Comparison and application of Forest fire detection system based on a ZigBee wireless sensor Network

Ummul Khair Maria Roohi[1]

Nawab Shah College Of Engineering & Technology (Affliated to JNTUH),

ABSTRACT: The significance of forest fire monitoring was determined by the importance of forest resource and the destructive of forest fire. In the paper, according to the limitation of traditional forest fire monitoring schemes, a new wireless network implementation scheme oriented to forest fire monitoring was presented based on GPRS communication technology and ZigBee technology. The related hardware schemes and software program flows were given. The forest environmental information was collected by ZigBee network and transmitted to FTP server with public network IP on the internet through GPRS network by GPRS module which was controlled by coordinator node. The monitoring center got the data, which was provided for relative experts and decision maker, from FTP server to implement the achievement of remote data from monitoring region. Through the analysis of historical data and real-time data, correct judges and decisions were made. It had strategic significance to improve the level of modernization of forest fire monitoring.

KEYWORDS: Zigbee , Real time data, Historical data, Forest fire monitoring, GBRS communication Technology, FTP server.

INTRODUCTION

Forests are part of the important and indispensable resources for human survival and social development that protect the balance of the earth ecology. However, because of some uncontrolled anthropogenic activities and abnormal natural conditions, forest fires occur frequently. These fires are among the most serious disasters to forest resources and the human environment. In recent years, the frequency of forest fires has increased considerably due to climate change, human activities and other factors. The prevention and monitoring of forest fires has become a global concern in forest fire prevention organizations. Currently, forest fire prevention methods largely consist of patrols, observation from watch towers and lately satellite monitoring (Lai, 2004; Huang et al., 2005). Although observation from watch towers is easy and feasible, it has several defects. In the first place, this method requires many financial and material resources and a trained labor force. Second, many problems with fire protection personnel abound, such as carelessness, absence from the post, inability for real-time monitoring and the limited area coverage. The scope of application of satellite detection systems is also restricted by a number of factors, which reduces its effectiveness in forest fire detection. For example, a satellite monitoring system has a long scanning cycle and the resolution of its saturated pixel dots of images is low. Another problem is cloud layers may mask images during the scanning period and the real-time mathematical quantification of fire parameters is very difficult to achieve (Shu et al., 2005; Yu et al., 2005; Calle et al., 2006). Given these shortcomings of traditional monitoring, we suggest the ZigBee wireless sensor network technology and explain its application as a monitoring system. This system can monitor real-time related parameters, e.g., temperature, relative humidity, and send the data immediately to the computer of the monitoring center. The collected data will be analyzed and managed by the computer. Compared with the normal meteorological information and basic forest resource data, the system can make a quick assessment of a potential fire danger. The analytical results will then be sent to the relevant department as the policy-making basis by which the department will make the decision of fire fighting or fire prevention.

LITERATURE SURVEY

Three factors compose the basis of a forest fire: the fire source, environmental elements and combustible material. A forest fire usually occurs as the result of their combined effects (Song et al., 2006). According to the Canada Fire Weather Index Forecast Model, the moisture content of the combustible material plays an important role in forest fires, which means the probability of forest fires depends on the moisture content (Tian et al., 2006). Therefore, the moisture content of combustible materials is a major point of assessment and predicts whether a fire will take place. The moisture content has much to do with relative humidity in the atmosphere, air temperature,wind and similar factors (Shu et al., 2003; Zhang, 2004). Water evaporation can be directly affected by relative humidity. At the same time, the physical properties of combustible materials can be changed indirectly by air temperature. Thus, relative humidity and air temperature are regarded as the two main factors which affect the moisture content of the fuel. Therefore, to reflect the moisture content indirectly, these two parameters are the main objects of our investigation, which should provide an important basis for the prediction and monitoring of forest fires. Certainly, forest fires are also caused by other factors, such as the active degree of thunder and lightning above the forest, human factors, wind speed, and condition of area vegetation. However, these factors will be ignored in our discussion.

METHODOLOGIES

1) RFID data transmission problem:

GIS and RFID to achieve the separate wiring problem of personnel location under the traditional way; Because of geographical complexity of the mine, bad environment wired connections will cause the data route in the mine complex and redundant and data lines will be influenced by poor environments to rotten skin, breaking leading to data transfer instability.; and effective data are collected precisely to ensure personnel safety of important security; relying on wireless sensor networks to transmit data, security, high reliability and eliminating the need for separate wiring problems, reducing input costs.

2) Personnel positioning problem:

The combination of RFID technology and GIS, can solve based on ZigBee technology the personnel positioning inaccuracy of theproblem; Under the ZigBee technology to realize personnel positioning mode, Personnel to wear the positioning of a ZigBee module which regularly sent the existed information, the sensor node which distributed in mine roadway to receive this signal, according to signal strength to determine its location ; When the mine tunnel barrier is greater, the existed signal attenuation occurs during transmission, detection accuracy of sensor nodes will be reduced or even fail. And when the network transmission links due to the malfunctioning of a node failure, the data will not reach the ground control center. Using RFID technology, Anti-pollution features of the electronic tag and the reader transmission and the diffraction function, to minimize the environmental impact of geography; with GIS analysis of the surrounding environment, truly accurate personnel positioning. And when the mine accidents occur, RFID tag will bring help to rescue; use of handheld devices that have targeted the location of facilities, staff side edge detection rescue, relief to improve greatly.

