Research on Test and Trusted Defense of Railway Communication Network based on Zigbee and GPRS

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Abstract. Using the respective characteristics of ZigBee and GPRS technology, it shows its reliability and security in data transmission. At the same time, the combination of the two communication modes brings complementary advantages. This paper studies the railway communication network test and credible defense based on ZigBee and GPRS. This system adopts the communication mode of waking up module when star topology and requirement are adopted, which effectively reduces the power consumption of each sensor node and the probability of collision between sensor nodes when reporting data to sink node. Using GPRS network to transmit data of sink node has changed the limitation of traditional wireless sensor networks that need to rely on wired public network for data transmission. The system scheme of low cost and low power wireless sensor network based on ZigBee technology and GPRS network proposed in this paper has broad application prospects in environmental monitoring, military, medical health, home intelligent monitoring and wireless meter reading system.

Keywords: ZigBee; GPRS; communication network; monitoring system.

1. Introduction

In recent years, with the continuous increase of the total length of railway lines in our country, the railway has been continuously strengthened and developed, and the topic of "railway traffic safety" has been constantly concerned by the people and has become a hot topic of public opinion for many times [1-2]. The complex geographical, climatic and natural environment has also created the reality that China is one of the countries with the most frequent natural disasters in the world, and the railway sector has naturally become one of the most serious victims. In order to reduce and prevent the serious losses and threats to national economy and personal safety caused by natural disasters more effectively, modern railways need to have a more complete and reliable alarm system [3-4]. This paper designs an intelligent monitoring and alarming system based on the combination of ZigBee and GPRS, which has the function of monitoring the lateral displacement, coverage and subsidence caused by natural disasters along the railway line. It can send alarm signals timely and accurately when natural disasters occur and affect the safety of driving, and remind the relevant railway department staff.

2. Key Technologies of the System

2.1 Introduction to ZigBee Technology

ZigBee technology is a short-distance, low-rate, low-power two-way wireless communication technology that has emerged in recent years. ZigBee's name comes from bees. When the bees find food, they will pass the "Z"-shaped dance to convey information such as food position and direction to their companions. Because the bees are small in size, the required energy is small, and the ability to transmit information is consistent with the technical characteristics, the technology is named ZigBee [5-6].

ZigBee technology is characterized by close proximity, low complexity, low power consumption, low data rate, and low cost. It is mainly suitable for use in the fields of automatic control and remote

control. It can be embedded in various devices and is designed to meet the wireless networking and control of small and inexpensive devices.

ZigBee technology features short range, short latency, low speed, high capacity, high security, low power consumption, free of charge, and low cost. In terms of research and application, foreign research started earlier, but later in China, but ZigBee technology has been widely used in the world, mainly used in smart home, intelligent transportation and other fields. In recent years, many domestic universities have also launched a number of wireless sensor network projects based on ZigBee. ZigBee technology is prosperous and prosperous in the field of short-range wireless communication.

2.2 Introduction to GPRS Technology

GPRS technology is a wide-area wireless communication technology based on the GSM system. It provides an end-to-end wireless IP connection that delivers data to users in a "packet" format. Since it transmits signals by means of a signal tower of a mobile company, its stability is generally good.

GPRS technology has the characteristics of always online, low cost, fast login, channel guarantee, high-speed transmission, flexible networking and lightning protection. In terms of research applications, GPRS has a wide range of applications and has many types of services, mainly used in transportation and public safety [7]. At present, domestic 4G has begun to spread gradually, and 3G has been widely used. In foreign countries such as South Korea, 4G has become popular and is marching toward 5G [8]. However, the system still uses GPRS to combine with ZigBee based on the principle of low cost and practicality. And the complementary advantages of these two long-distance wireless communication methods can well meet the system's demand for data transmission.

3. System Overall Design

The whole system consists of data acquisition module, communication module and host computer module. The system structure is shown in Figure 1. The scheme proposes to use GPRS and ZigBee two kinds of wireless communication methods to transmit the data collected by each sensor node to the upper computer.

