IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 3, Issue 7, July 2016

Monitoring of Home Security using GSM and Zig-Bee Network

Ms. Mali Swati Nimba[1], Prof. G.A. Kulkarni[2]
ME Second Year Student, E&TC, SSGBCOEIT, Bhusawal, India [1]
HOD, E&TC, SSGBCOEIT, Bhusawal, India [2]

Abstract: Home security and control is one of the basic needs of mankind from early days. But today it has to be updated with the rapidly changing technology to ensure vast coverage, remote control, reliability, and real time operation. Deploying wireless technologies for security and control in home automation systems offers attractive benefits along with user friendly interface. In this paper, implementation of a novel security and control system for home automation is presented. The proposed system consists of a control console interfaced with different sensors using ZigBee. Suspected activities are conveyed to remote user through SMS (Short Message Service) or Call using GSM (Global System for Mobile communication) technology. Upon reply, the remote user can control his premises again through GSM-ZigBee combination. Besides, traditional burglar alarm enhances security in case of no acknowledgment from remote user. This system offers a low cost, low power consumption and user friendly way of a reliable portable monitoring and control of the secured environment. Using the concept of serial communication and mobile phone AT-commands (Attention Telephone/Terminal commands), the software is programmed using C-language. The design has been implemented in the hardware using ZigBee EM357 module, Atmega128 MCU (microcontroller unit) and Sony Ericsson T290i mobile phone set.

Keywords: ARM 7 LPC 2138, Zig-Bee Module, GSM Modem, Sensors, Relay.

I. INTRODUCTION

Security is considered a major issue when it comes to home automation. Traditional techniques of alarm based security have gained much popularity in past decades. During recent past, a number of systems were introduced for security measurements based on wired networks. In literature, researchers suggested a number of security systems based on new technologies like GSM (Global System for Mobile communication), GPRS (general packet radio service), internet, USN (ubiquitous sensors network) and implemented through FPGA (field programmable gate arrays), ASICs (Application specific integrated circuit), DSP (digital signal processor), and MCU (microcontroller unit). [I] describes the architecture and simulation of a GSM based remote sensing and control system using FPGA [2] explains home automation system using GSM, Internet and speech recognition. In this system the home gateway is internet which require personal computer (PC). However, it's hard to manage PC and keep it ON all the time. Also it consumes more power. The system presented in [3] is an internet-based intelligent system for home power management aiming to reduce energy consumption. This system also uses internet cloud as a home gateway having the same limitations as described earlier. [4] describes a java equipped mobile based home automation system. Although the research proposes an embedded home server but still it requires internet connectivity for GPRS. Moreover, in all these systems wired sensors are connected with processors those are not only hard to install and difficult to move once installed but also increase cost and labor. In [5] authors proposed a zigbee based home network configuration. This system controls all home appliances through zigbee-infrared combination and zigbee power adapter. Hyung-Bong Lee et al. in [6] proposed a wireless network protocol providing a bidirectional communication channel between a gateway and control device, highlighting the significance of wireless sensors network in controlling home appliances. The system presented in this paper is a combination of ZigBee and GSM. Zigbee offers wireless connectivity of the sensors with control panel while GSM provides wide coverage as GSM association estimates 90% of the global mobile market using GSM standard. The proposed system provides reliable security, effortless installation and portability. Sensors and actuators use wireless ZigBee communication for sending information to the control panel which makes the system easy to install. Control panel, acting as a home gateway, controls the operation of the system. In this work neither computer nor internet connection is required, once programmed, thus ensuring easy installation and portability.

- **Objective**

The Objective is to develop a smart home system monitored by Personal computer, to design a smart home system based on Zigbee wireless technology, GSM and ARM 7 and to develop a system that can saves human energy and makes human life easier. The Goal is to continuous monitor the devices, to change the status of devices conveniently and remotely access the home appliances.

