© 2017 IJSRSET | Volume 3 | Issue 3 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Design and Implementation of Home Automated Security System Using Short Message Service (SMS) and Bluetooth

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ABSTRACT

Home security is a trending topic where crime is on the increase and everyone wants to take proper actions to avert unwanted access to their homes and offices. There was a need to automate home so that user can take advantage of the technological advancement. This research work provide a solution by designed and implemented a cost efficient home security system that has the capability of sensing the motion of the intruders and the macro quest MQ-7 (Gas Sensor) sensing gas leakage and setting off the alarm. The sensor detects any motion in its permissible range and triggers the alarm. It also sends the signal to Arduino Uno board which is a microcontroller designed to perform require task, it processes the signal and set off the alarm and sends Short Message Service (SMS) to the user via the HC-05 Bluetooth module. This system can easily set up a security alarm in our home for unwanted intruders and to prevent fire outbreak when there is a gas leakage in the home by buzzing the buzzer in order to alert the owner through SMS.

Keywords : Home Security, Arduino Uno, Macro Quest (MQ-7), SMS, and HC-05 Bluetooth Module.

I. INTRODUCTION

In recent years, home security is an essential requirement of households to keep home safe from intruders/thefts. It is a process for improving the quality of resident's life by facilitating a flexible, comfortable and secure environment in Rana et al, (2013).

Researchers and Companies tried to find solutions that keep homes safe from intruders and make our home intelligent, this is also known as Home Automation System (HAS). In order to save belongings most people buy dogs and employed security guard who can be easily deceived. If properly planned, the burglars can easily deceive a watch man and even kill him. Dogs can be made unconscious with the help of poison. These failures paved way for the design and implementation of proposed system (home based security system using short message service alert). Modern home security system offers many benefits such as protection of valuables, detection of crime, allows remote access to our home and provides enough security from burglars, fire, smoke, etc. They also provide immediate notification to the homeowner. Various types of Home Security systems include Sensor based Home security System, Finger print, Palm print and keypad activation for authentication. In this paper, the work mainly focuses on the security of home when the user is not around. This security system is Short Message Service (SMS) based and uses GSM technology to send SMS to the owner. Basically, the designed system aim is to keep home secure from intruders, to provide maximum possible security based on an automatic emergency care response using sensors, also prevent fire outbreak when there is a gas leakage in the house and to make the system much more user friendly.

II. RELATED WORK

Due to technology advancement, home automation is a necessities to make life unproblematic. This section discussed previous research works related to the designed system.

A. REMOTE MONITORING SYSTEM BASED ON GSM

Peijang et al, (2008), worked on the "Design and Implementation of Remote Monitoring System Based on GSM", the research used short Message Service

SMS through GSM for remote monitoring system. In the system, the remote signal was transmitted through GSM network. The system includes the monitoring centre and remote monitoring station. The software for the monitoring centre and the remote monitoring station were designed using Visual Basic (VB).

B. HUMAN MOVEMENT DETECTION USING PASSIVE INFRARED (PIR) SENSOR

Hashimoto et al, (1997), presented a people counting system composed of a one-dimensional eight-element custom-fabricated array detector, an IR-transparent lens and an oscillating mechanical chopper. Their result showed a recognition accuracy of 99% in the two-way back-and-forth moving direction and also a recognition accuracy of 95% in the number of passersby. Also, Wahl et al, (2012), also developed a people counting system. His work was targeted for offices. He used self-sustaining ultra-low power sensor nodes that composed of a pair of unidirectional PIR sensors. The system differentiated the direction of movement at a gateway by observing the time difference between inward-facing and outward-facing PIR sensors. Their prototype system performed well on detecting all occupant movements to and from the office room with a very low error rate of (<1%).

HUMAN MOVEMENT DETECTION USING PASSIVE INFRARED (PIR) SENSOR WITH

ANALOG OUTPUTS

Lee (1994), developed a motion direction detecting system for a moving object in the field of PIR sensor, whose dual sensing elements are reversely polarized and aligned in the motion plane of the PIR sensor. As Lee presented in his work, the analog output signal of PIR sensors involves more aspects beyond simple on-off triggering, and such features have been exploited in several ways for recognizing motion direction.