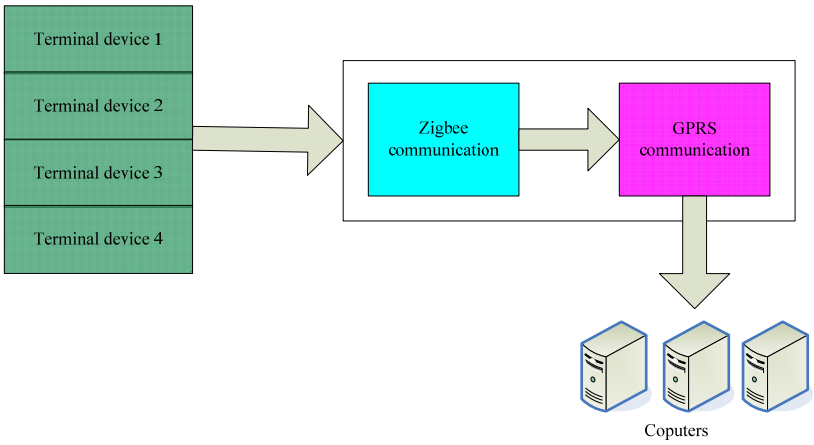

Figure 1. System block diagram

There are three kinds of nodes in the ZigBee network: coordinator, router, and terminal node. The system ZigBee adopts a star network structure, which is composed of a group of data terminal nodes (5 in the system) and a coordinator installed along the railway. The coordinator not only constructs and maintains the network, but also undertakes. Routing function. The star network structure is shown in Figure 2. While using the ZigBee wireless sensor network, the GPRS network is used to receive and transmit the data collected by the terminal nodes collected by the coordinator, and one GPRS module corresponds to one coordinator [9]. By installing multiple sets of star network nodes along the railway to form a large data collection network, the problem of data errors collected by the system

due to the failure of one or several network nodes is effectively solved. The watchdog setting is added to the data collection node and the GPRS module to have a power-off reset function. In this way, the call response between the data acquisition module, the communication module and the upper computer module is realized, thereby effectively solving the system data error problem.

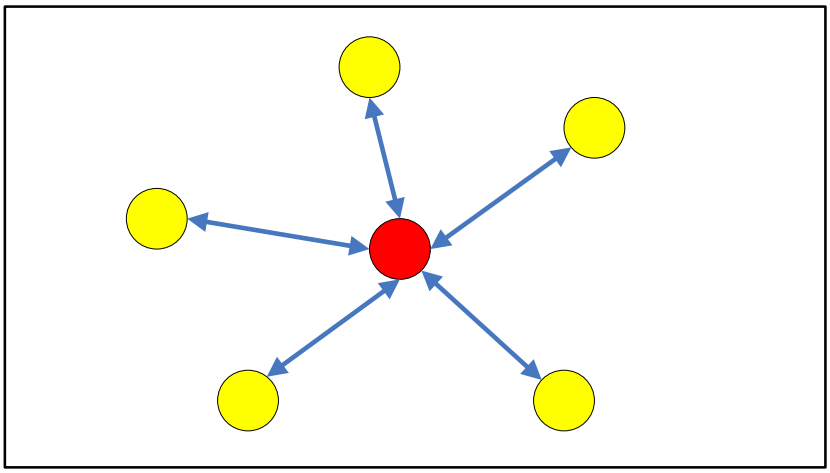

Figure 2. Star network structure diagram

4. System Software Design

4.1 Pc Software Design and Implementation

The central information control center consists of three parts: monitoring software, configuration module, and database. It is indirectly connected to multiple sink nodes through the GPRS network. The monitoring module monitors the serial port of the distributed sink node, analyzes, processes, and sends control signaling to different IDs through monitoring the communication serial port. The sink node implements indirect, real-time monitoring and data acquisition of sensor nodes. Figure 3 is a flow chart of the upper cleaning program.

