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Research Article

APPLICATION OF WIRELESS SENSORS NETWORK IN FOREST FIRE PREVENTION

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Abstract

Forest fires are generally the main and the big reason for the destruction of humanity and the environment that we thrive in. To stop these most destructive and tragic things to happen many ideas were established out of which many of them were made to be implemented in the forests for generally monitoring the forest but the methods that were implemented were not up to the mark and were giving much less results than imagined one of the many systems that were introduced into the daily life (or) the forest environment were based on satellites and other methods were based on forest watching and monitoring with the help of a human watcher and another one were based on the CCD and CCTV cameras but they were also of very little help because they were easily destructible. In this paper we introduce a prevention idea which is totally based on sensors and serial communications they are three sensors and a serial communication HC-12 long range wireless communication which works on the 433Mhz of frequency which will reduce the response time that is to be taken and also improve the monitoring situations.

INTRODUCTION

The wireless sensor network (WSN) is the most effective and the most sophisticated method to imply when it comes to monitoring and making automation related stuff much easier to perform and to implement quickly wireless sensor has networks of all kinds and from implementing fire and humidity sensors together to using a network of fingerprint and LDR sensors thus making it easier and quick way to implement and proceed

In this project we are connecting temperature, fire and humidity sensor as a network with the help of a microcontroller and a serial communication device on the transmitter side and another serial communication and a microprocessor to process the code and to know the findings we are using a (16*2) LCD one LCD is connected on the transmitter side which will project the data on the module and it is also connected to the microprocessor on the receiver side which will process the data more quick the microprocessor used in this project also has a in-built Wi-Fi and Bluetooth module and with the help of the Wi-Fi module we are processing the data into an online server which comes to using the IoT technology and for the power efficiency we are using the a solar

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panel (or) a photovoltaic cell which will help source the power with the help of the natural sunlight making this project energy efficient and quick responsive.

LITERATURE SURVEY

Forest is regarded as valueable and irreplacable resource of nature but the fires in forest possess a threat to that resource and also endanger humankind. Problems arise when we need to continuously observe, since humans can't observe them all the time. Due to the rise of sensors and their vast usage, The wireless sensor networks have multiple uses in different types of fields. With the rise of MEMS and sensor technology, The shortcomings of traditional fire detection has been addressed and we can get accurate information on it.Various methods like aerial observation, satellite observation and manual observation has been introduced. This helped the forest officials to determine the forest fire patterns and extinguish it efficiently and timely manner. The monitoring is done by utilising the IoT technology. A wireless sensor network (WSN) which applies IoT is used to observe the fire and send the data to concerning officials. Many problems can arise here such as the validation of sensors and also the security of wireless communication in such sensors.

The rise of wireless sensors has been advantageous for many sectors to avoid dangerous situations such as :

1) Usage in medical field.

2) Preventing fires in forest

3) Automation of homes
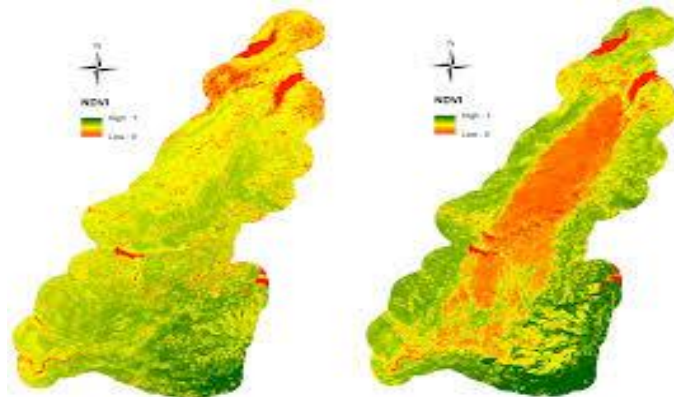
4) Military usage.

EXISTING MODEL

Presently, The detection of forest fires is mainly done by observers employed from forest department. They use watch towers to observe and recently monitoring through satellite has also been done. But manual observing has been obstacles such as resource and financial deficiency. Also manual observing has many problems such as lack of awareness in observing, No skill regarding real time observation and also not much area is covered by manual workforce which leads to inefficiency.

