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Review of Implementation of ZIG BEE - GSM Based Home Security Monitoring and Remote Control System

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Abstract - 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. In this paper we present a smart security system comprises of Zigbee, GSM, Sensors and Smartphone for Security monitoring and control, when the user is at remote premises. 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.

General Terms

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 **- ZC (Zig-Bee coordinator), GSM (Global System for Mobile Communication), Home Security and Automation.**

1. 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.

2. Literature Review

Subhas C. Mukhopadhyay et al. [3] presents review of several wireless sensors, which are used for home monitoring particularly to look after aged people. The monitoring system is established on the combination of several sensors, and it has the ability of broadcasting data via wireless communication. The central processor collects data and stores all data for current requirement and for future purpose. The system stores the habit of life style of a person. The system compares collected data with stored pattern, which depends on situations and actions are already defined like abnormal or unusual. In case of any abnormal activity, the system detects it and generates an alarming or warning or SMS and it is transmitted to the caregiver. This wireless sensing system is available for this type of application with low cost and has great potential to save human lives of old age people.

Wei-Chung Teng et al. [4] proposed the design and implementation of a residential gateway: My Server, which gives home security services. The system driven by peripherals connected through WSNs. My Server structural designed to operate on Message Oriented Middleware (MOM) with six clearly defined core service modules. Sukun Kim et al. [5] present an active research in a WSN for Structural Health Monitoring (SHM).Requirements are identified to acquire data for sufficient quality to have a real scientific value to the researchers for structural health monitoring. The collected data matches with theoretical models and as well as with previous studies of the bridge. The deployment is the biggest WSN for SHM.

Alan Mainwaring et al. [6], provides a depth study regarding using of WSNs to real environment habitat monitoring. The developed system covers the hardware design of nodes and sensor network for remote access and its management. Architecture of system is suggested to deal with the requirements of habitat monitoring. The example of system architecture for monitoring of sea-bird nesting environment and activities is presented. As per presently instalment, the network has 32 notes on a small island off the coast of Maine useful live data on web. The application driven design serves to identify important areas of additional work in communications, network re tasking, data sampling, and health monitoring.

Huiping Huang et al. [7], presents a remote home security alarm system with a solution for set-up Low power consumption. The system detects s the theft, fir, and leakage of raw-gas by using the WSN and GSM technology. In case of any abnormality, the system sends alarm message remotely. The single chip C5081F310 is hardware of the system, which communicates via wireless using chip CC1100withSIMENS TC35 GSM module. The software of the system developed using C51 language, which has capability of gathering, receiving and sending data via wireless. In case of detection of some dangerous condition, it sends alarming SMS to users of 35 cellular phone. With easy-usage advantages, low-power consumption, reliability, and complement wireless, this systemcan be used for practical value in other fields too.

Jianjun Chen et al. [8], by using othe-shelf WLAN components, those are commercially available, described implementation of indoor surveillance system. This security system constantly scanned the environment. It had the ability to deliver real-time alarm signals on the basis of detected changes in the received signal strength values. The experimental results showed promising intrusion detection capabilities but the exact performance limitation and strength of this surveillance system is yet to be investigated.

Yous souf Zat out et al. [9] present solution of saving the energy of wireless sensor in a mixed environment for Home Monitoring. It suggests a design and an implementation of three –tier sensor network solution, which uses energy efficiently for home applications. The network consists of heterogeneous sensors e.g. environmental, medical, and video/audio sensors. The base solution is to organize the sensors into different groups as per their particular functions and roles. According to intelligent behaviour of the sensor, the activity duration and communication are reduced at the same time.

Dong-Sun Kim et al. [10] describes a time synchronized forwarding protocol (TSFP), which is used for remote control home devices. For transferring data to another node, WSN has an extremely large latency, so, it uses TSFP. TSFP provides scalability by a self – organization function based on a virtual sensor line and mainly it utilizes distributed time division multiple access (TDMA).On the large scale WSNs, it reduces transmission latency and energy consumption.

