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Forest Fire Detection and Prediction for Alert Generation and Safety Measure

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Abstract: ***Forest is an important asset of this world as it creates ecological balance and provides several resources that are helpful to mankind. It is important to preserve the forest areas. Fire is one of the most dangerous threats to the forest. Every year number of forest areas reported to catch fire. Many areas in forest are still not on surveillance to provide information of fire. Thus it spreads over large area and destroys forest. Amazon fire is recently occurred fire. In this project a prototype is designed such that it will detect and inform about the occurrence of fire at distant location. The system proposed in this project comprises of two sensors, namely smoke and fire. These sensors detect change in small measurable physical quantity and help within the early detection of a fire. Large number of self powered monitoring units are placed over the forest area. In this project a single unit with reporting system is presented and evaluated.***
Keywords: Ecological balance, self powered monitoring units, reporting system, sensors

I. INTRODUCTION

Forests protect the earth's ecosystem. Unfortunately, fires are often seen only when they are already in contact with the outside world, making their control and suspension difficult and impossible from time to time. The result of traumatic and irreversible losses damages the environment and atmosphere (30% of (CO2) inside the atmosphere from forest fires), in addition to irreversible environmental damage (heavy smoke and dioxide (CO2) in the atmosphere). Among the most devastating effects of forest fires are the long-term adverse effects such as effects on local climate patterns, warming, and extinction of rare plant and animal species. The problem with forest fires is that forests are often remote, abandoned / uncontrolled areas lined with trees, dry and leafy wood, leaves, and the like. These materials form a very flammable substance and represent the ideal context for starting a fire first and act as fuel for the latest phases of a fire. The heat of the fire can also be caused by human actions such as smoking or barbecue groups or by natural causes such as excessive heat on a hot summer day or broken glass acting as a concentrated lens focusing on sunlight in a small area of your time thus leading to fire. Once started, a fire can burn easily to ignite fires in the center and become larger and wider. The first stage of fire is often referred to as the "upper fire" category. This strength may cause him to feed on nearby trees and the flame of the fire becomes greater and better, thus becoming a "crown of fire." In particular, at this stage, the fireplace is uncontrollable and the damage to the land may be severe and will remain square depending on the prevailing weather conditions.

II. LITERATURE SURVEY

In fire detection, it's essential to understand how fire affects the soil mantle, stems and treetops, further as a way to detect underground fires. The sensor network must cover large areas, distributing high amount of sensing node and expensive sensors are needed to attain cost reduction. Video cameras sensitive in color spectrum supports smoke recognition during the day and fire flame recognition during the night, Infrared thermal imaging cameras supports detection of heat flux from the fireplace, IR spectrometer which identifies the spectral characteristics of smoke gases, and “Light detection and ranging” system which measures laser light back scattered by smoke particles. Infrared and laser-based systems have higher accuracy than the opposite systems. Generally if the infrared level exceeds a predetermined threshold, an alarm is sent; but this technique has some drawbacks that affect detection capability and reliability. Detection capabilities is negatively influenced by the very fact that often fires don't seem to be directly visible from the sensor because during the primary phases they become older within the underbrush and are occluded from the herbage. On the opposite hand the smoke (water vapour plus carbon monoxide), copiously produced during the wood drying process, is perfectly transparent within the infrared region (3-7 pm). So it cannot be detected with the help of IR sensors. To become directly IR-visible, generally a hearth must be at the tree top, in order that when it may be detected is already widely extended from the fireplace starting moment.

Handling uncertainty because of data aggregation and missing information require space-time synthesis in rigorous formalism. Information granulation is at the center of rough pure mathematics. Meteorological data and pictures are parameters over space and time with relatively high frequency. The change of meteorological data might be recognized in hour scale, and the change of image data, taking into consideration only information connected to forest fires, in minute scale. Also for the forest fire prediction system, meteorological data history (archive values) is kind of important. So to observe meteorological parameters and collect images in real time, the sensory network must be established. The most critical issue during fire detection system is immediate response so as to attenuate the dimensions of the disaster. This needs constant surveillance of the forest area. Current medium and large-scale fire surveillance systems don't accomplish timely detection thanks to low resolution and long period of scan. Therefore, there's a requirement for a scalable solution that may provide real-time fire detection with high accuracy

III. OBJECTIVE

Monitoring of hazardous areas and premature fire detection can reduce the interval and reduce potential damage as well as firefighting costs. There are various detection and monitoring methods used by the authorities. This includes viewers within the monitoring style or monitoring towers, aerial and satellite monitoring and advanced detection that support the visual camera sensors and various types of sensor detection or their union. The main goal is to find the center very quickly and send its location directly using the GPS module and early

