Design Research on Smart Home Control System Based on Internet of Things

Weibin Yan

Yunnan College of Business Management, Kunming, 650106, China

Keywords: Internet of Things, Smart home, Control system

Abstract: With the development of science and technology, the Internet of Things has attracted more and more people's attention, which is called the third revolutionary wave of the information industry after computers and the internet. Nowadays, Internet of Things has gradually affected people's residential areas. Under the background, this paper first analyzes the application feasibility of Internet of Things technology in smart home areas. The overall design framework of smart home, smart home's hardware system, smart home's software system is elaborated. It is hoped that the design and research of smart home will bring more convenience to people's lives.

1. Research Background

With the rapid development of economic level and science and technology, people's requirements for quality of life and convenience of life are gradually improved. The rapid development of Internet and Internet of Things technology also provides a new direction and new ideas for the new generation of smart home systems. In the scene of modern home life, the accurate, real-time and remote control of household appliances can reduce more energy, time and energy for family members. We call such a system smart home control system. Smart home control system includes lighting control, remote control of household appliances, security monitoring, remote control, access control and some smart operations. These functions react on the basis of collecting, fusing and processing various sensor data. Smart home system provides users with a convenient and fast way of monitoring, so that users can view the home environment information and control the home equipment at any time in a network location. Smart home is not necessarily expensive, but it must be very smart, its intelligence comes from these system devices. In order to better meet the needs of the development of the times, we need to develop a more suitable smart home control system for modern life. Through the control of home terminal equipment and remote-control equipment and based on the development of Internet of Things technology, the smart home control system is gradually improved [1].

2. Introduction of Internet of Things

2.1. Technology of Internet of Things.

The Internet of Things is a network that monitors and supervises objects by collecting ontology information and control information of certain objects and realizing the interconnection of objects and the internet [2]. At present, different scholars have given different definitions for the application of Internet of Things and Internet of Things. But generally speaking, the Internet of Things shows that although it originates from the Internet, its connotation is higher than the Internet, and its application is wider than the Internet. This situation can be divided into two dimensions. First, from the breakthrough point of view of links, the Internet of Things has a broader scope of expansion, not only the interconnection between computers, but also the information links between objects. Second, the sublimation dimension of perception ranges from the initial link between people and people to things and things, so as to realize the perception, monitoring and control of objects and even people [3].

2.2. Framework of Internet of Things.

The Internet of Things has three important characteristics. The first one is perception, which means that the Internet of Things can achieve comprehensive perception through sensors, RFID and other devices to obtain immediate information about the surrounding environment and objects [4].

The second characteristics is transferability. Through a variety of sensors, induction devices, the objects are connected with the internet for connectivity, integration, real-time, accurate peripheral. Finally, intelligence is to use cloud computing and fuzzy recognition technology to analyze and process a large amount of information and data to form an smart solution, so as to achieve the monitoring and control of objects. Figure 1 is the architecture of the Internet of Things, which is divided into the bottom layer of data perception, the middle layer of data network and the upper layer of smart application.
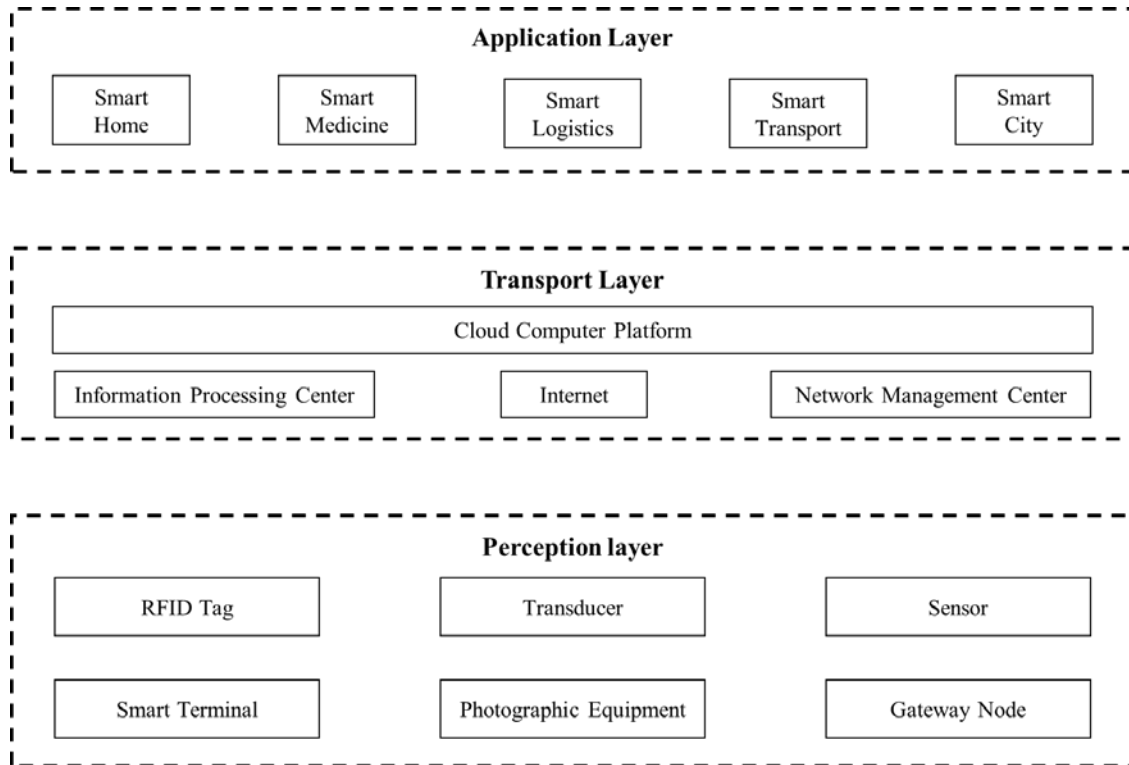

