

Research of Intelligent Home Security Surveillance System Based on ZigBee

Suman Kumari Panigrahi¹, Manjog Padhi², Samita Nayak³, Soumya Prakash Bhoi⁴, Akshya Kumar Bag⁵

^{1,3,4,5}GIET, Baniatangi, Khorda

²REC, Bhubaneswar

¹sumankumaripanigrahi@giet.edu.in, ²manjogpadhi@gmail.com, ³samitanayak@gmail.com,

⁴soumyaparakashbhoi@gmail.com, ⁵akshyakumarbag@gmail.com

Abstract

Nowadays, Wireless Monitoring for home security is among the cutting-edge researches in the field of International Intelligent Building. To implement real-time surveillance of the home security, the intelligent remote monitoring system was developed for home security based on ZigBee technology and GSM / GPRS network. The system can send abnormal images and warning messages through MMS and SMS, receive remote instruction, and remote monitor household appliances. Meanwhile, the introduction of a variety of sensors and the enhancement of system's reliability guaranteed that the intelligent remote monitoring system can be responsible for home security. The hardware and software design and system performance are expounded in details. A number of surveillance devices in wireless network were connected. The experimental result shows that the system can attain remote surveillance of intelligent home safety with high availability and reliability.

1. Introduction

Intelligent home, also known as the smart residential home, is moving towards the wireless remote control, multi-media control, and high-speed data transmission. The key technology of intelligent home is compatible to household controllers and it can also meet the transmission requirements through home networking [1-3]. At present, lots of integrated transport network is based on comprehensive wiring technology [4], limiting the system to special places, and higher cost. Currently, researches on the wireless

intelligent home security surveillance system is becoming a hotspot due to its flexibility and convenience.

At present, the application of intelligent home wireless communication technologies mainly include: IrDA infrared technology, Bluetooth and ZigBee technology, and so on [5] [6]. IrDA is a short distance for the half-duplex point-to-point communication. Besides, it's inconvenient and of high error rate, which make IrDA not applicable to the family network communication. Bluetooth technology is limited by network capacity and it costs much. So Bluetooth technology is not suitable for the home network with a large number of nodes. ZigBee technology has the moderate transmission range and larger network capacity [7-9]. Here ZigBee technology is developed in the monitoring system.

2. System Architecture

Modular Design is throughout the system. System is built on the embedded system, and it can monitor the important position through the CMOS camera. Home state SMS and images MMS are sent to specialized mobile phones. Besides, household appliances can be remotely controlled by SMS. ZigBee module connects household appliances, the system motherboard with smoke, temperature, gas sensors, forming a wireless networking.

The system motherboard core controller is S3C44B0X-32 microcontroller and mainly responsible for dealing with the data. Through MMS modules and ZigBee module it can send information and instructions. And Expand access plate to smoke, infrared, gas and other domestic security state sensor.

MMS module makes the system controller send the family security status information to mobile phone users. Users send and receive text messages of instruction; ZigBee module is responsible for the system motherboard with the expansion of household appliances between the board and cross-linking of data. System structure is shown in Figure 1.

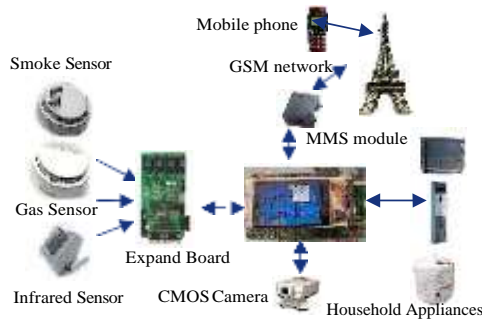


Fig1.Intelligent Home Security Surveillance System

3. System hardware design

System Controller

The system uses 32-bit RISC processor S3C44B0X, with rich feature sets and peripherals, including: 8 KB Cache, internal SRAM, LCD controller, 2-channel UART, 4-channel DMA, PWM functions with the five-channel timer, and so on. The processor performance in all aspects of the system can meet the needs. And compared with other similar products, its price is more suitable.

MMS module design

MMS module, built-in MMS protocol, is the GSM / GPRS module integrating SMS and MMS. It uses AT commands to control module through the RS232 interfaces. It has 600 K internal integration of flash storage space, which makes it possible to upload several pictures at the same while sending MMS .

ZigBee Transceiver Device

The system uses a chip CC2430 ZigBee wireless communication module. CC2430 ZigBee integrated

radio frequency (RF) front end, memory and microcontroller^[10].

CC2430 integrated with IEEE802.15.4 standard of the 2.4 GHz RF transceiver, support CSMA / CA features, the digital RSSI / LQI support and a powerful DMA function, a battery monitoring and temperature-sensing feature, with a strong and flexible Development tools.

4. System Software Design

The whole system software is modular in design, and can be concretely divided into three parts: ZigBee wireless transceiver, MMS and SMS transceiver, and image acquisition and processing.

Detection of Abnormal Status

The system can image the way through, outsider invasion, fire and other indoor anomalies automatically determine. Its advanced intelligence primarily reflected in the following two areas. Firstly, system could adapt to the background environment changes through self-learning so that it can be available in different environment. Secondly, for the critical state, the software will automatically start tracking monitor. More accurately monitoring can be achieved, with more pictures are taken. Based on the difference in background and the difference between frames, the system uses a combination of static and dynamic threshold. The main objectives of the testing process, including image pretreatment, quantify motion detection function (or small target tracking detection), unusual situation and determine treatment.