IV. BLOCK DIAGRAM

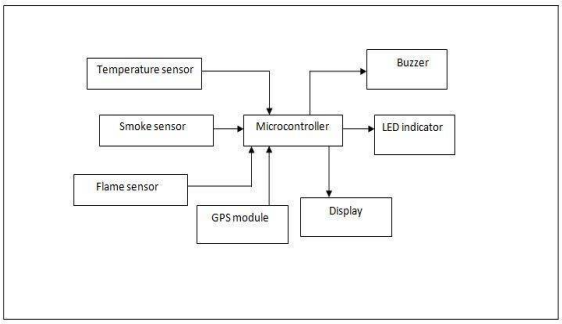

Fig.1. Block diagram

V. FLOWCHART

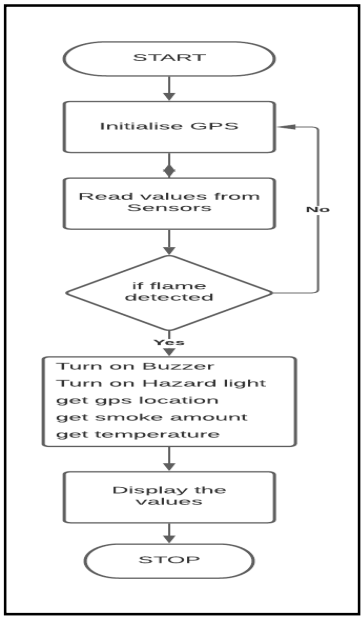

Fig.2. Flow chart

VI. WORKING

In this prototype, the fire is detected and an alarm indicating the presence of fire in the forest is shown. The device will detect the location where the fire has started and will send the exact location to the host, this is done using the GPS module -Neo 6m along with antenna. The GPS receiver extracts signal from each GPS satellite. The satellites transmit the exact time the signals are sent. By subtracting the time, the signal was transmitted from the time it was received, the GPS can tell how far it is from each satellite. The fire is detected using various sensors as listed. The smoke sensor senses the smoke value around the fire, the temperature sensor gives the exact temperature of the region where the fire is observed. Flame sensor is also used in detecting fire. This sensor/detector can be constructed with an electronic circuit 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. Initially when there is no fire, green LED is shown on the device and a message saying no flame detected is shown on the display . When the fire is detected by the flame sensor, the device sends the location of the fire accident to the host by using the GPS antenna, which gives the exact coordinates of the area indicating the latitude and the longitude values. Along with these values, the sensors also give analog and digital readings of the fire detected. The smoke sensor gives the values in parts per million and the temperature of the location in Celsius. this is all displayed on the screen when the fire is detected. To indicate the immediate fire detected a buzzer is used to alert the user about the fire. This is all done using the Arduino microcontroller ATmega328

VII. HARDWARE AND SOFTWARE

A. Flame Sensor

A flame-sensor is one quite detector which is principally designed for detecting additionally as responding to the occurrence of a heat or flame. The flame detection response can depend on its fitting. A flame sensor detects the presence of fireplace or flames. In extremely hazardous environments, flame sensors work to minimize the risks related to fire.

B. Temperature Sensor

A temperature sensor may be a tool, typically, a thermocouple or resistance temperature detector, that offers temperature measurement during a readable form through an electrical signal. A thermometer is that the most simple type of a temperature meter that is accustomed to measure the degree of hotness and coolness.

C. Arduino Uno

The arduino uno is an open source microcontroller board supported the Micro chip ATmega328p microcontroller and developed by Arduino.cc.The board is supplied with sets of digital and analog input/output (I/O) pins which will be interfaced to numerous expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a sort B USB cable. It may be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. it's almost like the Arduino Nano and Leonardo. The hardware reference design is distributed under a clever Common Attribution Share-Alike 2.5 license and is offered on the Arduino website. Layout and production files for a few versions of the hardware are available.

D. GPS Module

GPS receiver uses a constellation of satellites and ground stations to calculate accurate location wherever it is located. These GPS satellites transmit information signal over radio frequency (1.1 to 1.5 GHz) to the receiver. With the help of this received information, a ground station or GPS module can compute its position and time. GPS receiver receives information signals from GPS satellites and calculates its distance from satellites. This is done by measuring the time required for the signal to travel from satellite to the receiver.

E. Smoke Sensor

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemi resistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected. MQ2 Gas sensor works on 5V DC and draws around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000ppm.

F. Buzzer

A buzzer is a small yet efficient component to add sound features to our project/system. It is very small and thick 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this extensively used component in most electronic applications. This buzzer can be used by simply powering it with a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is suggested to use a regulated +5V or +6V DC supply. The buzzer is normally connected with a switching circuit to turn ON or turn OFF the buzzer at required time and require interval**.**

G. Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, and Linux) that's written in the Java artificial language. It includes a code editor with features like text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The ASCII text file for the IDE is released under the GNU General Public License, version 2.

