DESIGN OF A REAL-TIME MICROCONTROLLER BASED GSM-EMBEDDED INTRUSION SECURITY SYSTEM

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ABSTRACT: Intrusion detection systems are essential if home security is to be guaranteed. This paper aims at developing a real-time intrusion detection system using Passive IR sensor, ATmega32 microcontroller, SIM1900a GSM Modem, Liquid Crystal Display and buzzer. The Passive IR detects motion and intrusion within a desired perimeter range and sends pulses to microcontroller continuously. The microcontroller will trigger an alarm and sends alert messages to preprogrammed mobile device via GSM in case of untoward situations. The passive Infrared is low-powered which utilizes pyroelectricity effect to detect a human body that is a constant source of infrared radiation. Use of real-time SMS notification with in-house alarm system will increase home safety and security.

KEYWORDS: Pyroelectricity, Passive IR sensor, GSM, ATmega32, Liquid Crystal Display

1. INTRODUCTION

The need for an effective and reliable intrusion detection with alarm systems have become vital necessity because of the frequent and rampant cases of burglary. Attack on homes, offices, factories, banks etc. is on the increase. These forces security system manufacturers to use modern technology to enhance real-time safety as well as security. Considerable efforts have been made to develop remote control systems for home security. The earlier works of such systems are mainly based on the use of telephone lines such as phone-based systems coupled to a hardware remote controller interface. [1]Global System for Mobile communication (GSM) was initially designed for voice; it can also be used to serve other purposes than talking. The idea is reinforced by the fact that GSM infrastructure has wireless interconnectivity which can be implemented using radio home automation system method. Jawarkar et. al in [4] have proposed a remote monitoring through mobile phones involving the use of AT commands. These commands are generated in form of spoken text SMS via a microcontroller designed on the basis of SMS decision prompt.

been deployed in many countries. GSM can be used as a communication link to send and receive signals captured by machines in remote places. It can also send control signals to remote machines. The installation of long wires to reach remote places is more expensive than the use of mobile network that can perfect same. Of course suitable sensors and actuators are needed for the mentioned example. [2]

The proliferation of telecommunications technology has made most recent automation scenarios focus on using wireless communication to communicate home situations. Shepard[3] has introduced the idea of using Bluetooth wire technology as a cable replacement that exploited the

This paper is a prototype of such security system consisting of a microcontroller unit, SIM1900a GSM module and Passive IR sensor. The microcontroller system is used in processing and controlling the system which receives and processes the data from passive IR. The GSM unit acts

as an interface between the microcontroller and user's mobile device and is responsible for communication between them thereby enabling mobile phone user to access it from anywhere in the world if GSM network is available for sending and receiving alert messages. The Passive IR sensor is to be installed in the rooms or points where security is required. It detects the presence of human in the area and generates pulses which are captured by microcontroller. According to the pulse received by the microcontroller an alarm is triggered at security post and an SMS is established to mobile stations through the GSM Modem thus warning the occupant of intrusion or of the presence of a burglar.

2. PROPOSED SYSTEM

The system contains a sensor to detect motion. The whole system is controlled by a PIC micro- controller Atmeg32. It collects information from the sensors, makes a decision and sends SMS to a corresponding number by using a GSM modem. If it finds any interruption in its sensors like if the IR is interrupted then PIC will send a SMS to the home owner. [5]

