A Data Acquisition and Control System in Smart Home Based on the Internet of Things

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Abstract — The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. Smart home is the application of Internet technology in household life, and it combines data acquisition, data communication, data storage, data analysis, software design, electrical design, a series of technology such as energy conservation and environmental protection. In this paper, we studied data analysis method and data mining technology to smart home user behavior analysis. We then discusses the application of various mining and the user's life behavior of data gathered in real life to verify this idea, and concluded that the user's behavior, daily household behavior patterns, for the users of smart home system provides the reliable theory basis for the establishment of control strategy. According the mining results, this paper designed the smart home environment and the control strategy of three layer model based on Internet of things, to improve the smart home user behavior patterns mining system.

Keywords - The Internet of Things (IoT); Data Acquisition; Smart Home; Control System

I. INTRODUCTION

The Internet of Things is an important part of the future of Internet. Its task is to build complete for all things are widely connection and perception of infrastructure, building a network, information, services, and the height of objective things fully connected network. Smart home is the application of Internet technology in household life, and it combines data collection, data communication, data storage, data analysis, software design, electrical design, a series of technology such as energy conservation and environmental protection. Therefore, the nature of the Internet of things is the scale of the connectivity, namely universality. Because the characteristics of universality, iot data has its own characteristics. Mass: due to the time of Internet of things is characterized by way of data flow of collecting data and information, with the passage of time, the increasing amount of data, and due to the perception of the multi-angle data has the property of high dimension; Heterogeneity: because of the Internet of various types of sensors connected with information exchange, a large number of heterogeneous data exist inside makes the Internet of things; Real-time: due to the time of Internet of things is characterized of objective things and the observation of the change, for the time dimension data requirements; Distributed nature: the Internet of things, the perception equipment planners at all levels corresponding to its data center for data storage and maintenance management. Effective use of the Internet of things in the challenges faced by data information is the Internet of things.

Internet platform for the intelligent household industry technology is the use of housing, by adopting comprehensive wiring technology for whole, anti-theft security technology and Internet communication technology, sensor technology, automatic control technology and audio technology means to concentrate all the associated device in the life that occupy the home as a whole, building high quality residential device and family daily affairs management system, so as to improve the life that occupy the home convenience, comfort, security, and artistic appreciation value, and build a set of energy saving and environmental protection as one of the smart home living environment. This design to build a remote wireless control system based on unit. Considering the intelligence lives in low cost, low power consumption, short transmission distance etc, based on the cluster network topology structure, using the terminal control node, intelligent gateway, end node and data display platform to complete the seamless connection between Internet and home network. For hardware design, according to the different node structure to the function of the corresponding framework, using chip as the core chip, including core unit using micro controller design. In addition, the software, this paper also adopts unitary train of thought, the communication between different units, use of communication interface implementation. Using a series of measures, the development of more effective software system, the late maintenance and update more humanization.

Our research approach is to design and develop reliable, efficient, flexible, economical, real-time and realistic wellness sensor networks for smart home systems.

II. METHODOLOGY

A. Smart Home based on The Internet of Things

The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is
uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.

The realization of the Internet of things is the result of a variety of equipment to build, including: sensors, RFID, a new intelligent gateway, intelligent terminal, high performance distributed computing devices and large capacity storage devices, etc.

1) Wireless sensor networks: equipped with low cost, high performance, safe and reliable network of multi-types sensors, sensor types are varied: camera, sound sensors, light sensors, hall sensors, three-axis accelerometer, atmospheric pressure sensors, temperature sensors, etc.;

2) Identification device: with ultra-low power consumption low cost active, semi-active and passive RFID tag, RFID Signal reading devices (Reader) and tag reading and writing;

3) New intelligent gateway: can send a variety of sensors signal receiving and transformation, and information access to the Internet;

4) Intelligent terminals, smart phones, tablets, and other small computing device;

5) High performance distributed computing devices and large capacity storage devices: assembly in the background of the cloud computing and storage of various kinds and great number of Internet data and information.

Figure 1. Smart home based on the Internet of Things

Internet platform for the intelligent household industry technology is the use of housing, by adopting comprehensive wiring technology for whole, anti-theft security technology and Internet communication technology, sensor technology, automatic control technology and audio technology means to concentrate all the associated device in the life that occupy the home as a whole, building high quality residential device and family daily affairs management system, so as to improve the life that occupy the home convenience, comfort, security, and artistic appreciation value, and build a set of energy saving and environmental protection as one of the smart home living environment. Iot of smart home, and in fact is a platform for housing regulation of smart home through the Internet of things a habitable environment, using the Internet control process of smart home system, we call the Internet of things smart home integration process.

