Design of Monitoring and Management System of Tourist Attractions Based on RFID Technology

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Abstract—This paper presents a monitoring and management system of tourist attractions based on RFID technology. RFID is applied to monitor tourist flows and relics of scenic spots. BP-neural network algorithm is adopted to analyze and forecast tourist flows. Temperature sensors, humidity sensors and wind sensors are organized as Wireless sensor networks by ZigBee technology to complete the real-time monitoring of natural environment. Software system provides visualization service to rescue tourists, eliminate danger and trace the route of relics.

Keywords—RFID, ZigBee, Multi-sensors, Real-time monitoring

I. INTRODUCTION

With boom of the tourism, tourist attractions become high risk areas. Problems of tourist safety, relics’ security and geological disasters come up. Parts of the popular attractions with high personnel-intensity may be unsafe. Natural scenic spots in more remote areas have higher fire risk and more geological disasters. Damage and theft abound often happen in areas with lots of precious relics. At present, most of the tourist attractions keep paper tickets and use regular personnel inspection as monitoring method which has poor effectiveness and can’t make a timely manner when danger takes place. Therefore, it’s necessary to develop a scientific and rational system of monitoring and management of tourism attractions.

II. DESIGN OF HARDWARE SYSTEM

Hardware system is composed by RFID system and multi-sensors system. The overall structure is shown as Figure 1.

A. Components of RFID system

RFID is the abbreviation of Radio Frequency Identification. It usually consists of electronic tags (RFID tags), readers and supporting software applications[1]. Electronic tags contain a certain format electronic data which is often used as identity information for objects to be identified. Readers and tags can transfer information through agreed communication protocol. Usually in non-contact mode, readers send commands and tags return the identity data to the readers according to the commands received[2].
the location of tourist can be obtained. Relics can be detected when moved by RFID readers nearby as well. Data is saved in the database and integrated by computer[4]. The system workflow chart is shown as Figure 2.

![Figure 2. The system workflow chart](image)

RFID readers are put in the outer and inside place of a spot’s entrances and exports. Set the scope of their control do not overlap. There are three types of the state of a tourist: ready to enter, enter, and leave. The state of a tourist in a particular area is divided into: ready to enter, enter, and leave. Readers in the outer place are set with a unified type of sign, as same as readers in the insider place. No matter how many times a tourist in a spot are detected by outer readers, the system will only maintain its original state, or leave, or preparing to enter.

### B. The System Of Multi-Sensors

The system mainly introduces three kinds of sensors as temperature, humidity and wind sensors. The distribution model of the sensors that determines the location and number of nodes in sensor placement should be established according to the actual situation of attractions. Meteorological data is collected by sensing devices, and passed by wireless sensor networks which are organized by ZigBee.

ZigBee is a short distance, self-organizing, low power and low-cost wireless communication technology, which is suitable for the field of automatic control and remote control and can be embedded in various devices[5]. ZigBee is based on the IEEE 802. 15. 4 which is a wireless network protocol stack designed for the low-power, low-rate sensor and network control. In network performance, Zig Bee technology can construct a star network or peer to peer network, which can achieve large area coverage and scalable network.

ZigBee wireless sensor networks in this passage consist of coordinators, routers and sensor nodes. Sensor nodes are responsible for collecting and transmitting meteorological data which are deployed in the critical areas of tourist attractions; routers transit data in the middle and can also cater to the sensor node function to conduct data acquisition; coordinators as known as collection nodes are responsible for data collection, organizing network and communicating with the host computer [6]. The hardware structure of sensor node is shown as Figure 3.

![Figure 3. Hardware structure of ZigBee sensor node](image)

Because of the scenery wide distribution of data collection nodes, the system applies tree network structure shown in Figure 1. Collection nodes and router nodes are FFD (full function device). With routing and relay functions, they can communicate with any device in the network. The sensor nodes are RFD (reduced function device) and can not directly communicate with each other only through the FFD nodes[7].

With the controller function, FFD provides two-way transmission of information. It has all function and features of 802 15. 4 specified by the standard. More memory and computing power can make it in the role of network router at idle time. It can be used as a terminal device as well.

RFD eliminates the need for memory and other circuitry to reduce the cost of Zig Bee components. Simple 8-bit processor and a small stack also help reduce costs.