3) Under the mine the personal safety of staff problem:

Implantation of clothes in the wireless data receiver can be realized well into the double protection of personnel; it apart from the ground control center received a warning message sent over in addition to the autonomy of the receiving sensor node detection data; when the data transmission is not stability or failure of data link control center to send the correct data can't be reached, it still can be achieved well into the safety of the personnel on alert.

PROBLEM DEFINITION:

Zigbee wireless communication technology has wide perspective, Zigbee will be used in a couple of years in the area of industry control, industrial wireless location, home network, building automation, medical equipment control, mine safety, etc, especially home automation and industry control will be the main application fields. Zigbee wireless communication is applied in families. With the development of people's life, the concept of smart home and home automation is well known, but it must relate to the transmission of information and signal if it comes true, so it is troublesome to wire cables. Zigbee is a new short-range technology for wireless communication, it is specially designed for applications of wireless communication of low speed and low power dissipation, and it is ideally suited for establishing family wireless net. It is effortless to realize home temperature regulation, remote control of interior lighting systems, and automatic adjustment of curtain. Zigbee wireless communication technology is applied in meter reading system in the monitoring center just needs to analyze and calculate data acquired from users and obtain electricity consumption of users. After that, electric charge of the month is deducted from electricity account of users, the workers who is obliged to read the meter in user's home, the thing that users are not at home when workers are to read the meter is avoided[8]. Compared to working expediently for workers, it is the most important to be used in safety. introduces an experimental home security monitoring and alarming system based on Zigbee technology, it is capable of monitoring door and window magnetic contact, smoke, gas leak, water flooding, providing simple controls such as turning off the valves, and sending the alarms to the residential area security network, etc. Zigbee wireless communication technology is applied in factories or enterprises. It is applied in information system of coal preparation enterprises in, all kinds of disadvantages of traditional cable network system are avoided by coal preparation enterprises, it highly improves the level of information automatic, automation, and management. Zigbee wireless communication technology is applied in ARM NC system network in Experimental results showed that the improved method can guarantee the processing efficiency of NC system with satisfied accuracy and data transmission speed. Aiming at substation perimeter safety, a novel laser alarm system based on Zigbee is proposed in. It consists of laser railing security subsystem and data central monitoring subsystem, the communication between the two subsystems is realized by Zigbee wireless technology, a real-time human-machine interface can be provided for worker. Zigbee wireless communication is applied in mine. Aiming at improving safety of production and staff safety, Zigbee technology is applied in the Miner's Lamp Monitoring in.This system can realize underground staff orientation and achieve monitoring and control of the state of charge on the miner's lamp, and the high effective control and management on use of miner's lamp [10]. Utilizing the underground existing net and the extension Zigbee nodes, the system also can be more easily increased the humidity, gas and other sensors, to achieve mine environmental monitoring, ensure safety in production, the improved method has been researched in Zigbee has been widely used in many areas due to the advantage of low power consumption and low cost, it is good for wide-scale application. But there are some problems now, the coordinator carry too much nodes, especially in the large scale wireless sensor network, it is necessary to result in bad real-time, data packet loss, and stability decrease; also, there are some places where it is difficult for humans to change the batteries of nodes, or there is a fairly large number of nodes which is troublesome to change presents an improved design, the coordinator only deal with the task on the Zigbee network, the rest tasks will be processed by another processor. Prolonging the lifetime of the Zigbee network is the important goal of designing the Zigbee routing protocol. An energy-aware routing

mechanism EA-AODV is presented in it can save energy and improve the performance of Zigbee network. Zigbee wireless communication technology is applied in container Information system in the paper presents the strategy of networking and routing in order to keep energy load balancing between network nodes, prolonged the lifetime of node and network effectively. It is highly necessary to research these respects. ZigBee technology is a new standard in wireless personal area after Bluetooth. After an introduction to this technology, a new wireless meterreading system based on ZigBee protocol is possible. This system, which is comprised of ZigBee network and database management system, has many important advantages such as low cost, low power consumption, and low date rate

CONCLUSION

In this paper, a forest fire monitoring system is built based on ZigBee wireless sensor network and GPRS wireless communication technology, from the perspective of construction cost, flexible networking, real-time monitoring. ZigBee network is used to monitor forest areas relative parameters such as temperature, relative humidity, UV intensity of flame, smoke concentration. GPRS controlled by coordinator node is used to connect, log on GPRS network to transmit data to FTP server with public IP. Finally monitoring center obtain the data from FTP server. The successful connection between ZigBee network and internet through GPRS network makes the functional complementarities of several networks and implements remote access to the data of forest monitoring region. Compared to traditional forest fire monitoring system, the program is good at flexible structure, low one-time cost, easy operation, wide expansion and better promotional value.

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