A Comparative Approach to Remote Home Security System Based on Wireless System Network and GSM

Nelofar Tyagi, Ashish Joshi, Sangya Singh

Abstract— Security has always been an important issue in the home and other applications. A remote home security system offers many more benefits apart from keeping home owners, and their property, safe from intruders. The system is a low power consumption security alarm system developed by applying WSN and GSM technology. The system is composed of the microcontroller based wireless sensor network center node with GSM module, data collecting node, device control node and mobile phone. The wireless sensor network data collecting node module is connected with Pyroelectric Infrared Detector, Temperature Sensor, Smoke Detector and Gas Sensor separately. The PIR can detect the theft, leaking of raw gas and fire, and send alarm message remotely. The hardware of this system includes the single chip C5081F310, wireless receiving and sending chip CC1100 as well as the SIMENS TC35 GSM module. Security monitoring systems are popular in home automation and in recently, wireless sensor networks such as Zigbee are used to structure such systems. The security alarming system is based on Zigbee chip MC13192 and low power consumption micro-controller MSP430F135. This paper presents an experimental home security monitoring and alarming system based on Zigbee technology. It also describes the system architecture, circuit principle, firmware flowchart, operation and the future developments in field of remote security system.

Index Terms— Remote Control, Wireless sensor network, zigbee, PIR sensor, TEMP sensor, IR sensor, home security system, Micro-Controller, Cell Phone, Global System for Mobile Communication.

1 INTRODUCTION

Safety is the most important requirement of home for people. With the development of IT technology, network and automatic control technology, a remote home security monitoring and alarming system becomes more and more practicable today. By combining wireless sensor network (WSN) and GSM technology, this paper designs a low-power consumption remote home security monitoring and alarming system that can detect the theft, leaking of raw gas and fire, and send alarm message to the house owner's mobile phone. Wireless sensor network is composed of a large amount of miniature self-organizing wireless sensor nodes. By combining three kinds of technology such as sensor, micro mechatronics and wireless communication, WSN can detect, collect and deal with the object information in its covering area, and send data to the observer.

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In a word, WSN technology has the advantages of wide covering area, able to remote monitoring, high monitoring precision, fast network establishment and reasonable cost. GSM network has the advantages of mature technology, wide covering area, long communication distance, and sound communication effect and so on.

The remote home security system presented in this paper combines so many advantages of WSN and GSM. Firstly, wherever the users are, once some dangerous instance happens in home, such as gas leaking or thief intruding, this system can send alarm short message to the users through GSM network immediately, informing people the possible dangerous circumstances in home. Secondly, the wireless sensor network established in home has the features of ease establishment, without use of cable, and low-power consumption. 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. At present, lots of integrated transport network is based on comprehensive wiring technology, limiting the system to special places, and higher cost. Currently, researches on the wireless intelligent home security surveillance system are 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. 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. 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. Fig. 1. shows the block diagram of the system 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.

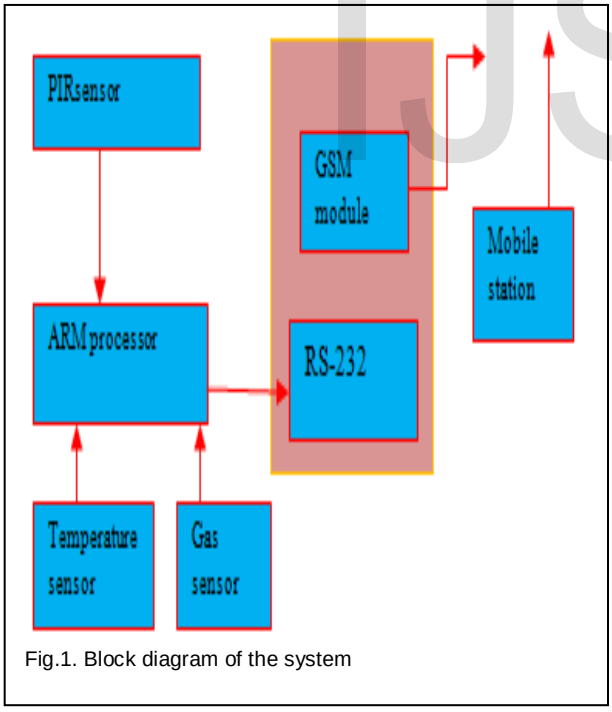

Fig.1. Block diagram of the system

Zigbee module is responsible for the system motherboard with the expansion of household appliances between the board and cross-linking of data. The system structure is illustrated in Fig.2. It is composed of the MCU-based home wireless control center, one WSN center node module, and several data collecting nodes, GSM module, GSM network and mobile phone. The WSN data collecting node modules are connected with pyroelectric infrared detector, temperature sensor, smoke detector and gas sensor separately. When the pyroelectric infrared detector finds that some people intrudes into the house abnormally; or when the temperature sensor detects too high indoor temperature and at the same time, the smoke sensor detects over proof smoke concentration; or when the gas sensor detects over proof combustible gas concentration, the sensors will send encoded alarm signal to the home control center through the wireless sensor network established in home. Once the wireless control center receives alarm signal, it will send alarm short message to the users through the GSM module and GSM network immediately