VIII. EXPERIMENTAL RESULTS

This project consists of a device containing different sensors interfaced with arduino. All these sensors helps in detecting the fire and send the exact location to the host with the help of GPS module. Along with GPS coordinates it also gives us information about the temperature and the amount of smoke generated in ppm. There is also a buzzer which alerts the authorities as soon as the fire is detected.

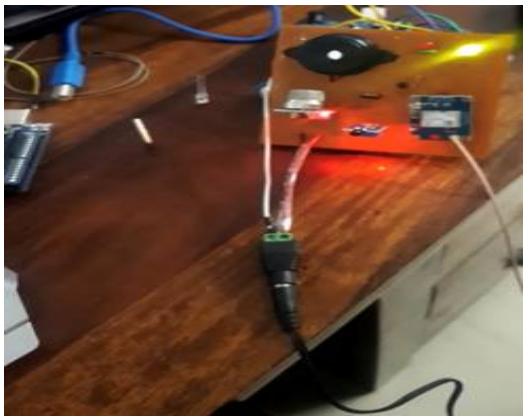

Fig.3. Device with all the sensors and the GPS module

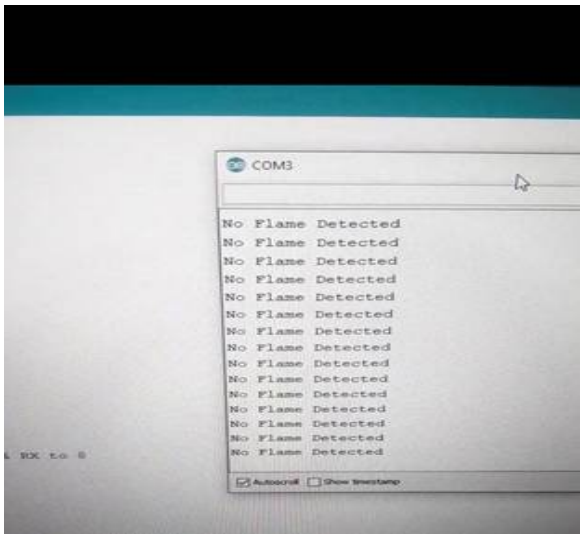

Fig.4.When there is no fire detected

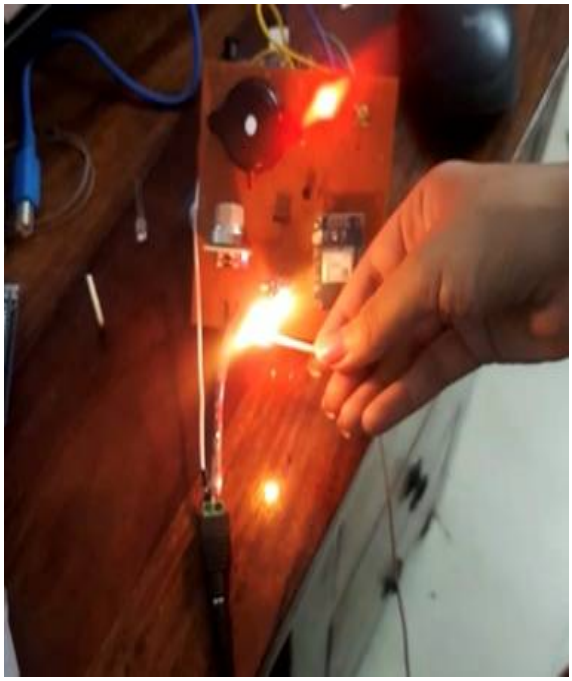

Fig.5.When the fire is detected by the device

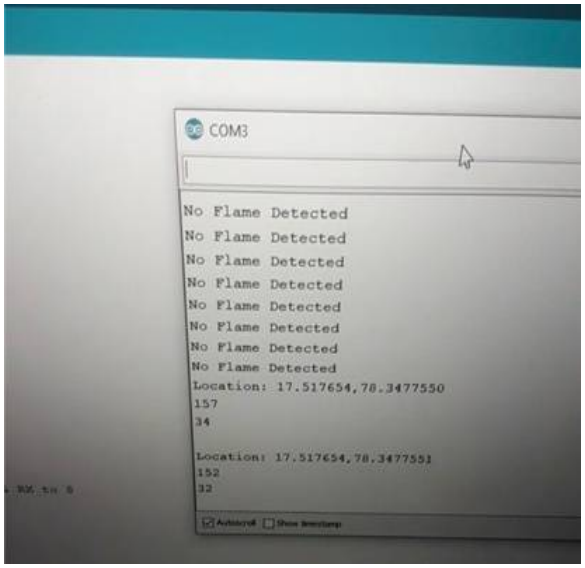

Fig.6.Display indicating the location and sensor values

IX. CONCLUSION AND FUTURE SCOPE

It is easier to suppress a fireplace in its drawing board than in the later stages. Hence, the foremost important important goal is quick, reliable detection of the hearth. The proposed fire alert system overcomes the necessity