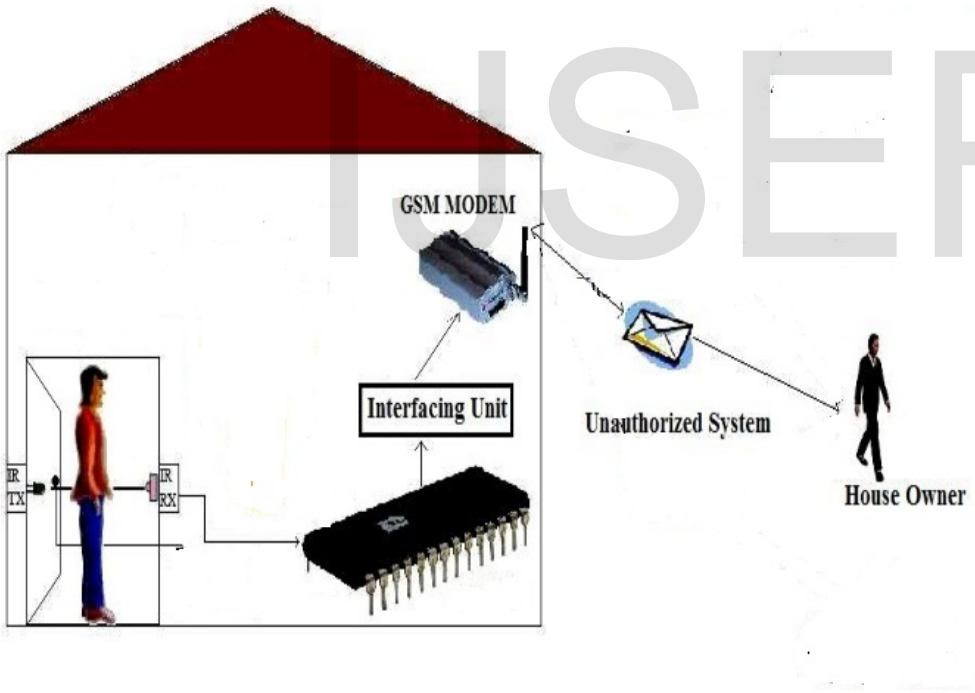
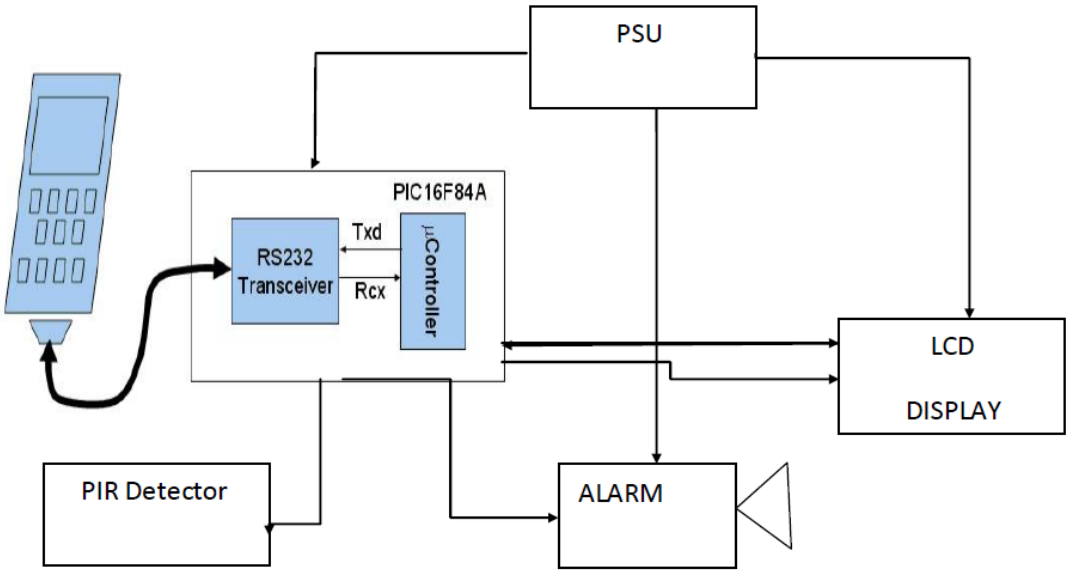


Fig1.0 The proposed system

This system can be represented in the block diagram below.



2.1 Block diagram of Real-time Microcontroller based GSM-embedded intrusion security

The block diagram shows the following;

(i) Detection Unit
(ii) Microcontroller unit
(iii) Mobile phone unit
(iv) Alarm unit
(v) Display Unit

3. WORKING PRINCIPLE

From the above block diagram, the microcontroller continuously scans its sensor input to check when it detects an intrusion. Whenever the sensor input goes high, the internal timer of the micro will begin to increment until, in our own case, it will count up to 30 seconds (enough time for the user to enter his secret password on the keypad to reset the system) after which it the system will trigger an alarm at the same time it will send a Short Message Service to a predefined mobile number.

The PSU (power supply unit) provides the recommended voltage to the various stages and the LCD is used to display the status of the system as well as the user input. Program in written in microcontroller C language and burned into the controller using a program that defines the working of the entire system.