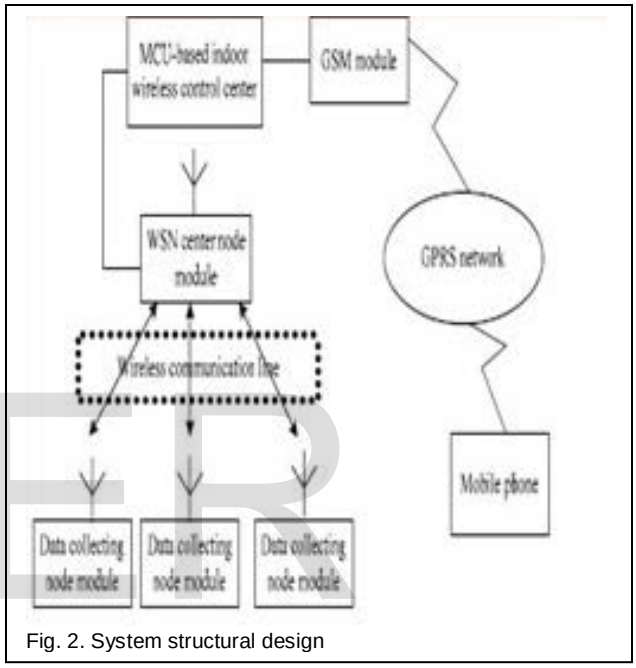

Fig. 2. System structural design

3 Selection And Design Of System Hardware

3.1 Wireless Sensor Network Node Module

The wireless sensor network in home of this system is composed of one center node module and several data collecting node modules, operating in point-to-multipoint communication mode. In different application, the formation of a WSN node is not always the same. In general, a WSN node includes four parts: data collecting unit, data processing unit, wireless communication unit and power management unit. The composition of WSN node is shown in Fig. 3. The data collecting unit is composed of the sensors and A/D conversion module. In this remote wireless home security system, some pyroelectric infrared detectors, temperature sensors, smoke detectors and gas sensors are used .The data processing unit is responsible to save and deal with the data collected by the sensors and received from other nodes.

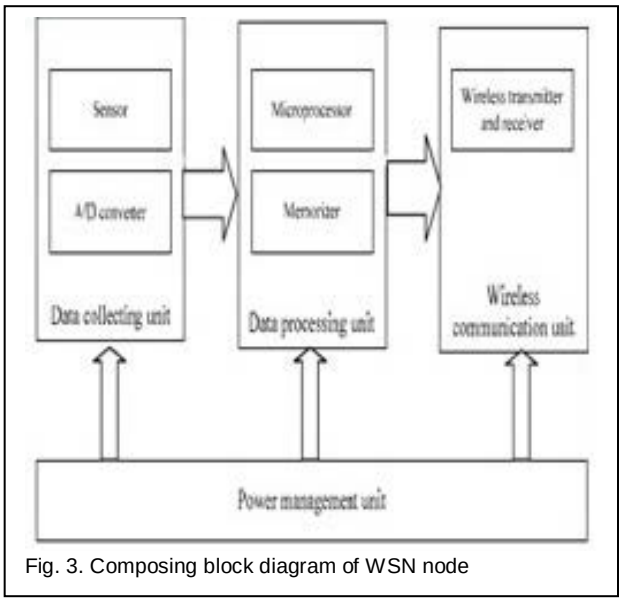

Fig. 3. Composing block diagram of WSN node

In this system, the C8051F310 MCU from Cygnal Corporation is chosen as the data processing unit. The wireless communication unit is often composed of the low power consumption, short distance radio frequency (RF) transceiver. In this system, the wireless dual-way chip CC1100 dedicated in wireless and low power consumption application is chosen to implement wireless communication. C8051F310 MCU can control the main working parameter of CC1100 and communicate with CC1100 through SPI interface. The SPI standard interface include main output slave input (MOSI), main input slave output (MISO) and serial clock (CLK). The master CLK is synchronized with the slave CLK.CC1100 can set the working mode, read and write cache data and status register through SPI bus. The RF chip is connected with MCU through SPI interface to make a wireless communication system that can control receiving and sending function freely. The hardware connection between C8051F310 with CC1100 is showed in Fig. 3. The SPI interface of CC1100 is to be connected to the hardware SPI interface of CPU. In general, GDO0 or GDO2 pin of CC1100 can be connected to any pin of CPU. But if an interrupt service program is to be used to implement the function of data receiving and transmitting or wireless wakeup, GDO0 or GDO2 pin of CC1100 must be connected to the out interrupt pin of CPU.

The system software, which is developed with C51 programming language, has two main modules, one for the WSN node communication, and one for the GSM communication.

