FIRE DETECTION USING WSN AND ZIGBEE HAVING USER INTERFACE

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Abstract

This paper based on the wireless sensing network. This system is basically ideal for the forest like places where we deals with the plants and trees for example, college campus, hospital campus, big gardens, farms, etc. In order to prevent fire occurrence, this paper designs the monitoring system based on wireless sensing networks (WSN). The system gives hardware design of different modules for collecting the data from various places having wireless sensors for wireless connections which form a network. Data collected by modules are transfer to the receiver module using ZigBee and it will display on the computer, then prevention action will takes place by the operator on the receiver side. Received data will be collected to the hard drive using user interface.

Keywords- WSN, ZigBee, fire, user interface, wireless sensors

I.   INTRODUCTION

As we know, trees and plants are most important factor in our life; we need to protect them from the disasters like fire. Our system is basically design to detect and monitor the plants and trees in the places where the human beings are occur, like farms, big gardens, campus of college or hospitals using this system we can also save their lives.

In our system we have different transmitter module having wireless sensors on it, which collect the data from the specific area using wireless sensors and send it to the receiver module using ZigBee. On the other hand the receiver model collects the data from the different modules using ZigBee. Receiver analyses this data and alert the operator about fire. Further prevention action must be taken by the operator who is attending the receiver side.

Furthermore we are using user interface for the simple interaction of our system and user. This user interface is designed using virtual basics which will provide simple drag and drop mechanism for our interfacing buttons. This user interface provide current status of our nodes if any one of our node detects any parameter by the sensors which we are using then this information will be directly disply on the computer. User can save the data received from the system with its time and date.

II.   LITERATURE SURVEY

Most frequently used fire detection and monitoring techniques in the areas like farms and gardens are takes place in the traditional ways. These techniques are summarized as,

1)   Human based observations
2)   Satellite systems
3)   Optical cameras
4)   Wireless sensing networks

Following table 1, gives comparison about all these techniques. Among these techniques wireless sensing networks is most accurate reliable and real time technique,

hence we implement our system using wireless sensing networks.

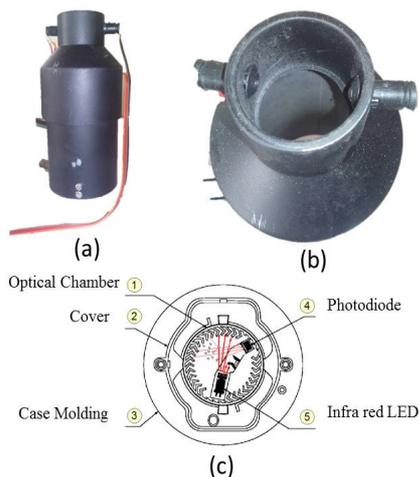**Table1: Comparison of Fire monitoring techniques**

Comparison	Human based observations	Satellite system	Optical cameras	Wireless sensing networks
Cost	Low	Very high	High	Medium
Efficiency and practicality	Low	Low	Medium	High
Faulty alarms repetition	Low	Low	Medium	Medium
Fire localising accuracy	Low	Medium	Medium	High
Detection delay	Long	Very long	Long	Small
Fire behaviour information	---	Yes	---	Yes
Can be used for other purposes	No	Yes	No	Yes

III.   DESIGN IMPLEMENTATION

3.1 Block diagram

In our system we are using various sensors on transmitter module, like Wind direction sensor for detection of direction of wind using which we can get idea about which direction our fire will elaborate, temperature sensor for detecting sudden change in the environmental temperature and smock sensor for detection of smock occurrence. All these sensors are controlled by ARM 7 processor and the data collected by the processor is transmitting using ZigBee. On the other hand at the receiver side we have ARM 7 processor along with ZigBee.

Following Fig 1 showing block diagram will give brief idea about our system,

Fig. 1 Block diagram of proposed system

IV.   HARDWARE REQUIREMENT

We require following hardware to design our system. Let's see one by one.

4.1 ARM 7 (LPC 2148)

Over the last few years, the ARM architecture has become the most pervasive 32-bitarchitecture in the world, with wide range of ICs available from various IC manufacturers. ARM7 is one of the widely used micro-controller family in embedded system application. A RISC-based computer design approach means ARM processors require significantly fewer transistors than typical processors in average computers. This approach reduces costs, heat and power use.

Fig. 2 LPC 2148

LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips above fig 2(a) shows this IC and circuit diagram is shown in fig 2 (b). Let's discuss some features about this processor,

• 8 to 40 kB of on-chip static RAM and 32 to 512 kB of on- chip flash program memory.
• Low power real-time clock with independent power and dedicated 32 kHz clock input.
• Power saving modes include idle and Power-down.

