Design of Stadium Security System Based on Android and Zigbee

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ABSTRACT

With the rapid development of IoT application technology, to develop efficient and fast design a scenario of Internet of things application has been becoming the current hot topic. This paper was designed using an Android and ZigBee this two common Internet of things technology development sports venues monitoring system, the method of system adopts hierarchical design, simple and efficient development process, has a certain popularization significance.

1. INTRODUCTION

In recent years, the development of Internet of Things technology in China has grown by leaps and bounds. From 2009 to 2015, the scale of China's Internet of Things industry jumped from 170 billion yuan to 750 billion yuan, with a compound annual growth rate of more than 25%. Internet of Things technology in industrial manufacturing and agriculture, Transportation, energy, home, safety, medical health, and old-age care are all applicable. IoT technology needs to develop different applications in different fields of different occasions. The Internet of Things industry has higher requirements for product development efficiency. This paper applies Android to develop mobile applications and uses Zigbee network technology to realize the connection of the underlying sensors. Designed and developed a stadium security system, using the layered design of the sensing layer, network layer and application layer, the design and development process is efficient and fast, and hopes to promote the development of efficient IoT applications.

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2. OVERALL SYSTEM DESIGN

In the stadium security system, Android mobile terminal needs to realize the real-time display of the temperature and humidity value of the ZigBee channel of the main venue, and use the IoT sensing device such as infrared sensor and smoke sensor characteristic gas sensor to realize the security monitoring system of the stadium.

When there is an abnormal situation, the alarm light in the control field flashes, and the system notifies the security movement through the Socket communication mode. After receiving the notification, the security mobile system can check the scene and turn off the alarm light.

The system consists of a sensing layer, a network layer and an application layer, and is implemented layer by layer from bottom to top. The hardware equipment and network topology relationship mainly involved in this project. Figure 1 below is the physical architecture diagram.

The system needs to monitor the illuminance, temperature and humidity, air quality, etc. in the stadium in real time. In addition to the function of collecting the corresponding values of the sensor, it is also necessary to realize the networking communication between the sensor and the coordinator to transfer the data to the application layer. Realize the use of client software to display the current lighting, temperature and humidity, air quality and other data values of the stadium.
3. PERCEPTION LAYER DESIGN

The sensing layer intelligent environment module is composed of various types of wireless sensors. The number of specific sensors depends on the size of the stadium and the requirements of the system. The field data collected by the sensor module of the sensing layer is transmitted to the system gateway through the wireless sensor network, and the gateway converts the data into a TCP/IP data format and sends it to the application layer for use. The communication between the sensor and the sensor, the sensor and the coordinator is to transmit and receive data through the wireless 2.4 GHz frequency band, without using a transmission medium such as a cable as a channel for data transmission. This requires a built-in wireless local area network protocol for encoding in the wireless sensor to achieve wireless data transmission. The system uses the Zigbee protocol as the wireless LAN protocol to perform wireless data transmission and reception between sensors.

The configuration of the WLAN wireless local area network is mainly for configuring the coordinator, relay, and sensor in the sensor network, and configuring the relevant parameters of the above various devices by using the ZigBee networking parameter configuration tool. In IAR (C), the format of the transmitted data packet is confirmed as shown in Table I, and is downloaded to each of the above device modules by using the SmartRF Flash Programmer download tool.

<table>
<thead>
<tr>
<th>Head</th>
<th>Type</th>
<th>Len</th>
<th>Data</th>
<th>Count</th>
<th>Chk</th>
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<tbody>
<tr>
<td>0xFF</td>
<td>0xFD</td>
<td>0x00</td>
<td>0x04</td>
<td>0xX</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0xX</td>
<td>0xX</td>
<td>0xX</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Count[L]</td>
<td>Count[H]</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>0xX</td>
<td>X</td>
</tr>
</tbody>
</table>

4. NETWORK LAYER DESIGN

A wireless local area network is a network that is established within a certain local area by using wireless communication technology. The standard protocols adopted by WLAN are mainly IEEE 802.11 series protocols. In addition, other wireless LAN standard protocols include Bluetooth, UWB, ZigBee, WiMax, IrDA, HomeRF and other technologies. The sensor network in this system uses the ZigBee wireless network.

