately, the forest fire is usually only observed when it has already spread over a large area, making its control and stoppage arduous and even impossible at times. The result is devastating loss and irreparable damage to the environment and atmosphere (30% of carbon dioxide (CO₂) in the atmosphere comes from forest fires) [1], in addition to irreparable damage to the ecology (huge amounts of smoke and carbon dioxide (CO₂) in the atmosphere). Among other terrible consequences of forest fires are long-term disastrous effects such as impacts on local weather patterns, global warming, and extinction of rare species of the flora and fauna.

Owing to a paradigm shift toward Internet of Things (IoT), researches into IoT services have been conducted in a wide range of fields. As a major application field of IoT, Forest fire detection has become one such issue. The havoc due to forest fire has caused serious environmental problems and devastation of flora and fauna. Within the current turbulent global economic, demographic, social and ecologic context, governments, local administrative authorities, researchers

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and commercial companies or even individuals have to recognize the importance of the resources contained in the forest environment - not only from the perspective of the biodiversity, but also from the point of view of the economic resources which forests enclose. Therefore, any major threat posed to this essential component of the environment should be identified, studied and fought through the most efficient and modern economic policies and technological means. One of the most dangerous phenomena, which jeopardize forests, is represented by forest fires.[3]

II. LITERATURE SURVEY

Forest Survey of India (FSI) is an organization under the Ministry of Environment & Forests, Government of India Its principal mandate is to conduct survey and assessment of forest resources in the country. It started as an organization called Pre- Investment Survey of Forest Resources (PISFR) in 1965 as FAO/UNDP/GOI Project. The changing information needs resulted in enlarging the scope of activities of PISFR and it was re- organized as Forest Survey of India in 1981. Forest fires are a regular phenomenon in our country often observed during the fire season. A number of 37,059 fires were detected in year 2018 using MODIS (Moderate Resolution Imaging Spectro-radiometer) sensor data. Every year large areas of forests are affected by fires of varying intensity and extent. 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. Precious forest resources including carbon locked in the biomass is lost due to forest fires every year, which adversely impact the flow of goods and services from forests. Satellite based remote sensing technology and GIS tools have been effective in better prevention and management of fires through creation of early warning for fire prone areas, monitoring fires on real time basis and estimation of burnt scars. Satellite based remote sensing technology and GIS tools have been effective in better prevention and management of fires through creation of early warning for fire prone areas, monitoring fires on real time basis and estimation of burnt scars.[3]

Over the past decade there is a massive destruction in forest. The majority of those accidents were caused by forest fire. On May 2016, the fire had damaged around 3500 hectares of land and claimed at least seven human lives apart from loss of fauna and flora in Uttarakhand. In 2015 wildfire that burned across the state of California. In which 8,745 fires burned a total area of 893,362 acres. On August 2014, 2 people died and 20 were seriously injured when fire broke out at the Vastmanland . This incidents shows that forest do not have proper fire prevention and rescue system. Moreover, most of the forest departments do not have an automatic system to stop fire. And it takes a lot of time for the fire service to reach the disaster spot. In this perspective, a system to detect fire and alert the forest department before it breaks out. In this paper, we designed an IOT Infrastructure for forest fire detection and alerting system to help detect fire as soon as possible and save precious human lives. The system will use several sensors to detect any symptoms of fire. The sensors will be placed on proper places after doing surveys. After choosing the best places for placing the sensors, the sensor will be activated. The data collected by sensors will be sent to Arduino microcontrollers placed on various places. The microcontroller will then process the data. At the same time the system will send SMS using WiFi module to the nearby fire service station informing them of the incident.[4]

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III.SYSTEM DEVELOPMENT

1) Hardware Component.

- ARDUINO UNO MICROCONTROLLER
- Wi-Fi MODULE
- HUMIDITY ANDTEMPRATURE SENSOR
- LCD(16*2)
- BUZZER
- LDR
- ULTRASONIC RANGE SENSOR
- SOIL MOISTURISER SENSOR
- SMOKE SENSOR
- ACCELEROMETER SENSOR

2) Working of it can be explained in following steps.

