

Smart Home System Conception Based on Internet of Things

YANG Weichao^{[a],*}

^[a]School of Electronic Information Engineering, China West Normal University, Nanchong, China.

*Corresponding author.

Supported by China West Normal University Project "Intelligent Home Furnishing System Based on Internet of Things" (416341).

Received 22 February 2016; accepted 20 May 2016
Published online 26 June 2016

Abstract

With rapid development of information technology, Internet of Things (IoT) technology becomes increasingly mature, and information sharing is realized gradually. These bring convenience for people. As the application breadth and depth of sensors and other components in IoT technology improve, security and protection system and energy conservation system of smart building improvement, and people's living quality also improves. At present, smart home also develops to some extent. This paper will start from current application status of Internet of Things in smart home and analyze the feasibility of IoT application in smart home so as to improve its the application degree and promote the development of smart home.

Key word: Internet of things technology; Smart home; System conception

Yang, W. C. (2016). Smart Home System Conception Based on Internet of Things. *Management Science and Engineering*, 10(2), 85-88. Available from: URL: <http://www.cscanada.net/index.php/mse/article/view/8313>
DOI: <http://dx.doi.org/10.3968/8313>

ABSTRACT

As the living standard improves, people have higher requirements for dwelling quality. The rapid development of IoT technology offers technical support for the

development of smart home and creates infinite possibility. Smart home is a very promising and potential field with great research value. The application level of smart home can improve to provide better living environment for people.

1. OVERVIEW ABOUT SMART HOME BASED ON INTERNET OF THINGS

IoT is an emerging technology which develops under the support of computer technology, but its functions are more outstanding. It breaks the limit of traditional network and unites multiple fields to establish a public information sharing platform. Smart home technology has developed in recent years. It reduces the occurrence of safety accidents through intelligent information transmission. Besides, it can detect dwelling environment in real time, make adjustment by mobile phone terminal, decrease resource waste, guarantee environmental comfort level, reduce factitious direct contact control and improve dwelling quality. When unsafe factors happen at home or the light is not off, the temperature of air conditioner is not comfortable and the house is not cleaned, sensor signal will be directly transmitted to user's mobile phone or the terminal of the administrator. Then, the terminal will control. This achieves both-way interaction. Smart home is mainly based on IoT technology, achieves informatization of household appliances and devices and realize such functions as comfort, convenience, green, environmental protection and energy conservation so that people can manage conveniently. Meanwhile, it enhances house monitoring function and security and protection function and improves comprehensive dwelling quality.

Traditional smart home knowledge realizes wired contact, and makes various systems interlinked simply. It fails to achieve organic contact among household devices. Thus, it has many defects, such as slow transmission

speed and incapability of receding g signals in time and adjusting dwelling environment in real time. The application of IoT technology makes up for many defects. IoT technology mainly adopts wireless communication. The sensor is sensitive and can perceive objects very fast. In addition, signal transmission efficiency is high. Moreover, IoT technology enhances organic connection of household devices and boosts the development of smart home. With regard to the application of IoT technology in smart home, people put forward more conceptions.

2. KEY TECHNOLOGIES OF SMART HOME SYSTEM BASED ON IOT

2.1 Radio Frequency Identification Technology (RFID)

This technology belongs to RFID and automatically identifies the identity through radio signal and data receiving. This process is intellectualized and non-manual manipulation. External intervention factors are small. Thus, it has strong adaptation to all kinds of working environments. RFID is mainly composed of three parts: identity identification tag, tag reader and antenna. Each active or passive tag has corresponding ad independent identify identification code through the form of electronic coding. During applying the technology, it is necessary to pair and bind tags and identified objects which can be effectively distinguished in accordance with diverse transmission forms for different forms of tag radio signals. Multiple tags can be distinguished in one time. Besides, functional expansion can be achieved to track and position the target object as well as share information through combining various technologies.

2.2 Wireless Sensor Network Technology

This technology is a small network information system with distributed structure. It integrates information acquisition, transmission and processing and has many advantages. Relative to other technologies, it has a low price, low energy consumption and light structure. In addition, its operation mode is flexible and diversified, with strong operability. The wireless sensor mainly consists of information acquisition unit, data processing and control unit, wireless transmission device and so on. Firstly, information acquisition is conducted. Then, data conversion is carried out. The physical signal is converted to digital signal by the sensor so that people can receive and process the signal conveniently. Wireless sensor network technology has the following features in actual operation. Firstly, limited power supply. This technology adopts the battery for power supply and does not transmit current continuously. Each node is equipped with certain number of batteries. When the electric quantity of battery is exhausted and there is sufficient power supply and rich power supply channels, the while circuit will not

