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Design and analysis of the system of Internet of Things Smart Home

Zhu Shun-bing[1,2,a], Du Chun-quan[2] and Niu Miao-miao[2]

[1]Jiangsu Key Laboratory of Urban and Industrial Safety, Nanjing University of Technology, Nanjing 210009,China

[2] School of Urban Construction and Safety Engineering, Nanjing University of Technology, Nanjing 210009,China

[a]13913399658@139.com

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Abstract. Application of Internet of Things (IOT) in smart home is the direction of the development and promotion of networking industry. This article first proposes smart home system architecture , based on the analysis of typical services provided by home network and within the family intelligent devices inside, then the article describes the solutions of IOT smart home and smart community based on the family intelligent terminals and the features and characteristics of the family intelligent terminals. Finally, detailed analysis the key technical issues of IOT Smart Home middleware and application platforms,standard-setting and so on, provides detail content of IOT smart home equipments research and develop and testing and verifying.

Introduction

Internet of Things (IOT) has a wide range of application requirements and a huge development space. The major developed countries in the world from the height of the national strategy promote the development of IOT; our government has attached great importance to IOT. China's "The 12th Five-Year Plan" has made it clear to IOT as a strategic emerging industry to foster and the construction of IOT application demonstration projects as a strategic emerging industry[1].

From the architecture point of view based on IOT Smart Home, IOT Smart Home constitute of the perception, transmission, and information applications. Perception refers to the induction, information collection and controlled equipment, transmission including the family inside network and external network data collection and transmission, information application mainly refers to the smart home application service operators to provide a variety of business. IOT Smart Home works are involved to address home gateway, middleware and application platforms, network application proxy, heterogeneous network interconnection and interoperability and other technologies, how to make breakthroughs of key technology problems in IOT industry development and application promotion during the progress of building IOT application demonstration projects is very important and urgent.

IOT Smart Home System Architecture

Home electronics system follows the HES (refer to ISO/IEC TR 14543 series standards) standard, which is composed by home network and all devices connected to it and including control communications and management rules in the home application process correspondingly[2]. Typical services provided by the home network shown in Fig.1.

