Development Status of Smart Home System in the Era of Internet of Everything

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Abstract. Driven by the Internet of things technology, the development of smart home is showing a rapid and vigorous development trend. This paper mainly studies the development status of smart home system in the era of Internet of things. After a long time of operation, the system should check the power supply voltage, check whether the LCD display is normal, whether the wireless module can transmit the signal, and whether the signal collected by the sensor is normal. We check all kinds of interfaces and the circuit works normally. After running for a long time, the program checks the working condition of the chip and checks the working state of the chip. The accuracy test environment of this system is the test of air conditioner, TV and socket in the laboratory. Each command word is tested 50 times, and the number of successful experiments is recorded. The data shows that the average transmission time is about 10 ms, and 99.9% of the data transmission delay is less than 30 ms. The results show that the hardware circuit meets the requirements of low-power design, and the embedded software can reduce the system power consumption and achieve business functions through sleep wake-up mechanism.

Keywords: Internet of Everything; Smart Home System; Smart Control; ZigBee Wireless Communication

1. Introduction
The Internet is infiltrating our lives with its openness and sharing spirit, and it has brought a profound impact on human life style and the business model of enterprises. No individual or enterprise can escape. Nowadays, modern information technology is a kind of technology that has a decisive significance for the current state of society. Under certain circumstances, it is more important for a society to recognize the development trend of technology than the existing technology itself.

As a part of the Internet of Things technology, smart home combines cutting-edge technology to achieve unified centralized intelligent management of electrical equipment in the home [1]. With the development of China's economic level, the country vigorously supports technological innovation, and the smart home industry has become a powerful promoter of "China's smart manufacturing" [2]. At present, a large number of smart home appliances have appeared, which greatly facilitates people's production and life, and improves people's quality of life [3]. It is believed that in the near future, traditional home appliances will be gradually replaced by smart home appliances, thus developing towards smart home life [4]. The data generated by the home system equipment is diverse, and the file
data embodied in the computer is also in various forms [5]. This is not only because different types of data require specific transmission methods, but also different communication methods used by devices that produce the same data type [6]. Due to the different connection methods, networks with different data transmission protocols and different standards have been produced [7]. How these networks of different protocol standards interact and how to convert protocol messages are one of the problems to be solved by the Internet of Things system [8]. The wireless sensor network connects various nodes through the network, so each node no longer exists independently, and can complete centralized data management and home-related intelligent operations [9-10].

The functions that can be realized by the smart home system are the collection, security, monitoring and control of home environment information, which is convenient for people to effectively manage the home environment. The application of low energy consumption technology also provides people with daily life while achieving environmental protection. A lot of convenience. Smart home has the characteristics of complete functions and advanced technology, so it has a wide range of applications.

2. Smart Home System in the Era of Internet of Everything

2.1. Era of Internet of Everything
People and things are in the process of interconnection, and interconnection has become the basic state of society. People can easily and conveniently contact their relatives and friends; people can easily remote monitor the home situation, and also can manage and control home appliances. The introduction of mobile Internet technology enriches people's communication methods and ensures that people can still communicate under unfavorable conditions such as time and space constraints. The functions of real-time chat, group chat, and circle of friends in mobile Internet social tools promote the flattening of enterprise organization, fragmentation of communication, instant understanding of other people's dynamics, and saving communication costs, these characteristics fill in the barriers of interpersonal information transmission.

2.2. Smart Home System
The data communication between each device node in the internal network and the main control center is completed with radio frequency signals. The external network consists of clients and routers. The clients include mobile clients such as smart phones, tablets, and portable PCs. The external network and the internal network communicate data through a wireless network. Smart home systems are generally arranged in households where they live daily. A large number of sensors are distributed in different areas, and finally receive the information transmitted by the control terminal and complete the corresponding instructions. The main function of the coordinator in this system is networking and data transmission. The networking is to initialize the ZigBee network, set appropriate channel parameters and network names, and regularly scan the network for new devices to apply for joining. After verifying its identity, the legal device can join the network, and the coordinator can communicate with it after recording the node information. Suppose the calculated evaluation standard R is:

\[
R = \begin{bmatrix}
    r_{11} & r_{12} & \cdots & r_{1n} \\
    r_{21} & r_{22} & \cdots & r_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    r_{k1} & r_{k2} & \cdots & r_{kn}
\end{bmatrix}
\]