DOI 10.17148/IARJSET.2016.3725

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 3, Issue 7, July 2016

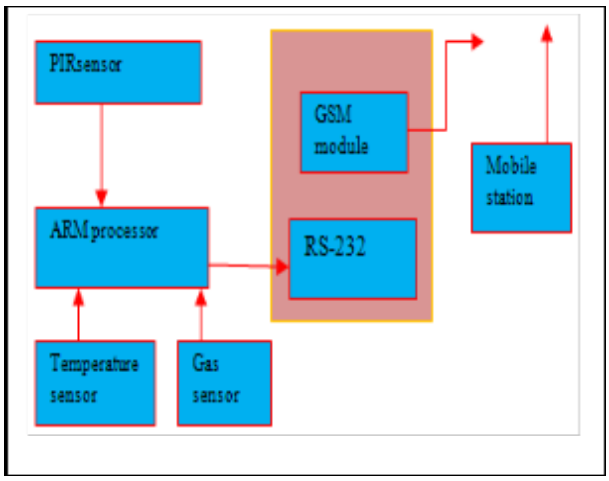

Fig. 1.1 System structural design

• **ARM7TDMI Core**

ARM-Advanced RISC Machine is a 32-bit RISC (Reduced Instruction Set Computer) processor architecture developed by ARM Holdings. ARM is architecture which is used in may processors and microcontrollers. The ARM architecture licensed to companies that want to manufacture ARM-based CPUs or System-on-Chip products.

• **GSM modem (Global System for Mobile Communication)**

GSM is the most popular standard for mobile telephony systems in the world. The GSM Association, its promoting industry trade organization of mobile phone carriers and manufacturers, estimates that 80% of the global mobile market uses the standard. GSM is used by over 1.5 billion people across more than 212 countries and territories.

• **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.

• **Sensors**

A sensor is a device, which responds to change in physical parameters. It's actually a converter that measures physical quantity and converts it in to an electrical signal which can be understood by an electronic instrument. In this study we are using RTD, PIR and MQ7.

Pyroelectric Passive Infrared (PIR) Sensor

A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector".

Resistance Temperature Detectors

Here, PT100-TF101N platinum based resistance temperature detectors are used. Its precision is up to 0.1 degrees. They give stable output for long period of time; calibration is easy and accurate readings. They are immune to the electrical noise and is well suited to work in different environment conditions. They can measure from -50 to 550°C which is very much needed for detecting fire.

Gas Sensor (MQ-Series)

Its sensitive material is SnO_2, which has lower conductivity in air and has an Electro-circuit that changes conductivity to matching gas concentration. When the gas concentration starts rising the sensor conductivity also rises.

MQ-7 sensor is highly sensitive to Carbon Monoxide. This sensor can detect gases which are CO derivatives. MQ-5 gas sensor detects LPG leakages. Its low cost makes it suitable for different applications.

• **Mobile Phone**

A mobile phone is a device for making and receiving telephone calls over a wireless network at the same time can move through a wide geographical area. Today, Mobile phones are being used by almost all the people which makes them a suitable device capable of sending commands to the distant operator. This system uses mobile phone for sending SMS through SIM 300 GPRS modem.

• **Zig – Bee Module**

The IEEE 802.15.4 standard defines the characteristics of the physical and Medium Access Control (MAC) layers for Wireless Personal Area Network (WPAN). Taking this standard as a "chassis" the ZigBee Alliance has defined the upper layers in the ZigBee standard. Devices are the main components of the WPAN.

• **Need of the system**

As technology becomes more advanced and modernized more features are added to the existing system for the purpose of satisfying the increasing security needs of the people. Deploying wireless technologies for security and control in home offers attractive benefits along with user friendly interface. Author present a smart security system comprises of Zigbee, GSM, ARM Processor, different Sensors and Smartphone for Security monitoring and control, when the user is at remote premises. Three sensors namely P IR Sensor, Temperature sensor and Gas Sensors are used.

