Forest Fire Detection and Prediction Using IoT and Machine Learning

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Abstract

We can't underestimate the significance of forest because forest contributes to the development of a nation by providing goods and services to the people and industry. But when the fire inside forest begins, it spreads everywhere within the forest and destroys everything. Our technique is to detect and predict the forest fire in advance to avoid the maximum losses.

Keywords: Fire detection, Fire prediction, Arduino, Sensors.

1. Introduction

Forest play an significant role in the economic advancement of a nation. Forest protection is more important for pollution control, natural resource preservation and also to defend earth from being overheated. But these days most common problem in forest is fire which causes significant damage to the wildlife and imbalances in nature. When blaze begins it quickly spreads throughout the forest and results in huge loss. It is necessary to make some major improvement in forest fire management strategy. So the objective is to design a system that can detect and predict the fire as soon as possible to avoid the fire spreading over the large area.

2. Related work

Abhinav kumar sharma et al. [1] Designed a system for fire detection with the help of Arduinouno which is incorporated with buzzer, smoke sensor, temperature sensor. Smoke sensor detects smoke produced because of fire and temperature sensor detects the warmth and alarm indication will be given by buzzer. They have connected the whole monitoring process to the webpage naming- "fire security system".

Sathish Kumar et al. [2] Objective of thisproject is to build a fire detector based on automated fire voice alerting system. During the fire accidents this system guides the usage of fire extinguisher, GSM is placed inside the system in order to send up to date information. It is more beneficial to the industrial premises.

Lloret et al. [3] Motivation behind this work is to identify and confirm fire in rural and forest areas, they used wireless sensors with internet protocol(IP) cameras, here sensor will recognize the fire and data will be sent to the nearest base station. Base station sends the response then the cameras will be switched 'ON' closest to the event to avoid false alarms and to get the real images. But the problem with this system is it requires lots of space to transfer captured images. In addition to this, IP cameras efficiency will be less in dark, foggy weather conditions.

Duraivel et al. [4] Objective of this work is to design a system which detects forest fire and locates affected region. Built a system using Rasp- berry pi3, integrated with sensors and camera so this system immediately sends data and images ofthe afflicted region.

Doolin et al. [5] Have proposed WSN for forest fire monitoring where temperature, humidity and barometric pressure is measured by the sensors. Every sensor node has a GPS device, for alarm monitoring base station was connected to MySQL database. But there is a problem with this network i.e, System is more expensive because of usage of GPS device with every sensor node. In addition to this, sensors and base station connection might be lost in case of node failure, because sensor node distance is too far.
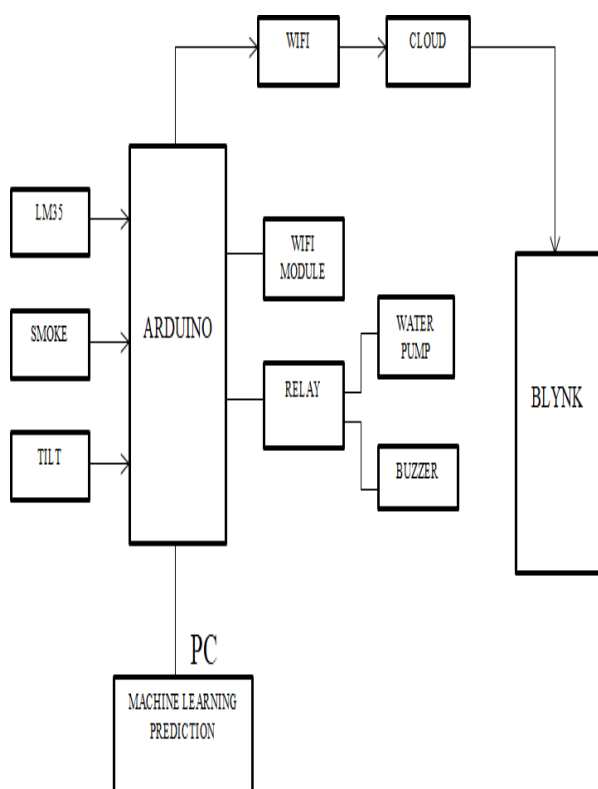
Figure 1: System architecture

3. Proposed System

In this project we are using IOT for the forest fire safety. There are three sensors i.e, temperature, tilt and the smoke sensor. All three sensors are connected to the microcontroller called Arduino Uno, this microcontroller controls all the signal sent from the sensors and send the values to the blynk app or PC. The smoke sensor measures gas/smoke content in the forest, heat is measured by temperature sensor, when the temperature is above 35 degree then the water pump will get 'ON'. The tilt sensor will be placed on the trees, if the movement of the trees occur more than the certain value then the buzzer will 'ON' to alert the forest department. In PC, Prediction will be done using machine learning concept. Predicting how much the chances of fire getting caught in the forest.

