Greenhouse Equipment Data Acquisition and Display Platform Based on Socket Java

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Abstract. With the continuous development of agricultural information, greenhouse facilities have become an important part of the development of modern agriculture. In order to facilitate remote monitoring of the environment in the greenhouse of farmers, the Java language is used to design and implement the data acquisition and display platform of the greenhouse. This paper introduces the greenhouse data acquisition and display system based on Socket Java, which can receive the data transmitted by multi thread technology, and allows the data display of multi greenhouse monitoring equipment.

Introduction

At present, the extensive use of information technology in agricultural production, making the traditional agricultural production has gradually been eliminated, modern agriculture has become the development trend of agricultural production in China. More and more of the greenhouse, the greenhouse appeared in the intensive farm, which makes agriculture to overcome the time and geographical problems [1]. In the season that is not suitable for plant growth, the greenhouse can provide the plant with the growth period and increase the yield. Therefore, the monitoring of various environmental factors (such as light intensity, CO₂ concentration, air temperature and humidity, soil temperature and humidity) has become an important issue in the greenhouse.

The way of traditional manual monitoring of the greenhouse environment is time-consuming and laborious, so it is a common way to use the sensor to collect the data and transmit it to the client. However, different manufacturers data are managed by the manufacturers, users have to buy its data platform if want to use data, users are manufacturers in the use of the restrictions, brought great inconvenience to their production and life.

This paper developed a greenhouse equipment data acquisition platform based on Java language, it can add their own automatic receiving equipment data sent by the underlying equipment, (with TCP/IP protocol), simple data display window etc.. Using Socket (socket) to carry out network communication programming, Java as a network programming language, provides a powerful network programming interface, the JDK development kit provides a strong support for Socket programming. At the same time, the use of IP to specify the Socket address and port number and in accordance with the data of the TCP/IP protocol to receive. The data collected by the greenhouse monitoring equipment was demonstrated successfully.

Key Technologies and Development Environment

Socket Communication Mechanism

Socket Chinese translation for the socket, but it and the C language socket is not a concept, It is a way to communicate with programs using well-defined standard file identifiers [2]. Popular talk Socket is to provide a communication port, and then with the other end of the Socket interface to communicate with the computer. Socket can be used alone, its type is: Protocol + local address + local port; you can also communicate both ends of the Socket, the type is: Protocol + local address +
local port + remote address + remote port. Each socket has a socket assigned by the local operating system, and is unique.

Socket according to the data used by the different protocols can be divided into the following three categories: SOCK_STREAM, SOCK_DGRAM, the original Socket.

(1) SOCK_STREAM: Its face is the use of TCP/IP protocol data flow, in this way for the two communication procedures between the first to establish a virtual connection, Used to provide a reliable, connection-oriented communication flow, so that data can be transmitted in the process to ensure the correctness and orderly.

(2) SOCK_DGRAM: Its face is to use UDP protocol data flow, this method does not need to establish a virtual connection in advance, data is transmitted through separate messages, used to provide unreliable, unordered communication flow.

(3) The original Socket: It can access the underlying protocol directly, powerful but inconvenient to use, mainly used for the development of some agreements.

The platform introduced in this paper is based on the actual needs of the flow type Socket. TCP/IP protocol based on the flow of the network communication Socket class has two: the client's Socket class and the ServerSocket class at the server side. No matter how complete the function of a Socket communication program, the program is so complex, Socket basic structure is the same, including the following four basic steps:

(1) In the client and server side to create Socket and Socket Server instance;
(2) Open the input / output stream connected to the Socket;
(3) To use the input / output flow, according to a certain agreement on the Socket to read and write operations;
(4) Close the input / output stream and Socket.

SOCK_DGRAM communication mechanism diagram shown in figure 1.

![SOCK_DGRAM communication mechanism diagram](image)

**Figure 1. Block diagram of communication mechanism of SOCK_DGRAM.**

**Spring MVC Framework**

Spring MVC is a follow-up to SpringFrameWork products, has been integrated in the Spring Web Flow inside. The Spring framework provides a full-featured MVC module for building Web applications. The use of MVC can be inserted into the Spring architecture, which in the use of WEB for Spring development, you can choose to use the Spring MVC Spring framework or the integration of other MVC development frameworks, such as Struts2, Struts1, etc.. Through the policy interface,
Spring framework is highly configurable, but also contains a variety of view technologies, such as Pages JavaServer (JSP) technology, Velocity, Tiles, iText and POI. Spring MVC separates the controller, model objects, filters, and the role of the handler object, which makes them easier to customize.

**System Development Environment**

The system is mainly used in the development platform and tools are: Windows 7, JDK1.7.0_71, Eclipse, Mysql database, serial debugging assistant.

(1) Windows 7: Is the operating system developed by the Microsoft Corp (Microsoft), can be used for home and business environment, notebook computers, tablet computers, multimedia centers, etc.. The system is easy to use, simple, integrated search function is very powerful, easy for developers to the development of the source code.

(2) Eclipse development platform: Is an open source, Java based extensible development platform. In its own case, it is just a framework and a set of services that are used to build a development environment through a plug-in component. Eclipse comes with a standard set of plug-ins, including Java development tools (Development Kit Java, JDK). Eclipse is primarily used for Java language development, through the installation of different plug-ins Eclipse can support different computer languages, such as C++ and Python, and other development tools. The support of a large number of plug-ins makes it difficult for Eclipse to have other features that are relatively fixed to the IDE software. Many software developers to Eclipse as the framework to develop their own IDE.

