The Study of Smart Home Networking System Based on PLC Communications

Degen-Chen

University of Science Technology, Dongguan, 523083, china

Keywords: Programmable Logic Controller(PLC), communication, Smart Home Networking, Internet of Things

Abstract. With the development of networking technology and people's increasing requirements for living standards, people demand more and more for life safety, comfort, convenience and so on. In recent years, the concept of the family home has undergone tremendous change, smart home will become the development trend of modern housing, and the research and development about it is an issue related to automatic control, wireless connectivity and wireless communications multidisciplinary. Based on many years of work and learning experiences, this paper discusses how to build intelligent home networking system using PLC communication technologies.

PLC has superiorities of high reliability, easy learning, simple programming, small volume, convenient usage and so on. It can implement sequential logic control and automatic control of analog according to the requirement of technological process, so it is widely used in industrial field and also make a good control effect.

Introduction

Programmable Logic Controller (PLC for short) is an electronic system based on microprocessor digital operation device. In recent years it rapidly developed into a sophisticated and highly versatile control system component. Many control systems emerge based on programmable logic controller (plc) technology as the times require .Units today are capable of performing complex math functions including numerical integration and differentiation and operate at the fast microprocessor speeds now available. Older PLCs were capable of only handling discrete inputs and outputs (that is, on-off type signals), while today's systems can accept and generate analog voltages and currents as well as a wide range of voltage levels and pulsed signals. PLCs are also designed to be rugged. Unlike their personal computer cousin, they can typically withstand vibration, shock, elevated temperatures, and electrical noise to which manufacturing equipment is exposed.

PLC is a product of microcomputer technology combined with traditional relay contact control technology. It overcomes the connection of mechanical contact in the relay control system complexity, low reliability, high power consumption, versatility and flexibility, make full use of the advantages of the microprocessor, and care to the skills and habits for on-site electrical operation and maintenance personnel, especially for the PLC program, do not need special knowledge of computer programming language, instead of using a set of relay ladder diagram based simple instruction form, the user program image, intuitive and easy to learn; debugging and error checking is also very convenient. The user to the desired PLC in the post purchase, just press the manual tips, do a small amount of wiring and simple user programming work, can be flexible and convenient application of PLC in the production practice.

The building of PLC intelligent home systems

With the development of social economic and technology, the intelligent home isthe new development direction of future home, so the research of building standard wireless home sub-network has become the hot spot. because of the Programmable controller (PLC Programmable Logic Controller) control system compared with other control system has the following characteristics:

(1) the system is flexible and extended easily;

(2) convenience, simple programming, can modify the program online, change control scheme without open hardware;

(3) Can work well in all kinds atrocious work conditions,strong anti-jamming capability, high reliability.

So it is the first choice for Intelligent control of household and provide good protection for maintaining and improving the service.

System design requirements. The so-called smart home is to ask the user inside the room appliances, doors, windows and other facilities can be controlled by computer-related, promptly report problems to the client, and the computer has a certain self-control capabilities through a predetermined program design. System design requirements can achieve the following: First, in a timely manner to detect the indicators in the room; Second, to control related appliances, doors and windows to make the appropriate adjustments; Third, to provide users with real-time room and related equipment information; Four, to provide reasonable suggestions for the use of the recent users.

PLC communication network structure. Internet of things broadband power line carrier communication appliances is sent to the gateway through the PLC power line, then, PLC gateway appliance sends data to where it is needed through the Internet, at the same time, they can be the user's needs through the Internet to the PLC gateways, PLC gateway needs command data is sent to the PLC appliances through power lines, home appliances according to the user's needs instructions run, run the feedback information, appliances run and run information feedback according to the user's needs instruction. PLC smart home system network consists of several parts -- perception layer, PLC communication layer, network layer, application layer, the physical structure shown in Figure 1.

