

Solar Powered Forest Fire Detection by Using Arduino and Zigbee Wireless Sensor Network

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Abstract: In the recent years wireless sensor networks has attracted a lot of attention. Now a day's wireless sensor networks are used for different applications like habitat monitoring, automation, agriculture and security purpose. As forest fire is prevalent type of disaster it can deal great deal of environmental impact and therefore the early detection of fire is important. With the help of temperature sensor, zigbee wireless sensor network and arduino it is possible. This article presents the design of a system for temperature and smoke detection by using wireless sensor network ZIGBEE, GPS, GSM and ARDUINO to avoid the forest fire that could lead to loss of a significant number of natural resources.

Keywords: Zigbee, Arduino, Receiver, transmitter, wireless sensor network

1. Introduction

Forests are indispensable resources for the human survival and social development that protect the balance of the ecology of earth. But because of some uncontrolled anthropogenic activities, abnormal conditions, lightning forest fire occur frequently and a huge disaster may take place. In recent years forest fires has considerably increased due to climate changes, human activities and other reasons.

Currently, the forest fires are protected by the methods like observation from watch towers, satellite monitoring, MODIS, and lately wireless sensor networks. Although observation from watch towers is easy and feasible but it has several defects and so many problems are personnel abound. Forest fires spread very quickly causing million dollar damage that's why we are proposing this system as wireless sensor network is one of the emerging technology. Because of wireless sensor network based forest fire detection system has potential to achieve the real time data accurately and early detection of fire is possible. This system contains two main modules. First is Transmitter part or sending end module which is located at forest and second is the receiving end module which is located at the operator's office. In addition a buzzer is provided at both modules for indication of fire with an LED.

2. Background Study

Because of the lately wireless sensor network and existing forest fire detection methods are not much effective. The forest fire detection methods having zigbee are present now a days which are microcontroller based systems. But in our project we are using arduino instead of microcontroller to make the communication between the sending end and receiving end easy and to make the system more feasible and effective. Arduino is an open source microcontroller based on the microchip ATmega328P microcontroller. It has a set of digital and analog input/output pins which can be interfaced with various circuits. The operating voltage of arduino is 5 volts. The arduino uno has 14 digital pins and 6 analog pins and is programmable. Arduino accepts the voltage between 7 to 20 Volts.

Zigbee is suitable for high level communication protocols which creates personnel area networks for different applications like automation, medical device data collection, and other low bandwidth needs. Zigbee is a low power, low data rate, and close proximity wireless sensor network. And a temperature sensor along with a buzzer and LED are used.

The components used in this project are –

- 1) Solar Module
- 2) Boost Converter
- 3) ZigBee Module
- 4) Arduino UNO ATmega328P
- 5) Arduino NANO ATmega328P
- 6) Battery 12V/1.2 Ah
- 7) Fire Sensor
- 8) GPS Module
- 9) GSM Module