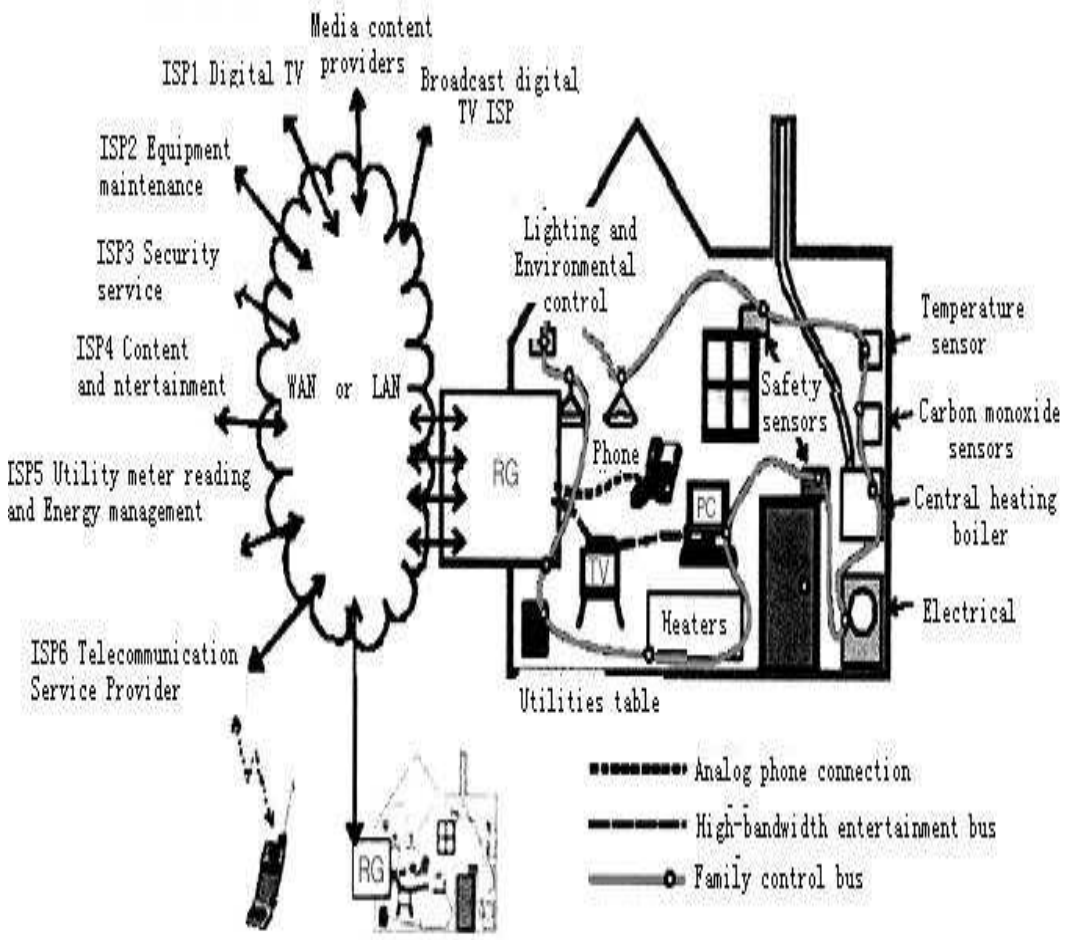

Fig.1 Typical services provided by the home network

Analysis from the type of information sent, the family inside intelligent devices can be divided into two categories: one is to sent control commands such as a variety of home appliances including refrigerators, air conditioners, as well as kinds of control equipments consist of smoke, infrared sensors, switching power supplies, relays, etc. These devices can be connected to a home network, their status and receive instructions can be check. The other one is to transfer large amounts of information and data including various audios, videos, graphics and images equipments. These devices provide a standard user interface. These intelligent devices can make people never leave home to control and monitor. Home gateway is the key to connect the intelligent devices and external network, through the home gateway and the family inside network, all devices can be easily manipulated outside the door. In outdoor environments, network providers, service providers, content providers can provide the residents with a variety of services. Intelligent home system architecture is described in Fig.2[3].

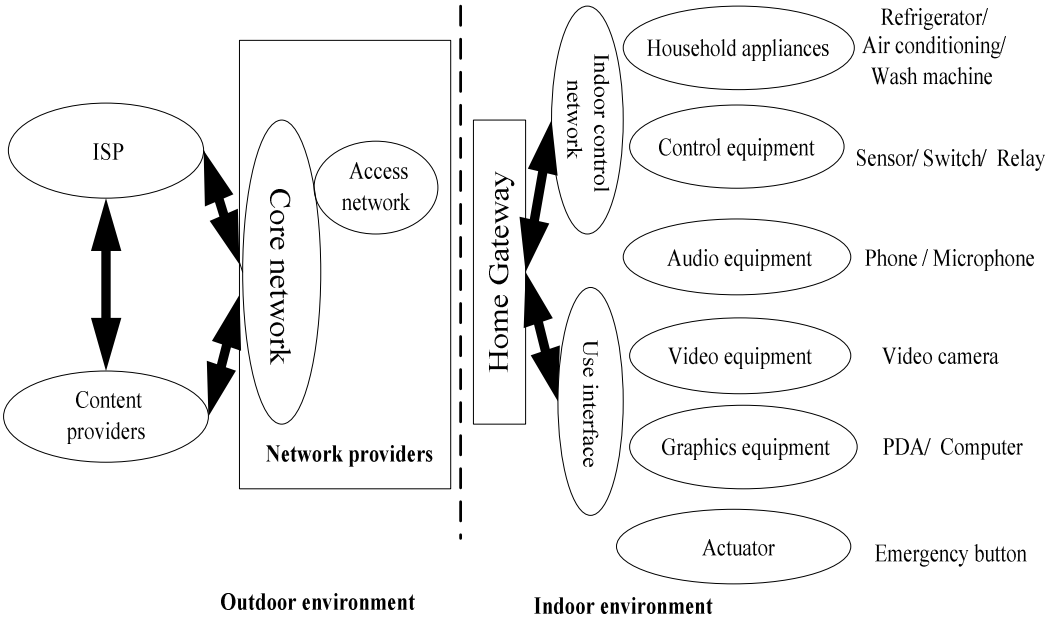

Fig.2 Chart of the smart home system

Smart Home System Design Based on the Family Intelligent Terminals

Smart Home and Smart Community Solutions Based on Family Intelligent Terminals. Intellectual community integrated management system is shown in Fig. 3. It is a technical solution to achieve three networks integration in community and family, containing three networks integration and home gateway with Web server. Also it is an underlying home appliances network (home electronic system) platform with Web service, the smart home systems unify the gateway as the core[4-6].