### III. DESIGN OF SOFTWARE SYSTEM

#### A. Functions Of Softwaresystem

In order to meet the needs of monitoring and management of tourist attractions, the software system should have some necessary functions. Specific functions are shown as Table 1.

<table>
<thead>
<tr>
<th>Table 1. Specific Functions</th>
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<tr>
<td><strong>Functions</strong></td>
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<td>Information Management</td>
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<td>Reader information management</td>
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<td>Information Query</td>
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<td>Queries of relics</td>
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<td>Queries of tourist's distribution</td>
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<td>Map Displaying</td>
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<td>Weather condition</td>
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<td>Alarm Management</td>
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<td>Preventing alarm</td>
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<td>Setting alarm</td>
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<td>Queries of alarm tag</td>
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<td>(1) Provide complete information operating mechanism</td>
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<td>System should offer functions of user information management, reader information management and chip information management. User information may contain user name, user ID, sex, telephone number and so on. Reader information should contain reader number, reader name, kind, position and so on. Chip information should contain chip number, chip name, chip kind and so on.</td>
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<td>(2) Provide complete query mechanisms of real-time information in tourist attractions.</td>
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<td>Input information of scenic spots to achieve the queries of tourists’ number, relics’ information and weather condition; Input information of chips to achieve the queries of tourists’ position, relics’ position. In addition, system should provide scenic spots’ Information Summary function.</td>
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<td>(3) Achieve real-time map displaying of tourist attractions’ information.</td>
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<td>Through real-time data reading, the distribution and number of tourists, relics’ state and weather condition should be displayed in the form of a map. Implement tourist...</td>
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density and weather condition forecasting analysis of key areas and display these information in the map as well. (4) Provide functions of real-time alarm, removing alarm, alarm setting and alarm querying.

When the number of tourists exceeds the maximum capacity, relic’s position is change, or meteorological disasters may happen in a scenic spot. System will produce an alarm prompt. Users can remove alarm when it happens. All of the alarms information should be automatically generated into the alarm log and users can query them. Furthermore, system should provide users with personalized alarm settings, such as sound, flash, alarm number, alarm cycles and so on.

B. Components Of Software system

Software system mainly completes four modules: basic information management, tourist flows monitoring and management, relics monitoring and management and meteorology monitoring and management. The main modules of software system are shown as Figure 4.

![Figure 4. Main functional block diagram of software system](image)

C. Basic Information Management

It composes user management, reader management of adding, deleting and modifying, and chip management of adding, deleting and modifying.

D. Tourist Flows Monitoring And Management

It completes showing of tourist flows map, tourist information management and warning information management.

Real-time electronic map shows tourist information, tourist flows and tourist capacity in every spot. When the tourist numbers overload, the corresponding region will alarm. BP-neural network algorithm is introduced to complete tourist density forecasting analysis of key areas. Learning model should be established according to actual situation. In this model, Inputting number and learning times should be set to make the best predictive analysis algorithms[8]. Referencing to the predictions, diversion suggestion is given for intensive areas.

In addition, this module should implement function of tourist’s line history back to facilitate rescuing work when the danger occurs.

E. RELICS MONITORING AND MANAGEMENT

It mainly completes showing of relics map, relics’ information management and warning information management.

Real-time electronic map shows information of the relics in every spots. Corresponding region will alarm when position of relic changes:

(1) The reader can not detect the relic attaching with chip in the spot information.

(2) The reader detects illegal information of relics which should not in the spot. This module should provide track of relic path to staff in attractions.

F. Weather Monitoring And Management

It completes showing of the weather map, weather information management and warning of weather management.

Real-time electronic map shows the weather information of major spots. A certain multi-information fusion algorithm is adopted to analyze the information, determine the real conditions in areas monitored, and make reasonable alarm or warning tips. Weather graphs are drawn to facilitate removing danger.

IV. SUMMARIES

Simple and reusable RFID electronic ticket management for attractions can save time and paper printing costs and has more significant economic benefits. RFID and Zig Bee wireless sensor networks technologies are more advanced. Economical and practical monitoring hardware can save both human and material resources, as well as acquire real-time feedback information. Software system can provide convenient services of direct visualization and accurate displaying of tourists intensity which makes scientific reference to the environmental carrying capacity. Real-time relics monitoring and early warning systems for disaster prevention provide an exact basis for decision making and environmental resource protection. With enhancing the overall management of tourist attractions and receiving higher social benefits, the system has a more broad application prospect.

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REFERENCES