Suppose the burglar is able to get into the house without being detected due to malfunctioning of proximity sensor and enters into the coverage region of the PIR sensor, then output pulses are generated. These pulses are then taken as input by arduino unit. The unit then waits for a pre-defined time of maximum 30 seconds and checks for that signal again. This is done to avoid false triggering. If signal still exists, then the same protocol as that of proximity sensor is followed.

The GSM/SMS system hardware is available in a number of different configurations. All system however, is variations of two basic designs; they are the forward transfer mode and the reverse transfer mode. Forward transfer mode is when the user sends a predefined text message from a remote mobile phone to the system, requesting the status of its input condition or to arm or disarm the unit

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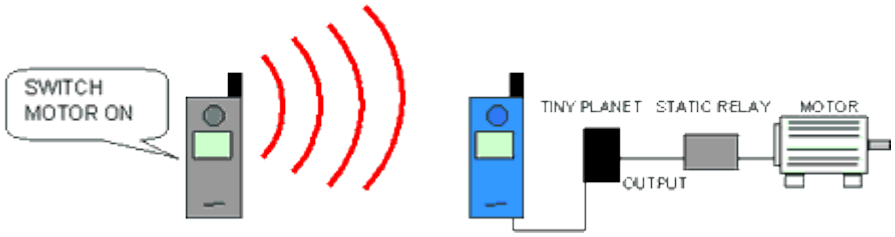


Fig 2.2 Forward Transfer Mode

In this mode, the unit sends a predefined SMS to the user or any incorporated user whenever it detects an intrusion. This is illustrated below

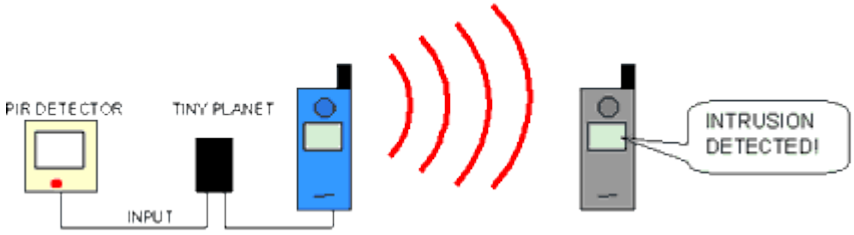
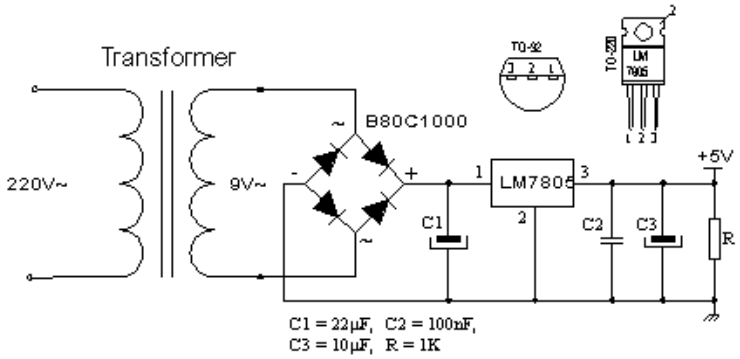


Fig 2.3 Reverse Transfer Mode

4.0 HARDWARE DESIGN

4.1 power Supply Unit

For a proper functionality of any microcontroller, it is necessary to provide a stable source of power supply, a sure reset when it is turned on and an oscillator. According to technical specification by the manufacturers of AVR microcontroller. Supply voltage should move between 2.0volts to 6.0 volts in all versions [6]. The simplest solution to this is to use an LM7805 stabilizer which gives +5volts on its output. One such source is shown in fig. 2.3 below:



A full wave bridge rectifier is also incorporated in the UPS. This is made of ofur rectifier diodes configured in a bridge arrangement as shown in fig 2.3 above. The rectifier is used to convert the step down voltage of the transformer from A.C to D.C. This is necessary because integrated circuit as well as microcontrollers can only run on D.C voltage

4.2 DETECTION UNIT

As shown in the fig above of an infra-red transmitter/detector, the transmitter transmits pulse signal at a frequency of 36KHZ to the receiver in the line of sight arrangement. The receiver receives this pulse signal at an operating frequency of 36KHZ. This pulse signal will make the infra-red receiver pin high or at logic 1.

Once this pulse is broken, it makes the receiver output low. This low signal is then sent to the input pin of the micro controller which will make the microcontroller perform the predefined task indicating an intrusion.

