

Monitoring of Forest Fire Detection System using ZigBee

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Most of people, animals are died because firefighting or fire prevention cannot be provided in time and forest fire information cannot be provided the emergency facilities to the fire department as soon as possible. This proposed system was constructed with sensors (temperature, humidity and gas). They detect the forest condition and send the signal to the main station and report information. In this proposed system, there are three nodes (node1, node2 and main node). Each node has temperature sensor (LM35), humidity sensor (DHT-11) and gas sensor (MQ2) along with the Arduino and ZigBee wireless module. ZigBee wireless module is used to communicate with other nodes and send and receive data. In this work, program will be developed on Arduino Mega board using the Arduino IDE software. For this system, ZigBee is a suitable technology to be adopted as the communication infrastructure in fire detection and monitoring system. In this way, many people and animals of lives can be saved.

II. LITERATURE REVIEW

Some of the previous important literatures that have been studied are discussed below. P:Sjadhav, V:U. Deshmukh, 2012 proposed Forest Fire Monitoring System Based on ZigBee Wireless Sensor Network [1]. The purpose of this system aims at using for habit monitoring automation, agriculture and security and it consists monitoring nodes base stations, communication systems, internet access and the structure of monitoring hardware and software system. The author better has designed based on WSN protocol includes sensors such as temperature, smoke, humidity

ABSTRACT

A large number of valuable forests are destroyed in every second caused by fire around the world. As a result of insufficient information of firefighting cannot be provided in time to the occurrence of fire places. Therefore, the lives of people, animals and valuable forest have been lost for wild fire. This proposed system is designed by using sensors nodes and empowering them to communicate with each other through wireless technologies. The system mainly consists of three parts: detecting part, monitoring part and wireless sensor network part. The detecting part was devised using Simulated Sensor Program. Temperature sensor (LM35), humidity sensor (DHT-11) and gas sensor (MQ2) detect the occurrence of forest fire. The monitoring part is integrated with LCD display. The ZigBee protocol is utilized for the wireless sensor network communication.

Keywords: Arduino, Gas Sensor, Humidity Sensor, Temperature Sensor, ZigBee wireless communication

I. INTRODUCTION

Nowadays, many natural disasters have been caused in various way all over the world. Forest fire are one of the most important disasters and they can create a great deal of environmental impacts due to which their early detection is very vital. As the number of causing forest fire is rapidly increased in the world, the number of fire accident also increased that is huge problem for the world.

along with the processor LPC2138 and ZigBee as a RF device. In this system, the processor module controls the operation of the sensor nodes, stores and processes the collected data.

Wireless communication module communicates with other nodes, exchanges control information and sends and receive data. The power modular provides the energy to the sensor module, processing module and wireless communication module.

U. Arun Ganesh, M. Anand, S. Arun, M. Dinesh, P. Gunaseelan and R. Karthik 2013 proposed Forest Fire Detection Using Optimized Solar- Powered ZigBee Wireless Sensor Networks [5]. This system consists of two part the monitoring area module part and the forest area module part. The hardware includes sensor's module, serial communication module using ZigBee, Optimized solar energy harvester using maximum power point tracking (MPPT).

Wireless Sensor Network Technology was used to detect forest fires and send the information to computer in the Monitoring centres. The collected data will be analysed and managed by the computer.

Harjinder, 2016 presented Forest Fire Detection using Wireless Sensor [3]. This paper highlights the powerful feature of wireless sensors for forest fire detection. The sensor data is collected using Arduino development board and transmitted to base station wirelessly. Also an alert is send using GSM module.

The main components of the system are GSM (Global System for Mobile Communication), DHT-11(Digital Temperature Humidity Sensor), Smoke Sensor, WSN (Wireless Sensor Network).

The system proposed solution presents the prototype for early forest fire detection in which an alert is send to base station via SMS (Short Message Service) and call using GSM module when the temperature exceeds the threshold value.

All previous research works used GSM modem to inform the danger condition of the forest to the forest department. In this system ZigBee module is used to perform as a serial communication between two nodes so that information of forest fire can be send easily. Using this proposed system can save many people and animals of lives and valuable forest.

III. BLOCK DIAGRAM OF THE SYSTEM AND COMPONENTS

Block diagram of overall system is shown in Figure 1. This system incorporates Arduino Mega, temperature sensor, humidity sensor, gas sensor and ZigBee module.