Figure 1. Framework of Internet of Things

Perception Layer: The main technologies of Perception Layer include RFID, sensor control technology, wireless communication technology, which is the basis of the development and application of Internet of Things theory. The perception layer recognizes objects and collects information through sensors, RFID and so on, so as to access the facilities related to network management.

Network layer: The network layer is the central nervous system and brain of the Internet of Things based on the existing internet. It mainly includes mobile communication network, network management center, Internet and information center. Cloud computing platform is a platform for storage and analysis of a large number of perceptual information processing. It is an important part of the network layer, and also the basis of a large number of Internet of Things applications in the application layer.

Application layer: Application layer provides relevant services for users. It is the product of satisfying industry demands, division of labor, cooperation and organic integration in the Internet of Things. The ultimate goal is to achieve the relevance, collaboration and intellectualization of related applications in the Internet of Things and realize "all things interacting" in smart home.

2.3. Application Feasibility of Internet of Things Technology in Smart Home Areas.

In the smart home environment based on the Internet of Things, we can monitor and control smart devices such as household appliances, lights, doors and windows through the network, such as the water and electricity situation, gas situation, safety situation and fire situation at anytime and anywhere. Smart appliances in the home can also be adjusted according to the actual temperature and power consumption to achieve the purpose of energy saving. Camera equipment in smart home

environment can communicate with visitors through intercom system or door and window control system. Sensors in smart home environment can effectively monitor gas leakage and ensure the safe use of gas. Smart security equipment in smart home can ensure security by relevant snapping and monitoring, and at the same time, the alarm device can be activated, to a certain extent, to achieve overall security in a small range. RFID radio frequency technology, sensor technology, positioning technology, Internet technology, two-dimensional code identification technology and the corresponding development of a variety of technologies to create and improve the smart home such a comprehensive, smart, multi-functional system.

3. Smart Home Control System Based on Internet of Things

Based on the Internet of Things technology, smart home control system is relying on the house as the entity, network technology as the software support platform, and the information transmission network connected by wired or wireless way as the hardware support platform. It connects household appliances, communication equipment, water and gas equipment, cameras, safety devices and other devices in the family residence through bus devices, thus forming a smart home control system capable of device detection and remote control.

3.1. Smart Home Control System and Its Subsystems.

Smart home system mainly includes eight related subsystems, which are smart lighting subsystem, smart security subsystem, home entertainment subsystem, home energy management subsystem, home information processing subsystem, background music subsystem, home environment control subsystem and home network subsystem.

Smart lighting subsystem can adjust and remote control the lighting in the home. Its advantages include energy saving, long service life, convenience and controllability.