II. SYSTEM DESIGN

General block diagram of the proposed system is shown in Fig3.1. It explains the whole story about the devices installed and their communication protocol in the system. The project can be served into two parts: the hardware part and the software part. While the former is all about incorporating MCU with sensors, ZigBee architecture, and mobile phone to build a working circuit that supports

DOI 10.17148/IARJSET.2016.3725

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 3, Issue 7, July 2016

portability without compromising reliability, the latter is to make an ingenious C-code for programming the MCU and ZigBee module to monitor and control secured environment.

Block Diagram

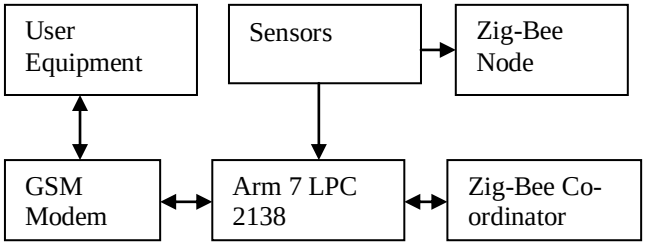

Fig. 1.2 Block Diagram of system

The overall block diagram of the entire system is shown in the Fig.1.2. The major components and their connections are shown. The block diagram comprises of LPC2138 which is an ARM based microcontroller and the tracking components are Gas sensors to detect LPG and smoke, Resistance Temperature Detectors (RTD) to measure temperature and based on the output of RTD and gas sensor, the fire alarm will be activated and SMS is send with an accident message to the owner through GSM (Li and Cai, 2010), sensor module will detect unauthenticated entry with password security system at door.

The set up consists of one LPC2138 boards, two ZigBee module, one GSM module and one stepper motor. Proposed system comprises of three modules. The first module comprises of temperature and gas sensor (MQ-7) in which LPC2138 continuously monitors the temperature from RTD and also the output of smoke sensor though ADC. If the temperature value is above 50°C and concentration of CO is more than 200 ppm, then MCU will activate the alarm as well as relay which in turn will activate the sprinkler.

The challenges of zigbee based home automation systems

Although the ZigBee technology is considered as the most popular technology for WHAS, it has some challenges too. Some of the challenges are as follows:

Resource Constraint: The sensors (or nodes) used in WHAS have limited resources (i.e.,limited processing power, low memory, and limited battery).

Limited Range: The ZigBee has limited transmission range and multi hop communication is required to increase the range of a ZigBee network.

Technological Limitation: The ZigBee technology depends on the physical layer and medium access control layer of IEEE 802.15.4 standard.

Interferences: The WHAS has to co-exist with other systems operating in the same free band called Industrial Scientific and Medical (ISM) bands. Hence the communication of WHAS can be interfered by other systems (i.e., Bluetooth, WiFi, cordless phone, and microwave oven) operating in the same frequency band.

Internet Connectivity: For remote monitoring the WHAS may need to have internet connectivity.

Table 1.1 Interfacing standards

Sr. No	DEVICES	INTERFACE
1	Sensors ↔ MCU	EM357 UART
2	MCU ↔ ZED	Max 232
3	ZED ↔ ZC	Zigbee RF Communication
4	ZC ↔ MCU	Max 232
5	MCU ↔ Mobile phone	RS232
6	Mobile Phone ↔ User mobile phone	GSM Communication

Table 1.1 shows Interfacing standards and Table 1.2 shows AT -commands that are used in the proposed system.

Table 1.2 AT Commands

SR. NO.	COMMANDS	DESCRIPTION
1	ATD	Call dialing
2	AT + CMGS	SMS to specific number
3	AT + CMGD	Delete unauthorized SMS
4	AT + CMGR	Read authorized SMS
5	AT + CMEE	To report mobile equipment error

