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IoT based system for alerting Forest Fire and control of Smuggling

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Abstract
The analysis of environmental conditions in real time (such as weather events and polluting gases) could provide relevant data on the environment that could help prevent or detect an emergency situation. Nowadays, IOT (Internet of Things) devices and sensors allow the monitoring of different environmental variables, such as temperature, humidity, pressure and concentrations of pollutant gases, such as carbon monoxide and carbon dioxide. Radical changes and combinations of these variables could indicate the occurrence of adverse weather events that could cause a natural disaster, such as a forest fire. This paper presents an IoT system that can perform a real time control of fire and tree cut events. Fire usually causes serious hazards. Therefore, to prevent catastrophes that occur in industries, buildings, and forest areas, IOT and sensor based fire detection has become an important issue. In this proposed system, sensors and microcontroller are incorporated to detect the hazardous situations. Light and smoke indicate the chances of fire. If the fire level is mild or severe, then it is alerted by using a buzzer. Tree cuting can be detected by using wireless bend sensor. This helps to prevent tree smuggling and protect forest life. An IOT based system is developed and tested for correct working.

1. Introduction

Forest is a major resource for human life. Protecting it is highly important for environment health, climatic conditions and natural resource preservation. In present days, emergency conditions due to natural hazards incur big loss in terms of material and personal assets. Further damages to the ecosystem and disease spreading occurs due to environmental pollution and natural calamities. The effects of such hazards can magnify due to improper resource planning. Certain reasons could be security lapses or improper control, plans for emergency and alerting systems. With such measures we can have increased options for detecting and controlling major hazards and spread. The problematic situations can increase the density of the pollutant gases such as CO2 and CO in air and also can cause frequently occurring forest fire. Events of that kind lead to emergency conditions which need efficient management agencies and services for handling emergency. The enhancing factors for these emergency situations include topography of the land, vegetation categories in the surroundings and climatic conditions. The control and monitoring of atmospheric variables(temperature, relative humidity and atmospheric pressure) in addition to the concentration levels of certain pollutant gases can enable finding out fire generation and monitoring of their progress. In this context certain parameters like increase in temperature, reduction in the humidity level, or increase in pollution level can lead to indications of fire emergency or its beginning. To address these issues an information system has been developed that involves IOT devices together with sensors that can detect smoke and light for fire detection. Smoke and fire can increase the level of atmospheric pollution and affect people health, cause damage to trees and forest life.

2.Literature Survey

Sensor networks can be greatly helpful in monitoring and tracking remote system activities [1-3] and emergency conditions. Most of the time emergency situations lead to losses to material and personnel. Hostile events in the nature and atmospheric pollution because of human related activities create disasters beyond certain limit of normality. This causes damages to the environment as well as ecosystems and causes diseases among the population. These effects can be magnified because of improper resource planning, poor security plans or insufficient control steps, emergency management plans and alerting units that can enhance the options for predicting the occurrence of hazard or controlling their progress. The environment problem with excessive gas pollutants and other supportive conditions can have increased chances for the occurrence of natural forest fires with increased incidences[4-7]. Many sensor actuator systems with sensor networks driven by the microcontrollers are in use for such monitoring systems [4].

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2.1 Related work

To model fire behavior there are a lot of methods and approaches that aim to identify various characteristics of flame. The real time fire detection method that combines the information of the object with color pixel data of fire. The forepart information of the image is extracted by using adaptive background subtraction method, and then the fire color model is verified to decide whether the object that is detected is a fire candidate or not. Often methods helpful are early detection of fire [6], by using fire hazard monitoring system[5], identification of fire, observing incidences of fire can be very much supporting in controlling forest fire and other problems. The project proffers the application of adaptive background subtraction method that approves the segmentation of the fire candidate pixels from the background. And the other contribution of this project is that the use of a statistical based model for refined fire-pixel classification. It is better if fire is detected at initial stage, and it cannot be detected during explosions, where the smoke begins to spread before the fire does.

3. Design

The entire system architecture is shown in fig. 1 for detection of fire and tree cuting incidences. Organization of sensors, GPS units are shown in the figure. Signals are acquired and processed in the microcontroller from which alerts are generated. GPS unit finds location of the tree where suspected smuggling activity like cutting tree is done.

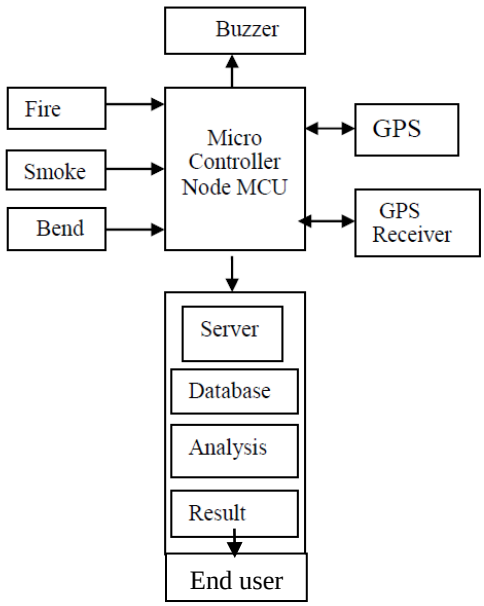

Fig.1 Architecture of the Forest Fire/tree theft Detection System

The proposed system shown in in fig.1 involves use of several sensors for fire detection and bending detection. The sensor inputs are captured in the Blynk app [8] and made to be available in the database and to the server.