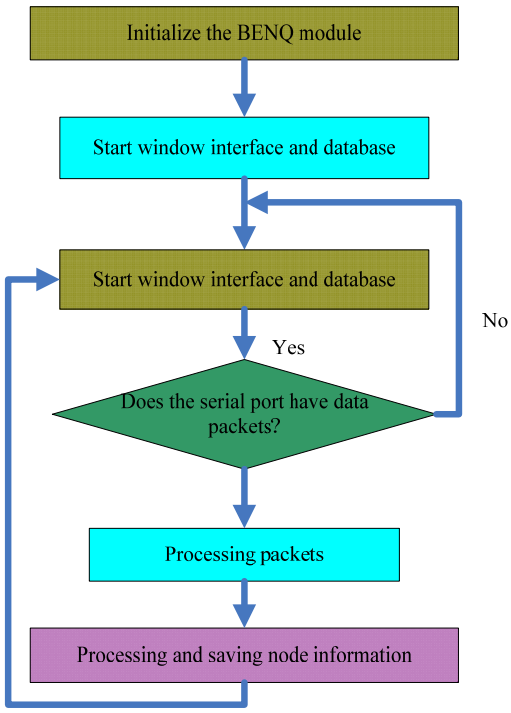

Figure 3. Flow chart of host computer main program

4.2 Software Design of Terminal Node

Firstly, a network is constructed by the coordinator, and then five terminal nodes in the real-time data request mode send the connection request signaling to the coordinator. After receiving this signaling, the coordinator starts to connect the network and returns a confirmation frame to the terminal node after the connection is successful. When the terminal node receives the confirmation frame, it begins to collect the status data along the railway line and send the collected data to the coordinator [10]. Whenever the terminal node sends data to the coordinator once, the coordinator returns a confirmation signal to the terminal node. When the terminal node successfully receives the confirmation, signal sent by the coordinator, the data transmission ends and the next data acquisition and transmission begins. If the terminal node fails to receive the confirmation signal sent by the coordinator, it will reset after three unsuccessful connections and start collecting and sending new data to the coordinator. The terminal node design process is shown in Figure 4.

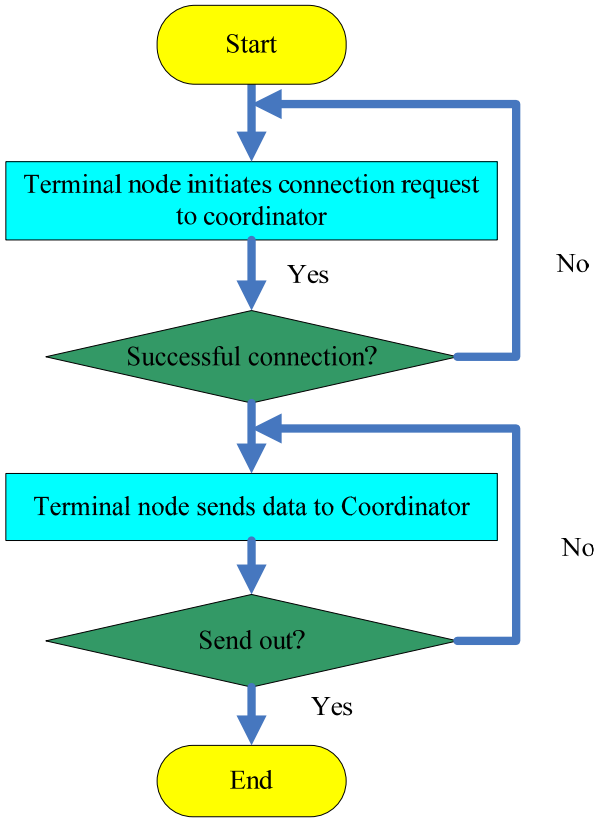

Figure 4. Flow chart of terminal node design

4.3 Coordinator Software Design

When the network between the coordinator and the terminal node is constructed, the coordinator begins to prepare to receive the data sent by the terminal node. When the data is received, the data is packaged and processed, and then sent to the host computer via GPRS which has constructed the network through the PPP protocol. In this system, GPRS also has the function of power off reset, which is the same as the design of terminal node.

5. Summary

In today's Internet and big data era, Internet of Things and wireless communication technology are also maturing and developing rapidly. This system is based on the frontier of the technology of the times and has many advantages, such as flexibility, economy and intelligence. It can solve the hidden dangers and threats of railway transportation caused by disasters, and thus meet the needs of Railways and the broad masses of people. The significance of this technology is that it greatly enriches the

monitoring scope of wireless sensor networks and makes up for the shortcomings of long-distance communication. To create a remote communication platform for ZigBee sensor network, so that ZigBee wireless sensor network can be applied more widely.

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