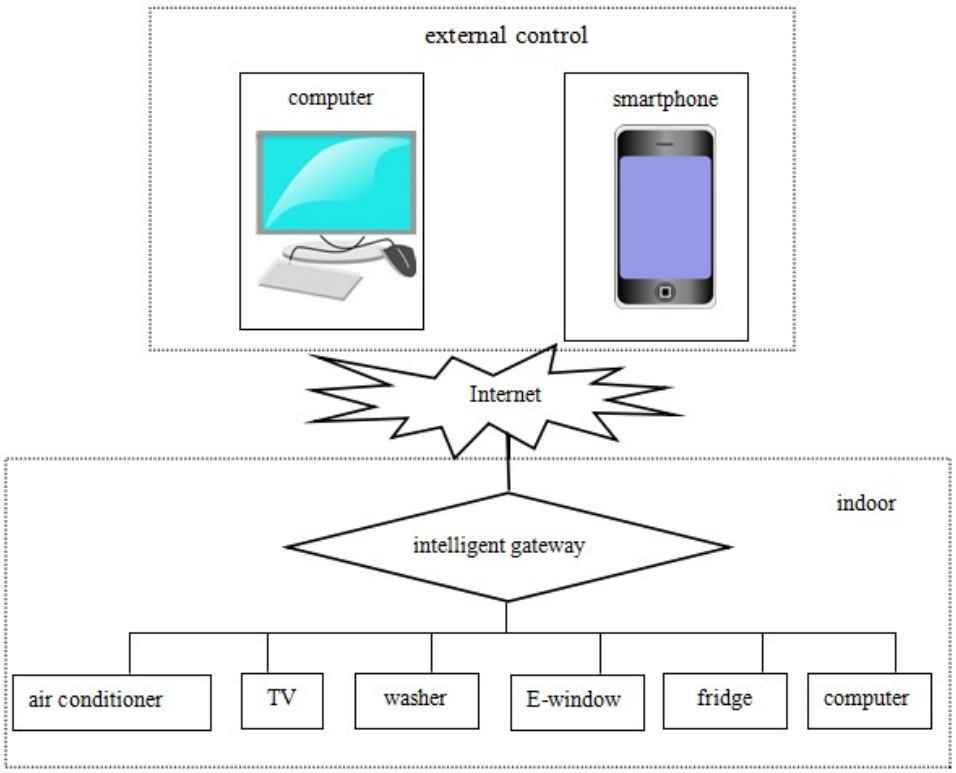

Fig.1 PLC intelligent home configuration diagram

Wherein, fridge, washer and other appliances are built-in PLC communication modules, fridge, washer and other appliances feedback data the user needs to mobile phones, computers and other equipment according to the user's command information. Users can access via smart phones,

computers and other related pages, send queries, control commands to the intelligent gateway to understand and control the information inside the home, getting room inside respective sensor data in real time, and this process is adjusted by the user, or it is hosted by intelligent gateway.

Hardware and software constitution of smart home internet of things

For smart home, Hardware and software are essential. The smart home is smart hardware and corresponding software applications.

The hardware constitution of the smart home. PLC intelligent home network hardware has two main parts, one part is PLC communication modules, and the other part is the intelligent gateway. PLC communication module is responsible for the corresponding display board to communicate, and it is also responsible for communicating with the PLC terminal gateway, network switching processing IC is responsible for receiving data transmitted from INT600, after transforming, the data is passed to RJ45 interface. Business processing IC parses the received data according to communication protocol and transfers the data directly to the MCU appliance PCB board, through the SPI interface or UART interface, Meanwhile, packs the data coming from appliances and sent it to INT600. Specific modules block diagram is shown in Figure 2.