(1)

The coordinate formula in the marginal mapping is:
When the signal source of the electronic tag is completely connected to the signal source for transmitting information, the electrical power of the information wavelength received by the RFID has a positive linear relationship with the transmitted electrical power.

\[
P_{TAG} = A_w S = \frac{\lambda^2}{4\pi} G_{TAG} S = EIRPG_{TAG} \left(\frac{\lambda}{4\pi R}\right)^2
\]

(3)

3. System Simulation Experiment

3.1. Development Environment

The development environment of the smart home system designed by this research is shown in Table 1.

| Project                  | Environment/Tools/Language                     |
|--------------------------|------------------------------------------------|
| Overall Framework        | SSH (Struts + Spring + Hibernate) Integration Framework |
| Programming Language     | Java                                           |
| Database                 | MySQL                                          |
| Server                   | Tomcat7.0                                      |
| Front Page               | Jquery&html&CSS                                |
| Operating Environment    | Windows7                                       |

3.2. System Test

(1) Stability test: After the system has been running for a long time, it is necessary to check the power supply voltage, check whether the LCD display is normal, whether the wireless module can transmit signals, and whether the sensor acquisition signal is normal.

(2) Hardware security: Comprehensive inspection of various interfaces, and the circuit works normally. After the program runs for a long time, the working condition of the chip is checked, and the working condition of the chip is checked at the same time. After testing, the system interfaces can operate normally.

(3) Accuracy test: The accuracy test environment of this system is to test air conditioners, TVs, and sockets in the laboratory. Each command word is tested 50 times, and the number of successful experiments is recorded. The system has a high accuracy of equipment control and can meet the daily needs of users.

4. Discussion

4.1. Test Results

In order to reduce the experimental error, three consecutive measurements were taken for each test, and the average of the three data was taken as the measurement result. This article uses the data measured by the temperature and humidity meter as a benchmark, compares the data collected by the sensor with the data measured by the temperature and humidity meter, and tests the accuracy of the data collected by the temperature and humidity detection circuit. The comparison results are shown in
Table 2. From the comparison results, it can be seen that the temperature collected by the sensor is generally higher than the temperature measured by the temperature and humidity meter, and the error is about 0.2 °C; the collected humidity is generally lower than the measured humidity, and the maximum error is -3%RH, the smallest The error is -0.7%RH. From the above data, it can be seen that the accuracy of the temperature and humidity acquisition circuit designed by this system is very close to that of the temperature and humidity instrument sold in the market. Considering that there are also certain errors in the measurement of the temperature and humidity meter, the error obtained in the experiment is within a reasonable range. Said that the data collected by the sensor is accurate and reliable. According to the test results, the coordinator successfully obtained the data packets transmitted from the device terminal. In the test process, the correctness and consistency of the data transmission and reception were checked, and the number of sent data packets was compared with the number of received data packets. It was found that no packet loss was found during the data transmission process. The content of the data packet was verified to prove that the content of the data packet was consistent before and after the data transmission, and no data transmission errors were found. According to the comparison of the difference between the sent data time stamp and the received data time stamp in the data packet header, we can calculate that the average transmission time is about 10ms, and 99.9% of the data transmission delay is less than 30ms.

| Serial number | Collected temperature (°C) | Measured temperature (°C) | Temperature error value (°C) | Collected humidity (%RH) | Measured humidity (%RH) | Humidity error value (%RH) |
|---------------|---------------------------|---------------------------|----------------------------|--------------------------|--------------------------|---------------------------|
| 1             | 17.5                      | 17.4                      | 0.1                        | 18.9                     | 22.9                     | -3.0                      |
| 2             | 18.0                      | 18.0                      | 0.0                        | 18.8                     | 20.9                     | -2.1                      |
| 3             | 18.4                      | 18.3                      | 0.1                        | 18.9                     | 20.6                     | -1.7                      |
| 4             | 18.7                      | 18.5                      | 0.2                        | 18.6                     | 20.2                     | -1.6                      |
| 5             | 18.9                      | 18.8                      | 0.1                        | 19.6                     | 20.6                     | -1.0                      |
| 6             | 19.1                      | 18.9                      | 0.2                        | 18.2                     | 19.4                     | -1.2                      |