4.Implementation, Methodology and Description of Process

4.1 LDR Sensor (Light Dependent Resistor)

An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. The most common type of LDR has a resistance that falls with an increase in the light intensity falling upon the device (as shown in the image above). The resistance of an LDR may typically have the following resistances:

Daylight = 5000Ω
Dark = 20000000Ω

An LDR sensor is shown in figure 2.

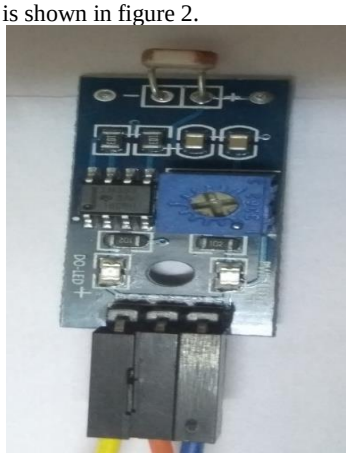

Fig.2: LDR Sensor

4.2 Smoke Sensor

Smoke sensor module (fig.3) is an easy tool to detect any type of gas or smoke occurred in the forest. Burning of waste materials or cigarettes causes fire. To overcome this issue system is integrated with the smoke sensor.

Smoke sensor Specification

1. Dimension: 32mm x 22mm x 30mm Specification
2. Operating voltage: 5V
3. Detection Zone: 300 – 10000ppmm
4. Characteristic Gas: 1000ppmm
5. Response time: 1 mili sec

Fig.3: Smoke Sensor

4.3 Bend Sensor

A flex sensor or bend sensor (fig.4) is a sensor that measures the amount of deflection or bending usually, the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface.

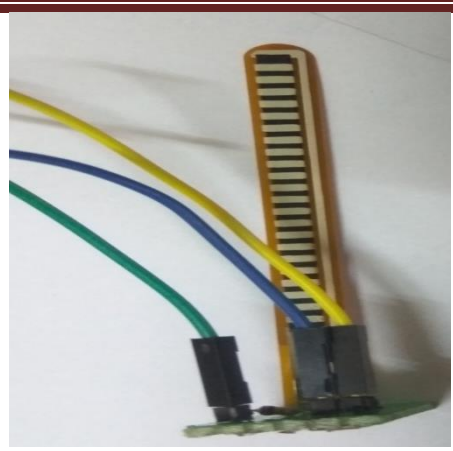

Fig.4: Bend Sensor

4.4 GPS

It is a global navigation satellite system that provides geo location and time information to a GPS receiver anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals. GPS can be a significant asset to help the wildland fire manager to better locate key resources and locations in the wildland fire setting.

A typical GPS module used in this project is as shown in figure 5.

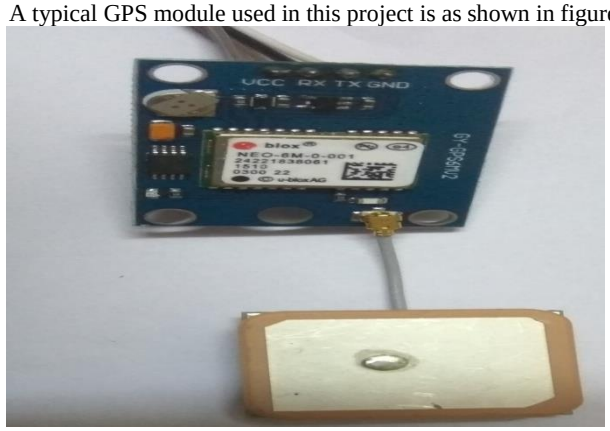

Fig.5: GPS system

4.5 Buzzer

A buzzer or beeper (fig.6) is an audio signaling device, which may be mechanical, electro mechanical, or piezoelectric type. Typical uses of buzzers and beepers include alarm devices, timers, and confirmaton of user input such as a mouse click or keystroke.

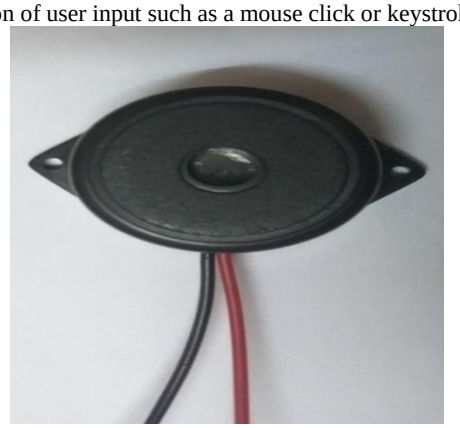

Fig.6: Buzzer device

5. Results

Results obtained indicate the output for fire detection and bend detection captured in the Blynk app in real time and displayed here.