of a human intervention to continuously monitor the forest area. Monitoring and detecting is completed by the sensors installed and message alerts are used to alert required authorities. It gives instantaneous information of the fireplace to the authorities and help block the fire before it reaches cultural heritage sites. This fire alert system is power efficient, low cost and low maintenance, and therefore the equipment is durable and reliable. In future, we will install a wind sensor to the system which helps to see the direction of the fire and also the rate at which it will spread. Along with this we will implement an automatic asphyxiator system. As soon as a sensor detects fire, extinguisher gets activated. By adding IOT, the information is sent to cloud databases for storage and prediction purposes. Additionally to these, many other sensors can be implemented as per user requirement.

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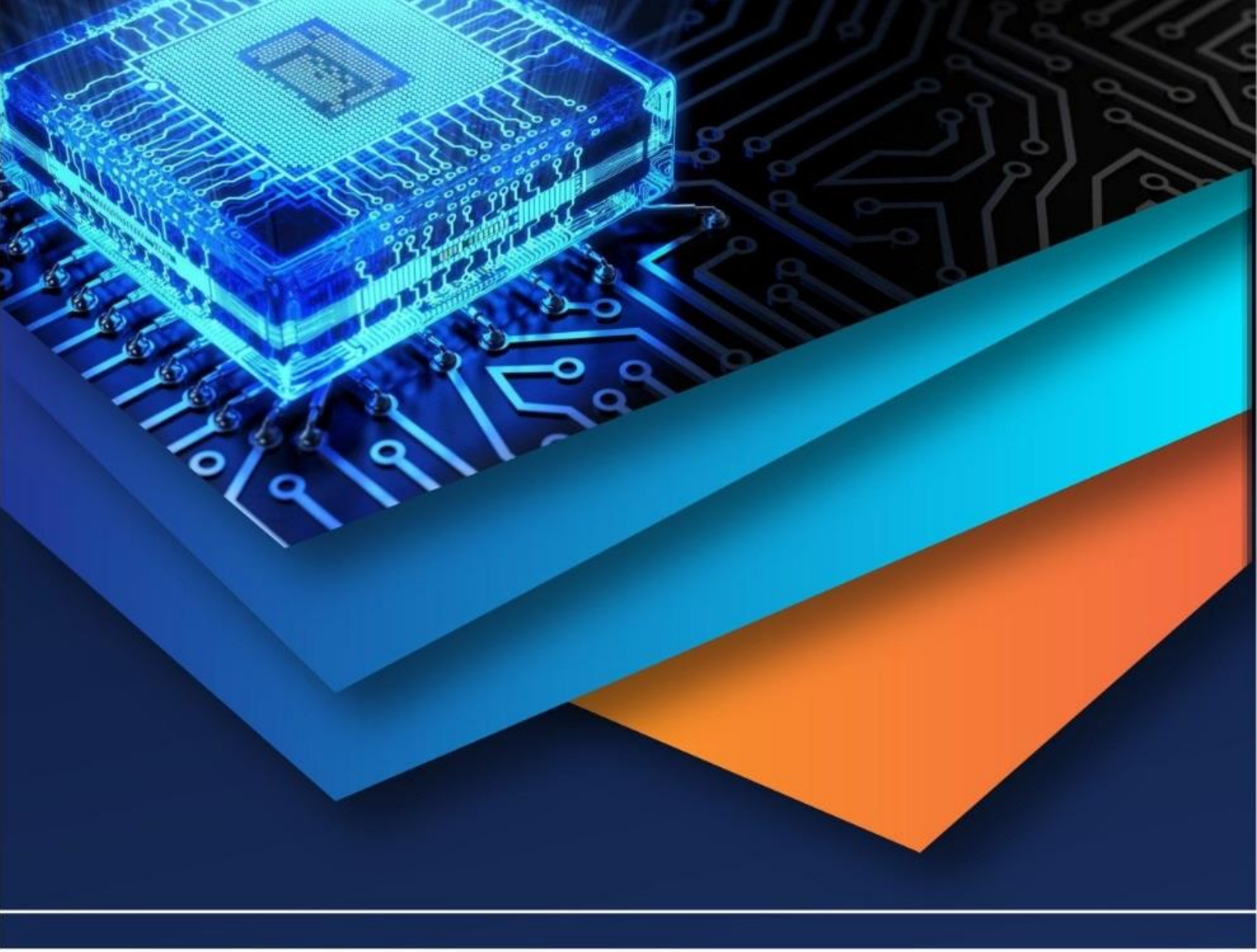

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