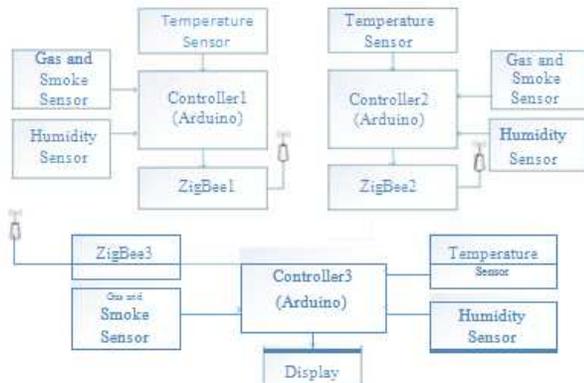


Fig.1. Block diagram of overall system

This paper is concerned with a practical model of a forest fire detection and monitoring system, which can do firefighting or fire prevention. Actually this system consists of three nodes. In node1, the detection of fire accident is through temperature, humidity and gas sensor. These sensors continuously sense for fire parameters in the forest and send the sensor values to node2 by using ZigBee wireless communication module. In node2, it can work two things that are transmitter and receiver. Firstly, it receive sensor values from node1. Secondly, read sensor values on node 2 and transmit the sensor values from node 1 and node 2 to main station. In main node, read sensor values on this node, receive sensor values from node2 and display on LCD.

A. ZigBee Module

ZigBee is wireless network protocol specifically designed for low data rate sensors and control networks. ZigBee is a group of software, hardware and service companies that have developed a common standard for wireless, networking of sensors and controllers. While other wireless standards are concerned with exchanging large amounts of data, ZigBee is for devices that have smaller throughout needs. The other driving factors are low cost, high security, low battery usage, simplicity and interoperability with other ZigBee devices. In this research, the XCore2530 ZigBee module is used. XCore2530 is a ZigBee module based on CC2530F256. Combined with our Coordinator/Router firmware, the XCore2530 allows transparent transmission of UART data, just as easy to use any UART module.

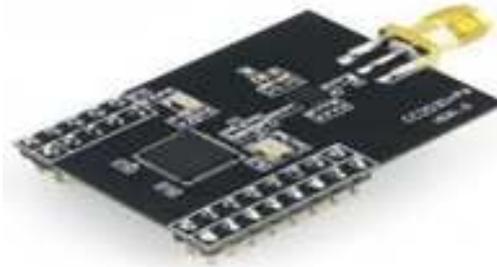


Fig.2. XCore2530 ZigBee module

B. Arduino Mega

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog, 4 UARTs (hardware serial ports), a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.



Fig.3. Arduino Mega

C. Temperature Sensor (LM35)

One of the important phenomenon that usually accompany forest fire is the increase in the temperature. The increase in the temperature may be because of fire in the forest. LM35 is used to detect the temperature. An increase in the temperature than normal temperature can give us indication of forest fire. LM35 can be used to detect temperature in the range of 0-150 degree Celsius.



Fig.4. Temperature

D. Sensor D. Humidity Sensor

Humidity is a very important feature in detecting a fire. Relative humidity is the percentage ratio of actual water vapour contain to the amount of water vapour that would saturate the atmosphere at the same temperature. If the humidity is low in environment, fuels normally transfers its

moisture to the atmosphere and becomes flammable. Sudden decrease in humidity indicates that the fire alerts. The DHT-11 sensor can be used to detect humidity in the range of 20-90% RH with the accuracy of $\pm 5\%$ RH. DHT-11 uses resistive type humidity measurement component.

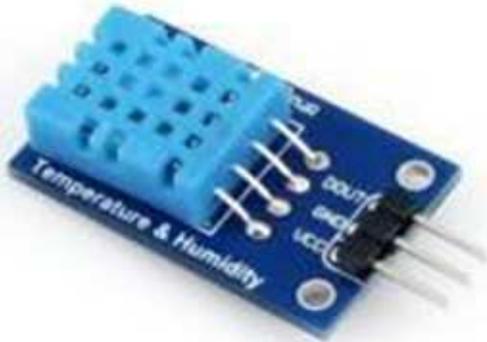


Fig.5. Humidity Sensor

E. Gas and Smoke Sensor

One of the main characteristics of fire is the smoke. Thus smoke sensors can play a vital role in detecting fire in the forest. Various types of smoke sensors are available in the market. Depending upon the availability and cost factor of sensors the smoke sensor used in this project is MQ2 sensor which is sensitive for methane, butane and LPG. The sensor is also sensitive for flammable and combustible gases. The principle of MQ2 sensor is that when gas interacts with the sensor it is first ionized into its constituents and is then absorbed by sensing element. This absorption creates potential difference on the element which is conveyed to the processor unit through output pin in the form of current.