work normally. Secondly, there are many nodes in the sensor. Sufficient nodes are arranged in the network, which is beneficial to rationally controlling node density, keeping normal interval, and processing information in a distributed way. Meanwhile, this can improve information processing accuracy, reduce corresponding node load, boost fault tolerance and reliability of each system, increase detection and decrease system loopholes. Thirdly, topological structure is dynamic. Relative to other technologies, this technology has strong dynamic nature. The nodes can be moved dynamically as needed. If the electric quantity of nodes is used up, it will quit the network automatically. The nodes may be added properly as required, which increases system operation flexibility. Fourthly, network is organized by itself. According to the need of actual work, the position of nodes can be adjusted automatically so that the organization mode of the sensor is more diversified. This optimizes system management. Fifthly, cross-router feature. Sensor nodes in the network can give play to the function of a router. Besides, data exchange can be conducted beyond the radio signal transmitted. The data relation among system nodes rather than node arrangement position is important in system operation process. Thus, it is necessary to attach importance to and analyze data relation.

2.3 Short-Distance Wireless Communication Technology

The major features of this technology include short distance and small range. Generally, the signal transmitted is high-frequency signal in operation process, so functional loss is small. Compared with other technologies, this technology has strong functions, high reliability and fast transmission speed. Common technological types include the following. Firstly, WIFI system. Currently, WIFI is often used in daily life. As a wireless extension technology, WIFI has come into use universally in many places and formed a small LAN system. It has such advantages as high radio frequency, fast transmission speed, connection convenience and use convenience. This system mainly includes two parts: wireless access node and wireless LAN card. The effects of the two are different. The two cooperate to receive and connect wireless signal, which achieves organic combination of the wired network and wireless LAN. Secondly, bluetooth technology. Compared with WIFI technology, bluetooth technology requires shorter distance in application, and its propagation speed is relatively slow. Within the short distance, bluetooth search can be achieved to complete signal transmission. It is frequently applied in mobile phone and headset. Thirdly, short-distance wireless communication. Although it has been tried at mobile terminal in recent years, it is not applied widely. However, it has good development prospect and may replace bluetooth technology. Fourthly, ZigBee. This technology has

obvious functional superiority. Compared with bluetooth technology, it has higher radio frequency, simpler structure, lower price and stronger applicability.

3. SMART HOME DEVELOPMENT CONCEPTION UNDER THE BACKGROUND OF IOT

3.1 Conception of Overall Software System Architecture

IoT-based smart home software is a software system which consists of IoT technology and internet technology. The whole system is relatively open, and internal logic structure is rigorous. It mainly applies network communication technology. Network communication technology is the foundation. It starts to be used in traditional smart home. At present, it fuses advanced communication form of IoT and boosts communication system reform. Each household device has independent IP and can be managed independently. The key component of communication technology is the middleware of IoT technology. The middleware as a bond-type tool connects external resource software to IoT and internal resources in smart home software system and boosts information transmission. JCR system may be adopted to design the middleware. It effectively avoids the problems in traditional software and has the following advantages. During smart fault processing, it can give the alarm in time when household equipment goes wrong. The system can process the fault and achieve automatic recovery, without the influence on other components. This improves home safety and reduces equipment repair cost. Therefore, the comprehensive performance is high. Open equipment management technology is adopted. The equipment can be adjusted properly as needed. Meanwhile, information acquisition speed and system working state can be adjusted. The platform system can analyze each element of independent equipment data and then convert to improve people's acceptability. It can support equipment at multiple terminals to operate, manage and adjust faults as well as change data system and carry out standard data output. In future development, this platform can continue to be researched and developed. For example, IoT terminal equipment driving module, interface and communication protocol analysis module, and original data and format analysis module can be established. The construction and use of modules can enhance the corresponding driving force. Meanwhile, it can load interface and communication protocol, allocate corresponding resources, improve data format output and enhance information data processing quality.

Ethernet communication module is also a key part in communication. The following problems still exist in the

current operating system: design complexity, large space occupancy and high cost. Thus, it is not convenient in use. With technological development, Ethernet communication module can choose the controller with high technical content, such as ENC28J60 which is portable, greatly simplifies design structure, reduce space occupancy and enhance system stability. ZigBee wireless communication module is common in current smart home and has certain superiority. It can be re-developed on the basis of existing technical degree to achieve re-innovation. CC2430 radio frequency identification receiving and sending module may be adopted to reduce the application cost. The module has good performance and high configuration. In addition, the application program is secure and reliable. It can support the work of multiple serial communication protocols and convertors, with low energy consumption and high quality of task completion. Hence, it has significant competition advantage in market. On this basis, ZigBee2006 protocol stack can be developed, and OSAL management operating system is embedded to cur down relative working procedures. The embedded API function can be applied to develop the application program, register, start and initialize tasks, achieve task synchronization and exclusion, interrupt and process tasks as well as allocate and manage internal storage. Moreover, it can realize coordinator node service task and serial port communication. Coordinator node is a key part of ZigBee. It can carry out network construction, wireless data sending and receiving as well as serial port communication. Hence, it has very important function (Liu, 2013).