3. System Development

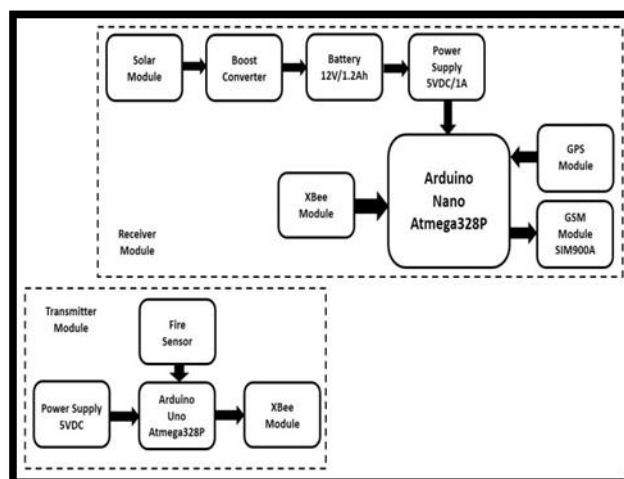


Figure 1: Block Diagram of Entire System

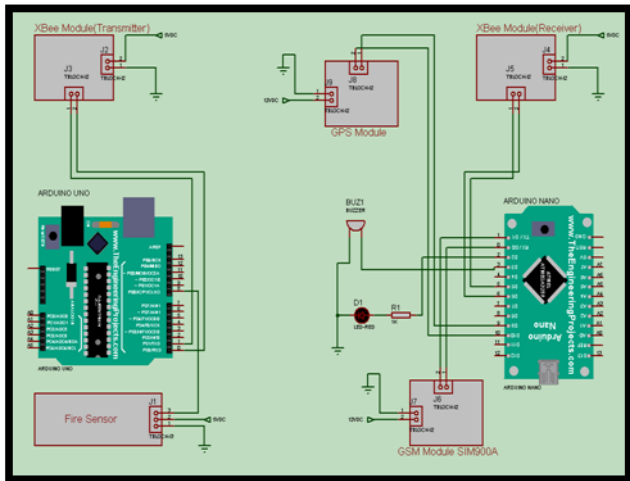


Figure 2: Circuit Diagram of System

For the forest fire detection a fire sensor has been used to detect the fire event. This fire sensor is incorporated in the transmitting module which is located at forest. Fire sensor has three terminals out of which two terminals are given for power supply (+5V and GND) and one pin is output pin, which will be made high in the event of fire. This digital pin is connect to one of the digital pin of Arduino UNO which has been configured as INPUT pin. When the fire will occur the digital output pin of sensor will be made logic HIGH, which will be detected by Arduino Uno and immediately after detecting the fire event the Arduino Uno will send a fire message through ZigBee wireless sensor network connected to its serial communication Rx and Tx pins. ZigBee module which is configured as Transmitter will transfer the message to another Remote ZigBee, which is far away from the transmitter ZigBee which is located at operators office surroundings.

The receiver ZigBee is getting the power from the solar module followed by a boost converter. Solar photovoltaic module absorbs the sunlight as a source of energy to generate electricity. Each solar module is rated by its DC output power under standard test conditions. Typically ranges from 100 to 365 W. To reduce the voltage ripples, filters made of capacitors are added to boost converters output side and input side. A Boost Converter is a charge regulator or battery regulator that limits the rate at which the electric current is added to or drawn from electric batteries. It prevents the overcharging and deep discharging which can reduce battery performance and lifespan and may pose a safety risk. The lead acid battery is used because it has higher cell voltage and lower cost. This Receiver ZigBee is connected to Arduino Nano, after receiving the message from remote ZigBee (Transmitter XBee). Receiver ZigBee will transfer that Message to Arduino Nano by using serial communication pins.

After receiving the message from receiver zigBee, Arduni Nano will take the Geographical coordinates i.e. Latitude and Longitude and it will send all this information (fire event information and latitude longitude information) to the registered mobile number with the help of GSM.

4. Conclusion

This paper describes the design and implementation of a system for forest fire detection by using wireless sensor network ZigBee and Arduino. This fire detection scheme can be used for many other applications too like in hospitals, malls, theaters and smart waste management etc. This system is developed to overcome the demerits of the existing system in order to protect the forest fire. Due to the accuracy of the project this system can be implemented on large scale and the system can be further developed. The higher version of ZigBee and with the use of solar module greater efficiency can be achieved.

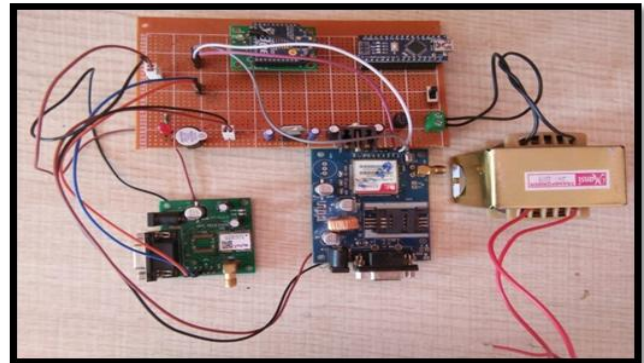


Figure 3: Receiving End Module

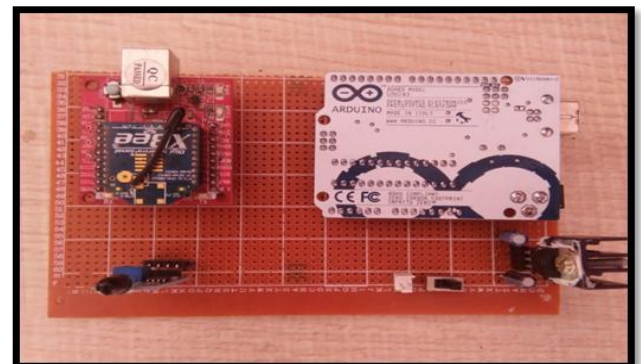


Figure 4: Sending End Module

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