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**ROLL NO:** 52

**TOPIC:** IoT based forest fire monitoring system

**Understanding of the problem statement:**

[1] Forest fires are as old as the forests themselves. when there is no rain for months during summer, the forests become littered with dry leaves and twinges, which could burst into flames initiated by even the slight spark They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region, also there is a danger for wild life, domestic crops and to the nearest people.. So there is a necessary to avoid the excess of losses due to forest fire by controlling the fire in its early stages.

Data acquisition is basically the process by which the signals are sampled which measure the real-world physical conditions and convert that signals into numeric values that can be easily manipulated by the computing device. In our project which is IOT based forest fire monitoring system, we require some sensors to detect the changes in temperature or sensors which detect smoke, which will help send data to the microcontroller, because of which the user monitoring this system will be alerted about the fire in the forest.

[2] In this proposed system we are using IOT as base to execute the plan to save forests. As we know it is a trending topic and easy to access. We have used sensors like flame sensor and DHT sensors which performs on the basis of the written code using Arduino Uno platform. A cloud platform called firebase is used to update the values of the sensors. When there is change in the set threshold value then it automatically sends a message to the user through an app saying whether fire is detected or smoke is detected. A threshold value is set for every sensor and they sense the environment changes and update it to the nearest forest officer at the earliest. We have used Nodemcu as the microcontroller which will receive data from sensors and send it through internet to a database or cloud which will be stored as values. To design this project specifically NodeMCU model is used, because to perform multiple tasks simultaneously and IOT is used to perform tasks automatically. NodeMCU is comprising of 30 GPIO pins out of which at most 5 to 6 pins are used as general purpose input and output pins. The GPIO pin 3, 4 and 5 are taken as input pin, and output is calculated using IOT cloud platform called firebase.

Sensors is a device that converts signals from one energy domain to electrical domain. The sensor node must essentially consist of a microprocessor, sensors, a long-range, low-consumption transmission part and an energy source optimized for a long duration.

**FLAME SENSOR**

[3]A sensor which is most sensitive to a normal light is known as a flame sensor. That’s why this [sensor module](https://www.elprocus.com/accelerometer-sensor-working-and-applications/) is used in flame alarms. This sensor detects flame otherwise wavelength within the range of 760 nm – 1100 nm from the light source. This sensor can be easily damaged to high temperature. So this sensor can be placed at a certain distance from the flame. The flame detection can be done from a 100cm distance and the detection angle will be 600. The output of this sensor is an analog signal or digital signal. This sensor/detector can be built with an [electronic circuit](https://www.elprocus.com/top-10-simple-electronic-circuits-for-beginners/) using a receiver like electromagnetic radiation. This sensor uses the infrared flame flash method, which allows the sensor to work through a coating of oil, dust, water vapor, otherwise ice.

Flame Sensor Module

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Flame-sensors are classified into four types

* IR single frequency
* IR multi-spectrum
* UV flame detectors
* UV/ IR flame detectors

### Features & Specifications

The features of this sensor include the following.

* Photosensitivity is high
* Response time is fast
* Simple to use
* Sensitivity is adjustable
* Detection angle is 600,
* It is responsive to the flame range.
* Accuracy can be adjustable
* Operating voltage of this sensor is 3.3V to 5V
* Analog voltage o/ps and digital switch o/ps
* The PCB size is 3cm X 1.6cm
* Power indicator & digital switch o/p indicator
* If the flame intensity is lighter within 0.8m then the flame test can be activated, if the flame intensity is high, then the detection of distance will be improved.

**DHT11 SENSOR**

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[4] DHT11 is a low-cost digital sensor for sensing temperature and humidity.  This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc… to measure humidity and temperature instantaneously.

DHT11 humidity and temperature sensor is available as a sensor and as a module. The difference between this sensor and module is the pull-up resistor and a power-on LED. DHT11 is a relative humidity sensor.  To measure the surrounding air this sensor uses a [thermistor](https://www.elprocus.com/introduction-to-thermistor-types-with-its-workings-and-applications/) and a capacitive humidity sensor.

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature.  The humidity sensing [capacitor](https://www.elprocus.com/construction-of-capacitor-with-working/) has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second.  DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.

DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro-controller.