A good smart home based on the Internet of things must meet the following elements: household high-speed access to the Internet of things network function; Home office automation function; Intelligent home entertainment system, such as automatic on demand, video conference, remote teaching, interactive video games, etc.; Home security all-weather monitoring features, such as fire, gas leak alarm, children and the old man for help, remote intelligent medical treatment and care, open close the door alarm, etc; Household intelligent management functions, such as community bulletin board area, remote fee; Home business system, such as online shopping, e-commerce, etc. Therefore, the Internet of things intelligent household is actually use the Internet of things engineering technology connect all kinds of information and household equipment, and to ensure that the information equipment with residential coordination between the user equipment, in order to jointly build a safe and comfortable living space, intelligent information, so as to make people realize the rapid development in the information society to be able to quickly and comfortable life. Iot intelligence changes household to purpose is to provide people with comfortable, convenient, safe in the environment, meet people, communication, entertainment, leisure at home life work needs, to provide health, community management, security monitor the home situation and the time when people go out to the necessary way. "the Internet of things intelligent household system includes end users, automation system and network system of three units, among them, the end users and information appliances with two unit network appliances.
B. Data Acquisition in Smart Home

In every corner of the smart home is filled with all kinds of data, life can only be truly master all kinds of data at any time control. Intelligence lives in rapid development, all kinds of smart devices to appear, but there is no unified communication interface description. At present, most Internet plan proposed by the smart home based on cable network, installation and maintenance have many inconvenience. Read sensor data through the network, the data collection process and then written to the database. The data produced by the sensors in the iot are usually small, but the quantity is huge. So, the data collection process will be collected a large amount of produce small data written to the database, thus the database storage system in a large number of small data synchronous write operations, lead to serious performance bottlenecks of storage system.

C. Unified interface description

Based on wireless sensor network in intelligent equipment is equivalent to have four the "black box" of the interface, the interface is: Set the DO, Set AO, Get DI, Get the AI. Monitor equipment through Set the DO and Set A0 interface Set of digital and analog network equipment, through the Get DI and Get A I interface to Get digital and analog network equipment, to achieve the purpose of the network equipment monitoring.

In this paper, the data collection process collected sensor data, after the first detection of database storage system operation load, at the time of database operation load is small, the data collection process directly to write data into the database (shown in Figure 2). When the database load is larger, the data collection process will collect data written to the disk buffer queue, and then by queue cleaning process and optimize the way the data written to the database. In this way, the database storage system load is low when will collect data written to the database directly, to avoid the time delay. When the database storage system with high load, using disk buffer queue to optimize the collected data, and written to the database, and reduce the load database storage system, thus improve the performance of the entire Internet data acquisition system.

III. HARDWARE IMPLEMENTATION

Communication process need to use the end node and intelligent gateway connect with each other, and through the use of implement, so the unit is very basic in the whole household intelligent system of a unit, the unit can be safe and stable operation will be closely related to all the feasibility of the smart home system. In this design, we chose technology because he has the following significant advantages: first, it has excellent anti-interference ability, the calculation of the direct sequence spread spectrum transceiver module, compared to the commonly used frequency hopping, and data such as radio has more excellent anti-jamming ability. Secondly, technology using the algorithm, the algorithm can provide reliable guarantee for the integrity of the data and confidentiality. In addition, the use of technology use short shout transmission means, can significantly improve the transmission speed, has the very strong timeliness. Finally, the recovery of ability is very strong, can be very easy for networking. Can be widely used in household, optional equipment increase or decrease.

In this paper, each packet, the data collected will be an index of data message parts Message-Index and a data packet data Message Data. Message Index recorded the ID, the acquisition of data message in time, message storage location. Message-Data recorded the actual data of data packets. In 256-byte disk buffer queue, because of the possible use of multiple data packets space to store a greater than 256 bytes of data message, therefore, in the 256-byte disk buffer queue Message-In increases the packet length field. For example, 256 bytes of disk buffer in the queue Message-Index format, as shown in figure 3.