• **Operation**

This allows the user to interact with the WSN node application to monitor individual node's health status, control and scale the deployed network at run-time. LPC2138, the ARM7TDMI-S based NXP's MCU is being proposed as the CPU in the design. This MCU has 32KB of on-chip static-RAM and 512 KB of on-chip Flash program memory, which is best suitable as a fusion center or the Coordinator or a Sink node in WSN scenario. The two 8-channel 10-bit A/D converters provide a total of up to 16 analog inputs, with conversion times as low as 2.44µs per channel. The low-power Real Time Clock (RTC) with independent power and dedicated 32 kHz clock input, two 32-bit timers/external event counters with four capture and four compare channels, PWM unit, watchdog, multiple serial interfaces including two UART, two I2C offering throughput of 400 Kbps. Moreover it also supports SPI and SSP with buffering and variable data length capabilities. The on-chip integrated oscillator operates with external crystal from 1 MHz to 25 MHz. The power saving modes include idle and power-down, processor wake-up from power down mode via external interrupt or RTC makes the design more power efficient. Because of forward and backward code compatibility of ARM, the design strategy is directly applicable to other

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 3, Issue 7, July 2016

advanced ARM core based motes equipped with MEMS MCUs using other ARM engines or Cortex M0+ or M3 or M4 cores. This approach will reduce the cost with less silicon offering a good hardware for WSN individual node design.

The proposed system illustrates the preliminary wrapper design for creating the user interface to ARM based Microcontroller Unit (MCU). The circuit arrangement is as shown in fig. The working setup images are also shown in this report whenever required.

Three sensors namely PIR Sensor, Gas Sensor and Temperature Sensors are used. PIR sensor is sensitive to the infrared radiation emitted by human being and hence used for human detection. Gas sensor is used for monitoring of leakage of Gas and Temperature sensor is used to monitoring of temperature.

When the intrusion is detected by these sensors, it then sends the signal immediately to the ARM microcontroller. The micro controller converts the analog signals in to digital signals for transmitting it to the zigbee. The zigbee is interfaced with the microcontroller using the max 232 converter which provides serial communication. The Zigbee end device then transmits the signal to the zigbee coordinator. The ZC is interfaced with the microcontroller by means of max 232 converter. A GSM/GPRS module consists of a GSM modem with standard communication interface max 232 converter, so that it can be easily interfaced with a microcontroller. The power supply circuit is also built in the module that can be activated by using a suitable adaptor. AT commands are sent by the microcontroller to the GSM module for communication with the GSM cellular network. Once intrusion is detected, a text message is sent to the owner indicating security breach. On receiving the text message, the user can use the Skype account in the mobile phone for making a video call. The Smartphone with net connectivity, present in the home feeds the owner with a live video. On viewing the video the user can know whether the intruder is a known person or not. Then the user can communicate with the system through reply SMS. If there is a reply SMS from the user, the GSM module communicates with MCU in the same manner, but in reverse direction. The mobile phone number is first scanned, if it is authorized, then further communication is made. Then accordingly the owner can control the faint gas valve and lock the door. The faint gas valve is activated by SMS sent by the owner, the DC motor starts working. The shaft of the DC motor exerts a force on the gas sprayer and as a result the gas starts spraying throughout the room. Then finally the user can lock the door by sending the corresponding command to the GSM module. Thus the system is not only used for monitoring but also for controlling purpose ensuring the reliability and safety of home.

- **Software**

Required software are as follows.

1) Keil 4.0
2) Flash Magic
3) Proteus Professional

- **Hardware**

Required Hardware are as follows.

1) ARM 7 LPC 2138
2) Zig-Bee Module
3) GSM Modem
4) Sensors

- **Results**

At the client side user can monitor the status of the home appliances via computer or through cell phone by getting instant messages. The security personnel would continuously monitor home appliances as soon as the value of any home appliances crosses the threshold value necessary actions can be taken in order to prevent any damage.