3.2 GSM

In this the system uses TC35 dual band GSM 1800 modem. The TC35 Terminal is a compact GSM modem for the transfer of data, voice, SMS and faxes in GSM networks. Industrial standard interfaces and an integrated SIM card reader mean it can be used rapidly, easily and universally as a dual band GSM Terminal. Its performance band width and the robust housing make it easier to quickly implement new applications in areas such as telemetry and telematics.

The features, functions and interfaces of the GSM Terminal TC35 are described below. The functionality of the Terminal corresponds to the features of the TC35 module, to which a SIM card reader, an RS232 interface, an analog interface for the handset interface and a greater supply voltage range have been added. All the external interfaces of the GSM Terminal TC35 T are integrated permanently in the housing. The plug-in connections are standardized and suitable for use under vibration.

The TC35 GSM 1800 main advantage is compact and low power consumption and support dual frequency.

4 Design Of System Software

The system software, which is developed with C51 programming language, has two main modules, one for the WSN node communication, and one for the GSM communication.

4.1 Software Module for WSN Node Communication

In the indoor wireless sensor network, the communication protocol is divided into three layers.

The first layer is physical layer whose function has been implemented by CC1100 hardware itself. The second layer is network layer. The second layer is network layer which applies TEEN (threshold sensitive energy efficient sensor network) protocol. The data will be transmitted through the wireless sensor network only when the observed value changes suddenly. The third layer is application layer. In this layer, the system's application software is divided into two modules, WSN data collecting node software module and WSN center node software module. The former, running on the slave MCU of data collecting nodes, is responsible for collecting sensor data and wireless transmitting them. The latter, running on the master MCU of WSN center node, is responsible for wireless receiving data and judging whether it's need to start the alarming process or not. If yes, it will drive TC35 GSM module to send alarm short message to user's mobile phone.

The software flow of data collecting node module is illustrated in Fig. 4. And the software flow of center node module is illustrated in Fig. 5.

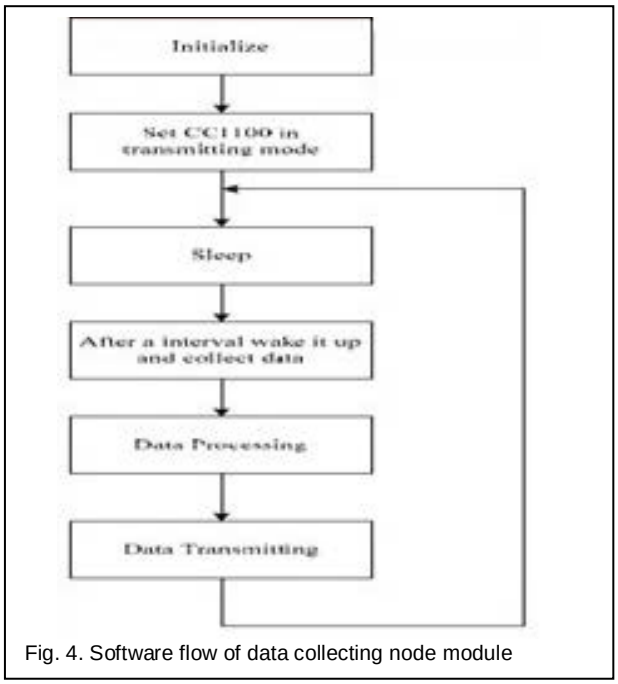

Fig. 4. Software flow of data collecting node module

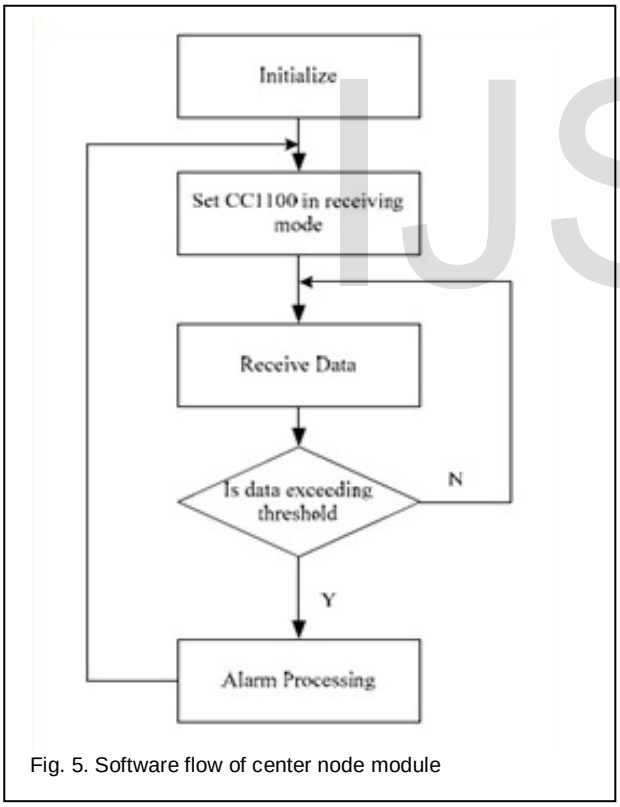

Fig. 5. Software flow of center node module

4.2 Software Module for GSM Communication

This segment is shown in Fig. 6. As GSM modem uses serial communication to interface with other peripherals, an interface is needed between MCU and GSM modem. This segment consists of four parts:

1. **DB9 male connector:** The serial port used here is a 9 pin DB9 male connector as the GSM modem side uses a female connector. Pin 14 and 13 of MAX232 are connected to pin 2 and 3 ofOB9 respectively. Pin 5 ofOB9 is grounded.

