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Forest Fire Detection Using Wireless Sensor Networks

Shainy Peter[1],Neenu Paul[2], Sreelakshmi.K.K[3],Thenu Elizabeth Sleeba[4]

Assistant professor, Dept. of ECE, Mar Baselios Institute of Technology and Science, Nelliamattom, Kerala,India[1]

UG student, Dept. of ECE, Mar Baselios Institute of Technology and Science, Nelliamattom, Kerala,India[2]

UG student, Dept. of ECE, Mar Baselios Institute of Technology and Science, Nelliamattom, Kerala,India[3]

UG student, Dept. of ECE, Mar Baselios Institute of Technology and Science, Nelliamattom, Kerala,India[4]

ABSTRACT: Wireless Sensor Networks (WSNs) are used for various applications such as habitat monitoring, automation, agriculture, and security. Since numerous sensors are usually deployed on remote and inaccessible places, the deployment and maintenance should be easy and scalable. Wireless sensor network consists of large number of small nodes. The nodes then sense environmental changes and report them to other nodes over flexible network architecture. Sensor nodes are great for deployment in hostile environments or over large geographical areas. This article presents the design of a system for detection of temperature and humidity and smoke for the prevention of forest fires using wireless sensor networks to prevent a disaster (forest fire) that could lead to loss of a significant number of natural resources. In this project, several tests had been conducted in order to prove the viability of the system. Test results indicated that the reliability of the system in propagating information directly to the base station could be gained excellently in various conditions.

KEY WORDS: Hub, Node, ZIGBEE, Sensing Parameters

I. INTRODUCTION

As we now know, the forest is the protector of the earth's ecological balance, which is considered as one of the most important and indispensable resource. However, forest fire occurs occasionally which due to some human uncontrolled behavior in social activities and abnormal natural factors. In recent years, forest fire increases rapidly, which leads to great loss of possession and life, a large number of animals and plants deaths, destruction of nature and ecological balance, even small climate change of the forest. Prevention and detection of the forest fire have gradually become to the focus that the nation and society concern on. So it is very necessary to research how to prevent the occurrence of forest fire. Traditional monitoring measures of forest fire include ground patrolling, watch tower, satellite monitoring and so on, but these fire monitoring methods still exist lots of problems. First of all, it is very difficult to accurately monitor of forest fire in a region at any time, for example, remote real-time monitoring level of satellite images is not very high, the forest fire in the same region can't be monitored all day, the thickness of sky clouds and other factors will reduce accuracy of fire positioning. With the development of sensor technology, MEMS and wireless communications, wireless sensor networks have been paid great attention in all fields. In order to solve the problems, we designed a forest fire monitoring system based on wireless sensor network and GPRS through which monitoring system can make it easy to implement the connection of monitoring field and remote monitoring center.

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II. METHODOLOGY

Selection of Deployment Area

In case of selection of deployment area, we mainly consider the fire prone area i.e., area is select based on the vulnerability to fire. Accordingly to the details available from the forest fire department, the areas are classified into high fire prone area, moderate fire prone area and low fire prone area. It will help to concentrate where the sensors need to be deployed.

Deployment of Sensors

The sensors are placed manually.

Checking Connectivity and Cluster Formation

Connectivity checking is essential to understand that each component in the network working as per our needs. For that handshaking mechanism can be used. The cluster formation has greater impact on connectivity checking. Because cluster head present in each cluster stores the details of each sensor nodes and also it helps in effective data transmission.

Sensing Parameters

In forest fire scenario, sensors are used to sense the parameters which are fueling the fire like temperatures, wind speed, smoke etc. In forest fire scenario, temperature is the important factor fueling the forest fire. If the temperature increases then the intensity of fire also increases where the wind can also affect the fire in terms of increases the intensity and may change the direction of fire.

Data Collection and Aggregation

Another important designing factor is that data collection and data aggregation. Data coming from multiple sensor nodes are aggregated if they are about the same attribute of the phenomenon when they reach the same routing node on the way back to the sink. It may cause problems like overlap problem, congestion and collision of data. It can be avoid by using handshaking mechanism like RTS, CTS.

III. ARCHITECTURE

Based on the findings from traditional and existing method, here proposed a system architecture for the real monitoring of forest fire given below:

The aim of this paper is to implement a forest fire early detection system using small and cheap sensor nodes which can be left unattended. We are not using large expensive centralized control equipment which adversely affects system robustness in such vulnerable environment. The monitoring system of forest fire based on wireless sensor networks is mainly made up of three parts: sensor node, hub, monitoring system. A trekking assist is also included with this.

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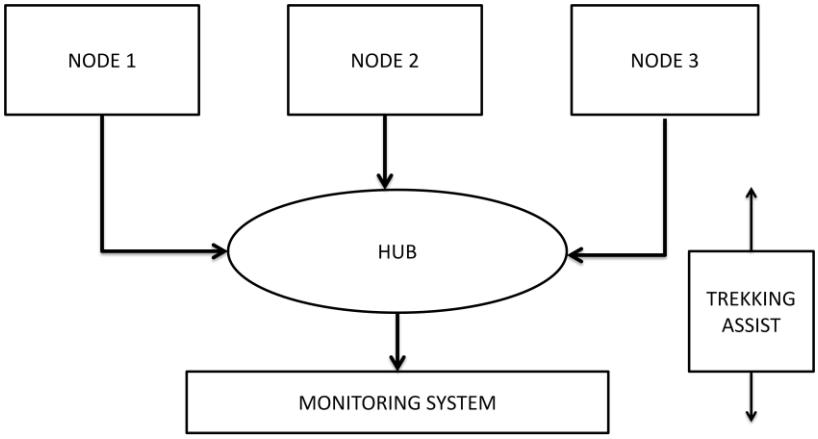

Fig. 1: Proposed Architecture

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 central node in multi-hop routing manner through large numbers of routing nodes placed in the forest, and then it is packaged by the central node to be sent to monitoring center.