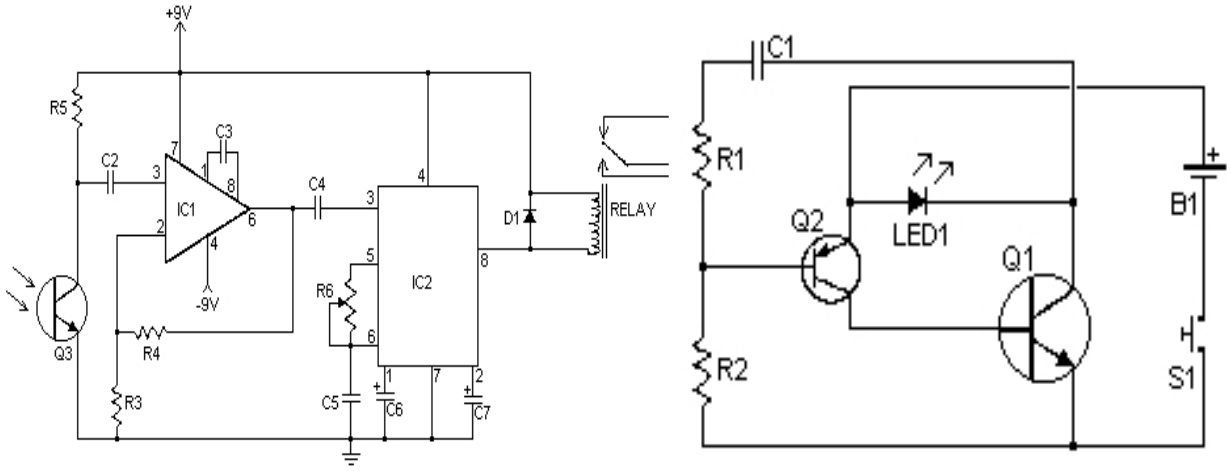


Fig 4.2 Simple detecting circuits: receiver and transmitter

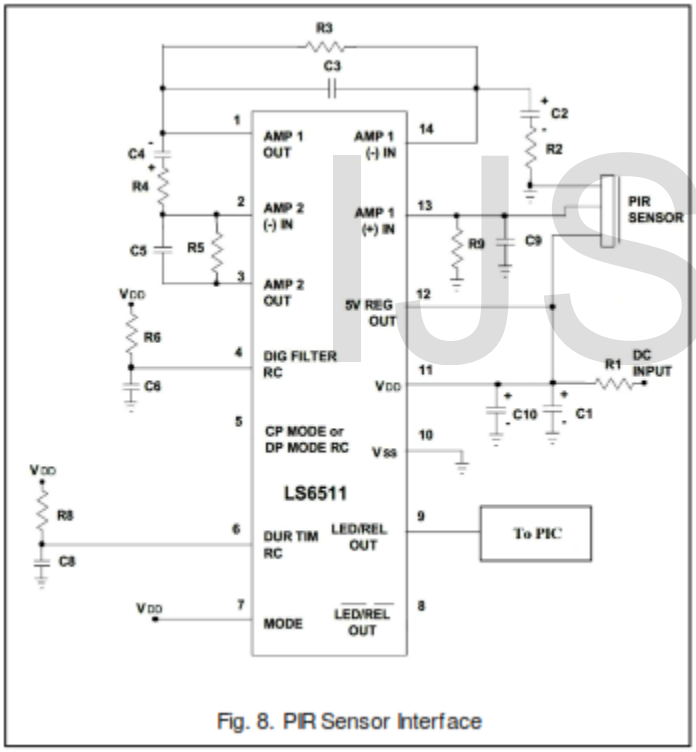


Fig. 8. PIR Sensor Interface

4.3 MOBILE PHONE

Modem stands for "modulator / demodulator" and it encodes and decodes signals sent to and from the network servers. A wireless modem is a network device which connects to a wireless network [7]. Modems are frequently associated with telephone systems, but wireless modems are used with computers and also with communication mediums Wireless modem interfaces include PCMCIA, Compact FlashUSB and Serial Port. In this project we interface the modem through a Serial Port with a microcontroller IC. AT command are used to automatically receive the call on system from the preconfigured number and system also sends the voice message to preconfigured number about the status of appliances and intrusion through AT commands [8].