A. Gad dam et al. [11] presents smart digital home monitoring system by using a bed sensor integrated with a wireless device. The Based system that uses wireless sensors to monitor electrical appliances, for example is it closed or open. To make the system exible by adding sensors of different types Using selective activity monitoring (SAM) system.

Yanjun Li. [12] described a blueprint of a novel reactive WSN for monitoring wild-fire and evaluated robustness, reactivity, longevity, and reliability of the network. The contribution of the paper is to design a sensor network that can meet the goal of reliability, reactivity, and that proves acceptable robustness and relatively longer life time network life.

Yu-Tso Chen et al. [13] proposed a Closer Tracking Algorithm (CTA) to pinpoint user of mobile inside the home by inquiring regarding RSSI solutions for indoor localization. The investigation results depict that projected Closer Tracking Algorithm has the ability to reveal the accurate position with error 6 distances less than 1 meter. If the distance is less than one member, the suggested Closer Tracking Algorithm has minimum 85% precision at the same time. The proposed Closer Tracking Algorithm was implemented by using ZigBee CC2431 modules.

3. Proposed System

Fig. a Shows block diagram of proposed system. It consists of two main parts hardware part and software part. Hardware part consists of MCU with sensors, ZigBee architecture and mobile phones to build a working circuit. The software part makes use of C programming to implement the system.

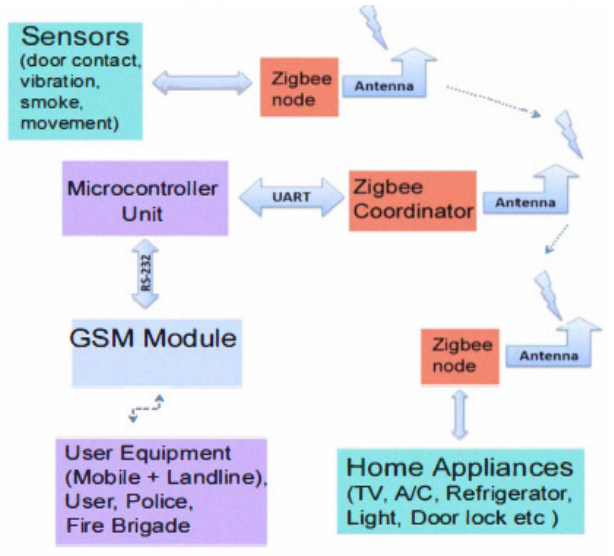


Fig. Block diagram

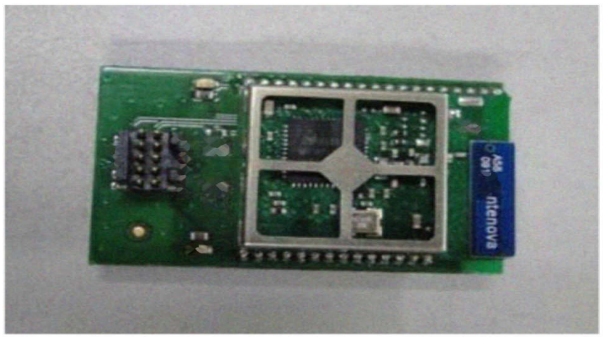
HARDWARE:

Hardware of the system is comprised of ZigBee EM357module, Atmega128 MCV, smart mobile phone and corresponding interfaces. ZigBee, a communication protocol, is designed to utilize the features supported by IEEE 802.15.4 radio communication standard and is implemented on the top of it. It operates in two separate frequency ranges: 868/915 MHz and 2.4 GHz and uses digital radios to allow devices to communicate. In particular the scope of ZigBee is applications with low requirements for data transmission rates and devices with constrained energy sources. The ZigBee network is a PAN(personal area network) network, comprises of one ZC(ZigBee coordinator) and one or more ZEDs (ZigBee end device) and optionally one or more ZRs (ZigBee routers). Fabio L. Zu catto et al. in [7] compares ZigBee with Bluetooth and narrates the significance of ZigBee in building control wireless sensor networks. ZigBee is a very reliable communication protocol using mesh networking topology for the reliable transmission of data between sender and receiver. The EM357 module can be installed with any sensor and home appliances as it is very small in size i.e. 21mm x 37mm, and a low power consuming device.