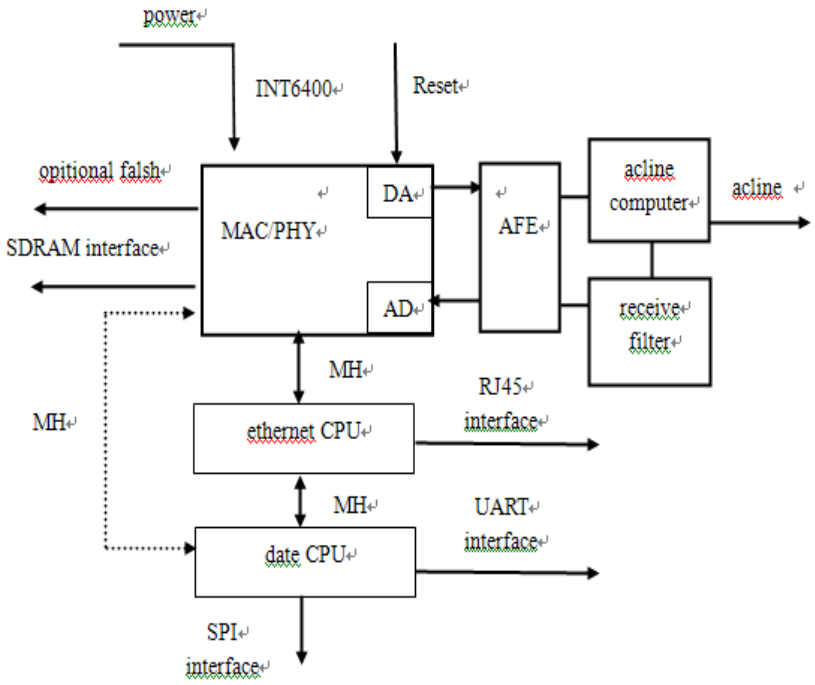

Fig.2 block diagram of PLC communication module composition

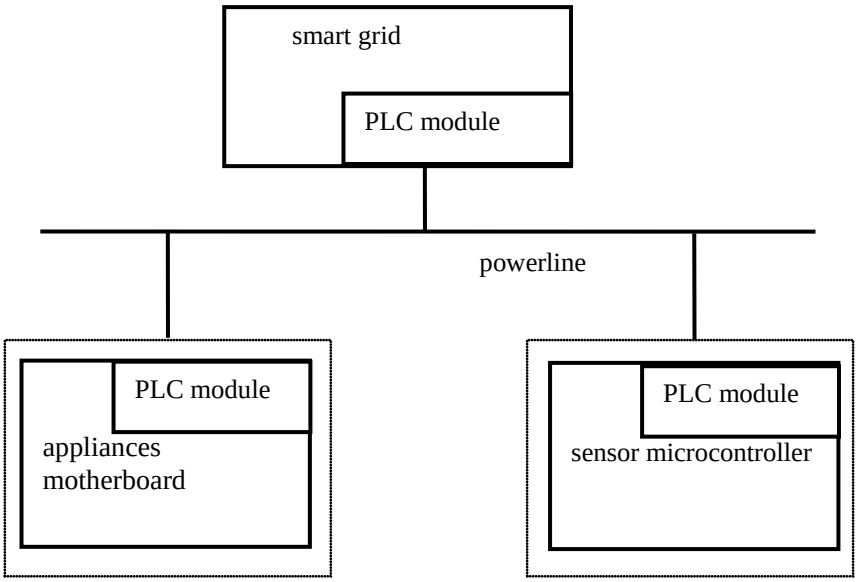

Fig.3 PLC communications equipment hardware configuration

PLC communication module integrated on the motherboard sensors and appliances, and then connects to the PLC gateway, shown in Figure 3.

Intelligent gateway choose a low-cost \ high-performance interface, and it can connect to the Internet, LAN or WAN. Household appliances, meters, load control, lighting, security systems, pumps and valves. These all practical electrical devices can be connected to the IP network or the Internet through intelligent gateway, which allows the service center can achieve configuration, monitor, and control a variety of everyday devices, either in the room or any corner on the earth.

Intelligent gateway software applications have a rich set of features, and it is like a separate controller work, requiring no PC or host processor. Standard applications include scheduling, data logging, alarm processing and sending, meter reading. Smart wireless gateway all applications can be accessed from the website and with the use of the built-in security features, and the application allows the daily operations can be achieved from anywhere using suitable, simple Web browser in the world.

Software implementation of smart home network key technology. PLC communication technology uses orthogonal frequency division multiplexing, its technical features are the high transmission speed, and the theoretical transfer speeds is up to 200M and with a strong anti-jamming capability. According to the above these features, broadband PLC communication technology is more suitable for this study in the field, at the same time, it is also suitable for the needs of things appliances characteristics of communication speed, interference and so on.Power line signal transmission protocol uses TCP / IP protocol, and uses the network key authentication mechanism, when the transferring sing information between different appliances, just follow the same protocol, using the same network key, it can be realized.