ZigBee is a low-power LAN protocol based on the IEEE802.15.4 standard. It is mainly for low-rate wireless personal area networks. Its typical features are close range, low complexity, self-organization, low power consumption and low data rate. In the ZigBee network, nodes can be divided into three types: coordinator node, router node and terminal node according to different functions. A ZigBee network consists of a coordinator node, multiple routers, and multiple end device nodes. The network structure has three network topologies: star, tree, and mesh.

ZigBee adopts a self-organizing way for networking. The so-called self-organizing method means that any operation without devices is required. As long as they are automatically searching between each other within the communication range of the network module, they can be formed quickly. An interconnected ZigBee
network. To ensure that each device in the network can perform normal networking communication, you need to configure the corresponding networking parameters so that the network PAN ID, channel, and baud rate of each device are consistent, and each device is on the same channel. In order to communicate with each other.

The configuration of the WLAN wireless local area network is mainly to configure the ZigBee coordinator, ZigBee relay, and ZigBee sensor in the sensor network. First, the driver is downloaded to the ZigBee coordinator (master) and the sensor module through the downloader. In the relay module, the parameter configuration of the coordinator (master), sensor module, and relay module is completed according to the parameter configuration given in Table II.

<table>
<thead>
<tr>
<th>Network number (Pan_id)</th>
<th>Arbitrary setting (do not repeat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel number (Channel)</td>
<td>13</td>
</tr>
<tr>
<td>Baud rate</td>
<td>38400</td>
</tr>
</tbody>
</table>

The sensor access process is divided into four steps. First, the sensor sends a beacon request to the coordinator (Beacon Req); when the coordinator receives the beacon request sent by the sensor, it sends a beacon response (Beacon Res) to the sensor. After the sensor receives the beacon response replied to by the coordinator, it sends a connection request (A Req) to the coordinator; when the coordinator receives the connection request, it immediately replies with a connection response (A Res) to the sensor. And assign an address to the network access sensor, and the network access process ends. The schematic diagram of the sensor access process is shown in Figure 2.

![Figure 2. Sensor access process.](image)
The coordinator sends data to the sensor through broadcast, and the sensor communicates with the coordinator by specifying the destination address of the transmitted data as a coordinator.

5. ANDROID APPLICATION DESIGN

According to the versatility of software development and use, the application layer development environment uses Android (Java) development, development tools Eclipse 4.2.1, development environment Jdk1.7, operating environment Android2.3 and above, application layer software is divided into security network management application software and Mobile application software, using socket technology for communication between the two.

5.1 Security Network Management Application Design

The security gateway receives the data sent by the sensor through the serial port. The main steps are as follows:
1. open the specified serial port and set the baud rate.
2. send the opcode through the message processor.
3. modify the UI, display the corresponding data, send to the socket 4, close the serial port.

The main implementation process of the program to open the serial port is as follows:
```java
com = ZigBeeAnalogServiceAPI.openPort(1, 0, 5);
if (com < 0) {
    Toast.makeText(MainActivity.this, "Serial port open failed", Toast.LENGTH_SHORT).show();
}
ZigBeeService service = new ZigBeeService();
Service.start();// Start serial thread
```

After receiving the data, the serial port sends an operation code to the socket through the message processor, waiting for the mobile terminal to receive
```java
private void getValue() {
    ZigBeeAnalogServiceAPI.getValue("byte", new OnByteValueResponse() {
        public void onValue(byte[] value) {
            // TODO Auto-generated method stub
            Message msg = Message.obtain(); msg.what = 1;
            msg.obj = value;
            mHandler.sendMessage(msg);// Send a message
        }
    });
```

Data communication between the mobile application and the system network management through the Socket. The communication process is shown in Figure 3:
In the system, security monitoring can be performed by multiple clients. Therefore, when designing the gateway, a one-to-many communication mode is adopted. The gateway program serves as the server end of the socket, and the server requests a separate thread for each client requesting access. Process to ensure efficient and stable system operation.

5.2 Mobile Application Design

The mobile terminal is mainly responsible for receiving the data sent by the gateway through the socket and displaying it on the application interface. When the data is abnormal, the system issues a vibration or an audible alarm. Socket data reception adopts the mode of asynchronous acquisition to prevent the application interface from dying.

After the power-on operation of the measured system, the Android mobile control program can read the underlying sensor data transmitted by the gateway in any scene within 0.1 seconds, and the system response speed is fast and real-time.

REFERENCES