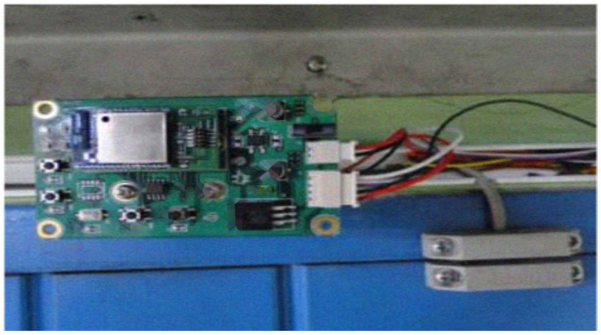
It is a low power consuming device as shown in Fig 2a. In the design sensors that are installed, to detect security breach are magnetic contact sensor for sensing door opening, vibration sensor for detecting window breaking, and PIR (Passive infra-red) sensor for detecting human presence. Each sensor and actuator is connected with ZigBee sensor node as shown in Fig 2b, 2c and 2d where EM357 ZED is connected with door contact sensor, PIR sensor, and door lock system respectively. ZigBee node

continuously checks input from corresponding sensor and sends a wireless message to the Zc and in case of the actuator, Zig Bee node checks input wirelessly from the ZC and order actuator to perform accordingly.

Fig. 2e shows control console which consists of Atmega128 MCU and ZC EM357 module that are mounted on same PCB in our design.

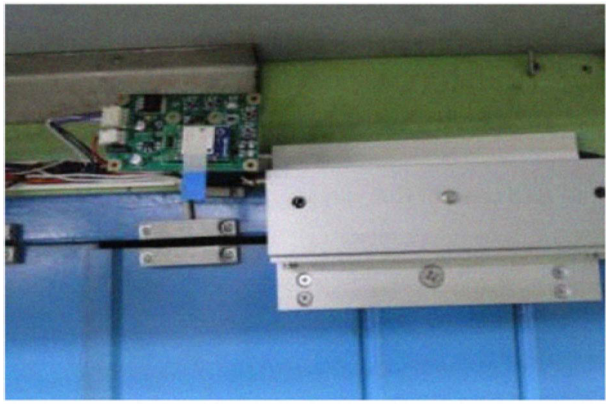


2a- EM357 module.



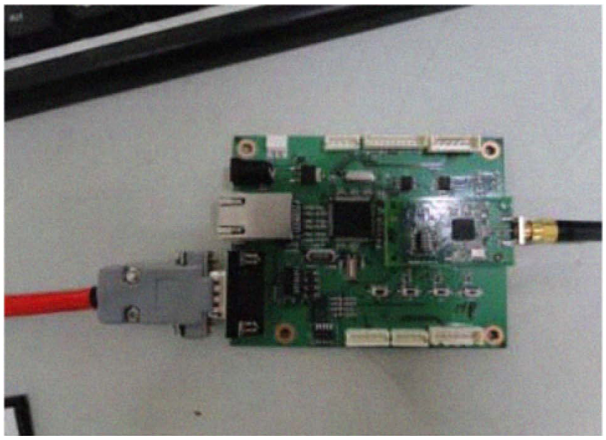
2b- ZED installation with door contact sensor

2c- ZED installation with PIR sensor



d.

2d- ZED installation with door lock system



2e- ZC and MCV

2f- Sony Ericsson T290i GSM phone

Fig 3. Finally, the mobile phone T290i is wirelessly connected with the user mobile phone through GSM network. Controlling part of the proposed system consists of home appliances control and door lock control. Controlling relay is used to control high voltage home appliances through socket and to make it wireless from the

control panel ZigBee sensor node is installed with the relay, controlling socket operation.