The Device Handle for the equipment in the network identity, the Address is in the function of network equipment to the scale of the operation quantity Address, D-Value is the digital quantity (0xFF is true, 0x00 for false), A-Value for floating-point analog.
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with index, this paper, the calculation is made by the company. The company production of chips is very suitable for the application of the wireless network node, whether it is used in the terminal device or a router. Its advantages than other chips is very significant. Its advantages include that the cost is low, the chip design is concise, has a very low cost. Power consumption is low, because of simple design, greatly reducing the use of unnecessary components, thus reducing the power consumption. The network uses more network nodes, better signal conduction and delivery. Additionally, the advantages include long transmission distance, and wireless receiving high sensitivity and anti-interference ability of long distance transmission.

The hardware implementation is shown in Figure 4. The hardware architecture presented is flexible and allows other home appliances and devices to be seamlessly integrated with some changes.

IV. SMART HOME CONTROL SYSTEM

Our control system contains a network of heterogeneous sensors. These heterogeneous sensors are temperature, force, PIR and electronic and electrical (E & E appliances sensing) appliances monitoring units. The sensors are scattered in such a manner so that the systems get every essential value from every corner of the ambient environment

A. Temperature Control

To design temperature sensing unit the LM35 IC is connected to conditioning circuit for ambient temperature monitoring.

B. Washing Machine Control

The sensors, actuators, controllers:

(1) Smart washing machine: In addition to the basic washing machine has the function, should have the following functions: wireless remote control, load detection sensors, frequency conversion washing, water injection according to clothes weight, clock timing, etc. These features have in some brand of washing machines.

(2) Main functions: automatic detection clothes weight, to upload status regularly, accepting instructions sent main controller and executed. Controller sent instructions are mainly start, stop, laundry, laundry, laundry way clothes to dry, etc.

(3) Main controller: It is a Zigbee wireless transceiver module of the single chip microcomputer, through the data line is connected to a computer.

(4) The main job: receive real-time information from rooms everywhere, and processing; On a regular basis to deal with the collected data, summing up the user habits and customs, schedule update user life; According to the schedule, send instruction to the actuator, simplify the life by the user.

C. Microwave oven control

Microwave sensors, actuators, controllers required:

(1) microwave oven. Need to have food detection (i.e., can sense if there is a food tray), Zigbee remote control function.

(2) the main controller. Is mainly responsible for microwave information collection, and send instructions to control the microwave oven.

Users in need heating in advance, the main controller receives the trigger condition, send instruction to the microwave oven. Detection to the user, for example, after getting up, began to heat the milk, etc.

D. Water machine control

Water dispensers for sensors, actuators, controllers:
(2) The main controller. Detection of user activity, remote control water dispenser.

Control mode:
(1) The user generally have certain habits of drinking water, for example, drink water after getting up in the morning, go to work during the day don't need to water machine work, need to drink at home in the evening.
(2) In the morning drink water: main controller receives the user get up after the news, send instruction to water machine heating a small amount of water (as in the morning drink). Water machine to connect the user has the news of the water back to the control center, control center according to the past, and the user behavior (for example) away from home for water dispenser send instruction to stop heating.
(3) The evening go home: if the user and the evening drinking habits, and in the master controller after receiving the user message home, start heating send instruction to the water cooler. Main controller receives the user instruction after sleep, send water machine stop heating instructions.

Figure 6. Smart Control Units.

V. CONCLUSIONS

The Internet of Things is an important part of the future of Internet. Its task is to build complete for all things are widely connection and perception of infrastructure, building a network, information, services, and the height of objective things fully connected network. Smart home is the application of Internet technology in household life, and it combines data collection, data communication, data storage, data analysis, software design, electrical design, a series of technology such as energy conservation and environmental protection.

In this paper, we analysis the on demand for smart home based on Internet of things, and then design the system structure of the smart home. We propose the curtain module, lighting module, temperature and humidity module, combustible gas module. We then build a remote wireless control system. Considering the intelligence lives in low cost, low power consumption, short transmission distance etc, based on the cluster network topology structure, we use the terminal control node, intelligent gateway, end node and data display platform to complete the seamless connection between Internet and home network. For hardware design, according to the different node structure to the function of the corresponding framework, we use technical chip, including core unit using micro controller design. In addition, the software. This paper also adopts unitary train of thought, the communication between different units, use of communication interface implementation. Using a series of measures, the development of more effective software system, the late maintenance and update more humanization.

Smart home is a complex research, the room user activity, security, remote control, and new energy self-sufficient system should be studied. More results will be reported in our future works.

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