4.2. System Performance Analysis

This experiment selects a group of home environment data, through a large number of simulation experiments and constantly update the relevant parameters according to the actual simulation effect, in order to achieve the optimal model required by the system simulation, and save the optimal model for experimental test. We divide the experimental sample data into two parts: training set and test set. 90 groups of 100 groups of sample data are used for network training, and the remaining 10 groups are used for system test effect. The comparison of user living temperature data is shown in Figure 1. Compared with the standard BP algorithm, the relative error of GA-BP neural network algorithm is smaller and closer to the preset data of users' life. Since the intelligent home system based on neural network continuously learns the family data to get the prediction data, the system always keeps self-learning and self-adjusting state. Therefore, even if users adjust their living habits due to weather changes and seasonal changes, or change users, the system can change training data in time to predict the temperature, humidity and light intensity that best meet the user's living habits. It is conducive to the intelligent decision-making of smart home system and provides a more intelligent control mode for users. At the same time, the experiment also verified the feasibility of introducing GA-BP optimization algorithm into the system. According to the experimental data, we can know that when we arrange the nodes in the home, we need to refer to the situation of the obstacle experiment. The node should be placed 1m above the ground. The distance of the nodes in the wireless network system is set to 10m, which can meet the needs of the system and communication quality at the same time, you can set the data to be forwarded by router nodes.
The system stability test results are shown in Figure 2. Through the above functional and stability tests of cloud home system, the results of the two types of tests show that the cloud home system has good functionality and performance and zero fault, which verifies the feasibility of cloud home system and the effectiveness of the HTTPS IOT encryption algorithm model, which meets the requirements of smart home system design. In smart home system, ZigBee module needs to be connected with multiple ZigBee protocol wireless sensors, so it is necessary to test the performance of the ZigBee module's attached nodes to prevent the situation that the multi attached nodes cannot be recognized. In the test process, the real ZigBee wireless sensor is used to connect with the module to test the data transmission and transmission of all modules. It is found that when the load number increases to 256, the module can still receive and receive the receipt accurately, and the packet loss rate is below 0.003%, which indicates that the communication performance of the module is good. UDP protocol does not carry out handshake connection in communication. It only sends data to the corresponding IP, and does not check the data. Therefore, it cannot guarantee whether the data reaches the receiver and whether there is a timeout retransmission mechanism. Therefore, it is an unreliable data connection. However, this communication speed is very fast, and it is mostly used for the transmission of media stream data, such as video data. At the same time, under the new trend of Internet of things, the supervision of telecom operation industry and big communication industry is becoming more and more mature, the industry standards are becoming more and more perfect, the service management and control is becoming more and more strict, and the enterprise development risk is reduced, at the same time, the old opportunities and development dividends are gradually disappearing. In the quiet environment of the laboratory, the recognition accuracy depends on the length of the voice command. In the case of a single phrase, the recognition accuracy rate is higher, which can reach 99%. In the phrase mode, due to the long calculation time, the recognition accuracy rate is reduced. In the future, the recognition algorithm needs to be further improved.

![Figure 1. Comparison of user living temperature data](image)
5. Conclusions

Internet information is huge and rich, and it is very meaningful to obtain data with certain characteristics from it. Usually, in order to speed up the speed of Internet information collection, the distributed and parallel way is used to grab web pages.

The smart home system can integrate infrared communication into the network, which solves the problem that most of the infrared communication home appliances cannot be integrated into the smart home system network in real life, so that users can realize smart home without changing home appliances, and further reduce the cost of this set of smart home system application in ordinary people's lives.

By adding the intelligent gateway module into the smart home system, users can view the indoor environment information in real time through the Internet, and in case of emergency, timely receive alarm information to protect property safety to the greatest extent.

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