

Analysis and optimization of smart home control system stability analysis and optimization

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Abstract. With the continuous development of intelligent technology, smart home systems have become part of people's lives. The stability of the system is an important aspect of the smart home control system, which affects the experience of using the smart home. Currently, the intelligentisation and convenience of smart home systems have greatly enriched the user experience and gained general recognition in the market. Through searching and reviewing related literature, this paper mainly discusses the factors and optimisation methods of the stability of the smart home control system, as well as the future development trend of the smart home. Through the research in this paper, we can better understand the future development direction of smart home system and its impact on our life.

Keywords: Smart Home, System Stability, Future Trends, Intelligence.

1. Introductory

Smart home system is the use of advanced computer technology, network communication technology, intelligent cloud control, integrated wiring technology in the resident's home to build efficient and convenient user facilities and the management of daily affairs, to enhance the convenience of daily life, comfort and can achieve environmental protection and energy saving [1]. With the development of social and economic level, network, communication and other technologies, the price of the smart home has dropped greatly, and now it has been widely used in our daily life, while enjoying the convenience of the smart home, it is inevitable that some situations will be encountered that will make its system malfunction, and there is also the problem that the home cannot respond to in the control process. In order to improve these problems, this paper will analyse the factors affecting the stability of the smart home control system, explore the reasons for the instability of the system, and put forward an improvement plan for its shortcomings.

2. Future Trends of Smart Home Systems

The future development of smart home systems will be in the direction of whole-house intelligence and community intelligence. From a technical level, the future smart home system will pay more attention to technological innovation in human-computer interaction, data security, and privacy protection. From the market level, the future smart home system will pay more attention to market investment and development in brand building, service provision and consumer experience. From the user demand level,

the future smart home system will pay more attention to intelligent, convenient and comfortable user demand, and improve the user's quality of life and life experience.

2.1. From Home Intelligence to Whole House Intelligence

With the rapid development and application of 5G, artificial intelligence, and the Internet of Things, the smart home has evolved from single product intelligence towards the stage of intelligent interconnection and whole-house intelligence [2]. Whole-house intelligence mainly refers to the intelligent control of home appliances and home equipment through the Internet, including smart TVs, smart lamps and lanterns, smart water heaters, smart curtains, smart door locks and so on. At present, home intelligence has achieved a high level. In the future, smart homes will pay more attention to the combination with people's lives, simplifying people's lives and improving the quality of life through more intelligent control. And Whole House Intelligence is the development direction of smart home system and the key development direction of future smart home. Whole House Intelligence connects all the devices, appliances, sensors and other equipment in the home together to form a unified intelligent network, allowing people to carry out unified control and management through smart devices. In the future, Whole House Intelligence will become the iconic product of the smart home system, which will bring a smarter, more convenient and comfortable living experience.

2.2. From Home Intelligence to Community Intelligence

Community intelligence is one of the future development directions of smart home systems. With the continuous advancement of urbanisation, people's lifestyles and needs have undergone great changes. The use of Internet of Things (IoT) technology in the intelligent community is an inevitable trend and has an important social significance, which helps to create an advanced community environment, satisfy the needs of different users, and thus improve the quality of life of community residents [3]. Community intelligence mainly includes intelligent access control, intelligent parking, intelligent lighting, intelligent security, etc., through intelligent technology to achieve intelligent community management and services. In the future, community intelligence will become one of the most important application scenarios for smart home systems.

3. Overview of the main factors included in the stability of smart home control systems

The stability of the smart home system is an important factor is the user experience, mainly including the following aspects: communication stability, data processing stability, system operation stability and device connection stability. The main factors include hardware equipment, software systems and environmental factors. Hardware equipment, smart home control systems in the various types of sensors, actuators, gateway devices, etc., whose stability directly affects the stability of the entire system. As for the software system, the stability of various software programmes, operating systems and databases in the smart home control system is also an important factor affecting the stability of the whole system. Environmental factors, network fluctuations, signal weakening and other situations will also have an impact on the stability of the system.