4. System Requirements

A. Temperature Sensor

Here temperature sensor used is LM35, this can measure temperature in the range of -55 to 150. To provide typical accuracies it does not require any external calibration, 4 to 30 volts is the operating range, drain is less than 60mA.

B. Smoke Sensor

Smoke can be considered as the primary indica- tion of fire, it detects any kind of smoke or gases present in the forest.

C. Tilt Sensor

Tendency of the tree is distinguished by tilt sensor while tree is being cut.

D. Arduino

Here Arduino Uno is used. Activities of a sys-tem can be controlled and monitored by the micro- controller called Arduino Uno, which is an open source. It is based on the microchip ATmega328P, operates at a voltage of 5 volts. As 14 digital I/O pins(PWM output can be provided by 6 pins), it has 32KB of flash memory where boot loader uses 0.5KBand16MHZistheclockspeed.

E. Wi-Fi Module

It is used to transfer data from the Arduino to the needed region. ESP8266 is the wi-fi module used for accessing the wi-fi network, it acts as both client as well as server.

F. Relay

Circuits that are operating at high AC voltage can be switched on or off using relay with the help of low DC control voltage.

G. Waterpump

It is simple, easy to use and low cost mini sub- mersible type water pump that operates at 2.5-6V DC voltage. It can be controlled from a Arduino using relay boards, uses 5V SMPS power supply adapter to run this pump.

H. Buzzer

Buzzer is used as audio warning instrument. It alerts when the given value limit exceeds. Includes alarm devices, timers.

I. Blynk

Controls hardware remotely, blynk can store data, display sensor data. The communication between the smartphone and hardware is done by blynk server. Can connect to the cloud using: WiFi, USB(serial), Bluetooth, Ethernet.

5. K-Nearest Neighbors

For prediction of forest fire various machine learning techniques are used. Here, in this paper we are using K-Nearest Neighbors for the prediction of forest fire because

A. K-NN algorithm can be used for both classification and regression.

B. K-NN can predict the values of any new data.

C. K-NN is a non-parametric algorithm, which means it does not make any assumption on underlying data.

6. Flowchart
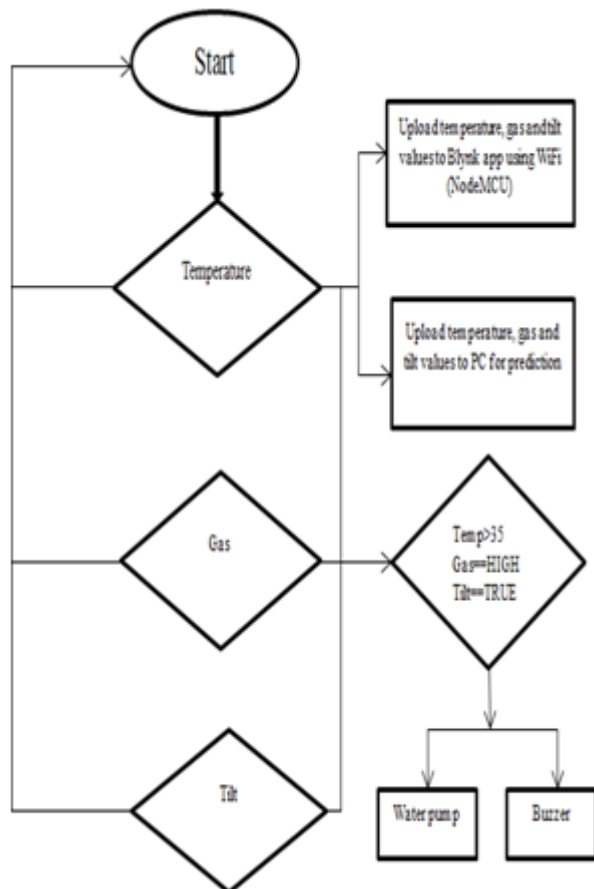
7. Conclusion

Great losses to the environment can be avoided if the early warnings are given about the forest fire incidents. So main purpose of this project is early forest fire detection and also Predicting how much the chances of fire getting caught in the forest.

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