Output of Temperature sensor

The output of LM35 sensor is analog in nature which is proportional to variations in environmental temperature. This baseband signal has to be converted in to digital signal so that we can process using ARM microcontroller

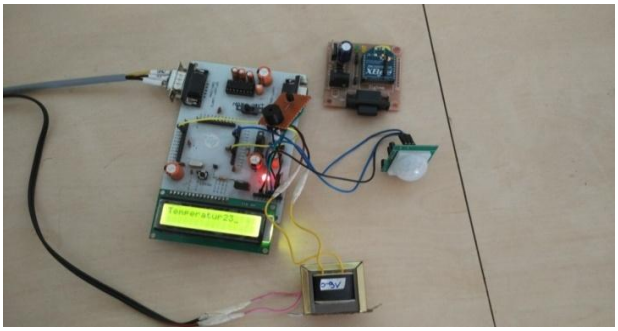

Fig. 1.3 Output of Temperature sensor

Output of Gas sensor

There is no specific value for the load resistor. Its value could be from 2kΩ to 47kΩ. Lower the value, the less sensitive. Higher the value less accurate for higher concentrations of gas. This output voltage can directly be given to any ADC or any comparator circuit and accordingly the gas value can be calculated. These sensors can be easily directly connected to micro controllers with internal ADC

Output of PIR sensor

The output of the PIR sensor module is monitored through pin of ARM 7. When the motion is sensed, this output is high at about 3.3 V (my sensor module has a 3.3V regulator IC on board). You could still use this voltage as a valid logic high for ARM 7 LPC 2138, but I preferred to use this voltage to drive the base of an NPN transistor (BC547) so that at the collector we will have the full swing of the logic voltages. Now, the microcontroller monitors the voltage at the collector of the transistor. During the normal condition, the transistor is cut off, and the collector output is at logic high (+5 V). When the motion is sensed, the high output from the sensor module saturates the transistor and the voltage at the collector drops down to logic low. The jumper selection for trigger

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 3, Issue 7, July 2016

is at H position, so the sensor output will remain active as long as the motion exists.