3.1. Communication protocols

In the smart home system, if the communication line is the bridge for communication between the control host and each sensor and actuator, then the communication protocol is the traffic rules on the bridge, and only by defining 1 set of practical and efficient traffic rules, the internal communication will be smoother [4]. Nowadays, the common communication protocols for smart home control systems are Wi-Fi, Zigbee, Z-wave and so on. Among these communication protocols, Zigbee and Z-wave are protocols developed specifically for smart homes, which are more stable, but the corresponding equipment cost is also higher. Wi-Fi, on the other hand, as a general-purpose wireless communication protocol, has a lower cost, but it is prone to problems such as interference and signal weakening in the case of large-scale device connection, which affects the stability of the system. In addition, today's manufacturers of communication protocol systems are not open; other manufacturers of products cannot

be effectively integrated into the existing system, resulting in a single use of the same brand of products. People cannot meet their needs.

3.2. Hardware

In the smart home system, the devices are communicating with each other wirelessly, and the wireless communication mainly includes Bluetooth and WiFi connection. Using RF technology to achieve communication between devices, each device is assembled with a Bluetooth chip that can send and receive data through wireless signals [5]. Among them, the quality of the Bluetooth chip often determines Bluetooth stability. Nowadays, there are a variety of chips on the market, such as Bluetooth 5.3, Bluetooth 5.2, Bluetooth 5.0, etc., and network chips such as WiFi 6. The performance of different chips has a great disparity, which often affects the degree of stability of the entire system.

3.3. Software systems

The realisation of the control function of the smart home system is mainly based on software. When the collected data is uploaded to the control terminal, the software will be visualised according to the data content and data type [6]. That means that the stability of some software itself will affect the user's experience. For example, some APPs require networking, and once a disconnection occurs, it will bring inconvenience to users in using them. Secondly, the stability of the APP application will also affect the stability of the product itself. For example, some APPs will experience lag when upgraded, which will lead to instability when users use them. There are also some products that require pairing, and if the pairing is not successful, the connection will be interrupted, automatically shut down, and so on. These problems are all factors that affect the stability of the system.

3.4. Network environment

The network environment is also an important factor affecting the stability of smart home control systems. Smart home control systems need to be connected to the Internet, and differences in the network environment can directly affect the stability of the system. Common problems in the network environment include network congestion, network delay, and network security. In the case of network congestion, the smart home control system may experience problems such as control delay and data loss. The network delay, on the other hand, directly affects the user's real-time control and feedback speed of the system. In terms of network security, all kinds of devices and information in the smart home control system need to be protected; otherwise, it will lead to the instability of the system.

4. Discussion

Firstly, there are problems in the design and realisation of the communication protocols, leading to loss or errors in the data transmission process. Secondly, the performance of the hardware equipment is insufficient to meet the requirements of the software system, which leads to poor operation of the system. Further, there are defects in the design and implementation of the software system, which makes the system crash or die when processing a large amount of data. Finally, signal interference, network delay and insufficient bandwidth in the network environment can also lead to instability of the control system. In addition, local hub gateways and routes that do not pass through the cloud can avoid such things to a certain extent, and if the installer operates incorrectly, it may also lead to normal equipment dropping and malfunctioning.

In view of the above problems, we can optimise the following aspects: firstly, choose suitable communication protocols to ensure the stability and reliability of data transmission. Secondly, improve the performance of hardware equipment to meet the requirements of the software system. Further, optimise the design and implementation of the software system to improve the stability of the system. Finally, improve the network environment to reduce the impact of signal interference, network delay and insufficient bandwidth on system stability. In addition, the way of local hub gateways and routes that do not pass through the cloud can avoid such things to a certain extent, which is also one of the current solutions for the pursuit of local stability. For example, Apple's HomeKit, Xiaomi's hub gateway,

etc., is to get a set of local hub gateways, you can avoid the server fluctuations triggered by the loss of connection with the smart devices at home [7].

5. Conclusion

For smart homes to gain sustainable development, they need to make continuous improvements in system stability and user experience. When smart home companies make improvements in hardware, software, and applications, they should always focus on improving the user experience. During the product design process, it is important to consider the problems that may arise for users and to be as thorough as possible. In addition, whole-house intelligence and community intelligence will become the key development directions of smart home systems. The future development of smart home systems should pay more attention to technological innovation, market investment, and user demand and bring people a more convenient, intelligent, and comfortable living experience through continuous innovation and development.

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