**TEMT6000 Sensor**

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[5] We can even use light intensity sensor such as **TEMT6000 Ambient Light Sensor.** The TEMT6000 is made up of a single **phototransistor,** which acts just like a simple **NPN transistor.** The greater is the incoming light on the Base, the more the current flowing from the Collector to the Emitter. The sensor only works in the visible spectrum **(390–700 nm).** The Infrared, ultraviolet ray or any other light will have no effect on the sensor. The sensor operates in the range of **3.3V to 5V.** The breakout board has a voltage divider circuit connected to the **10K Resistor**. The TEMT600 acts as one of the resistors in the divider network. As the light falls on the **phototransistor surface**, the resistance value changes which changes the voltage on the SIG pin. An Arduino or any other **microcontroller** is used to read the value and then to measure **illuminance and light intensity.** [TEMT6000 Ambient Light Sensor](https://www.vishay.com/docs/81579/temt6000.pdf) measures illuminance. The **Illuminance** is a measure of the total quantity of visible light emitted by a source. It is referred to as **luminous flux**and measured in **lumens (lm) per meter square.**

**PIR Sensor**

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[6] PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation.

Most PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V. Sometimes bigger modules don’t have direct output and instead just operate a relay which case there is ground, power and the two switch associations. Interfacing PIR with microcontroller is very easy and simple. The PIR acts as a digital output so all you need to do is listening for the pin to flip high or low. The motion can be detected by checking for a high signal on a single I/O pin. Once the sensor warms up the output will remain low until there is motion, at which time the output will swing high for a couple of seconds, then return low. If motion continues the output will cycle in this manner until the sensors line of sight of still again. The PIR sensor needs a warm-up time with a specific end goal to capacity fittingly. This is because of the settling time included in studying nature’s domain. This could be anyplace from 10-60 seconds.

**Software and Hardware Requirement:**

Hardware:

* Flame Sensor
* DHT11 Sensor:
* 3 to 5V power and I/O

2.5mA max current use during conversion (while requesting data)

Good for 20-80% humidity readings with 5% accuracy

Good for 0-50°C temperature readings ±2°C accuracy

No more than 1 Hz sampling rate (once every second)

Body size 15.5mm x 12mm x 5.5mm

4 pins with 0.1″ spacing

* TEMT6000 Sensor

Wide angle of half sensitivity ϕ = ± 60°

* PIR Sensor
* RASPBERRY PI
* GSM modem
* GPS module

Software:

* Arduino IDE
* Proteus Design Suite
* Python

**Updates:**

* We can add a extra module which consists of a servo motor and a camera, which after the detection of smoke, could capture the image of the forest fire in order to let the user know the severity of the forest fire. Also it could help us understand whether the forest fire detected by the sensors is true or not, as it would capture the image of the landscape at that particular moment.
* In future, we can update 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
* We can also implement the KILLFIRE method uses spatial segmentation and motion flow estimations to detect fire from moving videos. By the use of motion compensation techniques, high accuracy is achieved in the results. The temporal video segmentation adds the extra advantage in the proposed system which segments the fire regions.

**Application:**

Fire detection and management plays a very crucial part in terms of safety. In our project we have used it to detect fire in the forest, similarly the same system with little modification can be implemented in malls, offices, data centres etc.

**Advantages:**

The proposed system detects the forest fire at a faster rate compared to existing system. It has enhanced data collection feature. The major aspect is that it reduces false alarm and also has accuracy due to various sensors present. It minimizes the human effort as it works automatically. This is very affordable due to which can be easily accessed. The main objective of this project is to receive an alert message through an app to the respective user.

**Conclusion:**

This type of system is the first of its kind to ensure no further damage is then to forests when there is fire breakout and immediately a message is sent to the user through the App. Immediate response or early warning to a fire breakout is mostly the only ways to avoid losses and environmental, cultural heritage damages to a great extent. Therefore the most important goals in fire surveillance are quick and reliable detection of fire. It is so much easier to suppress fire while it is in its early stages. Information about progress of fire is highly valuable for managing fire during all its stages. Based on this information the firefighting staff can be guided on target to block fire before it reaches cultural heritage sites and to suppress it quickly by utilizing required firefighting equipment and vehicles. With further research and innovation, this project can be implemented in various forest areas so that we can save our forests and maintain great environment.

**References:**

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