5.1 LDR and Smoke Sensor

Based on the implementation of LDR sensor and smoke sensor, results are obtained for detecting light and smoke, there by fire as well. Blynk app directly shows the front end notification and display of these events. Situations of both fire and no fire, smoke and no smoke are identified. Displays are shown in Arduino UNO as in figure 7 through to 9.

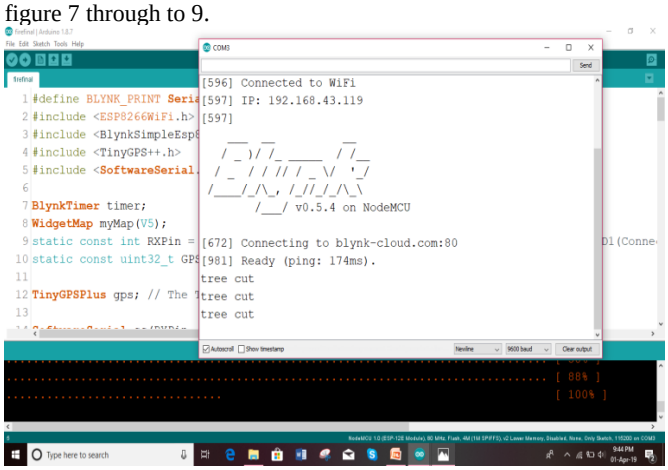

Fig.7: LDR and Smoke Sensor output

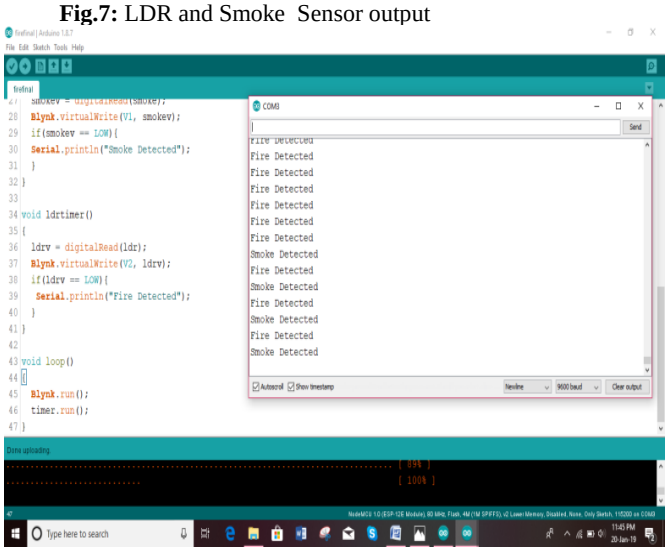

Fig.8: Bend Sensor output

The tree cut incidences and fire incidences with light and smoke are reported here and are verified with the actual situation. The outputs are found to be correct in the BlynkApp as shown in figure8 and figure 9.

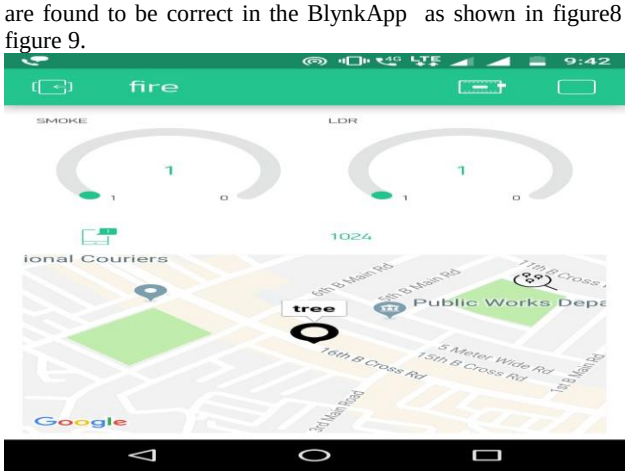

Fig.9: GPS location identification

6.Conclusions

The proposal presented in this paper describes a new information system that has been developed taking into account innovative technologies, IOT devices and the use of sensors with the aim of helping to improve the management of emergencies. Specifically, devices based on Arduino have been used. During the development of this solution, multiple challenges, such as the use of data transmission protocols(4G), interaction with hardware devices, integration of sensors and the transformation of registered data into useful information for the visualization of users have been solved. Furthermore, the integration of different technologies(mobile devices, web service and IOT devices), the synchronization of all system data among different platforms(new alerts, measurements, etc) and other considerations have been done. This would be useful in several areas such as forest fires, industries and buildings, as it sends message as soon as fire is detected and also an alert is produced by buzzer. And LCD also displays the fire level, which can be monitored by concerned person. By doing this it provides detection of fire at the initial stage.

With this system forest monitoring and illegal tree felling can be controlled to a greater extent and it also enables detection of forest fire at the early stage, before the damage becomes high.

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