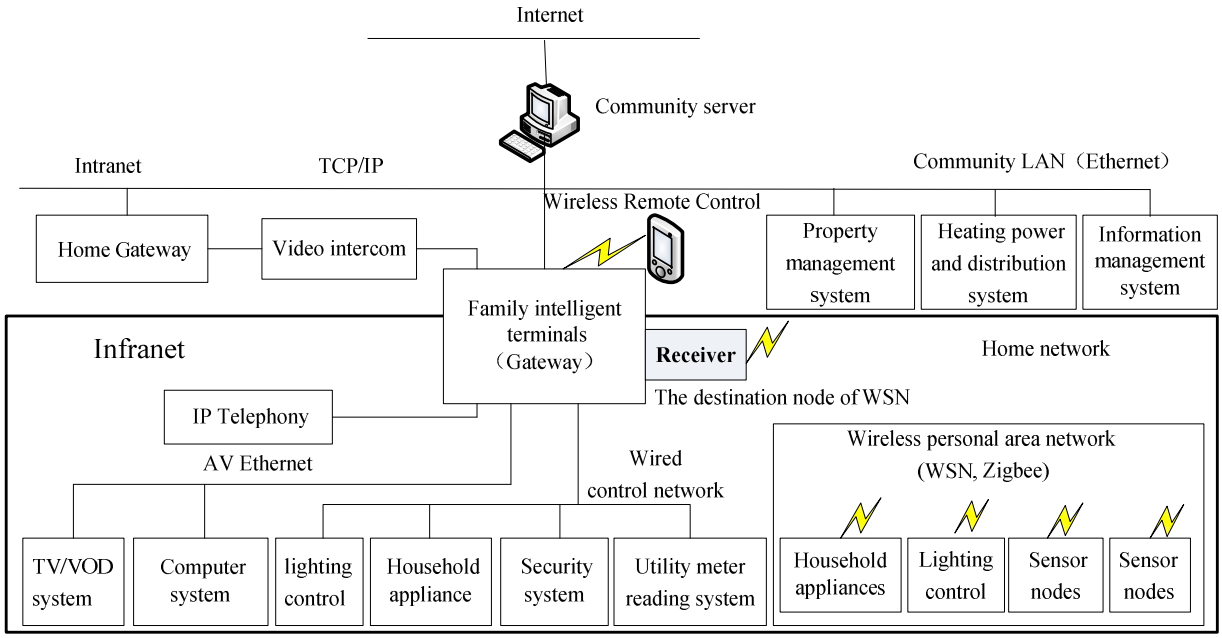

Fig.3 Diagram of smart community integrated system

As shown, the smart community integrated management system can be connected to the Internet via broadband or wireless communication. Community intranet can use the Fast Ethernet or Wireless Local Area Networks and TCP/IP protocol. Infranet is subnets of smart community including monitoring systems, information management and communication systems. Through

themselves gateways they access to the community network and compose of the smart community management systems. Each household's home gateway is integrated by control network, communication network and AV network. All networked devices in the community have a service description and release mechanism. They can be plugged and played any time. Gateway has the function of Web server as well as abilities of devices discovery and remote dynamic transmission which can act as a Web services platform. The home control network use Home Local Area Network, Wireless Personal Area Network communication protocol and a variety of transmission medias.

Features and Functions of the Family Intelligent Terminals. Family intelligent terminals have the following features:

(1) Each subsystem can be independent operation out of family intelligent terminals. Family intelligent terminals can collect the building intercom, home alarm, electrical control, access control, home entertainment and other subsystems' operation data to realize the interaction of each system.

(2) Entire smart home system is running under control and management of family intelligent terminals. Intelligent terminals only as a display and operate interface of various subsystems. Multi-intelligent terminals' configuration is easy and feasible. At the same time, family intelligent terminals can make a record and keep operating data of various subsystems. According to historical data summed up owners' habits and some laws of system operation to provide the basis for system operation optimization and self-learning.

(3) Family intelligent terminals support user to change control logics, control modes and user interface. In addition, family intelligent terminals are not only for the control system, but also the connection of information services and control.

(4) Products of different brands, different control transmission protocol can be interacted through family intelligent terminals. As the family intelligent terminals, under the unified management of cross-user platform different subsystems can work together and exchange and share data giving users maximum option right which fully reflect personalization of smart home. Meanwhile, family intelligent terminals have functional gateway. Through interactive platforms, intelligent home systems can be connected to the WAN to realize remote control and remote management. Family intelligent terminals have a variety of mainstream control interfaces. Continuously accord to customers and market requirement changes increase variety of bus, system driver software and hardware interfaces to provide basic guarantee for subsystems various electors and give maximum inclusiveness for smart home allowing users to have greater choices.