(3) JDK: Java language is a software development kit, mainly for mobile devices, embedded devices on the Java application. JDK is the core of the entire Java development, which contains the Java operating environment, Java tools and Java foundation class library.

(4) Mysql database: Is a relational database management system, the associated database will be stored in different tables in the data, rather than all the data in a large warehouse, so that the increase in speed and improve the flexibility. The SQL language used by Mysql is the most commonly used standardized language for accessing the database. Mysql software uses a dual licensing policy, which is divided into Community Edition and the commercial version, because of its small size, high speed, low total cost of ownership, especially the characteristics of open source, the development of small sites in general have chosen Mysql as the website database.

(5) Serial debugging assistant: In support of the 960019200 commonly used a variety of baud rate and custom baud rate, can automatically identify the serial port, can set the parity bit data bits and stop bits to sixteen hexadecimal ASCII code or receive or transmit any data or character, can be set to automatically send arbitrary cycle, and can receive data saved as a text file, any size can be sent text file.

**Design and Implementation of Data Collection and Display Platform for Greenhouse Equipment**

The greenhouse is equipped with various sensors to monitor the environmental factors, the data collected by remote transmission to the server, remote transmission protocol to follow the TCP/IP protocol can be. The overall function of the platform is realized by the server side function module and the page display terminal function module.

The server opens a port on the server, through which the port is monitored, to receive the request connection message of the sensor, and then the connection is established. After the connection is established, a data channel is set up to interact with the data of the sensor and the server. When the data is received, the data obtained will be processed according to a certain rule, and the corresponding processing results will be obtained. After that, the processed data will be stored in the Mysql database through JDBC Java. Through the front of the HTML+CSS to build, and then use Ajax to store the data stored in the database into the front container for display. So that the user can log on the site to see their own needs of the sensor data.
The flow chart of the system is shown in figure 2.

**Server Side Function Module**

Server to complete the function is: the server can be used to monitor an available port to get the sensor data transfer request, and thus the request for processing [3]. Because it is a multi-customer, that is, more than one greenhouse equipment, so the use of multi-threading, for each device to allocate a client thread, real-time processing of transaction requests for each device. The specific implementation, first set up the server interface (Server Socket), to achieve the specified port connection for receiving sensor monitoring, and establish a connection for each device (Socket), and for each device to open a separate thread. The working process is shown in figure 3.

**Page Display Terminal Function Module**

Page display end need to be divided into two parts front and back.

Background for data collection and storage. Record the IP address and port number of different devices, and the data received by the server will be processed. This system receives the Json data on Java Gson, through the package will be treated as a HashMap type key for each key, to include a name, a data value, then the Map type of data stored in the database, complete the background part of the function.
Front end is mainly used for data display. Because the system of the present stage of the measured data for air temperature and humidity in greenhouse soil temperature and humidity, light intensity, CO2 concentration, and a total of two sets of equipment were measured in the greenhouse and only one layer of greenhouse is divided into three layers, so in front of the display need to distinguish the process. Juicer templates were used as one layer and three layers of greenhouse design front style, through the front language HTML+CSS interface design, data display.

Enter the page, to see the device to choose, select the interface as shown in figure 4.

![Figure 4. Device selection interface.](image)

Three layer device data display interface as shown in figure 5.

![Figure 5. Three layer device data display interface.](image)

A layer of device data display interface as shown in figure 6.

![Figure 6. A layer of device data display interface.](image)

**Platform to Achieve the Key Procedures Using**

**Server-Side Listener**

The use of a special class ServerSocket Socket server, select a suitable port number (for example, 5000) to create a server object for the parameter[4].When a client program to establish a Socket
connection, and point to the port number 5000 that the server is connected to the server object server responds to this connection, the ss.accept() method creates a Socket object. The server side can use this Socket object to communicate with the customer. Specific code is as follows:

```java
ServerSocket serversocket = new ServerSocket(5000);
// Enable service listening on the specified port
while(true){
    socket = ss.accept(); // Waiting for sensor connection
    socketThread st = new socketThread(socket);
    // Connect the connection to the child thread for transaction processing
    Thread th = new Thread(st); // Instantiate the child thread
    th.start(); // Starts the child thread
}
```

**Json String Analysis Procedures**

JsonUtil class through the getJson method will receive the json data string for analysis, and parse them as Map key-value pairs, Insert the data into the database.

```java
Gson g = JsonUtil.getGson(); // Instantiate Json
Map<String, Object> map = new HashMap<String, Object>(); // Instantiate the Map
map = g.fromJson(str, Map.class); // Call the fromJson method
InsertDao insertDao = new InsertDao();
insertDao.insertDao(map);
```

**Summary**

Using Socket protocol TCP/IP is the basis of network programming [5]. In Java, as a result of providing a powerful network programming library, making network programming is relatively simple, concise. It has specialized Socket classes to handle user requests and responses. By using the method of Socket, the communication between multiple devices and computers can be realized. The design and realization of Greenhouse equipment data acquisition display platform based on Java Socket, facilitate the farmers in remote monitoring of greenhouse environment, makes farmers know the environment in the greenhouse cannot enter, control various environmental factors better, improve crop yield and quality, make more labor from agricultural production engaged in industrial production or service industry, improve the level of farmers' income.

**References**