Zappi (2007), Designed a low-cost passive infrared sensor PIR sensor system for motion detection and distinguishing the number of people walking in line or walking side by side in a hallway. The research showed an accuracy of 100% in motion detection and accuracy of 89% in detection of the number of people. The system also built a cluster system composed of two PIR sensors facing each other in a hallway for detecting the direction of movement and distance intervals (close to one sensor, in the middle, close to the other sensor) when a person is walking Zappi, et al, (2010). The system used Support Vector Machine (SVM) and k-nearest neighbour The results showed an accuracy of 100% in motion detection and accuracy of 83.49%–95.35% in detection of distance intervals. More recently, a novel method of detecting the relative direction of human movement in eight directions uniformly distributed with two pairs of PIR sensors whose sensing elements are orthogonally aligned Yun et al, (2014). With the raw data sets captured from two orthogonally-aligned PIR sensors with modified lenses, the system achieved accuracy of more than a 98% motion detection. It was also found that with the reduced feature set composed of three peak values in the time domain for each PIR sensor, they were able to achieve 89%–95% recognition accuracy according to machine learning algorithms.

C. SMS BASED FIRE DETECTION SYSTEM USING SMOKE AND TEMPERATURE SENSOR

Juntato et al, (2007), developed "SMS Based Fire Detection System using Smoke and Temperature Sensor" which has applications in many areas like Industries, Companies, Offices, Shopping malls and even at our home.

The developed system has a Smoke sensor and a Temperature sensor to detect the fire. Fire detection system sends SMS to user when any one of these sensor crosses threshold value. A buzzer is provided which turns on and SMS is sent to the user.

D. INTELLIGENT RESIDENTIAL SECURITY ALARM AND REMOTE CONTROL SYSTEM BASED

Zhen-ya et al (2008), Designed a remote automatic sound alarm and remote control system. The research work focused on, intelligent residential burglar alarm, emergency alarm, fire alarm, toxic gas leakage alarm The system can perform an automatic alarm, which calls the police hotline number automatically. It can be a voice alarm and shows alarm occurred address. This designed system can also be used to control the electrical power remotely through phone.

III. PROPOSED DESIGN SYSTEM

Over the years, the mode of operations of the existing systems were designed using SMS, these systems are prone to error because, there may be a lot of delay in the

arrival of the message in which some damages may have already been caused before the action is been perform. However, the proposed designed system added a Bluetooth module to the system and was able to develop a Bluetooth application for the android phone without SMS charges.

IV. SYSTEM REQUIREMENTS AND ARCHITECTURE

A. Hardware Requirements

i. ARDUNINO UNO BOARD OF ATMEGA 328

An Arduino is a single-board microcontroller and a software suite for programming it. The hardware consists of a simple open hardware design for the controller with an Atmel AVR processor and on-board I/O support. The software consists of a standard programming language and the boot loader that runs on the board.

An Arduino is a tiny computer that you can program to process inputs and outputs between the device and external components you connect to it. The Arduino is what is known as a Physical or Embedded Computing platform, which means that it is an interactive system that can interact with its environment through the use of hardware and software. The design of the system consists of the Arduino Uno board of Atmega 328.

The Atmel ATmega328 microcontroller is given in figure 4.0 programmed such that when these parameters cross their prescribed limits, it sends the command signals to the final controlling device which is the buzzer (alarm) device.

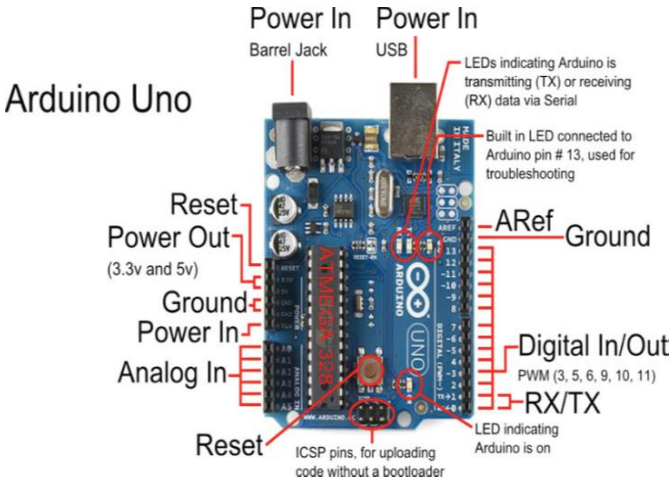

Figure 4. Ardiuno Uno Board

The Arduino board features an Atmel ATmega328 microcontroller operating at 5 V with 2Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second.