Family intelligent terminals have the following characteristics:

(5) Family intelligent terminals can adapt to people live way various changes. They can adapt to the device brand, function and control logical changes as well as users' habits changes and other front-end equipment changes.

(6) Family intelligent terminals are easy and convenient to be operated because they provide self-defined functions and operation menu and support a variety of intelligent terminals.

(7) Family intelligent terminals allow users to call the shots. They can automatically optimize the control system, learn user's habits and freed users from the control operation.

(8) Family intelligent terminals provide an interactive platform for information services. Intelligent information can be stored, the platform enables users to real-time browse and interacts, also it can provide richer content to open a pathway for the content operations, so not only provide users services, but also provide a certain replenishment to popularize and develop the market[7,8].

Middleware and Service Platforms of IOT Smart Home. The relationships of middleware, service platforms and engineering industry chain of IOT Smart Home are shown in Fig.4.

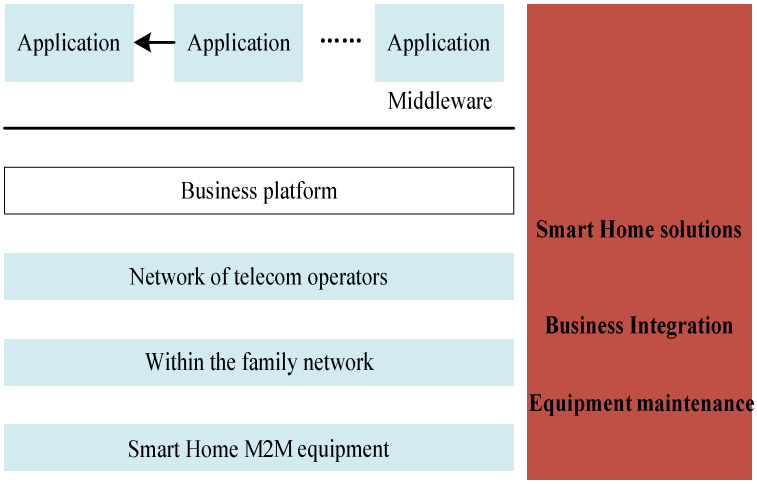

Fig.4 Photography of the relationships of middleware, service platforms and industry chain of IOT Smart Home

(1) Middleware is a cushion between device operating system and underlying hardware which defines the standard right and the next interface. They abstract out the common part of varieties of applications to provide users with a unified operation interface, shielding applications and hardware platforms a high degree of heterogeneity. Based on the current existing equipments hardware platforms middleware technology enables service providers to develop new applications flexibly and efficiently and has a strong scalability[9].

At present, only some individual operators in home networking business develop home gateway middleware specifications which are not enough for smart home business. Therefore, further studies are needed to develop smart home middleware platforms.

(2) Smart home business involves all aspects of live. Whether a variety of businesses will be integrated into a unified platform also need multi-party coordination and exploration. If they are discrete business platforms, and ultimately the businesses will be also brought into smart home devices together. Especially in a centralized network structure, intelligent home gateway and multiple business platforms should have the interfaces. If different kinds of interfaces can be unified as possible that will greatly reduce the complexity of smart home gateway[10,11].

(3) Smart home in order to realize scale development in the future need to appear smart home business operators involved in entire businesses chain providing the entire businesses chain solutions, business integration and maintenance of equipments. Like this that make the businesses chain healthy development to further promote family insurance, services, financial services and other industries as well as triple networks integration play.

IOT Smart Home Standard and Equipment Research and Development

Standard. International standardization work for different technical areas has already carried out. Because of the numerous of IOT technology system, standardization work is scattered in different standardization organizations. Each is focusing on. Smart home related international standardization organizations including X-10, CEBus, LonWorks, DLNA, UPnP, Broadband Forum, etc[12,13].

At beginning, the product is of independent functions at home. So in small self-organized system the product has each self-defined standards (foreign standard variation). Under the auspices of the Ministry of Information Industry establish and carry out "I Top Home" and 《Intelligent Grouping and Resource Sharing》 series electronic industry standards related to smart home. But they are not perfect. Local area network (TCP/IP) and lightweight IPv6 are the future smart home main communication protocols which are unified with the conventional network standards[14].

From the perspective of regulating the market and sustainable development, we can from some aspects to develop technology standards such as smart home system architecture standards, smart home sensor terminals interface standards, smart home communication protocols and centralized

control technology standards, the technical standards for smart home business providing platform[15].