When the system receives the new images sent by cameras, first step is preprocessing and de-noising. We can get the motion of body that can be quantified or binary image of unusual objects region. Then the system can analyze and judge the abnormal state.

System uses two types of abnormal function quantified, based on the overall situation bitmap handling and sampling detection processing individually. Then, according to quantified abnormal function of specific indicators, the system processes the follow-up operation. For the police entered the abnormal process, send alarm signals, sent MMS

messages and store the video; abnormal tracking For access to critical, critical abnormal start tracking procedures, otherwise the replacement of the background and wait for the judgment obtained under a control image.

The Transceiver of MMS and SMS

MMS module can achieve SMS and MMS function, through the AT commands controlling. First module is to carry out initial configuration, such as access points set up, IP settings, set up MMS communication mode, set up server address.

XMODEM agreement is the beginning of receiving documents issued "NAK" bytes. The documents can be sent to the receipt of the signal sent the data frame, in order to start a normal communication process by two sides. Based on the agreement Xmodem, uploading pictures of the process is shown in Figure 2.

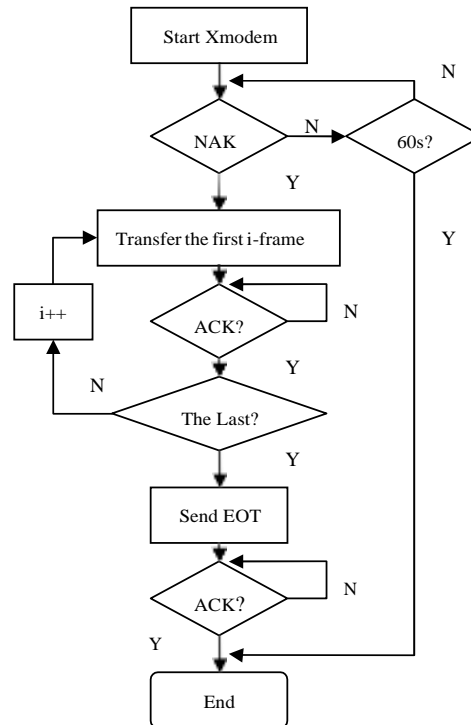


Fig2. Xmodem agreement to send the file process

The Application of Zigbee Wireless Network

Wireless communications software system designed mainly include abnormal alarm signal transmission and reception, ARM processor and ZigBee module as well as the ZigBee module data transferred with the controller.

According to the network, the level of ZigBee modules will be set to three operating modes.

Mode 1: Connected with the system motherboard. ZigBee modules receive others information and send the control command given by the system board to other ZigBee modules. This model is the core hub of the motherboard and wireless communications equipment.

Mode 2: ZigBee module,connected with household appliances through the relay, is placed in receiving state. When receiving the control command from other ZigBee modules, the ZigBee module controls electronics to make the appropriate action.

Mode 3: The sensors connected with the relay, placed sent state. When ZigBee module receives the alarm signal to the sensor, the alarm signal will be sent to other ZigBee module.

Module model can be set to switch codes. Different models of the module are responsible for all floors between the transmission of data and instruction, to make the family constitute a security LAN.

5. System Testing and Experimental Data Analysis

The system uses the moving target detection algorithm to achieve the targets of the surveillance image processing and abnormal judgment. Accounting for 7.5 % background of the small target the system can identify. The effective elimination of the system for environmental changes in light, change the background small goals gradual movement caused by factors, such as system misjudgment.

Figure 3 is the use of the system hardware and software for the intrusion detection and testing experimental picture effect.

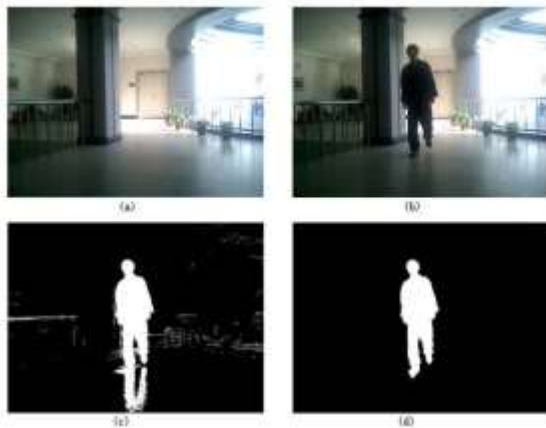


Fig3. Intrusion Detection to Results

The results show that, without obstruction in the transmission distance less than 60 m, the transmission of data packet loss rate is zero. The Test Data with No Obstruction is shown in Table 1. It can fully meet the normal home environment for the communication needs, with a low power; therefore it is very suitable for family use. If there are two cement walls between two ZigBee modules in 30 m distance, packet loss rate is only 1 percent. And if there is one cement wall, the rate is zero, which can completely meet the requirement of system design.

Table1. The Test Data with No Obstruction

Transmission distance (m)	Error Rate	Receive power (dBm)
10	0%	-57
20	0%	-66
30	0%	-68
40	0%	-69
50	0%	-72
60	0%	-72

6. CONCLUSION

This paper presents the design and completion of a ZigBee based smart home security monitoring system, respectively, from the system, hardware design, software design, experimental data analysis and other aspects of the ZigBee technology in the application of

the system. ZigBee technology will be applied in the intelligent home to achieve a rapid rate, low-cost, low-power wireless communication network. Through connecting the traditional sensor alarm system and image monitoring system, a new type of smart security system is formed. Users can use the phone or PC to receive MMS information. According to the need, users can set the mobile phone to achieve a flexible and convenient home security monitoring.

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