Previous methods adopted in fire prevention were useful but not that efficient, To get effective results, a real time monitoring is needed which provides us with accurate and fast data. Current methods are useful but can't cover large

FIG-2 REPRESENTATION OF STELLITE IMAGES

area effectively and also they utilize alot of time to send the data. Thus, We need a method in which the time taken to send data is better which gives proper results.

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Present models can sense different things like humidity, Temperature of an area and also detects smoke. We can expect advanced sensors in future which are specifically made for prevention and observation of forest fires.

Current models work on satellite imagery but unfortunately not utilized in real time applications because they have long process and utilize more time. Short range images and IR images has also been discussed but they can be insensitive and may not provide accurate data.

The areas which are more at risk are chosen and such sensors are placed so that the proper data is sent in right time to avoid the forest fire tragedies.
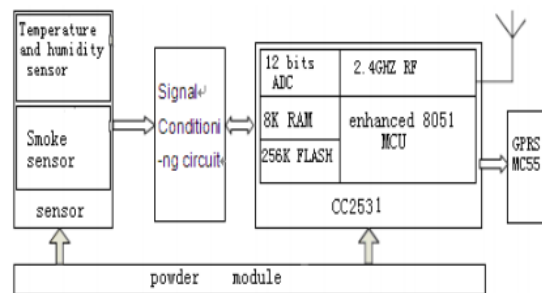

FIG1 – EXISTING MODEL BLOCK DIAGRAM

The forest fire monitoring system designed in this paper can real-time monitor smoke concentration, temperature, humidity and other environmental parameter, and it can automatically send warning signals to control room and completes corresponding control.

Data processing flow of the system is as follows: At first, sensor nodes widely distributed in forest can real-time collect signals such as wind speed, temperature, humidity, etc. Data collected by sensor nodes is sent to the nearest base station which will trigger immediate response from the fire safety officials which will stop the tragedy at the right time.

This method was proposed during the 90s which is shown in the above picture satellite imagery was becoming very much common in those days in which many countries adapted it for military

purpose and weather forecasts but though it had those capabilities it was a bit slower than it was expected the satellite imagery was used in such a way that it could send the exact signal which shows the dark red, orange and green colour parts which was differentiated by highly vulnerable to safe zone
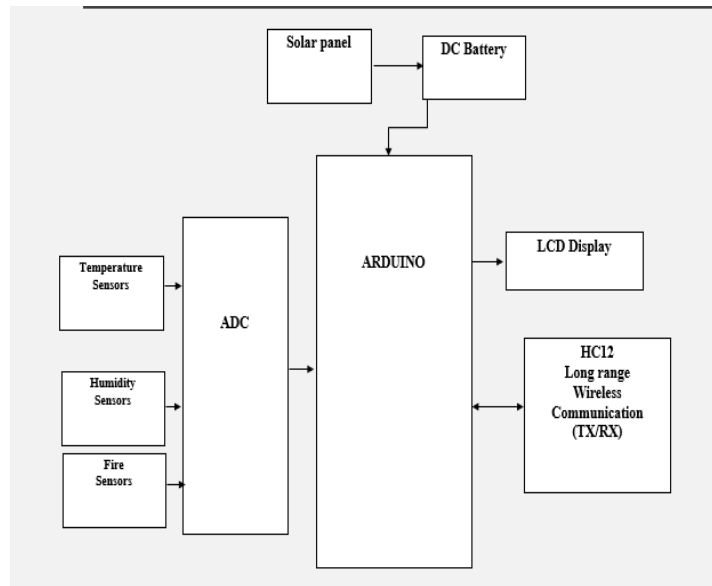
PROPOSED MODEL: (TX)

FIG-3 PROPOSED MODEL TX

PROPOSED MODEL: (RX)