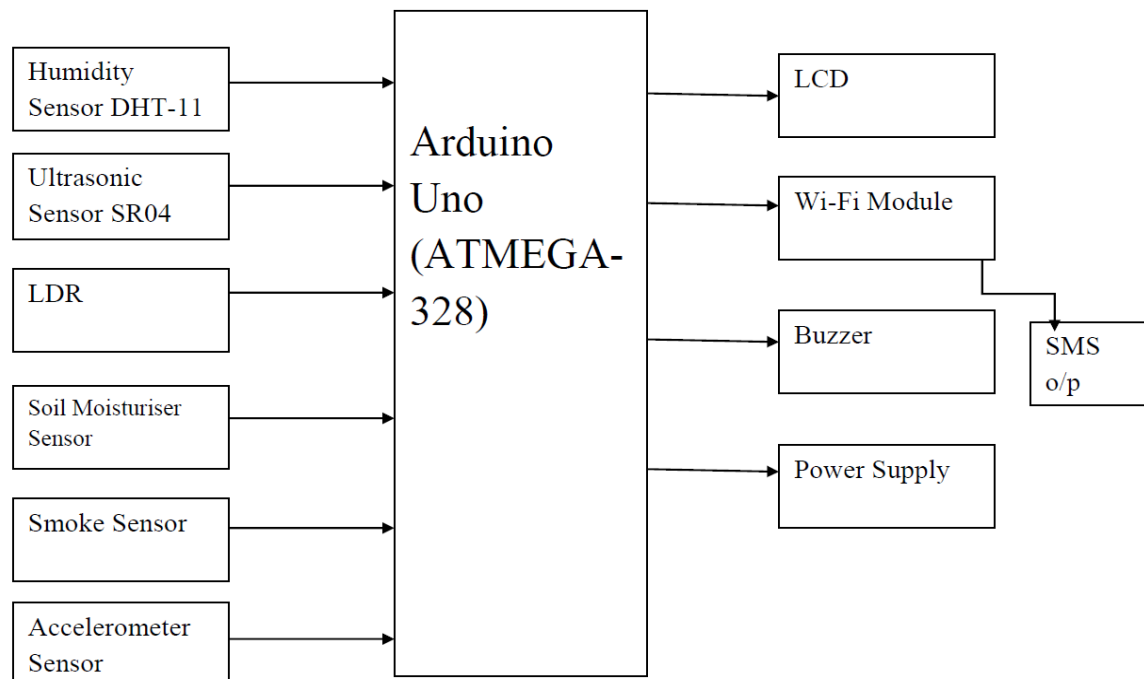


Fig. a. Block Diagram of Proposed System.

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1) Sensors Functions:-

i) LDR.

A light dependent resistor, or LDR, varies resistance in a circuit based on how much light shines on it. When fully illuminated, the LDR has no resistance and current flows freely, but with darkness the resistance increases and current flow stops. In most circuit designs, the LDR acts like an on/off switch based on how much light shines on it.

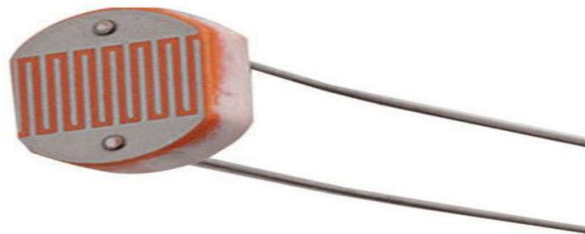


Fig.b.LDR sensor.

ii) DHT11.

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results.

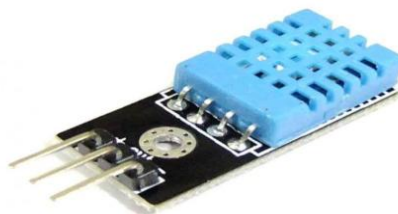


Fig.c.DHT11 Sensor

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iii) Ultrasonic sensor.



Fig.d. Ultrasonic Sensor.

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

iv) Soil moisture.

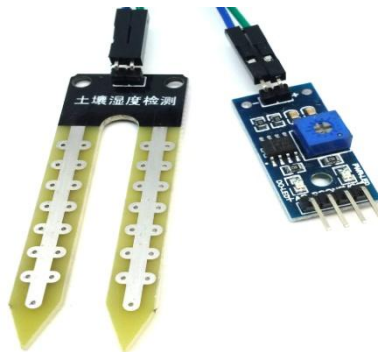


Fig.e. Soil Moisture Sensor.

Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

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v) Smoke sensor.



Fig.f. Smoke sensor

The smoke sensor has a built-in potentiometer that allows you to adjust the sensor sensitivity according to how accurate you want to detect gas.

Sensors used in system such as temperature sensor and smoke sensor are employed that need to be placed at certain distances so that a look can be kept on the entire forest area in order to detect the ignition alarming temperature and the level of carbon di oxide or carbon mono oxide gas. These sensors will send the signal or the information to the microcontroller. These will all sense changes in the environment and react automatically in the event of an emergency. New innovations in automatic initiating devices use cameras and computer algorithms to analyse visible effects of fire and movement in ways that other detection devices can't. Number of fire sensors are to be employed in practical situation that are needed to be placed at certain distances so that a look can be kept on the entire forest area.

2) IC and Arduino interfacing:-The IC ATmega 328(microcontroller) embedded in arduino platform present in the transmitter circuit receive the data sensed and collected by the temperature sensor and gas sensor and other given sensors. Then, the controller performs the programmed action to it and pass them to the transmitter for transmitting the data to the receiving station.

3) Display of output on SMS and webpage:-

Data regarding the activity happened in the forest surveillance project is sent by sms and simultaneously on webpage through ESP8366 Wi-Fi module which is programmed with different library functions of the Ethernet shield interfacing making it possible to create a webpage . The Wi-Fi module allows an arduino board to connect to the internet. It is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. Just plug this module onto your arduino Board, connect it to your network.