III. BLOCK DIAGRAM

Wireless Sensor network deployed in the forest. The whole forest area is divided into clusters and in each cluster, cluster head is chosen. Each location of cluster and nodes will be containing an identification number. All the sensor nodes runs an application program to sense the temperature, wind, humidity and smoke periodically. The sensor node forwards the sensed parameters to the cluster head.

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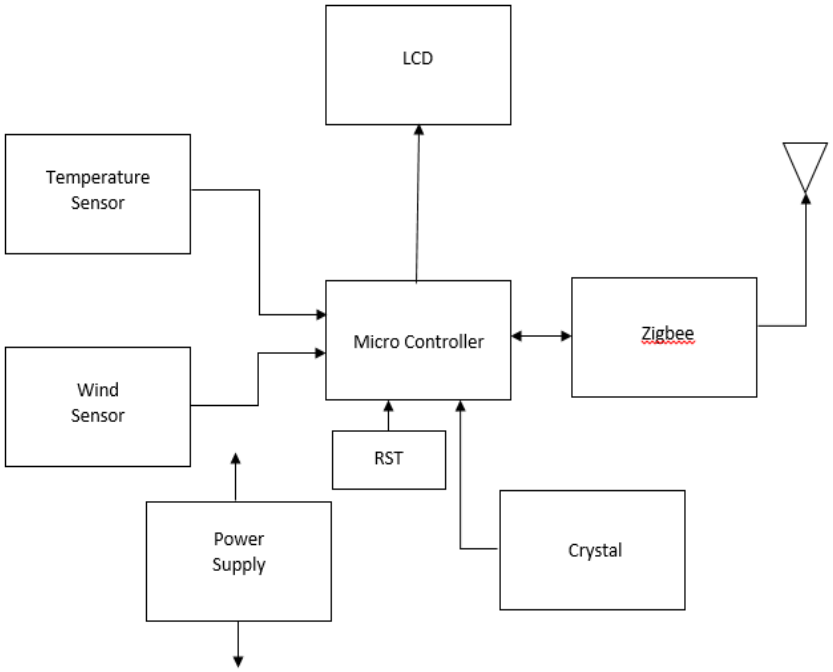

Fig. 2: Sensor Node (Cluster Head)

If the cluster head is abnormal depend on the threshold of each parameter, cluster head is responsible for communicating with the base station. If the received values in the base station are found critical a message is sent to a mobile number of the concerned staff about the critical condition. If two locations simultaneously send the critical data to the base station, then the data is sent to the admin based on the priority of location of the information. In order to reduce the energy consumption there is no need to send data continuously to the base station. To check that the sensor is in working condition, the check request is sent to each sensor periodically.

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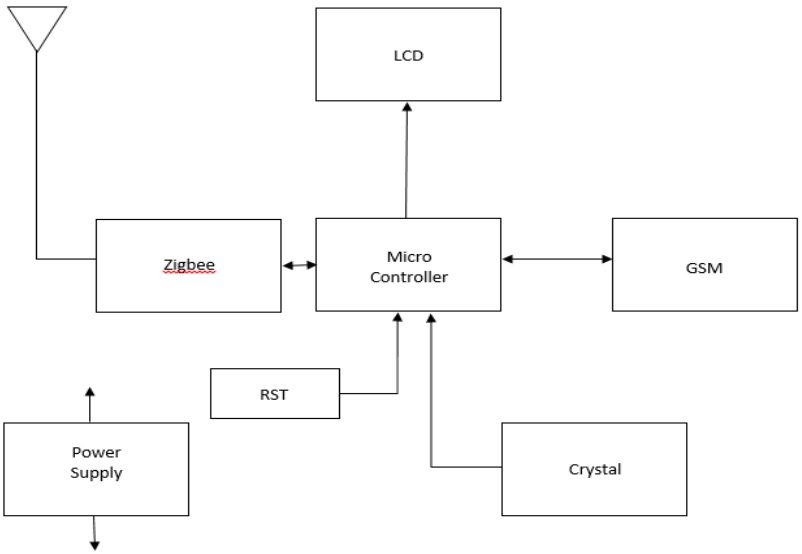

Fig. 3: Base Station (Transceiver)

IV. FUTURE SCOPES

- Trespasser's identification along with image processing .
- Transmitting signals and image of the trekker

V. CONCLUSION

Wireless sensor network has great impact on industry and our daily life, and this paper designs a monitoring system for forest fires based on wireless sensor network and GPS network. Our system is able to fairly accurately distinguish different forest fire scenarios and accurately determine the direction of growth of fire. This system with the advantages of real-time, low power, high reliability, remote control and so on, has a broad application prospect in forest fire monitoring.

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