IOT Smart Home Equipment Research and Development. The need for smart home networking, security access control and smart home information service in the wisdom of urban construction in China, by the smart home wireless IOT gateway device and the sensor node device to establish a home-oriented wireless IOT, the overall perception of safety in the home, health, energy, and other information, through the aggregation, integration, analysis, processing and control of information, and support the community for the family to develop and provide a timely, interactive, and efficient information service. These include:

(1) Breakthrough the key technologies in the family heterogeneous sensor networks integration, based on self-identity authentication information services and home mobile multi-terminal collaboration. Home wireless IOT gateway and other equipments support a variety of wireless means of networking, the wireless transmit power is low. It does not interfere with home appliances and electronic products, the sensor node device supports many kinds of sensors;

(2) Research and develop the home wireless IOT gateway equipment, household appliances wireless IOT interfaces, low-power sensor node device. Develop the intelligent home networking system, gateway, interface modules and nodes and other equipments to support cross-platform connectivity, provide awareness information on safe, healthy, energy-saving. Through the aggregation, integration, analysis, processing and control of information, to provide families with timely, interactive and efficient information services, have the information security and privacy protection measures, also have the ability of industrialization, large-scale applications;

(3) Put forward the home wireless IOT applications and operation programs, to carry out the application verification. Establish a maintenance management system for smart home wireless IOT networking, the system with multi-level, multi-dimensional comprehensive monitoring of the operational state;

(4) Establish the operational service system, to explore a sustainable mode of operation, to support the operational services for the family-oriented security, health, energy saving and family mobile multi-terminal collaborative information exchange.

Summary

Family intelligent terminals can adapt to various changes in the way people live. Family intelligent terminals are easily operated and allow users to call the shots. They provide information services interactive platform to open up a pathway for the content operations. So it is not only providing users with services but also providing a certain replenishment to popularize and develop the market. The intelligent home network platform based on family intelligent terminals, it close to the actual situation in China, the intelligent community integrated management information platform meet to the requirements of the Chinese consumer.

From the perspective of regulating the market and sustainable development, we can from some aspects to develop technology standards such as smart home system architecture standards, smart home sensor terminals interface standards, smart home communication protocols and centralized control technology standards, the technical standards for smart home business providing platforms.

For the needs of safety home and healthy family in smart urban construction, should to carry out the smart home wireless IOT technology research, equipment development and application and services based on the smart home IOT, lay the foundation for the industrialization of the smart home IOT. It is the direction of future work efforts.

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References

[1] China Academy of Telecommunication Research of MIIT. INTERNET of Things White Paper, Z . (2011).

[2] General Administration of Quality Supervision, Inspection and Quarantine of the Peoples Republic of China, Standardization Administration of the People's Republic of China. GB/T 20299. 1-2006 , DIGITAL technique application of building and residence community—Part 1 : System general requirement, S. (2006-7-1).

[3] Min Lijuan, Lu Hanhua, Chen Ling, Liu Jian, Min Hong, Research of architecture of smart home and related wireless communication technology, J. Computer Technology and Development. 21 (2011) 168-172.

[4] Zhu Shunbing, Zhang Jiugen, Key technique and design of smart home system, J. Building Electricity. 5 (2003) 25-31.

[5] Xie Houxian, Unified and integrated standard promote the smart home industrialization with Chinese characteristics, J. Intelligent Building and City Information. 10 (2011) 82-87.

[6] Jin Hai, Liu Wenchao, Han Jianting, Application study of Internet of Things in home, J. Telecommunications Science. 26 (2010) 10-13.

[7] Yang Shiyuan, Digital network technologies and applications, Beijing, 2002.

[8] Xiang Zhonghong, Smart home, Beijing, 2002.

[9] Lu Yang, Smart home business and key technologies, J. Telecommunications Technology. 5 (2010) 45-47.

[10] Wang Feiyue, Huang Xiaochi, The status quo and development trend of network-based smart home system, J. Household Appliance Technology. 6 (2001) 56-61.

[11] Wu Yu, Han Jianghong, Zhang Jianjun, Zhang Li, Disserting of several key technologies in intelligent residential system, J. Electronic Engineering and Product World. 12 (2002) 31-33.

[12] Open Services Gateway Initiative, Specification Overview, Ver.1.0, 2000.

[13] Cao Jiuxin, Zhang Deyun, The technology and evalution of homenet, J. Microcomputer and ITS Applications. 9 (2000) 4-8.

[14] Xiao Qing, Lu Hongyan, Home network system and its realization, J. Electronic Technology. 4 (2001) 61-64.

[15] Zhang Hui, Study on the construction and standard system of the Internet of Things in China, J. Information Technology and Standardization. 10 (2011) 4-7.