Embedded Intelligent Home Control System Design Based on ARM and Wireless Sensor Networks

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This paper studies the origin, current situation and development trend of smart home. Several popular analysis of the current smart home control technology, embedded systems and wireless communication technology, proposed the use of ARM processor-based controllers, embedded Linux operating system, GSM technology for remote wireless communication technology. ZigBee wireless sensor technology for the intelligent home design short-range communication technology. ARM master controller and GSM communications module is a program designed to focus on the analysis of everyday household device control method, developed a short message based on the format of the control command, to write a short message for remote control of GSM module communication program. Use Qt designer designed an easy to use interactive interface, human-computer interaction and the program as a separate program added to the Qtopia system.

1. Introduction

Information technology has been rapid development, application of computer and network technology has penetrated into all aspects of human life, they have become part of people's work and life, changing the way people work and live (Wang, 2005). The twenty-first century, with wireless Internet and the popularity of smart phones, smart terminal has played in our lives an important role, they give our lives and work has brought great convenience, changing people's communication, while also changing the way we communicate and the way home (Sarathi, 2013). These technologies are gradually entering our living environment, changing our lifestyle, smart home is in this environment came into being (Tong, et al., 2014). Smart Home is the use of computer technology, communication technology, network technology, automatic control technology, networking technology and other technologies, the original closely together independently working device or system, the purpose is to make them more intelligent (Wang, 2015). People can more convenient and efficient use and control of these devices and systems; at the same time providing people with comprehensive information exchange channels to protect the family and the outside world and the device can smooth exchange of information (Long , 2014).

Smart Home is a function of complex, large systems, involving a wide range of computer network systems. Wherein the intelligent gateway is the core component of the entire home network, it manages the entire home network and home equipment, but also the key to achieving the bridge member household equipment and external network connections (Lang and Ding, 2013). So it has two main functions: first, to achieve within the family to build the network, connecting all devices through an internal network, complete the integrated management of household equipment; second, the realization of foreign and external network access, complete home remote monitoring devices (Long, 2012). But from the specific function, the current Intelligent Gateway has the following features: Household equipment control, video monitoring, security alarm, four-meter (heat meter, meter, water meter, gas meter) remote functions (Huo, 2014; Xia, 2015; Zang, 2015).

In this paper, the main achievement of smart home wireless control function. Intelligent home control system achieved management control of home devices, all home devices constituting a network system and intelligent gateway via ZigBee network. With such intelligent home control system we can control our home through the intelligent lighting system terminal, it can adjust the brightness of the light intensity of light according to the house to meet own requirements, to achieve the effect you like. It also can be based on certain requirements,

scene settings, such as when you make a birthday dinner with your spouse when your smart home system can establish a romantic, elegant, warm environment.

2. Smart home system solutions

2.1 Master controller select

Embedded systems commonly used microcontroller includes 51 traditional microcontrollers, DSP digital signal processor and ARM embedded processors. 51 traditional single-chip 8-bit microcontroller, low frequency clock is running slow, small data memory space, less on-chip resources cannot be extended, less IO port, typically do not support the operating system stack operations; DSP is a 32-bit digital signal processor , on-chip resource-rich, running very fast, the current popular operating systems can be successfully transplanted, but because of its unique architecture, it is more suitable for processing large amounts of data occasions, usually used in the field of communications, image processing, etc. ; ARM processor is currently very popular low-power 32-bit processor performance than the 8-bit microcontroller has greatly improved on-chip modules very rich expansion interface provides easy expansion for popular embedded operating systems. Intelligent Gateway is the core of the whole system, it needs to have a good man-machine interface (GUI), a rich network interface, processing and subsystem control large amounts of data, so they need a high-performance processor, the choice here Samsung S3C2410A with MMU function as a system master controller.