For actual use, the system allows two ways to access the Internet of Things. The first way: retain interface on the new device and the terminal, when the two connected together by a signal line, the device automatically sends new registration command, after receiving the registration instructions, automatically sends the Terminal Services Device Network Key, MAC address, device protocols and other information to the new device, when new device communicate with group in the device, the device sends using terminal services to its device protocol for communication, thus completing the new automatic networking equipment. The second way: using the keys on the device, sending the information to activate pulse registration information, after the new device is working, pressing register button, and new devices automatically send the registration information to the power line, while monitoring the registration confirmation information terminal service equipment backhaul, both sides registered contrast information, if correct, network processing is completed automatically. Restore button to the initial state, and both normal continue to communication using the network key legacy systems as well.

The prospect of PLC in smart home system

With the development of society and the improvement of the living standards of human intelligence, the requirements for it requires smart home system higher and higher.The design and implement of intelligent home system emerge based on PLC communications technology.The combination of Power Line Communication、Network and Micro controller is the most realistic and most economic way to promote home automation based on the existing practice. The distribution in micro controller and PC every corner of home appliances connected to a network taking power line as the physical medium. Therefore, the PLC communication technology has a broad prospect in the application of intelligent home, especially the application in the transmission rate, because it has the advantages of high reliability, low cost and so on, so it can be comparable with the "Bluetooth".The system adopt PLC to have accurate, convenience, easily expand of characteristics, can better completion the complicated intelligence turn to control a task. there is the new trend of the development of smart home system to realize the home informat-ization and networking. Smart home system can provide more relaxed，orderly, efficient modern way of life is the inevitable trend of the development of future residential pattern，therefore，smart home system has gradually become a new research field.

Conclusions

Programmable controllers (the shortened name used for programmable logic controllers) are much like personal computers in that the user can be overwhelmed by the vast array of options and configurations available.

The home equipments that we use now heavy part adoption artificial closes a way, don't have aut omatically function. The control system composed of PLC and a variety of other equipments, PLC is to deal with logical relations of various signals. This paper discusses in detail for the smart home networking system design based on PLC communications technology, however, the application of PLC communication technology in the home appliances and other household equipment is still on the initial stage, this system is still a long way to go to the practical application stage, in view of the many advantages of PLC communication technology, it can be better completion the complicated intelligence turn to control a task. I believe that there is to be more power into research in this area.

References

[1] Suk Lee, Kyoung Nam Ha, Kyung Chang Lee. Performance evaluation of MAC layer of LnCP and LonWorks protocol as home networking system[J]. Computer Standards & Interfaces,2007,311:.

[2] Suk Lee, Kyoung Nam Ha, Kyung Chang Lee. Performance evaluation of MAC layer of LnCP and LonWorks protocol as home networking system.[J]. Computer Standards & Interfaces,2009,31:.

[3] Anonymous. Pace Leverages ViXS Video Processor for Wireless Home Networking System[J]. Wireless News,2008,:.

[4] Ricardo Gudwin,Fernando Gomide,Marcio (1998). “A Fuzzy Elevator Group Controller With Li near Context Adaptation”. IEEE World Congress on Computational Intelligence. Vol. 12, No. 5, pp. 481-486.

[5] Burger, Dennis. Access Networks Home Networking System[J]. Residential Systems,2014,158:.

[6]Ren Sheng-le. Development of PLC-based Tension Control System. Chinese Journal of Aeronautics20 (2007) 266-271.

[7] Xiaodong Zhu, Qingshan Zeng (2006). “A Elevator GroupControl Algorithm for Minimum Wa iting Time Based On PLC”. Journal of Hoisting and Conveying Machiner, No. 6,pp.38-40.

[8] Henning Dierks. PLC-automata: a new class of implementable real-time automate. Theotetical computer science, 2001, 253:61-93.

[9] David G. Johnson. Programmable Controllers for Factory Automation. New York and Basel: Marcel Dekker Inc,1987.

[10] T. Mikulczynski, Z. Samsonowicz, R Wieclawek. The Grafpol Programming Language for Programmable Logic Controllers. Archives of Control Sciences, 2000,10(1):17-30.

[11] Nanette Bauer, Sebastian Engell, Ralf Huuck, etal. Verification of PLC Programs Given as Sequential Function Charts. Lecture Notes in Computer Science, 2004, 45(22): 517-540.

[12] Stephane Klein, Georg Frey, Mark Minas. PLC Programming with Signal Interpreted Petri Nets. Lecture Notes in Computer Science, 2003, 4(8): 440-449.