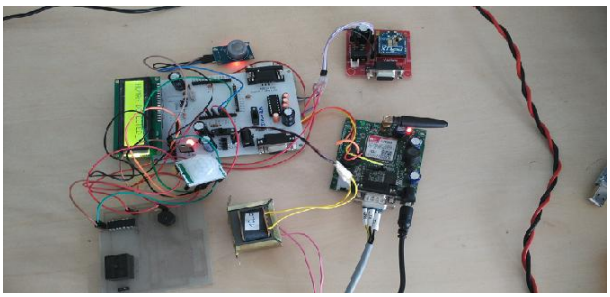

Fig. 1.4 Output of PIR sensor

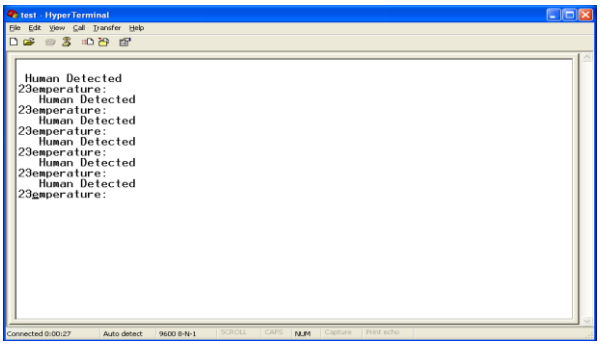

Fig. 1.4 Output on Hyper Terminal

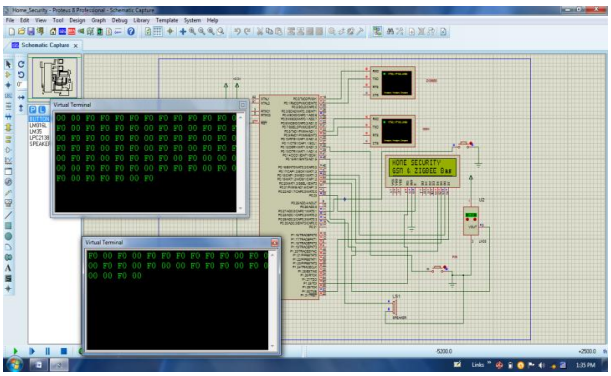

Fig. 1.5 Simulation of the system

III. CONCLUSION

A smart security system is proposed and implemented, using the wireless communication technology Zig Bee, wide covered GSM and app installed Smartphone. MCU is programmed for the system and is the heart of our project. The use of Zig Bee communication technology helps lower the expense of the system and the intrusiveness of the respective system installation. The GSM communication provides worldwide coverage, easy and a low cost way of information interchange. The MCU provides interoperability of Zig Bee and GSM and also makes this system portable and easy to install as the system is embedded. The system is designed to provide a secure environment by letting the user know about the security breach and who is involved in it. Not only that it also allows the user to control gas valve and door lock. Thus it enables the remote user to monitor and control his premises from any part of the world.

- **Applications**

1) Industrial Automation
2) Remote parameter monitoring
3) Chemical Plant
4) Home Automation

ACKNOWLEDGMENT

The successful completion on any task would not be complete without expression of the gratitude of all those who helped in doing that task. I hereby express my heartfelt gratitude towards the people whose help provided useful in completing my project on "MONITORING OF HOME SECURITY USING GSM AND ZIG-BEE NETWORK". I am directly indebted towards our honorable Principal **Dr. R. P. Singh** of Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal for his useful suggestion, guidance and untiring help at every phase of this project. I would like to thank our honorable H.O.D for providing necessary facilities to carry out this project work and also my guide **Prof. G.A.Kulkarni** to give his valuable and sufficient time toward project and gave me proper guidance in the direction of completing this work.

REFERENCES

[1] Ahmad, Arbab Waheed, et al. "Implementation of ZigBee-GSM based home security monitoring and remote control system." 2011IEEE 54th International Midwest Symposium on Circuits and Systems (MWSCAS). IEEE, 2011.
[2] Tikate, Mr Mayur D., Mr Rahul P. Yenare, Mr Darshan P. Thakkar, and Miss Shraddha R. Warale. "Biomedical Data Transmission System With Central Monitoring."
[3] Al-Ali, Abdul-Rahman, and Mohammad Al-Rousan. "Java-based home automation system." IEEE Transactions on Consumer Electronics 50.2 (2004): 498-504.
[4] Alkar, Ali Ziya, and Umit Buhur. "An Internet based wireless home automation system for multifunctional devices." IEEE Transactions on Consumer Electronics 51.4 (2005): 1169-1174.
[5] Al-Khateeb, Khalid AS, Wajdi F. Al-Khateeb, and Shihab A. Hameed. "Implementation of Internet based remote control and monitoring." 2009 4th IEEE Conference on Industrial Electronics and Applications. IEEE, 2009.
[6] Liu, Peng, Guojun Dai, and Tingting Fu. "A Web services based Email Extension for Remote Monitoring of Embedded Systems." Software Engineering, Artificial Intelligence, Networking, and Parallel/Distributed Computing, 2007. SNPD 2007. Eighth ACIS International Conference on. Vol. 2. IEEE, 2007.
[7] Tan, Kok-Kiong, and Chai-Yee Soh. "Internet home control system using Bluetooth over WAP." Engineering Science and Education Journal 11.4 (2002): 126-132.
[8] Nikolova, Mariana, Frans Meijs, and Peter Voorwinden. "Remote mobile control of home appliances." IEEE Transactions on Consumer Electronics49.1 (2003): 123-127.
[9] Lai, Yen-Shin, et al. "Internet-based monitoring and control of fuzzy-controlled inverter system." IECON 02 [Industrial Electronics Society, IEEE 2002 28th Annual Conference of the]. Vol. 3. IEEE, 2002.
[10] Zhang, Ximin, Junding Sun, and Lihua Zhou. "Development of an Internet home automation system using Java and dynamic DNS service." Sixth International Conference on Parallel and Distributed Computing Applications and Technologies (PDCAT'05). IEEE, 2005.
[11] Colak, Ilhami, et al. "Remote controlling and monitoring of HVAC system over Internet." Journal of Scientific and Industrial Research 67.9 (2008): 680.