2.2 Smart home system solutions

The smart home system was shown in Figure 1. Intelligent gateway system to the core, which is responsible for connecting ZigBee networks and GSM networks, complete information conversion between the two, the mobile phone via the GSM network to send control commands into the smart home system shown in Figure 1. Intelligent gateway system to the core, which is responsible for connecting ZigBee networks and GSM networks, complete information conversion between the two, the mobile phone via GSM network to send control commands to the conversion.
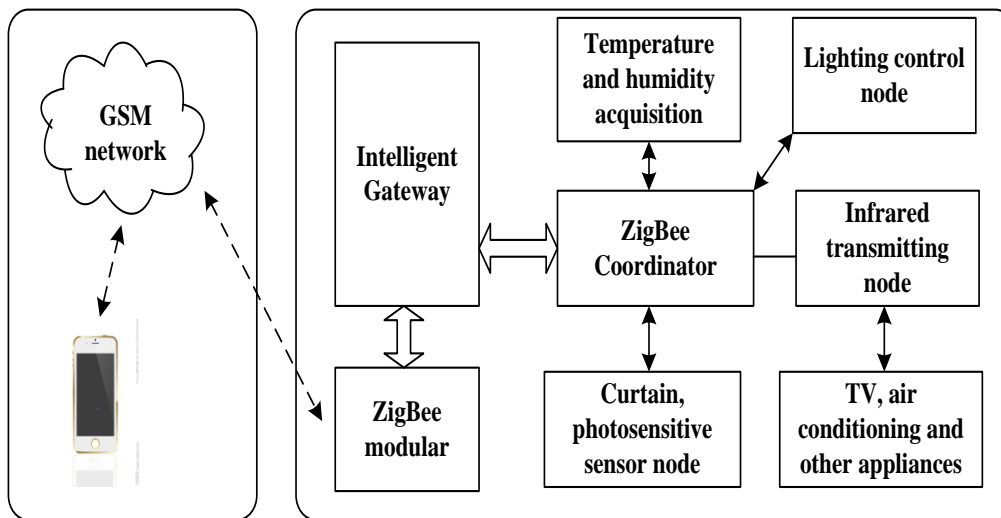

Figure 1: The smart home system

Temperature and humidity management module can be provided in each room of the real-time display of temperature and humidity sensors in each room, and the system can be set to the room temperature and humidity state, that by starting with air conditioning and humidifier to the room temperature and humidity within a constant range. Lighting system management module is an essential module of traditional smart home system, the main features include: users can phone, the graphical user interface of the smart home gateway control light switch and adjust the brightness of the lamp; light sensors and lighting controls can be combined, when when the light intensity drops below the set value lights turn on automatically when the light intensity is higher than the set value lights automatically turn off. Appliances intelligent control module complete TV sets, refrigerators, air conditioners, water heaters, rice cookers, home theater and other intelligent control home appliances, allowing appliances linked into a network, can local and remote control. Functional block diagram of the overall system was shown in Figure 2.
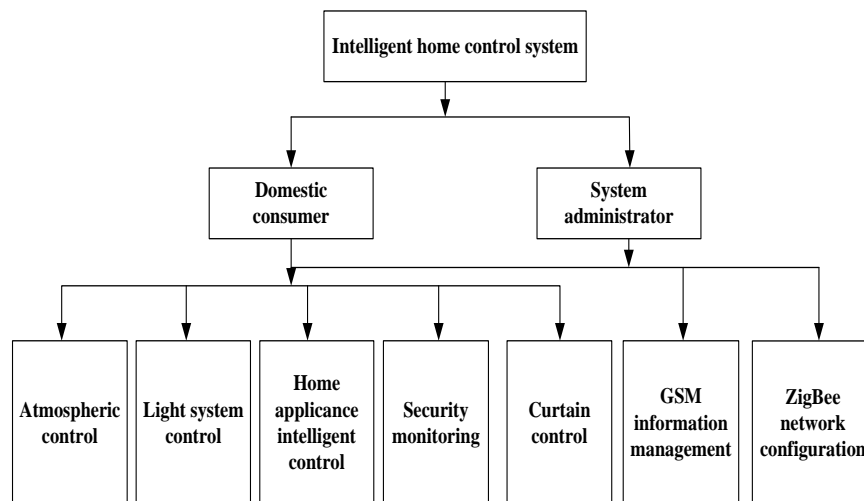
Figure 2: Functional block diagram of the overall system