Similar to modems, mobile phones use set of commands called AT command which is defined by the manufacturer. This AT command enables the mobile phone to be synchronized by a data terminal device, example of which is a computer but for the sake of this project we will be using a microcontroller. For this project, we will use a Sony Erickson T68i mobile phone. We have chosen to use this particular model for the following reasons; it is AT

complaint and has serial port which means it can be connected to the serial port of a computer for synchronization.[7]

4.4 SELECTING A MOBILE PHONE OR GSM MODULE

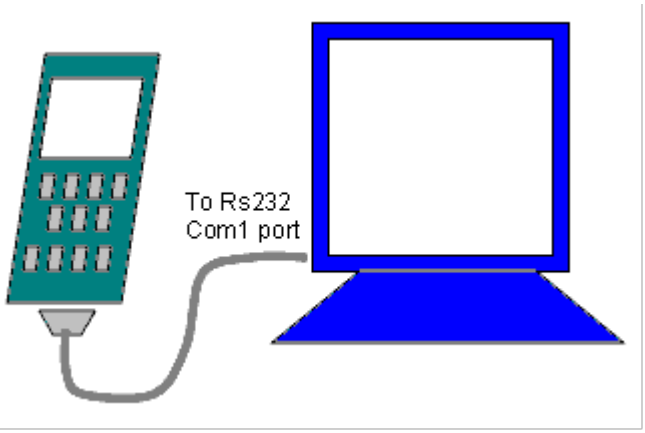
It is necessary to use a phone that is GSM AT compliant. Then, it is possible to communicate with the phone through AT commands.

1. All Sony Ericsson mobile phones, they used the same data connector on the phone. We connect the GSM phone using RS232 data cable. The tested phones are: T39, T65, T68, T68i, R320s, R520m, T310, T316, T610, T618, T628, and T630.

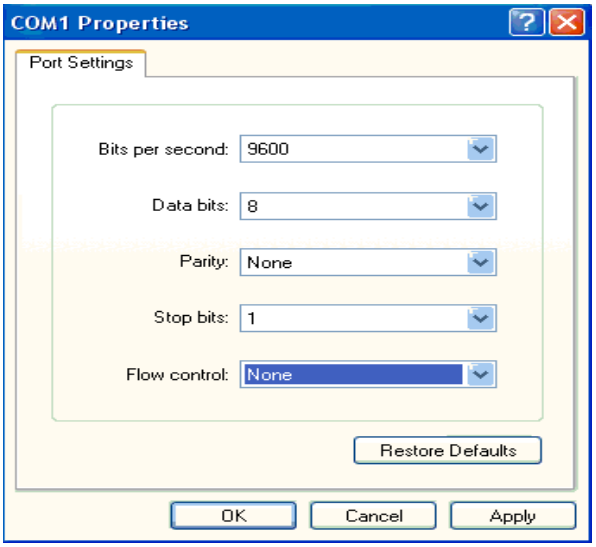
2. Siemens mobile phones: S25, S35, S45, S55, S65, C35, C45, C55, M35, ME45, M50, MT50.

3. Most Nokia phone are AT compliant only through the IrDA port. The data connector port uses a Nokia protocol called the FBus which is much more complicated. However, some phones still are useable -

* Nokia 5100 and 6100 - GSM AT and FBUS Type 3
* 5210 series - GSM AT and FBUS Type 1
* 6310 and 8310 series - GSM AT and FBUS Type 3
* 6510 and 6610 series - GSM AT and FBUS Type 3
* 7110 series - GSM AT and FBUS Type 2
* 7210 and 7610 series - GSM AT and FBUS Type 3
* 8210 and 8850 series - GSM AT and FBUS Type 1 [8]



Connect the Phone to your computer via the Data Cable shown here. You can either connect to the RS232 port 1, or, 2. But, on the hyperTerminal, you will need to select the same serial COM port.Use HyperTerminal which comes with Windows (Start->Accessories->Communications->HyperTerminal) to start a HyperTerminal window. Select the baud rate to be 9600 bps (actually, the module will accept all the baud rate setting, any selection will work). The other parameters are : Data Bits (8), Parity (None), Stop bits (1), Flow Control (None).



Click OK. This will open up a HyperTerminal Window.

SMS

The following are some simple AT commands to do SMS.