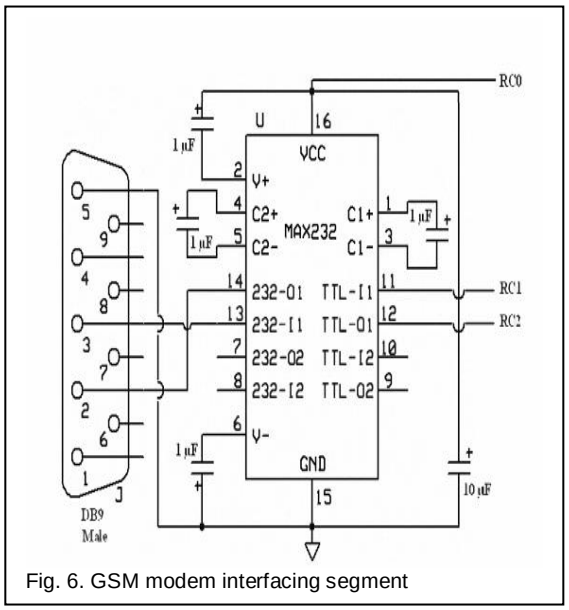

Fig. 6. GSM modem interfacing segment

2. **MAX232:** This particular IC is necessary for increasing the voltage swing at the outputs. It takes OV and +5V inputs and makes it a + 12V and -12V output voltages. This increased voltage swing is a requirement for serial communications. Two 1 /IF capacitors are connected between pins 4, 5 and 1, 3 of MAX232. V+ and V-pins are fed from VCC and GNO, i.e. Ground through two 1 /IF capacitors. Between VCC and GNO pins, one 10 /IF capacitor is placed.
3. **GSM modem:** GSM modem is connected through a OB9 female connector to the interfacing circuit.
4. **MCU:** The VCC, i.e. Power pin, TTL input and TTL output pins of MAX232 are connected to the pins RCO, RCI and RC2 of MCU respectively.

When the WSN center node module receives abnormal data, it will drive TC35 GSM module to send alarm short message through GSM network. TC35 GSM module supports standard AT command set. MCU control the operation of TC35 module by inputting different AT function commands through the serial port . Some GSM AT commands relevant to short message are listed. The sending mode of short message depends on the interface supported by the short message service center in the GSM network. European Telecommunications Standards Institute (ETSI) has defined three kinds of interface protocol for sending short message: Block mode, Text mode and PDU mode. Block mode requires the mobile phone manufacture to provide driving support. Text mode doesn't support Chinese text . So at present, PDU mode has become the core of most mobile phone for their short message communication. It can provide more powerful functions than the other modes. So, this system applies PDU mode to

send alarming short message.

5 Wireless Sensor Network Characteristics

For measuring and monitoring physical and non-physical activities in a remote area, various types of wireless sensors are generally grouped in a network. Apart from the sensors, the network may incorporate repeater hubs to extend the transmission range of the retrieved data. The network may also incorporate processing units to analyze the data. The sensor networks employ small, low power devices to do all the tasks. The sensors in the network capture the activity and the collected data is communicated to a remote monitoring centre using wireless data transfer techniques such as Radio Frequency (RF) communication. The size and cost constraints on these types of network result in corresponding constraints being exerted on the resources such as energy, memory, computational speed and bandwidth. a typical wireless sensor network. It consists of a Data Acquisition Network (DAN) and a Data Distribution Network (DDN). In the Data Acquisition Network, the data collected by the sensor nodes are transmitted, using RF channel, to the Base Station Controller (BSC), which in turn is connected to the Management Centre using wired or wireless connection. Some pre-processing of data is often done at the base station which, for a small and simple sensor network, is generally equipped with a microprocessor or microcontroller. The entire network is monitored and controlled by the Management Centre which is equipped with large storage capacity and computational resources to undertake data analysis and presentation. The Base Station provides a gateway to the Data Distribution Network. For distribution of data within the DDN, various kinds of transmission techniques are used, such as Wi-Fi, Bluetooth and Cellular networks (CDMA/GSM). Data may be distributed to remote PCs/ Notebooks, handheld PDAs and cellular phones. Thus, to build and implement a sensor network, a designer needs to consider several aspects which are discussed in the following sub-sections.

5.1 Wi-Fi

Wi-Fi networks use radio technologies IEEE 802.11x standard, which is a standard that uses the 2.4 GHz and 5 GHz bands, to transmit and receive the wireless data . Wi–Fi is useful in implementing ad-hoc wireless networks.