3. Experiments and results

3.1 Intelligent home gateway hardware structure

Intelligent Gateway is the core of the system, the processor used must meet high performance, low power consumption, small size, and rich interface features. The system selected Samsung (Samsung) company S3C2410A processor as the system master controller. Smart Home Gateway is a ARM-based embedded hardware and software development platform, from a hardware perspective, it includes the following components: embedded processors S3C2410A, power modules, memory module, man-machine interface module, serial communication module, Ethernet module, GSM expansion module. Smart Home Gateway block diagram was shown in Figure 3.
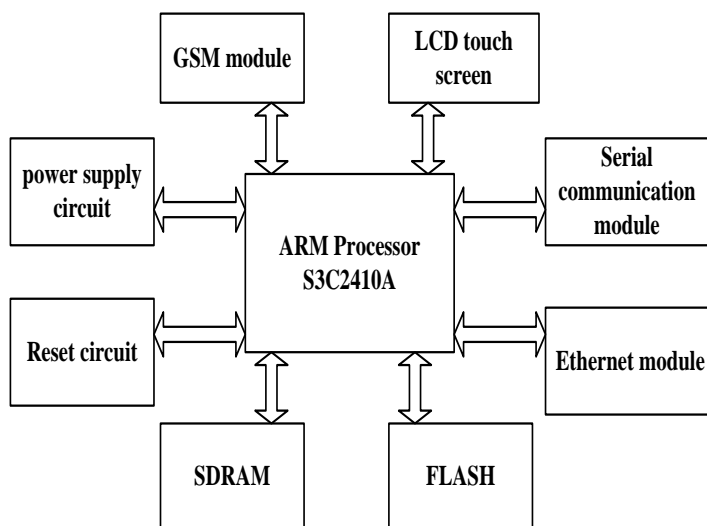

Figure 3: Smart Home Gateway block diagram

3.2 GSM communication program

AT command set is a set of command between the terminal (such as PC) and modem (MODEM) communications control. ATTENTION AT is an abbreviation. All AT commands are in ASCII characters "AT" starts with a carriage return <CR> or newline <LF> End. Commonly used command was shown in Table 1.

Specific way remote control for mobile phones to send short messages to intelligent gateway, intelligent gateway parse the contents of the short message, extract specific command, you need to pre-agreed format of short messages. Message format consists of the following elements: password (PIN), the device code, sub-

code equipment, command 1, parameters, commands 2, parameters, the password is to prevent misuse of the equipment; equipment codes distinguish various home appliances such as air conditioners = 1, TV = 2, 3 = lamp, washing machines, etc. = 4; the difference between one kind of equipment subcode first of several appliances, such as air-conditioning at home has several sub-code corresponding to different air conditioning; appliance control command set command, which after the parameters for the parameter corresponding to the command.

When a new message is received on the implementation of the short message processing function, the function first extracts text message sender's phone number, and then verify that the system recognized in numbers, you can prevent others operating system. After extracting the number is correct message content, in order to prevent misuse, requires short message contains the control password is set, and after you verify the password, according to the short message control information, giving the machine sends a signal interface, updated interface. Program flow chart was shown in Figure 4.

Table 1: The commonly used AT commands

| Dial command	ATD	Dial telephone number
Hook command	ATH	Hang up
New message	AT+CNMI	Select the system prompt when there is a short message
Read short message	AT+CMGR	Read short message
Column short message	AT+GMGL	A list of short messages to be stored
send message	AT+CMGS	send message
Write short message	AT+CMGW	Write short message and save it in memory.
Delete Message	AT+CMGD	Delete save short message
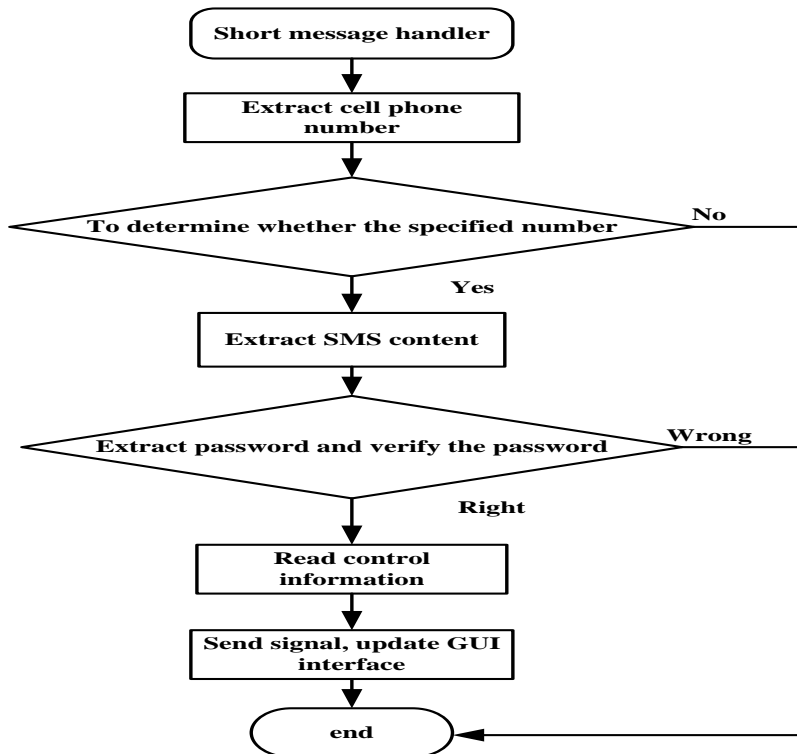
Figure 4: Program flow chart

