

A Review on ZigBee based Home Automation Control of Electrical Appliances and Detection of Gas in Smart Homes

Kundan Vishwanath Dhobre¹, Dr. S P Mohani²

¹M.Tech (E & Tc), Government College of Engineering, Jalgaon, Maharashtra, India

²Associate Professor, Dept. of E&TC, Government College of Engineering, Jalgaon, Maharashtra, India

Abstract:- The development of remote control technology has grown rapidly along with the development of communication technology now a days. In recent years, the home environment has seen a rapid introduction of network enabled digital technology. This technology offers new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation. Moreover, with the rapid expansion of the Internet, there is the added potential for the remote control and monitoring of such network enabled devices. In this system, the LPG leakage is detected through the sensor and information is sent to the user by Short Message Service (SMS) and simultaneously the customer is given an alert using a GSM module. The effective application of Wireless Personal Area Network (WPAN) with the use of Zigbee results in low-cost communication.

Key Words: Zigbee, Home Automation, Wireless Sensor Network (WSN), GSM.

1. INTRODUCTION

Wireless sensor network inside a house that provides user with special needs essential and basic control within a home environment. The proposed work enables the user to perform his/her daily activities by remotely monitoring and controlling home appliances without depending on others. The input and output are automatically adjusted depending on the user's special needs and environment. The smart home area network (HAN) technology offers users a wide range of services. Users that integrate HANs into their homes can monitor and/or control their appliances remotely and within the house using smart phones or control panels. However, most of the monitoring and control system in the HAN technology are not feasible to people with disabilities such as visually impaired, deaf, and handicapped. A blind person cannot see whether the window is open/close, similarly a deaf person cannot hear the fire alarm [1].

A handicapped person (with hand disability) one the other hand cannot use his/her phone to check if the refrigerator door is open or closed. Hence, most of the existing HAN technologies are aimed at healthy people. Other specialized devices are developed; however, the devices operate only based on one specific disability. This work proposes a framework that enables the integration,

monitoring, and control of events within a HAN. This work also use device that integrates with HAN that is targeted for people with special needs such as deaf and blind people.

1.1 Zigbee

Zigbee is an IEEE 802.15.4 based specification for a suit of high level communication protocol used to create personal area network. It is wireless connection between electronic devices and sensors within area.



Fig -1: Zigbee module s1

Specification of Zigbee

Standard	:	IEEE 802.15.4
Frequency	:	2.4 GHz (home automation), 784 MHz, 868 MHz and 915 MHz (country specific)
Range	:	10 to 100 meters (line of sight)
Data Rate	:	20 kbps to 250 kbps
Network type	:	Mesh networking and device to device communication

1.2 MQ6 Gas sensors

A gas sensor, MQ6 is used to detect dangerous gas leaks. This unit is incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG leakage. The sensor has good sensitivity combined with a quick response time at low cost. If leakage is detected, message to the authorized person or family member using cellular network called GSM is sent automatically. [1]



Fig 2: MQ6 Gas sensor

Specification of MQ6

- Highly sensitive to LPG, iso-butane, propane
- 5V AC/DC Supply
- Load Resistance 20KΩ
- 200-1000 ppm of detecting concentration of LPG
- Fast response

1.3 PIR SENSOR

The PIR (Passive Infra-Red) Sensor is nothing but pyroelectric device that detects motion by sensing changes in the infrared (radiant heat) levels emitted by surrounding objects. This motion can be detected by checking for a sudden change in the surrounding IR pattern.



Fig 3: PIR Sensor

It detects a human being moving around within approximately 10m from the sensor. It detects the levels of infrared radiation. PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V. The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected. [3]

1.4 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. [4].



Fig 4: Arduino Uno

Specification of Arduino UNO

Microcontroller	:	ATmega328
Operating Voltage	:	5V
Input Voltage (recommended)	:	7-12V
Input Voltage (limits)	:	6-20V
Digital I/O Pins	:	14
Analog Input Pins	:	6
DC Current per I/O Pin	:	40 mA
DC Current for 3.3V Pin	:	50 mA
Flash memory	:	boot loader
SRAM	:	2 KB
EEPROM	:	1 KB
Clock Speed	:	16 MHz

2. LITERATURE REVIEW

The work in proposes a wireless sensor network based system consists of three major blocks namely; Intelligent Door Control system, a Gas Detection system and Warning Hearing Impaired people (for the doorbell). Each block has sensor nodes that monitor physical and environmental conditions such as detection of access card, gas level in the kitchen and pressure on the doorbell. A Wireless Smart Home Monitoring system for assistive independent living is presented in. The system has various functions to help elderly and people with special needs. The system consists of a base station, sensor nodes that contain RFID tags, accelerometer and buzzer. Each node monitors a specific home appliance. The system in introduces a ZigBee-based smart home monitoring system that supports multiple user. The system allows users to monitor their home appliances simultaneously. [1] The work in discussed a system that recognizes and monitors the daily activities of living of elderly people on wheelchairs using triaxial accelerometer. A study was conducted on a spinal cord injury user who needs to communicate with other people

through text-voice conversation and control the home appliances in. An assistive dialog agent was proposed for the case using a dialog agent requirements modeling methodology. The Intelligent Home Environment (IHE) controller provides an interface between hardware and software to gather data from the environment and monitor the home appliances according to the commands from the application sensor devices.

2.1 SIM900 GPRS/GSM Module

SIM900 widely used in GSM protocol communication SIM 900 is a complete Quad-band GSM / GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core. A GSM module SIM900 has been interfaced with the 32-bit ARM processor-based LPC2148 microcontroller. It is connected to LPC2148 through a USB to RS232 driver. The module contains a SIM card holder, RS232-based serial port for connection, an antenna for sending / receiving signals to the SIM and an LED as a status for power, signal and incoming call. Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. It can be seen in figure 5. [1].