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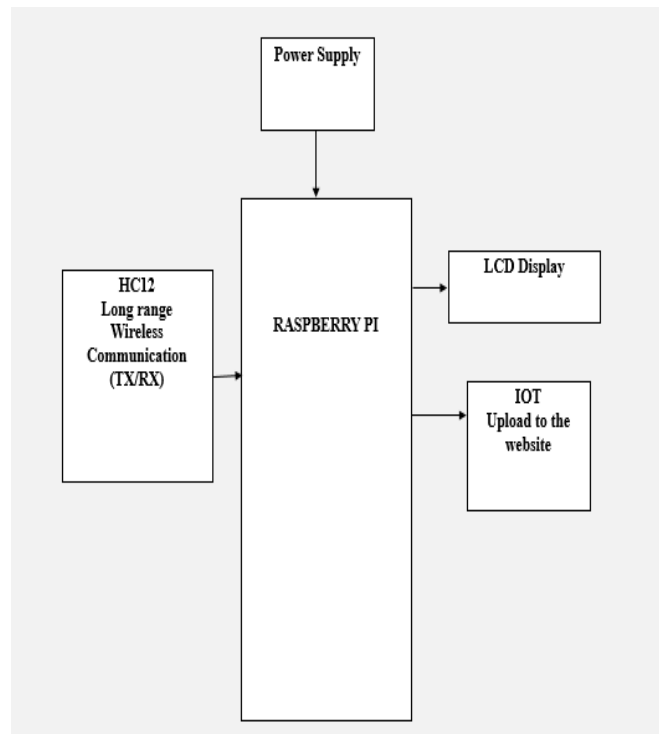
.

FIG-4 PROPOSED MODEL RX

These method was improved by adding a raspberry pi 3 which has inbuilt capabilities of wifi and Bluetooth module technologies. This sensor based device has three different sensors which will measure the amount of humidity the temperature as well as the fire with the help of a fire sensor which is IR based.
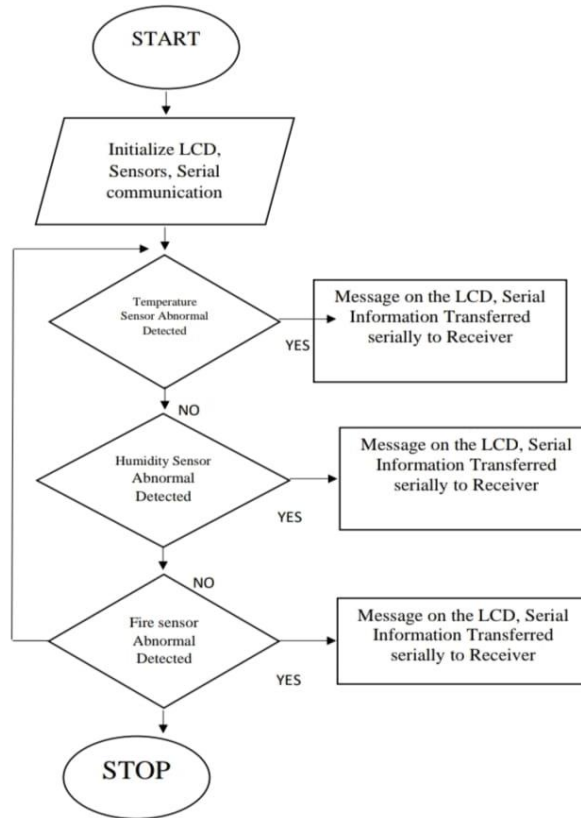
These model when implemented can help in stopping not only the dangers of the fire but also helps in the monitoring the forest humidity and temperature whereas the fire monitoring is done using the fire sensor which will help in the forest fires and also stop great tragedies from happening