ii. GAS SENSOR

MQ-7 is required in this research to sense if there was any gas leakage inside the house. This sensor is sensitive for flammable and combustible gasses. The heater uses 5V. The MQ series of gas sensors use a small heater inside with an electro-chemical sensor. They are sensitive for a range of gasses and are used indoors at room temperature. They can be calibrated more or less but a known concentration of the measured gas or gasses is needed for that. The output is an analog signal and can be read with an analog input of the Arduino.

iii. MOTION SENSOR

The motion sensor used in this project was a Passive Infrared (PIR) sensor that allows us to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. It is small, inexpensive, low-power, easy to use and don't wear out. The PIRs won't tell you how many people are around or how close they are to the sensor; the lens is often fixed to a certain sweep and distance.

The PIR sensors connection to the microcontroller is really simple, powered with 5V and was connected ground to ground. Then the output was connected to an analog pin. In this project we used pin 3.

iv. SERVO MOTOR

This motor represents a function of door knob. This is an essential hardware being used as an actual physical lock. Servos have integrated gears and a shaft that can be precisely controlled. Standard servos allow the shaft to be positioned at various angles, usually between 0 and 180 degrees. Continuous rotation servos allow the rotation of the shaft to be set to various speeds. Servo motors have three wires: power, ground, and signal. The power wire is typically red, and should be connected to the 5V pin on the Arduino board. The ground wire is typically black or brown and should be connected to a

ground pin on the Arduino board. The signal pins is typically yellow, orange or white and are to be connected to a digital pin on the Arduino board, figure 4.1 shows servo motor.

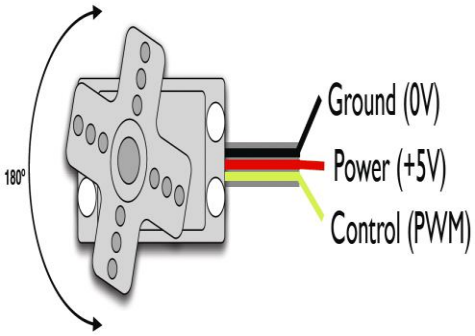

Fig 4.1 Servo Motor

v. LONET MINI GPRS SHIELD

LoNet 800L show in figure 4.2 is a mini GSM module that offers 2G GSM and GPRS data. It features small size and low power consumption. Twice size as a coin and the working current low to 1mA when in sleep mode. It uses a serial port communication, supports 3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands. Also, it supports A-GPS technique that helps get indoor position by the mobile network.

Fig 4.2 Lonet Mini GPRS Shield

vi. BLUETOOTH HC-05

HC-05 embedded Bluetooth serial communication module as shown in figure 4.3 (can be short for module) have two work modes: order-response work mode and automatic connection work mode. And there are three work roles (Master, Slave and Loopback) at the automatic connection work mode. When the module is at the automatic connection work mode, it will follow the default way set lastly to transmit the data automatically.

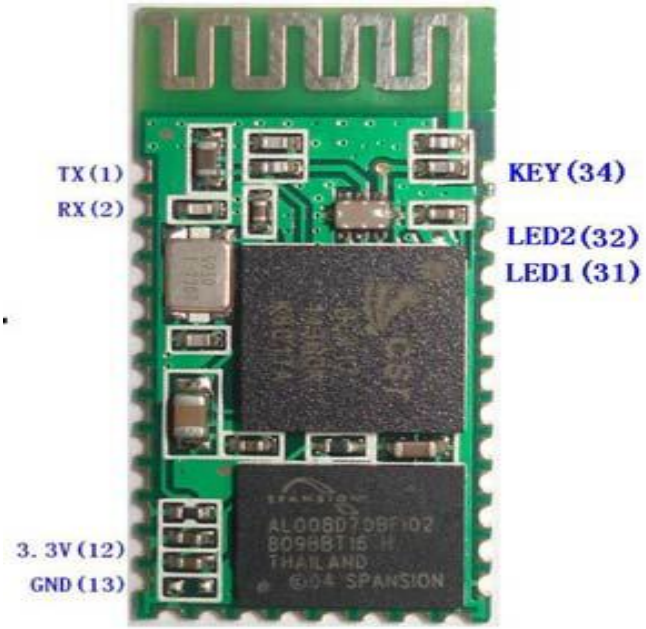

Fig 4.3 Bluetooth HC-05

The system was designed with figure 4.4 as the circuit diagram; the Arduino Uno serves as the central processing unit of the design.