Specifically in our project ZigBee sensor nodes are installed with a light bulb and door lock system to control it, as shown in Fig 2d.

Figure 3: Serial Communication and Level Conversion between T290i and MCV

SOFTWARE:

The ZigBee module EM357 is supported by insight desktop a comprehensive integrated development environment (IDE) and C-Language compiler tool-chain. Ember insight desktop is designed for writing, compiling, loading and debugging software on to multiple nodes in a networked environment. Now to connect this chip with the sensors and MCU, its built-in UART is deployed. The sensor node EM357 uses a built-in 32-bit ARM Cortex-M3 microprocessor to control all the interfaces and uses RF antenna at the end for communication purpose as shown in the Fig 2a. The microprocessor is programmed via an ISP header on board to program flash memory of the chip. On the other hand Atmega128 is a general purpose MCU with a rich set of built-in peripherals. The MCU also features a built-in Flash and EEPROM memories. The flash is used to store code that is also programmed via the ISP header on the board. For the proposed system, the MCU on one hand deals with the ZC to receive intrusion detection from the sensors installed while on the other hand it deals with the GSM module to send Short Message Service (SMS) or to call the owner. Now that it is all set for the communication between mobile phone and the MCU, in order to control the mobile phone through its ports, we used AT Commands, provided by the vendor companies. AT commands are used to access and control the built in modem of the mobile phone.

APPLICATIONS

- Industrial Automation
- Remote parameter monitoring
- Chemical Plant

Future Scope

- To keep the record of the system it needs the database. Future scope is database creation.

References

[1] Wael M EI-Medany, Mahmoud R EI-Sabry. "GSM-Based Remote Sensing and Control System using FPGA" Proceedings of the International Conference on Computer and Communication Engineering 2008(ICCCE08) .

[2] Baris Yuksekkaya, A. Alper Kayalar, M. Bilgehan Tosun, M. Kaan Ozcan, and Ali Ziya Alkar. "A GSM, Internet and Speech Controlled Wireless Interactive Home Automation System" IEEE Transactions on Consumer Electronics, Vol.52 No. 3, pp: 837-843,2006.

[3] Manouchehr Ghahramanian Golzar, HamidReza Tajozzakerin. "A New Intelligent Remote Control System for Home Automation and Reduce Energy Consumption" Fourth Asia International Conference on Mathematical/Analytical Modelling and Computer Simulation. pp 174- 180,2010.

[4] M. Van Der Werff, X. Gui, and W.L. Xu. "A Mobile-Based Home Automation System" 2nd International conference on mobile technology, Applications and systems. pp 1-5,2005.

[5] II-Kyu Hwang, Member, IEEE and Dae-Sung Lee, Jin-Wook Baek. "Home Network Configuring Scheme for All Electric Appliances Using ZigBee-based Integrated Remote Controller" IEEE Transactions on Consumer Electronics, Vol. 55, No. 3,pp 1300-1307, August 2009.

[6] Hyung-bong Lee, Lae-Jeong Park, Sung-wook Par, Tae-yun Chung, Jung-ho Moon. "Interactive remote control of legacy home appliances thropugh a virtually wired sensor network" IEEE Transactions on Consumer Electronics, Vol.56 No. 4, pp: 2241-2248,2010.

[7] Fabio L. Zucatto, Clecio A. Biscassi, Ferdinando Monsignore, Francis Fidelix, samuel coutinho, Monica L. Rocha "ZigBee for Building Control Wireless Sensor Networks" IMOC 2007. SBMOIIEEE MTI-S international Microwave and Optoelectronics Conference, pp 511- 515,2007.

[8] Kwang Koog Lee, Seong Hoon Kim, Yong Soon Choi and Hong Seong Park. "A Mesh Routing Protocol using Cluster Label in the ZigBee Network"IEEE International Conference on Mobile Adhoc and sensor Systems, pp 801-806, 2006.

[9] Atmel 8-bit AVR Microcontroller Atmegal28 from http://www.atmel.comldynlresources/prod_documents/doc2467.pdf