4.2 Temperature sensor (LM 35)

We are using LM 35 as a temperature sensor. This series are precision integrated-circuit temperature device with an output voltage linearly proportional to the centigrade temperature.

Fig. 3 Temperature sensor (LM 35)

Above Fig.3 (a) shows the actual look of LM 35 and Fig.3 (b) shows pin diagram of LM 35

These are some features of LM35,

• It has an output voltage that is proportional to the Celsius temperature.
• The scale factor is .01V/^{0}C or 1mV/C.
• Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1 ^{0}C temperature rise in still air.
• The operating temperature range is from -55 ^{0}C to 150 ^{0}C

4.3 Smoke sensor

A smoke sensor is a device that senses smoke, typically as an indicator of fire. Here we are using photoelectric smoke detector (also known as an optical smoke detector) contains optical chamber, outer cover, case moulding, a light (light-emitting diode), a lens, and a photoelectric receiver (typically a photodiode). These all parts are shown in Fig 4 (c) whereas Fig 4(a) and (b) shows the sensor which is used in our system.

The sensor uses a light source to detect smoke. The Infra-Red LED is a lens that shots a beam over a large area. If smoke is present in the area, it enters the optical chamber, having smoke particles scatter and sensor will send data to the receiver.

Fig. 4 Smoke sensor

4.4 Wind direction sensor

Wind direction sensor will give us the direction in which the fire will increase. Fig 5 shows the wind direction sensor used in our system,

Here the vanes are made of PVC material and also the base mounting is also the PVC material. Here in this sensor the sensing unit is a high strength variable resistor element and the shaft of the element is connected to the vane and when the wind direction is change the vane gets the direction from wind and the which then the shaft is rotated and the resistance is changed.

Fig. 5 Wind direction sensor

That resistor element has three terminals which are connected as one terminal is given 5v and other terminal is connected to the ground. And the variable terminal is connected to the sensing circuit designed using the Ic Lm324.when the shaft rotates the voltage available is varying from 0 to 5v.that change is voltage is assigned to the 8 directions.so 0.5 v difference is separates the 8 directions.

IC LM324 ,it is quad op amp IC, so two IC are used and are configured as comparator and its reference level is set differently with a difference of 0.55v for every direction the output of the comparator output is turn high. That is then feed to the arm7.then the controller change in bit detects and decides and shows on the LCD the direction.

4.5 ZigBee

ZigBee provides self-organized, multi-hop, and reliable mesh networking. It is use for transfer the data wirelessly from the transmitters to the receiver. ZigBee works on 2.4 GHz. Following fig 6 shows the experimental ZigBee module which are connected to transmitter modules.

Fig. 6 ZigBee module

- Low-power sleep modes
- Multiple antenna options
- Industrial temperature rating (-40° C to 85° C)
- Low-power and long-range Variants available
-

ZigBee less consumes battery so it will work efficiently over low power for long time. It also has benefit of long range of transmission.

V.   CONCLUSION

As we discuss above our system is based on wireless sensing networks which is best system among any other observation techniques. We are using smoke sensor for detection of smoke which are the first happening factor when the fire is occur to the plants. Using this smoke detection we are get information about fire much earlier. Hence we get the early detection of fire than any other system.

Further we are using the LM 35 temperature sensor which will also give the sudden change in environment. We are also using the wind direction sensor which will give us the direction of the fire occurrence. Using these sensors we are developed a reliable, early detecting system that results the proper way of prevention. Using this system we can rescue lots of environmental factors and also human beings. Disasters are not come with notice, so prevention on the proper way is most important.

VI.   ADVANTAGES

1) This system is real-time, hence reliable.
2) Gives early detection of fire which is the big advantage.
3) System uses ZigBee, hence can be work efficiently on long distance.
4) A wireless sensing network reduces the cost as well as the all-time attention of human for detection of fire.
5) Using our user interface we can get immediate information about field at our office.

VII. RESULT

As per our survey on different techniques for fire detection and monitoring we have been propose the above system and successfully implemented it. Our system is based on wireless sensing networks using various sensors such as temperature, smoke, wind direction along with LPC 2148 and ZigBee. We have also tested our system on field. The fire protection and monitoring system is developed which gives early detection of fire.

Following figures shows the implemented system hardware and user interface screenshots.