5.2 Bluetooth

Bluetooth is an open standard for short-range, low power, and low-cost digital radio wireless communication. Bluetooth is now being used in a wide range of personal products and the technology is readily available in the market. The blue tooth transceiver use unlicensed 2.4 GHz frequency band, with a nominal bandwidth of 1 MHz for each channel. It offers an effective range of 10 meters (32 feet). Bluetooth can indeed be used in wireless sensor network for short range applications.

5.3 ZigBee

Zigbee is a relatively new, wireless personal area network technology based on IEEE 802.15.4, with a transmission range of 100+ meters. ZigBee based communication devices consume very little power and hence the battery life of 1000+ days is common. ZigBee has enormous advantages compared to Bluetooth when used in wireless sensor networks. The reasons include more coverage area, less power consumption, and secure networking. ZigBee operates in the industrial, scientific and medical radio bands - 868 MHz in Europe, 915 MHz in the USA and 2.4 GHz in most other countries in the rest of the world. A typical appliance control board with zigbee module is shown in Fig. 7.

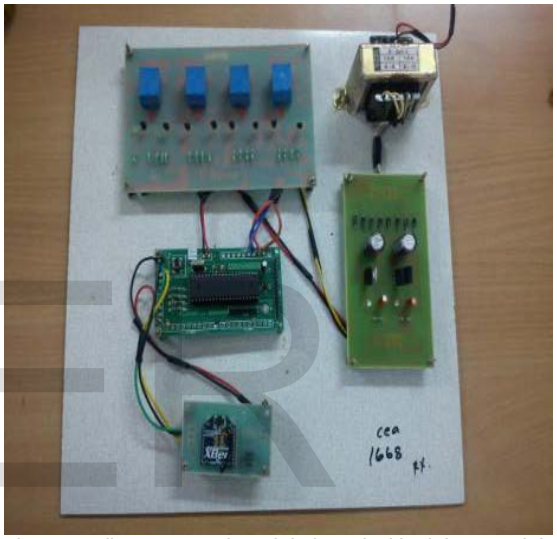

Fig. 7. Appliance control module board with zigbee module

5.4 Network Topology

In any communication network, the message should be transmitted with a prescribed throughput and reliability. This is usually termed as "Quality of Service" (QoS). It can be specified in terms of message delay, bit error rates, packet loss, economic cost of transmission, transmission power, etc. Depending on the QoS, the installation environment, economic considerations, and the application, one of several basic network topologies such as star, ring bus or tree connection may be used. A communication network consists of nodes, which in our case are sensors, each of which has computing power and can transmit and receive messages over communication links, wireless or cabled.

5.5 Communication Protocols and Routing

In a wireless sensor network, one can implement different types of communication protocols and routing techniques. The protocol employed depends on the application in which the sensor is meant to be used. A basic communication protocol consists of packets of data which

has a header for identification, data bits and also some special frames to identify and correct errors in transmission. When a sensor node desires to transmit a message, handshaking protocols are implemented with the destination node to improve reliability and ultimately the QoS of the wireless network. This hand shaking protocol makes the sensor node to retransmit messages that were not properly received. To use the extremely limited resources effectively and efficiently, a new technique called CodeBlue is implemented in wireless networks in order to cope up with the sensor nodes which have limited communication and computation capabilities. The CodeBlue integrates sensor nodes and other wireless devices in the network, thus performing various tasks, such as device discovery - naming, routing, prioritization of critical data, security and tracking device locations. The inventors designed Code Blue for rapidly changing, critical care environments. It acts as an "Information Plane", letting various devices detect each other, report events, and establish communication channels. For medical applications, CodeBlue is designed to scale across a wide range of network densities, ranging from sparse clinic and hospital deployments to very dense, ad hoc deployments at a mass casualty site.

Code Blue must also operate on a range of wireless devices, from resource-constrained motes to more powerful PDA and PC-class systems. The main advantage of this kind of structure is, it incorporates a flexible naming scheme, robust publish and subscribe routing framework; authentication and encryption provisions and handoff. The other services the CodeBlue provides to the network are location tracking, in-network filtering and aggregation.

5.6 Power Management

Since the wireless sensors are geographically distributed, often in remote sites, the lifetime of the sensor nodes is important. Power generation, power conservation and power management play very important roles in extending the lifetime of the motes. Most of the power is consumed in the process of RF communication since the required transmission power increases as the square of the distance between source and destination. While software power management techniques can greatly decrease the power consumed by RF sensor nodes, TDMA is especially useful for power conservation, since a node can power down between its assigned time slots, waking up in time to receive and transmit messages.

5.7 Network Coverage

The coverage area of the sensor is defined as the effective range of the sensor connected to its sensor node. In a network, high coverage makes it robust system and this can be exploited to extend the network lifetime by switching redundant nodes to power-saving and sleep modes

6 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 misjudgement. Fig. 8. is the use of the system hardware and software for the intrusion detection and testing experimental picture effect.

