

IOT Based Forest Fire Prediction and Detection

N. Saranya, S. Sahana, B. Suganthi, R. K. Vijaynigilesh, T. Vivin



Abstract : *In recent days, satellite-based surveillance gadget is used to notice wooded area hearth however this works when fireplace is unfold in the massive area. So these methods are no longer efficient. According to a survey, about 80% losses are accumulated in the woodland due to the late detection of fire. To overcome this two, we proposed a new method to predict and the fire at early stages . In our proposed method the hardware kit with temperature and humidity sensor is connected to the PC and it is deployed in many places in the forest area. The PC is connected with the Internet . The details collected using sensor is upload with the fixed interval time. Then this data is uploaded to the cloud application. If the forest temperature is increased abnormally this will detect send notification to the forest authorities then the fire alarm will rung .It can also predict the fire that will be occur in future by using machine learning . This is done by using KNN algorithm. This can be used in all kind of forest and considering the effectiveness of the sensors it be also used in industrial areas.*

Keywords : DHT11 Sensor , ARDUINO , Raspberry Pi.

I. INTRODUCTION

The IOT industry is growing rapidly in the current scenario. Each and everyone now understood the significance of the Internet of Things . In this present time the IOT is used in all of the industries. It is now became a everyday necessity. By using these technologies we can simplify our lives and make great us of time. This will reduce the time ,the effort taken by human and reduce the errors. In this project we used sensors to collect the temperature and humidity. This sensors are connected the Arduino . By using this hardware the data is collected with the fixed interval time period. The collected data can be viewed in the hardware by using liquid crystal display and can be viewed in the cloud also. This hardware is connected to the PC to send the information to the cloud without any interruption. The uninterrupted internet connection is given to the pc using wireless sensor networks.

- Temperature Sensor – To Find Climatic Temperature
- Humidity Sensor – To Find the presence of water molecules in air
- Arduino Board – Controller Board for Sensor integration
- LCD – Liquid crystal display for data display
- PS Unit – Power Supply board with transformer
- COMM to USB convertor – For System interface

All the above mentioned hardware process has been implemented in a single interface controller board.

All the sensors will be connected to main interface to upload the data. According the area of the forest it is decided that how many sensors can be deployed in the forest . If the forest area is very large then the number of sensor deployment in the forest is high. If the area is low then the number of sensors is reduced. The sensor count will also vary by considering the density of the forest.

The collected data from the hardware is uploaded in the cloud server seamlessly. A threshold value is assigned , if the collected data is above this value then the alarm will get activated and e-mail is sent to the respective forest authorities. Our proposed system will also detect the fire even before the occurrence of the fire by using KNN algorithm.

This project works under two phases:

- 1) Offline phase

The hardware shows the corresponding sensor values in the hardware itself, without any internet connection. Using LCD display the values generated in the sensors will be displayed.

- 2) Online Phase

The phase need internet. Using COMM port from the hardware, the sensor value will be uploaded to a cloud server over internet.

Multi user rights will be provided to view the sensor data from multiple locations and in multiple devices. KNN algorithm has been used for prediction purpose. Using the KNN Algorithm forest fire occurrence prediction can be done. Consolidated results will be displayed in the IOT web application.

II. EXISTING SYSTEM

The already existing system or the system that has been used currently in detecting forest fire is not efficient enough to detect the fire in the initial stage. It can detect only when the fire is widely affected the forest. This cause many damages.

But the cost of these devices are very high. These are not making use of the IOT that is main disadvantage of these system. If it make use of the IOT it can detect and warn the fire in the early stages. Even it can predict the fire occurrence.

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III. LITERATURE SURVEY

[1] Simultaneous Forest Fire Detection and Analysis with WSN:

In this paper the forest fire detection is done using the wireless sensors. These wireless sensors are quite costly when compared to wired sensors. The mechanism is much more complex in designing the wireless sensors. There are many technical difficulties while using the sensors. Especially using these kind of sensors in forest, making it more difficult. In this the sensor-nodes are deployed in the forest region. These sensors are interconnected. This uses a neural community technique. These deployed sensor-nodes will accumulate the measured information. Measured information will be sent to the main node or interface. This main node is also known to be as a cluster head. These cluster heads will send the information to the supervisor or master node. These master nodes are like computers. This will process the information collected from the sensors. The collected information is sent with a particular interval time. This will reduce the traffic between the nodes. But in an emergency situation like smoke or fire in the forest the information is sent quickly.

Equation:

$$d(\mathbf{p}, \mathbf{q}) = d(\mathbf{q}, \mathbf{p}) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \dots + (q_n - p_n)^2}$$

$$= \sqrt{\sum_{i=1}^n (q_i - p_i)^2}.$$

This is used for analysing the forest fire data set.