Fig.6. Gas Sensor

IV. DEVELOPMENT OF SYSTEM

The system flow chart shown in Fig represents the sequenced processes and steps taken to carry out specific action with the application. Firstly, system initialize serial is 38400bps. When the system was started, the values of parameters (such as temperature, humidity, and gas) are read on node1. And then, these values that detect the condition of forest are transmitted to node2 start with * character by using the ZigBee module. In node2, the sensor values that comes from node1 are checked whether its start with * character. If it was, collect sensor values from node1.

If not, read sensor values from node1 again and again. Sensors values is also read on node2. After that, the sensor values from node1 and node2 are transmitted to main node start with \$ character. In also node3, the sensors values are read on main node and display on LCD. And then, the data that come from node2 are checked start with \$ character. If so, collect data from node2 and display on LCD

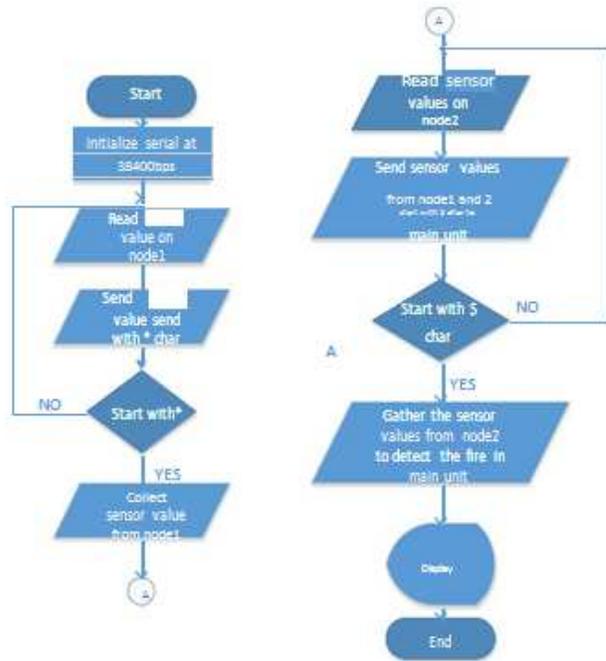


Fig.7. System Flow Chart

V. EXPERIMENTAL TEST AND RESULT

The construction of sensing node1 is shown in Figure 8. The main components of this circuit are ARDUINO, temperature (LM35), humidity (DHT-11) and gas (MQ2) and ZigBee module. The power supply of the following circuit is supplied by 12V battery. In this system Arduino Mega was used as a controller to all modules. Arduino Mega has 54 digital input/output pins. A2 pin of Arduino is connected to LM35 and pin4 is connected to DHT-11. A0 pin of Arduino is connected to MQ2. The sensing node2 and main node is the same as the node1 as shown in Figure 9 and Figure 10.



Fig.8. Sensor Node1



Fig. 9. Sensor Node2

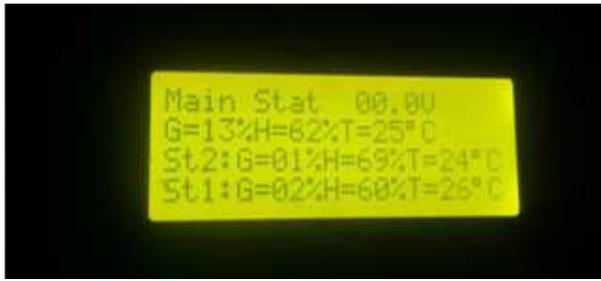


Fig.10. Main Node

VI. CONCLUSIONS

This system consists of fire detection and monitoring using ZigBee wireless communication technology. Wireless communication is a cheap and easy way to provide network communication at places where there is no wired infrastructure. In this design, ZigBee provides low power consumption, simple wireless communication to send the values of fire parameters for maximum coverage area. Because of the flexibility of wireless system, this system is very much compatible to any of system. This system will make the world a much better and save the human and animal lives in time.

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