SMS Commands

AT+CMGR Read Message
AT+CMGS Send Message

Text mode SMS are available on GSM module. This offers an easier path in which a micro-controller system to implement. For mobile phones, SMS uses PDU encoding in

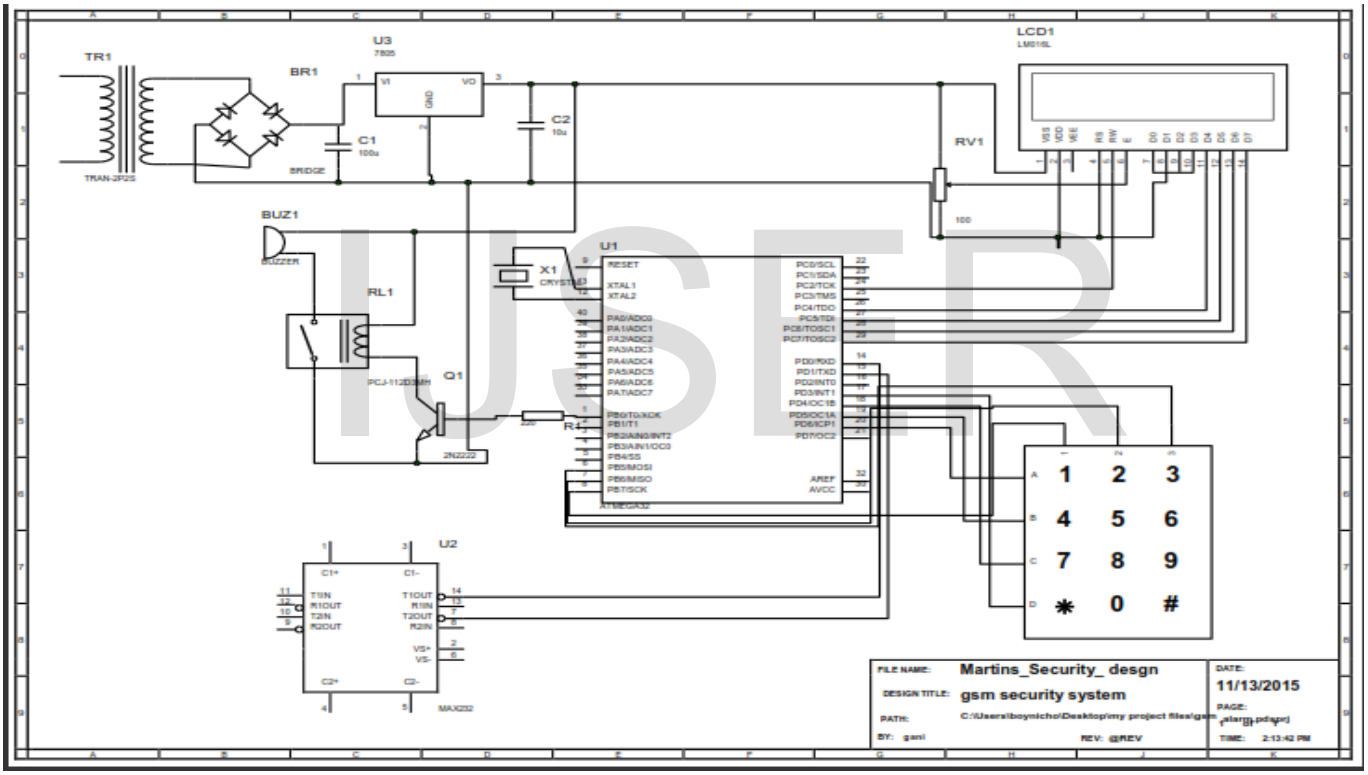
which a message is encapsulated into a fixed format and protocol. This structure of data is passed to the mobile phone in the event of sending out an SMS to the phone. Or, when receiving SMS, the data structure is read from the mobile phone via the RS232 port.[9]

THE FOLLOWING SECTION DESCRIBES THE AT-COMMAND SET. THE COMMANDS CAN BE TRIED OUT BY CONNECTING A GSM MODEM TO ONE OF THE PC'S COM PORTS.

Command	Description
ATD<number>	Dial to a number
ATA	Answer
AT+CMGF=1	Set message format to TEXT mode.
AT+CMGS="number"	Send a message to the telephone number.