[2] Identifying of Forest Fires using Machine Learning:

There are many machine learning algorithms or methods that can be used in forest fire detection. Basically machine learning algorithms are multi-purpose. These algorithms can be applied in almost all the domains. Forest fire detection is also one of them. Support Vector Machine, Random Forest Algorithm and K-Nearest Neighbour algorithm these algorithms and methods can be used to detect the forest fire. In this paper it checks which algorithm has generated the most accurate result within a short time of period. Initially the dataset is collected from the forest fire authorities. The collected data cannot be used as given. It has a lot of problems, like some of the rows will be empty, empty cells. In order to use the data the data should be pre-processed. The pre-processing is done with the help of Anaconda and Spyder software. The dataset is given to all of these algorithms to test the accuracy, speed and response time. It will be tested with different types of data. After analysing the test results K-Nearest Neighbour algorithm has the highest speed, accuracy and response time when compared to other algorithms. So it is suggested to use this algorithm in detecting forest fire.

[3] Forest Fire Prediction and Alert System Using Wireless Sensor Network:

The method that has been used in this paper senses temperature from all over the wooded area and sends this statistics for processing. The path in which the fire spreads is determined and the fee of unfold is calculated to take faster action. The proposed device consists of standalone boxes, with every field consisting of more than a few sensors like humidity and temperature sensors. These bins are unfolded round the whole wooded area location so that an entire insurance is obtained. When the temperature in

a specific node receives accelerated over a constant threshold cost then the alert is despatched to the management centre. The threshold fee is continually constant above the most temperature which is skilled in that precise location to keep away from any false alarm due to the extend in the atmospheric temperature. The goal of this paper is to decrease the harm and destruction brought on through the woodland hearth to the lifestyles and property of human beings and additionally wild- animals. Apart from early detection of woodland fireplace we have additionally tried to predict the hearth in enhance with the assist of the statistics received from the sensors that are deployed in the forest.

[4] Forest Fire Detection System (FFDS):

This paper describes the effective characteristics of wireless sensor networks. It highlights the wireless sensor networks as the solution to detection and prediction of forest fire at early stages. In this the wireless nodes are deployed all over the forest. In order to protect the sensors they are moulded using fibre optic plastic. These mouldings are used for protecting the sensors from the animals and extreme weather conditions. These are very light and thin glass kind of plastics. So this will not affect the sensors effectiveness in taking temperature and humidity reading. Collected information is sent to the main interface and then it is sent to the cloud. Set of sensors are deployed in the forest. Each set contains of humidity sensor, temperature, moisture sensor, smoke sensor and GPS module. These sensors are used for collecting real world data and the Global Positioning System module is used for identifying the location of the sensor. In case of fire occurrence in particular place it is very easy to identify the location. Here Low Noise Amplifier is used for reducing the noise in the data. By using this data will be more clearer, so forest detection is very accurate in the method.

[5] IOT established forest fire warning system:

In this paper the Node MCU acts as a main interface. There are several alternatives for this Node MCU but it is effective than the other options. It is effective in both economical and performance. Main advantage in Node MCU is the ease of handling. Arduino is also used as part of the project for triggering the alarm. Arduino is best when it comes to handle raw hardware. It can be used on almost every accessories. Temperature sensor, Humidity Sensor and Smoke sensor is used in this project. All these sensors are interfaced or connected with Node MCU in order to collect the real time data. Sensor connected with the Node MCU are very effective. It can even detect very small amount of smoke generated from burning the paper in the house. So the accuracy level when it is deployed in forest is high. Because of the high accuracy it can be also used in many places like homes, schools, shopping malls. When it detects fire or smoke then the buzzer connected with the Arduino is activated. The Node MCU is also connected with the Liquid Crystal Display to see the data collected from the sensors. An app is developed separately for this project to analyse the data even when we are away from the forest. This is the main advantage of this project. When the sensors interfaced with Node MCU detects fire or smoke it will send notification via the app.

The application is supported both android and apple phones. This app works seamlessly without any lag or error. This app is tested in multiple scenarios. This requires uninterrupted network connection. If internet is not connected then it will cause problems.

[6] Artificial Intelligence for Forest Fire Early Prevention:

Now a days the Artificial Intelligence has become a part of everyone’s life. We use it for our day to day work without the conscious. This paper makes use of this technology to prevent the forest fire. All the existing forest fire systems are only detect when the fire or smoke has been occurred .

This cause high damage to forest area the main aim of the project fails. To overcome this problem we can make use of this technology to predict the forest fire even before the occurrence by using the collected data. The algorithms are applied on the collected data to analyse the occurrence of the forest fire in future. Algorithms like Support Vector Machine and Random Forest Algorithms are used.

[7] Data Mining Method to Speculate Forest Fire:

This Data Mining method is also the effective method to predict the forest fire occurrence. If the forest fire can be predicted early then it can be prevented. To prevent all the precaution step has been taken. We have enough time to take all these preventive measures. For this approach it needs huge amount of data. It needs at least ten years of data . Larger the data , accuracy of the result will be high. If data is not enough the result are not perfect. It needs the historical forest fire places, forest fire occurrence data and time, damage caused by the fire, fire burning time and the total area lost due to forest fire. And also need temperature and humidity data. The collected is cleaned and pre processed to do data mining. The pre processing of data is very essential, in this step empty data is filled and the noise in the is removed. Only pre processed data can produce the accurate results. Regression modelling is used on the data. Support Vector Machine algorithm is used for predict the fire occurrence.