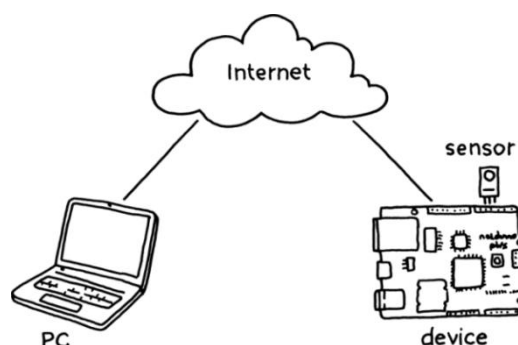


Fig.g. Interfacing of output with device

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Apart from the above, an alarm circuit has been made just to facilitate the fire security team to locate the vulnerable part as soon as possible. This fire alarm circuit will give alarm when any activity happens corresponding to the given sensors.

IV. PERFORMANCE ANALYSIS

	Sensors	Rang Values	Fault Detection
1	DHT11	Temp:- 0-40°C Humidity:- 0-90Rh	Greater or equal to 40°C
2	Ultrasonic	0-20cm	Greater or equal to 20cm
3	LDR	80 adc	Greater or equal to 80 adc
4	Soil Moisture	10 adc	Greater or equal to 10 adc
5	Smoke	0-450ppm	Greater or equal to 450ppm

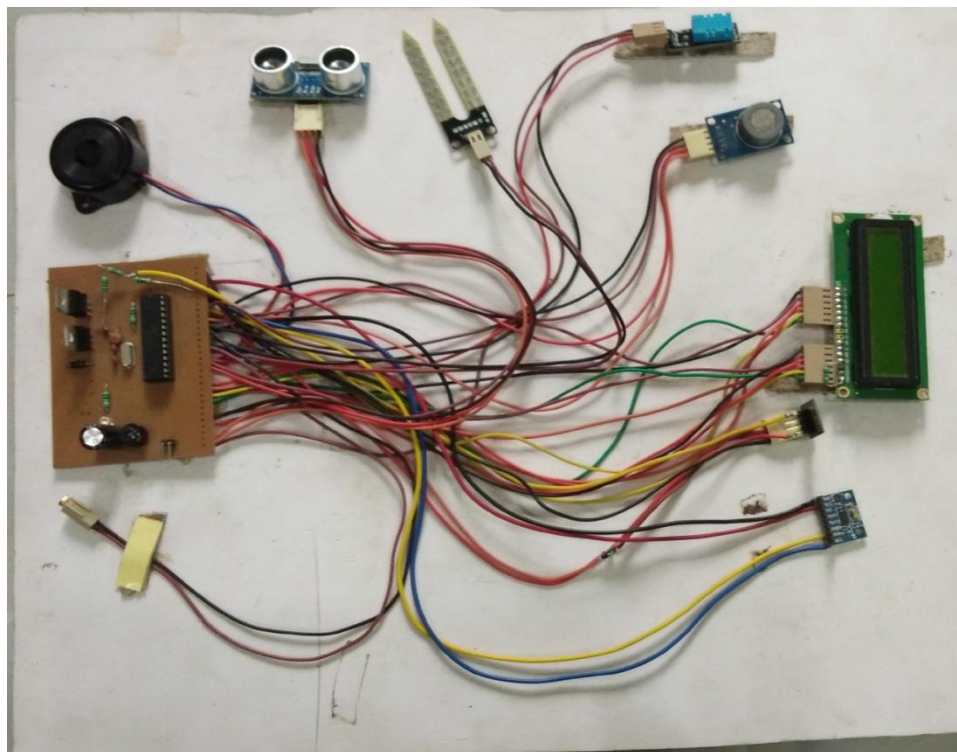


Fig.h. Project Image.

When any sensor value goes above the corresponding range sms is received on the registered mobile no. in the arduino programming through the process of wifi module used in the project which detects the real time fault of all the sensors. Also simultaneously result of all the output which was received by sms is updated on the web page of the corresponding project with date and time which helps to detect and record all the previous and present value of all sensors which detects faults.

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V. CONCLUSION

In this work the system is designed and evaluated for its effectiveness as well as scalability due to the improvement of sensor technology. In this work, 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. Quick and reliable detection and localization of fire are important goals of forest surveillance. It is much easier to suppress 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 managing the fire during all its stages. Based on this information, the fire fighting staff can be guided on target to block the fire before it reaches cultural heritage sites and to suppress it quickly by utilizing the required fire fighting equipment and vehicles.

V. FUTURE SCOPE

4.1. The monitoring and detection techniques used by fire authorities are as follows:-

- i) Weather forecast and estimation of fuel moisture.
- ii) Watch towers.
- iii) Spotter Planes.
- iv) Use of water tankers.
- v) Education through fire watch or similar schemes for house owners.
- vi) Video-camera, sensitive to visible spectrum of smoke recognizable during the day and a fire recognizable at night.

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