Fig 5: SIM 900 GPRS/GSM module

2.2 RM540C Relay Module

Relay Module is a module that is very practical for use as a main switch relay for 4 channels project with microcontroller based electronic circuits. This module turns on/off other electronic devices that are powered by 240 V AC electrical AC or DC high-voltage devices (up to 28 VDC), such as High Power DC motors. It has a maximum current of 7 Ampere for each channel in [4]. The figure of M540C Relay Module can be seen in Fig.6



Fig 6: RM540C relay module

3. Prototype Design

Figure7 shows system architecture in which user smart phone is connected to the server using internet. Arduino UNO board provides control to PIR sensor and MQ2 gas sensor. If PIR Sensor detects human body in room then it sends signal to Arduino UNO result of glow light of Room. If MQ2 gas sensor detects the LPG gas (LPG GAS Leakage), it will send signal to Arduino UNO and drive the alarming system connected with Buzzer. Bearing in mind user accessibility and convenience, the system is made to produce alarm while buzzers represent audible alarms are meant to draw immediate attention of user. Also it sends a warning message to user on mobile phone and other one to fire brigade through server which is connected to Arduino UNO board. The design of the prototype consists of two stages: the design and programming of SMS controller circuit and microcontroller. The block diagram of system can be seen in Fig. SIM900 GPRS / GSM Module will be connected to pin Rx/Tx of ATmega328 that contained in Arduino.SIM900 GPRS / GSM Module is used to receive and send text messages to mobile devices. RM540C Relay Module will be connected to the I/O Arduino pin. RM540C Relay Module will receive the orders from the Arduino to turn on or off. Schematic SMS controller circuit can be seen in Fig.7 [4].

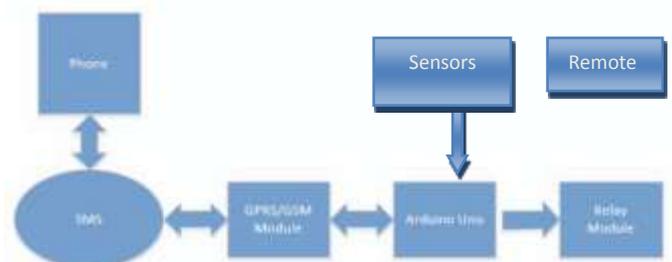


Fig -7: Block diagram of system

Microcontroller programming is used to write the programming code to translate input string obtained from SIM900 GPRS/GSM Module to turn on or turn off the relay. Beside that it is also used for writing code to send at commands to SIM900 GPRS / GSM module that will send SMS to mobile devices in response to commands sent. Previous predetermined input string that is used to control. Relays as well as feedback from Arduino message informing that the control has been carried out.

4. CONCLUSION

The home automation market is very promising field that is growing very fast and needs vast range of developments that can be carried out in the concept of smart home. In this work, the system can be made compatible not alone for home safety but also in various industries and the gas leak can be detected with the help of GPS. The

implementation work is under progress and this paper is submitted as a review paper.

- 10) MANOJ KOLLAMS. R. Bhagya Shree Shree "Zigbee Wireless Sensor Network For Better Interactive Industrial Automation", 2011 IEEE.

REFERENCES

- 1) Raafat Aburukba, A. R. Al-Ali, Nourhan Kandil, Diala AbuDamis. "Configurable ZigBee-based Control System for People with Multiple Disabilities in Smart Homes", 978-1-4673-8743-9/16/\$31.00 ©2016 IEEE
- 2) Khushvinder Gill, Shuang-Hua Yang, Fang Yao and Xin Lu. "A ZigBee- Based Home Automation System", IEEE Transactions on Consumers Electronics, Vol. 55, No. 2, May 2009.
- 3) A Wireless Home Safety Gas Leakage Detection System: Luay Friwan, Khaldon Lweesy, Aya Bani-Salma, Nour Mani. IEEE 2011.
- 4) Tigor Hamonangan Nasution, Muhammad Anggia Muchtar, Ikhsan Siregar, Ulfi Andayani, Esra Christian, Emerson Pascawira Sinulingga., "Electrical Appliances Control Prototype by Using GSM Module and Arduino" 978-1-5090-6775-6/17/\$31.00 ©2017 IEEE
- 5) Iyer, S. S. Kulkarni, V. Mhatre, C. P. Rosenberg, "A Taxonomy- based Approach to Design of Large-scale Sensor Networks", Wireless Sensor Networks and Applications, 1st ed., Springer US, 2008, pp. 3-33.
- 6) Saeed Uz Zaman Khan¹, Tanvir Hasnain Shovon, Jubayer Shawon, Adeeb Shahriar Zaman, Saadi Sabyasachi "Smart Box: A TV Remote Controller Based Programmable Home Appliance Manager", 2013 IEEE.
- 7) Il-Kyu Hwang, 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, AUGUST 2009 Contributed Paper.
- 8) Kamrul Islam, Weiming Shen, "Wireless Sensor Network Reliability and Security in Factory Automation: A Survey", IEEE Transactions On Systems, Man, And Cybernetics—Part C: Applications And Reviews, Vol. 42, No. 6, November 2012
- 9) Eva Besada-Portas, José A. Lopez-Orozco, Luis de la Torre, and JesusM. de la Cruz, "Remote Control Laboratory Using EJS Applets and TwinCAT Programmable Logic Controllers", IEEE TRANSACTIONS ON EDUCATION, VOL. 56, NO. 2, MAY 2013.