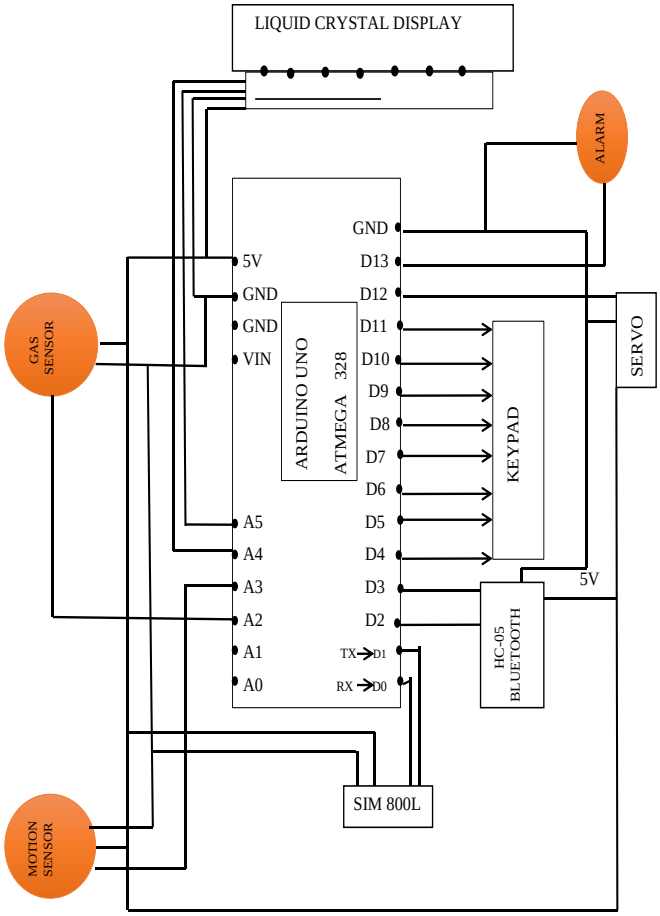

Fig 4.4 Circuit Diagram

In the design, components such as gas sensor, motion sensor, and servo motor has three legs, each connected

to the ground (GND), power out which is +5v and signal which could either be digital or analog. The gas sensor was connected to the GND, 5v and analog pin 2, motion sensor was connected to the GND, 5v and analog pin3, for the servo motor which was connected to the gnd,5v and digital pin 12 on the Arduino board.

Also a liquid crystal display screen was used to display message to users about authorized and unauthorized attempts using a 12 field connector with four legs which were connected to GND, 5v, analog pin 4 and pin 5 respectively on the Arduino board. The keypad was connected to the digital pin 4,5,6,7,8,9,10,11 on the Arduino.

The Arduino were connected to the pin legs RXD AND TXD, GND and 5V of the GSM module. The GSM module is then connected to the completed circuit was programmed into Arduino IDE Environment which allows the program code being used to have effective communications and fast processing between hardware components that are connected to the Arduino. This code has been written in Arduino IDE environment. It consists of two different files, one file is the main Arduino code file which is actually being uploaded to Arduino and the other file is being incorporated in to main file which has some melodies defined for motion, gas leakage authorized and unauthorized attempts etc.

V. PROGRAMMING LANGUAGE AND SOFTWARE USED

This section gives the details of language, tools used, platform used and other implementation details of the designed system.

The major reason for using C in this work is the ease and the control, the language gives control over the system and interface to input and output modules. C is best suitable for system level programming; for example a medium-level programming language to handle memory, I/O and peripheral devices and its recognized by the Arduino Software (IDE) and also JAVA programming language was used.