Equation:

$$|ln(x, y) - Bn(x, y)| > thr$$

[8] IOT Enabled Forest Fire Detection and Altering the Authorities:

Nowadays IOT (Internet of Things) units and sensors permit the monitoring of distinctive environmental variables, such as temperature, humidity, moisture etc. two Arduino platform primarily based IOT enabled furnace detector and monitoring machine is the answer to this problem. This paper proposed a furnace detector the usage of Arduino is connected with a temperature sensor, a smoke sensor. GSM is used to supply the last SMS to the consumer via the given range in the simulation program, Temperature sensor which is used to denote the temperature High and Low that will be displayed in the LCD Display, Flame sensor which is used to denote the flame tiers and if it is excessive the woodland fireplace will be detected in the LCD show and if it is low woodland hearth won’t be detected. When the fire is detected the alarm will rung and in it will send the information to the cloud server. Then the alert message is sent.

[9] Preventing and Observing of Forest Fire Detection using Data Analytics:

This project added the far off monitoring technique for stopping woodland furnace based totally on FFDA (Forest Fire Detection Algorithm) sensing the threshold price is recognized routinely intimate to the approved character to take motion and forestall the woodland fire. The entire designing of this IOT enabled wooded area fireplace detection and monitoring machine has been normally detection the use of FFDA algorithm. Using the FFDA algorithm it is convenient to discover the fireplace is going to occur based totally on the parameter value, take stop motion based totally on the fee the automated sends the generated message thru GSM to approved character to take forestall motion to end furnace in the forest.

[10] IOT Based Forest Fire Prevention Using Raspberry Pi:

In this project Raspberry is using instead of personal computer. This is like mini PC and very portable. The size is also very small , so the deployment of this hardware kit is became easy. It works seamlessly without any interruption like any other computers. Sensors are connected to the Arduino board to collect the data from the dense forest areas. PIR sensor , Smoke sensor and Temperature sensors are connected to this board. The PIR sensor is used for detecting the intruder. Camera is also installed with this to monitor the forest area. When an abnormal activity is detected in the sensor it will send the alert messages to the authorities. Alert message is also sent in case of smoke or fire has been detected.

IV. ALGORITHM

- 1) Load the collected dataset.
- 2) Arranging the data in the required format based on the location of the device.
- 3) Applying the Euclidean distance formula and other techniques to obtain the desired result.
- 4) The obtained results has been compared with the fire occurred data.
- 5) By comparing both the pattern is observed.
- 6) By using the observed pattern the probability of occurrence fire has been predicted.

This is the algorithm that has been used in prediction of forest fire.

V. RESULTS AND DISCUSSION:

Fire Occurrence Prediction:



Figure no: 1.1 Fire Occurrence Probability

Collected data are analysed by using K Nearest Neighbour algorithm and it is compared with the real time forest fire occurrence data. By comparing with the real time data the prediction is became very accurate. In this we can see the three location , that means three devices were deployed in the forest by using the data provided by them the result is predicted.

Alert Message:

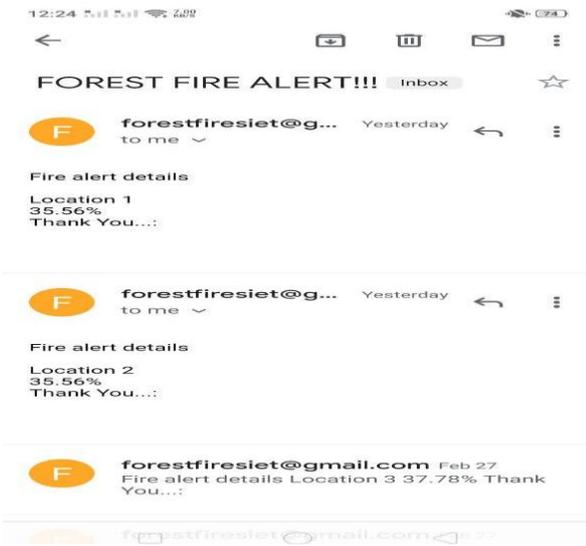


Figure no : 1.2 Alert Message

When the pre defined limit exceeds the system automatically send the alert messages to the respective authorities without any delay. This message contains the probability of occurrence of fire and the location which is vulnerable to fire.

VI. CONCLUSION

This project has proven that KNN is effective than all the other algorithm that can be used to predict the fire occurrence in the forest. It is very cheaper and efficient than the already existing system. So in order detect and prevent forest fire it is highly suggested to use these kind of wireless sensor technology. These sensor can be associated with any kind of hardware easily , so the setting up process complexity is reduced. It can be easily associated with Node MCU and Arduino. Installation and Deployment of this device is very easy when compared to older systems.s

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