The forest monitoring helps in maintaining the global warming levels and helping many great tragedies from happening this will not only help in the safe environment but also stop losses of human life and also many natural things that is very important in day to day life
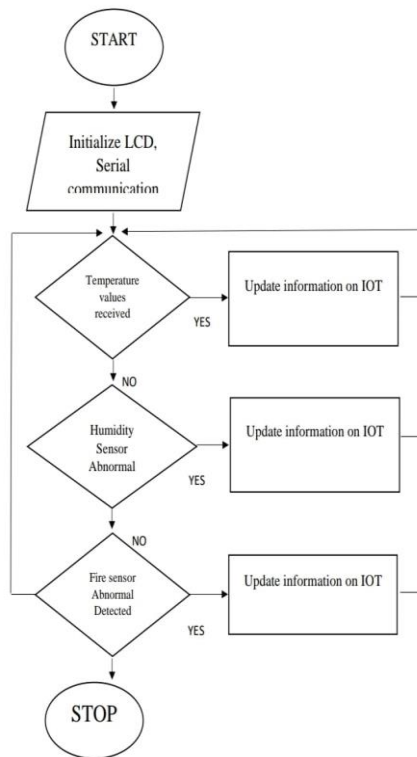
Many tragedies like the earthquake and the high range rainfalls also destroy the day tp day things in the forest and the animal life is also stops when the natural occurring tragedies like this happen so when the wireless sensor network helps in this process. design of a wireless sensor network for early detection of forest fires The improvement of the level of modernization of forest fires monitoring using information and communication technologies has strategic significance for many countries where forest fires occur frequently. Compared with the traditional techniques of forest fires detection, wireless sensor networks (WSNs) technology is a very promising green technology for the future.

FLOWCHART: (TX)

START

Initialize LCD, Sensors, Serial communication

Temperature Sensor Abnormal Detected

YES → Message on the LCD, Serial Information Transferred serially to Receiver

NO

Humidity Sensor Abnormal Detected

YES → Message on the LCD, Serial Information Transferred serially to Receiver

NO

Fire sensor Abnormal Detected

YES → Message on the LCD, Serial Information Transferred serially to Receiver

STOP

FLOWCHART: (RX)

START

Initialize LCD, Serial communication

Temperature values received

YES → Update information on IOT

NO

Humidity Sensor Abnormal

YES → Update information on IOT

NO

Fire sensor Abnormal Detected

YES → Update information on IOT

STOP

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ALGORITHM:

1. Start and initialize the project.

2. The transmitter and the Arduino part is initialized

3. The temperature, humidity and fire sensor starts reading the data.

4. If the data is abnormal on the transmitter part.

5. The receiver LCD shows that reading is abnormal and emergency situation should be initiated.

6. If the readings come out normal then the sensors go back to monitoring the analog data again.

HARDWARE COMPONENTS

Raspberry pi 3 is the main and the central processing unit of the project based upon its working basically the raspberry pi is single board computer which has its own operating system and can be programmed not only for the technical stuff but also for AI purpose it has total of 28 GPIO pins which can be used

FIG-5 RASPBERRY PI – 3 MICROPROCESSOR

Arduino uno:

The Arduino microcontroller is the most effective 8-bit microcontroller with 16 input output pins and two adapters which are to be considered as power source of the board It works on the constant voltage of 5V and pulse width modulated output

FIG-6 ARDUINO UNO

Temperature sensor:

The LM-35 temperature sensor has three pins out of which positive Vcc and negative and the third pin is the data pin it works on the operating voltage of 3.3V – 5V

FIG-7 TEMPERATURE SENSOR

Humidity Sensor:

Humidity sensor is an instrument used for measuring the moisture content in the environment humidity measurement instruments usually rely on measurements of some other quantity such as temperature, pressure, and calculations these measured quantities can lead to a measurement of humidity

FIG-8 HUMIDITY SENSOR

Fire sensor:

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5mm IR Diode can work as a fire detection flame sensor module, fire source detection modules. This Flame Sensor can be used to detect fire source or other light sources of the wave length in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation. It can be used as flame Sensor

FIG – 9 FIRE SENSOR

LCD LM016L:

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.
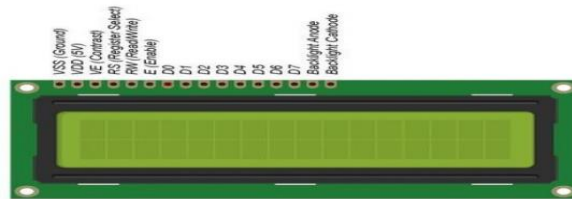
FIG-10 LCD (LIQUID CRYSTAL DISPLAY)
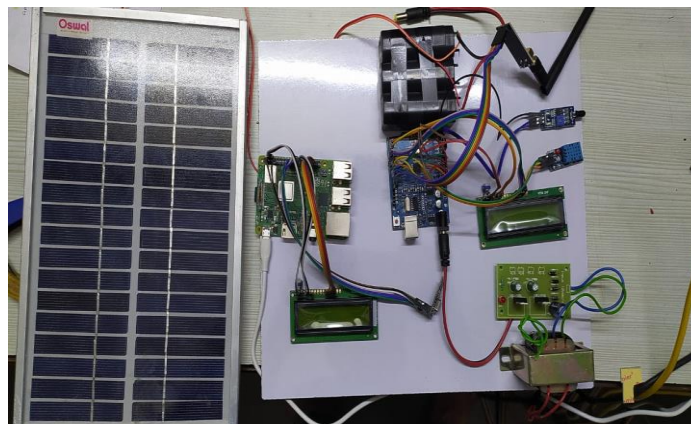
RESULT AND ANALYSIS

FIG-10 CIRCUIT CONNECTIONS

The raspberry pi is connected as receiver and the Arduino is the main transmitter of the circuit the sensor used here in the circuit are the temperature, humidity and the fire sensor the serial communication device is the HC-12 (NRF24L01) version
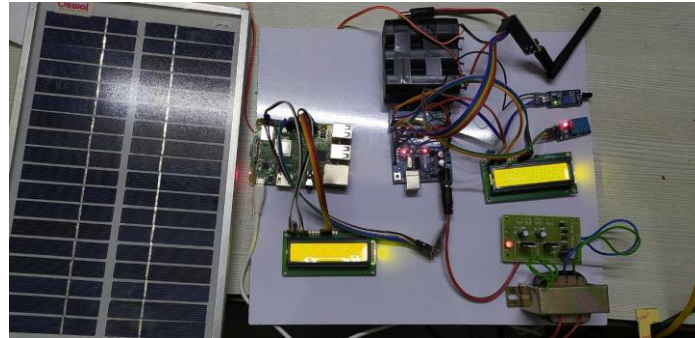

FIG-11 CIRCUIT WHEN ON

The circuit has two lcds in it when the process starts the transmitter side will first show the temperature and the humidity in the lcd connected in the transmitter side then with the serial communication transmitting the data it will be shown on the receiver side of the circuit which is the raspberry pi

The data all collected is then uploaded to an online server with the help of Wi-Fi enabled in the raspberry pi 3 the data parameters such as the temperature, humidity and the fire the data will be shown in the graph and it can be reviewed in case of any inconsistency.

FIG-12 IOT UPLOAD TO THINGS SPEAK

ADVANTAGES AND DISADVANTAGES

• The digital method used by the network of wireless sensors helps in detection of a fire hazard more quickly

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- The sensors are very cheap and easy to get

- This project not only helps in knowing the fire hazard but also can be used to stop before even starting if a rise in temperature is detected

- The main disadvantage detected is the humidity sensor and temperature sensor are easily damageable if not handled or used properly

- The fire can destruct the sensors if the fire is not treated in time

APPLICATIONS

The industrial application of this project are in digital transmission to monitor the natural aspects of forest like the humidity, temperature etc.

This project takes less time and is very precise way

Unique data transmission and flexibility of the network sensors helps very much in this aspect

This low-cost project helps in monitoring data and helps stopping catastrophic tragedies

FUTURE SCOPES

This circuit can be further modified and many sensors can be added in order to know the exact and main parameters of the environment further it can be modified by adding the gas sensor which will help us knowing the amount of methane and carbon dioxide which are the main sources of fierce fires

CONCLUSION

This concludes the present proposed work was success and it will provide a convenient method for effective monitoring of fires and other details in real time. This system is compact and cost effective when compared to prices of the instruments used to measure the environmental factors because the Arduino in the transmitter is the most effective to measure the changes and to experience the tough and harsh nature have to give and the raspberry with its capabilities of having a Wi-Fi and Bluetooth module embedded in it with because it has its own operating system and is considered as a "CREDIT CARD SIZED SINGLE BOARD COMPUTER" with the help of this

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