Smart security subsystem can achieve real-time and effective monitoring of home security. The scope of monitoring includes illegal intrusion, theft, fire hazards, gas use, etc. When entering the emergency situation set by the system, the system can dial the relevant telephone or direct alarm set in the system, and synchronize intelligence. The security equipment can be progressed to the state of emergency linkage, through the coordination of equipment, to minimize property losses in residential buildings and ensure personal safety.

Home entertainment subsystem can integrate cinema, singing bar, game entertainment and so on, so that households can enjoy a happy and comfortable audio-visual experience at home.

The household energy subsystem, mainly through the monitoring of gas meters, electricity meters and water meter, grasps the usage of the amount in real time, and can monitor and control the abnormal usage in time to effectively reduce the damage caused by leakage of electricity, water and gas.

Home information processing subsystem can effectively process community information, consumption information and action information in the home, and help households to make relevant planning.

Background music subsystem can make the music beautiful anytime and anywhere by configuring music equipment in one or more rooms.

Home environment control subsystem mainly refers to the relevant control of household humidifier, temperature sensor, humidity sensor and other equipment, so that households can enjoy a good home environment.

Home network subsystem mainly links household computer equipment, electrical equipment, lighting equipment and home network, so as to achieve effective remote control of smart home.

3.2. Framework of Smart Home Control System Based on Internet of Things.

Smart home system is based on the Internet of Things technology, which integrates sensor technology, network technology, cloud computing, artificial intelligence, big data and so on effectively to form an integrated and coordinated system, which can improve the ability of smart

home system comprehensively and effectively. The design framework of smart home system based on Internet of Things is shown in Figure 2.
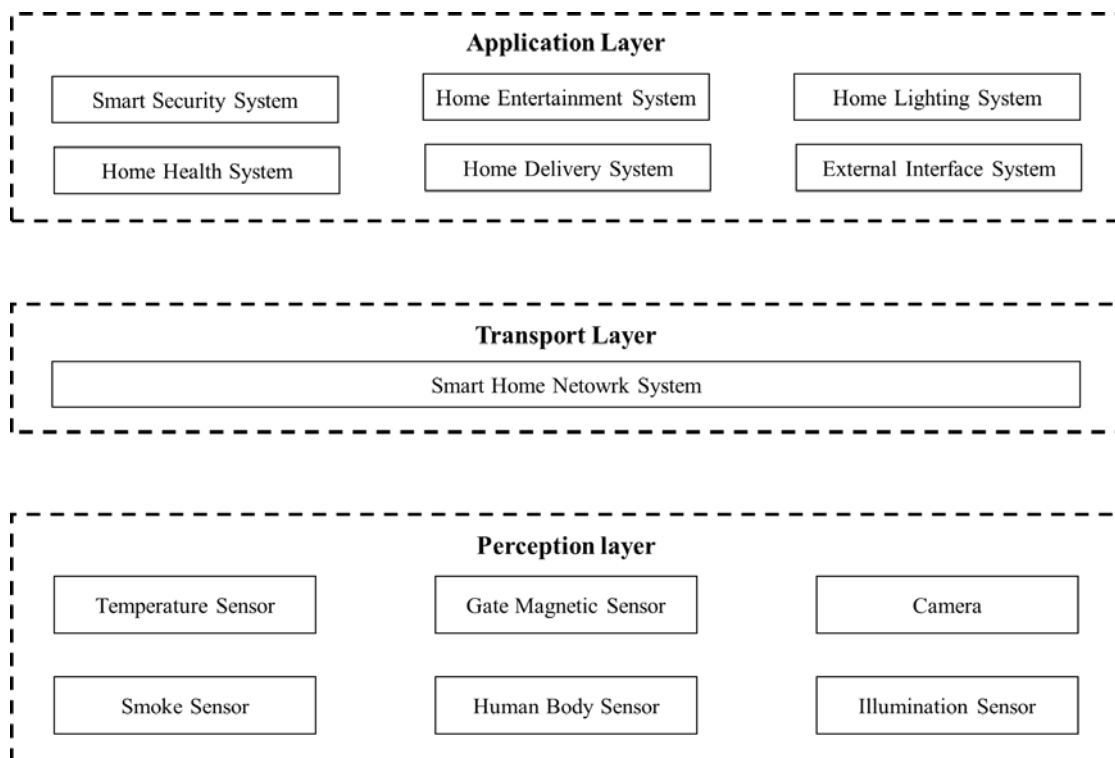

Figure 2. Framework of smart home control system based on Internet of Things

Smart Home Perception Layer: An important feature of Internet of Things technology is comprehensive perception. Smart home devices can capture information of people or things through RFID technology, two-dimensional code technology, sensors and so on. In addition, the intelligent home system of the Internet of Things can also apply other typical sensing technologies, such as gas leakage sensors, temperature and humidity sensors, wireless door and window sensors.