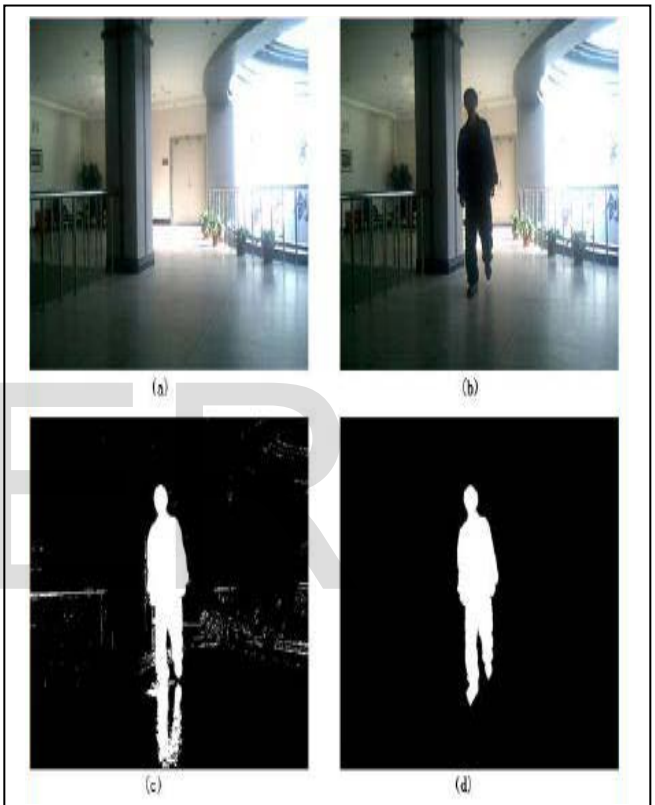

Fig. 8. Intrusion detection to results

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. 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.

7 Future Developments

The reported inventions on home monitoring are based on different sensors, collection of sensors data by a central processor, comparison of activities with a standard pattern and detection of unusual or abnormal event. In many

situations, the cameras are used for security surveillance which may be appropriate but in home monitoring applications the privacy is not protected. The cost of the complete system may be a critical factor for its universal use. In future, the research should be targeted to develop a low-cost system with the sensors essential to monitor the elder people at home. The time to detect any abnormal or unusual incident should be detected as fast as possible and the message to the caregiver should reach as quickly as practicable.

8 PROPOSED WORK

8.1 Zigbee

ZigBee is the product of the ZigBee Alliance, an organization of manufacturer dedicated to developing a new networking technology for small, ISM-band radios that could welcome even the simplest industrial and home end devices into wireless connectivity.The ZigBee specification was finalized in December, 2004, and products supporting the ZigBee standard are just now beginning to enter the market.ZigBee is designed as a low-cost, low-power, low-data rate wireless mesh technology.

The ZigBee specification identifies three kinds of devices that incorporate ZigBee radios,with all three found in a typical ZigBee network .

1. A coordinator, which organizes the network and maintains routing tables
2. Routers, which can talk to the coordinator, to other routers, and to reduced function end devices
3. Reduced function end devices, which can talk to routers and the coordinator, but not to each other in all of its uses, ZigBee offers four inherent characteristics that are highly beneficial.
4. The typical ZigBee radio is extremely **cost-effective**. Chipset prices can be as low as $12 each in quantities as few as 100 pieces (while the 802.15.4 and ZigBee stacks are typically included in this cost, crystals and other discrete components are not). Design-in modules fall in the neighbourhood of $25 in similar quantities. This pricing provides an economic justification for extending wireless networking to even the simplest of devices.
5. ZigBee routers double as input devices and repeaters to create a form of mesh network. If two network points are unable to communicate as intended, transmission is dynamically routed from the blocked node to a router with a clear path to the data's destination. This happens automatically, so that communications continue even when a link fails unexpectedly. The use of low-cost routers can also extend the network's effective reach; when the distance between the base station and a remote node exceeds the devices' range, an intermediate node or nodes can relay transmission, eliminating the need for separate repeaters
6. As an open standard, ZigBee provides customers with the ability to choose among vendors. ZigBee Alliance working groups define interoperability profiles to which ZigBee-certified devices must adhere, and certified radio will interoperate with any other ZigBee-certified radio adhering to the same profile, promoting compatibility and the associated competition that allows the end users to choose the best device for each particular network node, regardless of manufacturer.
7. Basic ZigBee radios operate at 1 mW RF power, and can sleep when not involved in transmission (higher RF power ZigBee radios for applications needing greater range also provide the sleep function). As this makes battery-powered radios more practical than ever, wireless devices are free to be placed without power cable runs in addition to eliminating data cable runs.