3.2 Conception of Data Management Module

When the system operates, data management module can improve according to data operation features and needs. BDB may be adopted for secondary development and use. BDB is a database. Besides, it is also a file management system. It is of cross-platform and cross-language and has multiple advantages. Therefore, it can manage large data size. High-speed buffer zone forms a sharing area through the application of BDB technology so as to better achieve data exchange and facilitate data updating. After the operation, data management module should innovate. Generally, when smart home equipment ends corresponding execution function, BDB will store operation data in the hard disk with certain format. However, it is far from enough to do this. The working mode should be more flexible. Information acquisition and storage should be conducted in the operation process. In such case, SQL Server can be adopted to develop the database. SQL Server is a platform database system. With strong storage capacity, it can offer more scientific and diversified data management method and is thus widely applied in high-performance database application program.

3.3 Conception of System Access Authority Management Function

In the software system of smart home, validity and stability of system software should be explored. The software system can be improved through restricting operation boundary and level of various household devices and users so as to enhance system security and reliability. In actual application, RBEC model can be applied. RBEC model mainly involves three concepts: user, role and authority. It can allocate responsibilities and tasks, divide respective role range and undertake respective work. In the application, the quantity and data size of household devices will increase continuously, so the authority and role will rise, which will result in the reduction of resource control efficiency of system. For this problem, the concept of device group can be introduced to enhance device connection and effectively improve resource control efficiency.

3.4 Conception of Remote Control and Task Management

In future smart home software system, connection among things is needed. To improve comfort of household device use, remote control and management function are required. The module receives operation orders for each node, then checks the orders and transmits the orders to household devices. Therefore, it is required to enhance attention to this module, improve and develop this module continuously so as to improve operation management of household devices. Firstly, remote control tool design is needed. C-s-c mode is mainly adopted for this part. This mode includes two parts, and it is of interactive information transmission. The mobile phone client can transmit the operation state of household devices to user's mobile phone. The user can choose the specific equipment for operation management according to the information. Secondly, the internal client of system can receive and feed back information, which effectively boosts working efficiency. Management module plays an intermediary role. In information transmission process, it will carry out pre-processing first and then transmit the information to the client for secondary processing. In certain circumstance, self-repair and adjustment can be conducted. After processing, it can continue to work, without destruction of system balance. Meanwhile, user's use trouble is reduced^[1].

3.5 Conception of Air Conditioning System Control Module

Air conditioner is a common household appliance. Although it brings great convenience to people, its energy consumption is relatively high and its cost is expensive. The management of air conditioning system can reduce harmful gas emission, cut down use cost and maintain normal comfort of the living environment. During control

and management of air conditioner, SCADA control system can be used. This system is widely applied and adopts smart data acquisition and all-round data processing. This system includes three aspects: site device control, communication network layer and monitoring center layer. Good control effect can be achieved through specific labor division and cooperation. With air conditioning control management, this system can divide organizational structure, such as perception and control layer, network layer and application layer. According to the needs of actual functions, some devices can be added under the relative hierarchy to improve actual application. Perception and control layer aims to perceive temperature. This layer is mainly composed of executing device, temperature sensor and temperature controller which are form a small cycle control system. Network layer mainly transmits operational state information to the application layer of perception and control layer. This layer applies to many network communication devices, achieves wired-wireless communication and improves the propagation speed. Network convergence form may be adopted in the application. Users can select different network communication forms in different conditions of multiple communication technologies. The application layer is the terminal of main functions. This part needs its own monitoring instrument and client. A key application of this application layer is SCADA monitoring software which can analyze and process the information received and detects whether it exceeds the standard or range. Meanwhile, it can adjust and control temperature according to seasonal weather, transmit adjustment and control order, reach the effect of energy conservation and emission reduction, reduce use cost and save manpower.

CONCLUSION

Smart home has a good market prospect, the future is the inevitable trend of the development of home industry. With the development of Internet of things technology, home industry to seize the opportunity, the development of technology and research, to achieve the rapid development of home industry, improve people's quality of life.

REFERENCES

- Zhang, Q. T. (2014). Design and implementation of smart home system based on Internet of things. *Engineering Management*, (4), 101-102.
- Liu, J. (2013). Research on intelligent home information processing and control system based on Internet of things. *Engineering Management*, (12), 265-266.
- Wu, W. F. (2015). Research and design of intelligent home control system based on Internet of things technology. *Engineering Management*, (5), 196-197.