Smart Home Transport Layer: Smart Home Transport Layer includes various communication networks, internet, cloud computing platform, Internet of Things management and control center, expert system, etc. to analyze and process the information in the home intelligently. In the network layer of smart home, it is necessary to deal with the two aspects of reliable information transmission and intelligent analysis and processing, so as to enhance the network operation ability and information operation ability of smart home system.

Smart Home Application Layer: Application Layer is a solution of intelligent home scenario application, which effectively combines the Internet of Things and smart home. Through application layer, information technology and traditional home can be deeply integrated in the scenario. This is generally manifested in intelligent security system, intelligent medical system, intelligent entertainment system, intelligent power system. At the same time, it can be used as an important interface of the third party to facilitate the third party to access the system and provide people with convenience.

3.3. Hardware System Design of Smart Home.

The microcontroller is the core of the hardware system of smart home. It focuses on data acquisition of temperature, illumination, humidity, and the processing of voice, pictures, data and other information. In terms of functional requirements, there are a certain number of data interfaces to support embedded operating systems. It needs to have the characteristics of high speed, low energy consumption and high stability, and can wake up and operate the equipment remotely. In the smart home system based on the Internet of Things, in the wireless transmission module, the corresponding wireless transmission technology can be selected according to the actual situation. The wireless transmission technology designed in this paper is based on Zigbee transmission settings. The task of

Zigbee Coordinator (PAN) is to establish Zigbee network and manage related family affairs. At the same time, data acquisition, data analysis, data processing and communication are carried out from various terminal devices, sensors and other nodes of smart home. Links to information. The coordinator transmits and receives electromagnetic signals by radio frequency antenna, and the related information is displayed in the terminal display module, so that it can be operated on the interface. Sensor node in Zigbee network is an important part of Zigbee network, which is responsible for data acquisition and transmission to Zigbee coordinator for each subsystem module.

3.4. Software System Design of Smart Home.

The smart home software system consists of information storage module, information processing and analysis module and human-computer interaction module. Application-level sensors for information acquisition can facilitate the software system to store, process and control information. The acquired information includes information acquisition time, command characteristics, hardware number and control information instructions. The more complete the relevant information is, the less errors the operation will be. The design of smart home control system should pay more attention to user experience on the basis of user convenience. In terms of function design, it can write the relevant data in real time and record the data situation in different time periods. Software system should have convenient and clear operation display interface, perfect log query and update function. The software system can not only indicate whether the signal is safe or not, but also process the signal and data based on the actual situation.

4. Conclusion

The emergence and development of Internet of Things technology has brought hope to the popularization of smart home to people's daily life. Some residential districts in China have made preliminary attempts to build "cloud communities" based on the new technology, but it is still in the exploratory period. In the future, the powerful perception technology of the Internet of Things will make smart home more intelligent. At the same time, supported by the development of big data and artificial intelligence technology, smart home system will provide people with practical and humanized services more wisely, and promote the smart home industry to develop better and faster.

References

[1] Khan M, Silva B N, Han K. Internet of Things Based Energy Aware Smart Home Control System[J]. IEEE Access, 2017, 4(99):7556-7566.

[2] Xu J, Wang B, Yan L, et al. The Strategy of the Smart Home Energy Optimization Control of the Hybrid Energy Coordinated Control[J]. Transactions of China Electrotechnical Society, 2017, 32(12):214-223.

[3] Rui H, Gao C. Fuzzy programming model and its application of the optimization design for smart home system[J]. Systems Science & Control Engineering, 2019, 7(1):171-178.

[4] Zheng S, Zhang Q, Zheng R, et al. Combining a Multi-Agent System and Communication Middleware for Smart Home Control: A Universal Control Platform Architecture.[J]. Sensors, 2017, 17(9):2135.