VI. IMPLEMENTATION OF DESIGN SYSTEM

This section describes the overall operations and procedures of the system. The designed system has three (3) basic modules. First module of this design detects if person is entering the house with the use of PIR motion sensor. Once the PIR motion sensor detects the movement around, it send a signal and alert the homeowner through SMS. This feature is helpful at night time or whenever we are out of our home.

Second module of the design system serves the functionality of a door-latch opening using a password entered through keypad, the password is displayed at LCD and the system remains at waiting state until password is conformed from user end, then the system is unlocked by the rotation of servo motor and separation of magnetic contacts after verifying the password. At the same time, a conformation message "DOOR OPEN" is displayed at LCD. This means someone is accessing the system in proper way. However, the system again returns at initial mode for receiving another password in order to lock the system. This password is also displayed at LCD until the password is verified from controller section. This module also turns on buzzer if wrong passwords are entered consecutively. User can change this password anytime he/she wishes, using a keypad. While the third module of this design uses MQ-7 gas sensor to detect the gas leakage. If there is leakage, then buzzer is turned on and send a signal through SMS to the homeowner, The message is send once the MQ-7 (gas sensor) notices there is a gas leakage, in determine this, the threshold level of MQ-7 is set high in order to prevent the false alarm and make it effective.

Figure 5.0 (a) shows the internal structure of the designed system and figure 5(b) shows testing mode of the designed system, with the outputs and results are exactly represent the aims and objective of the proposed system.

Fig 5.0 (a) Internal View of the Device

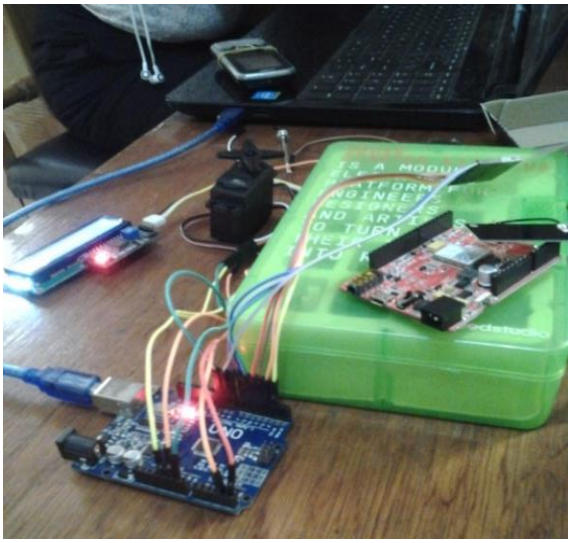

Fig. 5.0(b) System Testing

At idle state, when there is no leakage of gas, the LCD display "No Leakage detect as it shows in figure 5(c). When there is a leakage of gas, the system detects it and display on the LCD as it shows in figure 5.0 (d) and the corresponding message is send to the phone to alert the homeowner as it shows in figure 5.0 (e) below.

Fig 5.0(c) at idle state (No leakage detect)

Figure 5.0 (d) Gas Leakage detection display on LCD

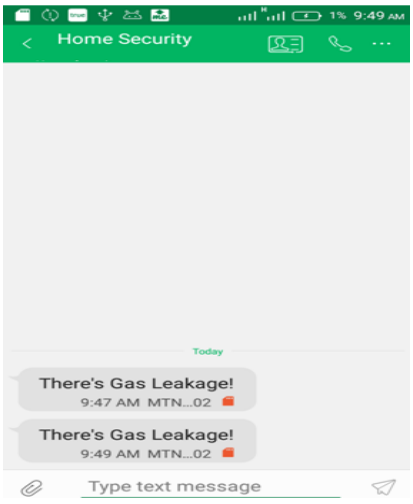

Fig 5.0 (e) SMS Alert to the Homeowner

VII. CONCLUSION AND FUTURE SCOPE

Automated security systems are a useful addition to today's home where safety is an important issue. This research work will allow user to protect home by providing the status of persons inside the house, Gas leakage status and the status of entered password (valid/invalid). It should be used in offices, banks, etc. for security breach notification.

In future system design, it can be expanded in a number of different aspects. The system should be able to cover more distance with the use of module that covers more ground than Bluetooth module, implementation of other related modules like fire sensor, wind sensor, addition of voice alarm system to indicate that the room is full and persons cannot enter inside and also creating a smart phone application to give access to guests when homeowner is away from home.

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