3.3 The structure of the data processing module
The data processing module using TMS320F2812 as the main processor, which is a simple, powerful, cost-effective, high-speed data processing chip, it has a data acquisition and processing. The data processing module structure was shown in Figure 5.
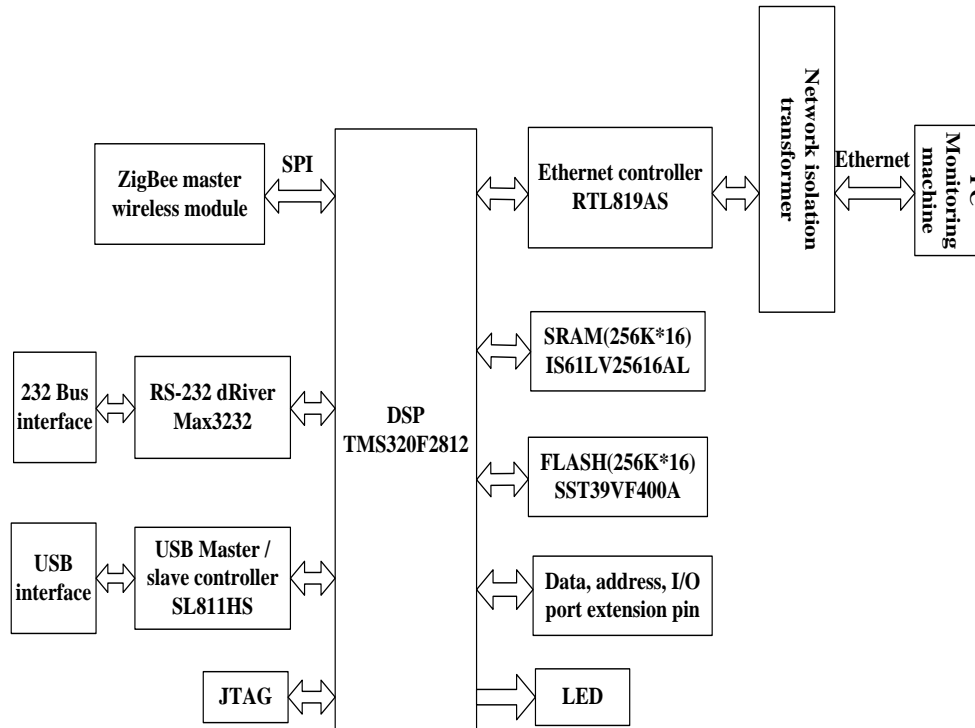
Figure 5: Data processing module structure

Use ZigBee wireless sensor network in the home monitoring from home to the layout of the unique advantages of the transmission is designed more in line with everyday household ZigBee wireless module, responsible for data collection and basic electrical power switch, and thereby build a Star Wireless sensor networks. In this paper ZigBee, Technology in the core protocol stack to start, and then chip-based CC2430 wireless module to complete the hardware design and complete software environment to compile under IAREmbeddedWbrkbenchIDE network coordinator from the network to add the node (terminal node) into the network software programming, and finally realize the communication.

In the hardware design, design the main controller, SDRAM memory circuit, a network interface circuit, LCD display circuit, serial communication circuit, designed and implemented at the same time regulating circuit lighting, air-conditioning control circuit, temperature and humidity acquisition circuit, curtain control circuit circuit subsystem. On the software side, the paper build embedded Linux system development platform, based on the completion of the short message communication program for remote control of the GSM module, ZigBee wireless network to multiple short-range communication module control program, and the development in the QT platform for the development of man-machine interface GUI.

4. Conclusions

In this paper, the main achievement of smart home wireless control function. Intelligent home control system is to achieve management control of home devices, all home devices constituting a network system and intelligent gateway via ZigBee network, embedded systems and wireless communication technology, proposed the use of ARM processor-based controllers, embedded Linux operating system, GSM technology for remote wireless communication technology, ZigBee wireless sensor technology for the intelligent home design short-range communication technology. ARM master controller and GSM communications module is a program designed to focus on the analysis of everyday household device control method, developed a short message based on the format of the control command, to write a short message for remote control of GSM module communication program. Use Qt Designer design an easy to use interactive interface, human-computer interaction and the program as a separate program added to the Qtopia system.

Acknowledgments

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