Fig. 7 Transmitter 1 module of developed system
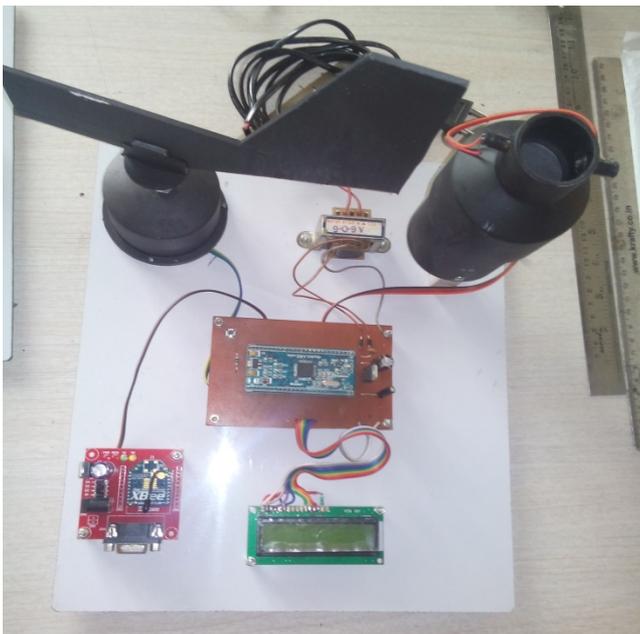
Fig. 8 Transmitter 2 module of developed system
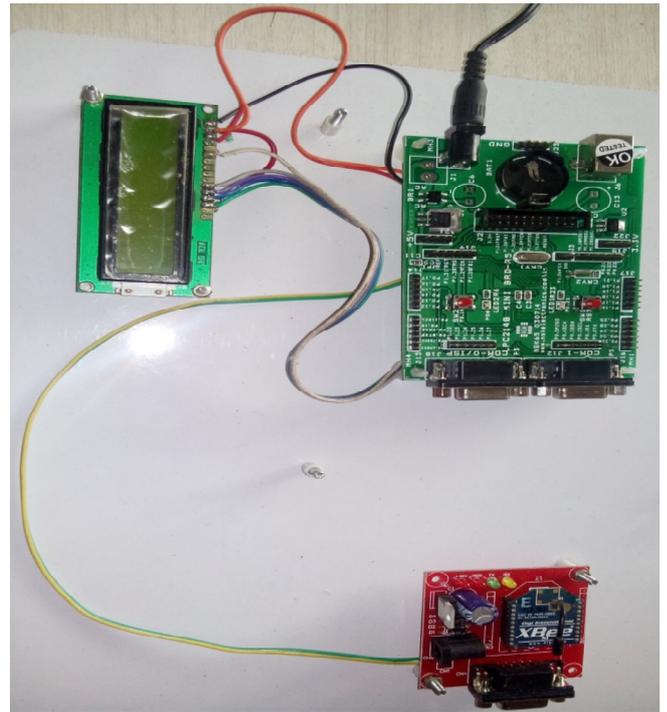
Fig. 9 Receiver module of developed system
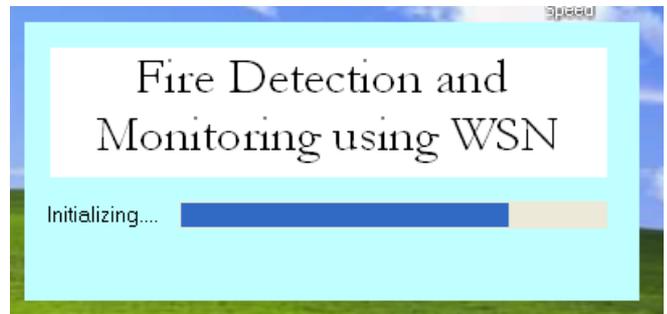
Fig. 10 Initializing user interface

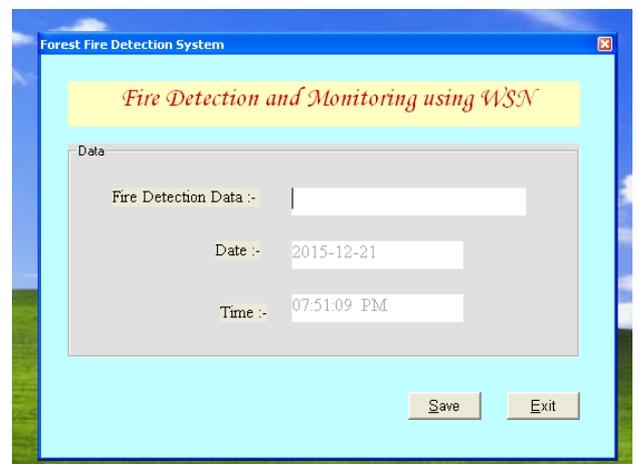**Fig. 10 User interface at computer**

VIII. FUTURE SCOPE

For experiment purpose, we are designed this system using direct power supply in future we can use batteries as well as solar for better efficiency and long life. If we want to extend the range of the ZigBee we can also place the repeaters in between transmitter and receiver. We can also increase the number of transmitter module as per the requirement of the area.

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