8.2 TEMP Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°Cat room temperature and ±3⁄4°C over a full −55 to +150°Ctemperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35 "s low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10°with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while theLM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Features:

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 µA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical
- Low impedance output, 0.1 Ω for 1 mA load

8.3 PIR Sensor

All PIR sensors detect changes in infra-red radiation, in the form of heat emitted by a number of bodies including people, cars and, to a lesser extent, dogs or other small animals. The bigger the body, the more infra-red radiation is emitted and the easier it is for a PIR sensor to detect. The field of view is the area in which changes in infra-red radiation can be detected. The field of view can alter with changes in temperature and the size of the heat source. The construction of the PIR and the Fresnel Lens divide the field of view into a number of zones both vertically and horizontally, as shown in the diagram overleaf (Fig. 9.).

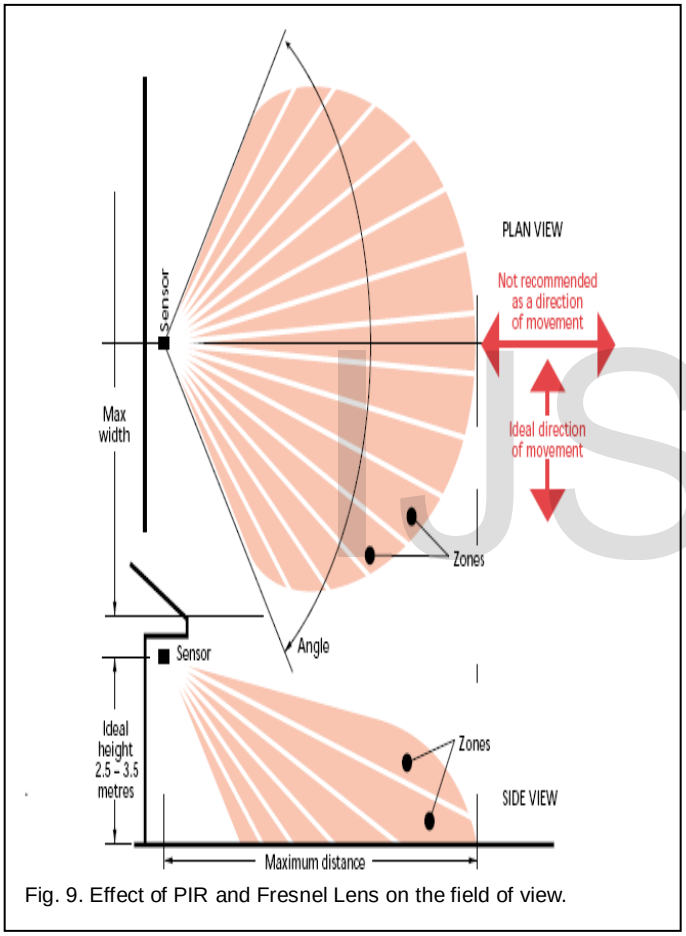

Fig. 9. Effect of PIR and Fresnel Lens on the field of view.

Each zone is constantly monitored by the sensor. When a person or other heat source enters any zone, the level of infra-red radiation in that zone increases. This change is detected and processed by the sensor, switching on the connected lighting and starting the in-built 'Time' process. Providing the heat source (person) continues to move in the field of view, the PIR sensor will keep processing the changes in infra-red radiation and the lighting will stay on. If a person stands still in the field of view or moves out of the detection area, the sensor will not detect any changes in infra-red radiation between the zones and the lights will go out after the 'Time' period is complete. In order for the sensor to most effectively detect changes in heat between zones, it is advisable to walk across the zones not up or along a zone. PIR sensors are passive devices, they do not emit or radiate any energy or beams.

8.4 Gas (IR) Sensor

Infrared (IR) gas detection is a well-developed measurement technology. Infrared gas analyzers have a reputation for being complicated, cumber some, and expensive. However, recent technical advancements, including the availability of powerful amplifiers and associated electronic components, have opened a new frontier for infrared gas analysis. These advancements have resulted from an increase in demand in the commercial sector, and these demands will likely continue to nourish the advancement of this technology. Gases to be detected are often corrosive and reactive. With most sensor types, the sensor itself is directly exposed to the gas, often causing the sensor to drift or die prematurely. The main advantage of IR instruments is that the detector does not directly interact with the gas (or gases) to be detected. The major functional components of the analyzer are protected with optical parts.

In other words, gas molecules interact only with a light beam. Only the sample cell and related components are directly exposed to the gas sample stream. These components can be treated, making them resistant to corrosion, and can be designed such that they are easily removable for maintenance or replacement. Today, many IR instruments are available for a wide variety of applications. Many of them offer simple, Hazardous Gas Monitors rugged, and reliable designs. In general, for toxic and combustible gas monitoring applications, IR instruments are among the most user friendly and require the least amount of maintenance. There are virtually an unlimited number of applications for which IR technology can be used. Gases whose molecules consist of two or more dissimilar atoms absorb infrared radiation in a unique manner and are detectable using infrared techniques. Infrared sensors are highly selective and offer a wide range of sensitivities, from parts per million levels to 100 percent concentrations. This chapter provides general information, with a special emphasis on instruments used for area air quality and safety applications.

Principle of Operation

The infrared detection principle incorporates only a small portion of the very wide electromagnetic spectrum. The portion used is that which we can feel as heat. This is the region close to the visible region of the spectrum to which our eyes are sensitive. Electromagnetic radiation travels at close to 3 x 108 m/sec and has a wave-like profile. Let's review the basic physics of electromagnetic radiation by defining the terminology involved with it.

Wave: Similar to a wave in the ocean, the electromagnetic radiation waves oscillate, one wave followed by another. There are both electromagnetic and mechanical waves,

with mechanical waves having a much longer wavelength. Fig. 10. is a simple mechanical wave showing 10 waves per centimeter.

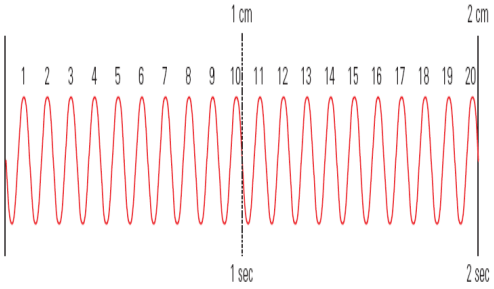

Fig. 10. Mechanical wave showing 10 waves per centimeter.

8.5 Microcontroller

In the microcontroller world some things are a bit tricky to do without some help. This can be some code libraries that help us talk to an LCD display, or communicate via some of the new serial protocols such as one wire. Elektronika.ba has done some work to help everyone out who wants to interface a microcontroller to a GSM phone.

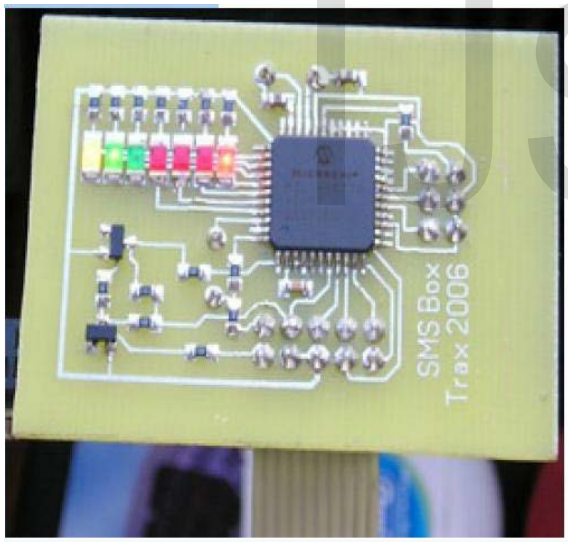

Fig. 11. A typical microcontroller

"This device acts as interface between your microcontroller project and a GSM phone. It handles all modem data communication between the GSM phone and your micro-project. The best thing is that it decodes PDU into TEXT on the fly! It's based on PIC16F877A microcontroller running on 16MHz at 5V. It has an onboard level converter for serial communication with the gsm phone because Pac's UART RX input pin has a Schmitt trigger triggering at 4,5 - 5V while the phone is sending only approx. 3V from it's TX pin. It also has a zener diode at TX pin so it doesn't kill the phone's network connection when talking to it. Firmware is 100% written in MPASM assembler

8.6 Camera

Conventional CCTV video surveillance has converged with PC and networking technology to create dramatic improvement in features and functionality. Digital security solutions can now deliver unprecedented price/performance on a scale that was previously impossible. Wireless technology accelerates this trend by almost totally removing the need for expensive cabling, which can account for over 80% of the cost of a surveillance installation in an outdoor environment. This promise is being delivered today by the expansion of high throughput Wi-Fi wireless networking from its in-building roots to outdoor deployments, now available on a city-wide scale.
Metro-scale Wi-Fi broadband data access, as pioneered and deployed by Tropos Networks using its patented metro-scale mesh technology, is now enabling many applications that were previously impossible. In the public safety sector, for example, applications such as virtual line-ups, fingerprint analysis and access to detailed mug-shots or floor plans are now being brought out of the station house and into the field where they are needed. Video and access control data streams are now routinely transported digitally using standard Internet Protocol (IP). When this happens over a metro-scale Wi-Fi network such as Tropos the result is affordable metro-scale video security. The use of standard IP technology allows customers and integrators to assemble complex video security solutions from readily available COTS (commercial, off-the-shelf), best-of breed components. This paper describes the convergence of video, computer and networking technologies, identifies the component pieces, and discusses how they can be assembled to deliver complete city-wide video security applications at a price/performance level and speed-of-deployment never before attainable.

9 Conclusion

This paper presents one solution for establishing a low power consumption remote home security alarm system. The system, based on WSN and GSM technology, can detect the theft, leaking of raw gas and fire, and send alarm message remotely. The hardware of this system includes the single chipC5081F310, wireless receiving and sending chip CC1100 as well as the SIMENS TC35 GSM module. The system software developed in C51 language has the ability of collecting, wireless receiving and transmitting data, and can send a piece of alarm short message to the user's mobile phone when some dangerous condition has been detected. With the advantages of reliability, easy usage, complement wireless, and low power consumption, the system also has practical value in other fields.
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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