Table 4.1 showing AT-Command sets

5. WORKING DIAGRAM



6 SOFTWARE DESIGN

6.1 MPLAB v 8.40

In this system MPLAB v8.40 is used to develop the program for PIC microchip. This compiler consists of Hitech C as well. So this compiler can be used to program in C language. Here the program is divided into six macros. The main macro controls the whole program. It calls the sub macro „Unauthorized intrusion", „Fire" and „Sound" whether there is any fault in the system. Inside this sub macro two sub macro, „Tx" and„Rx" are developed. This two macros help to set communication with network and send the SMS properly. If there is any

fault in RB0 pin of microcontroller then the system will send a preloaded SMS, „Unauthorized System "to two certain number of home owner only.

7. FLOW CHAT

Fig. 2 shows the flow chart of the total system, which is also clearly showing that if motion detector can detect any required signal the system will take necessary action to inform the house owner and sound an alarm

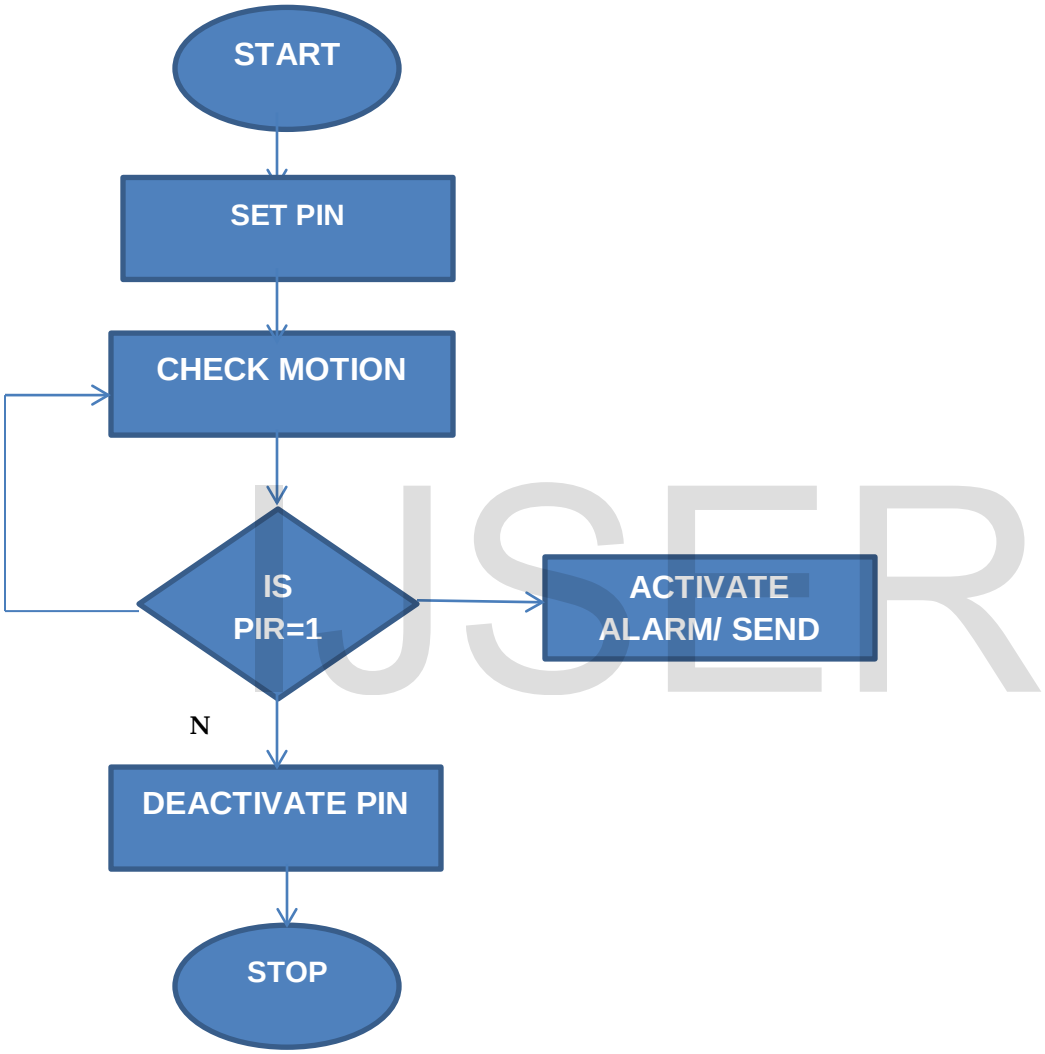
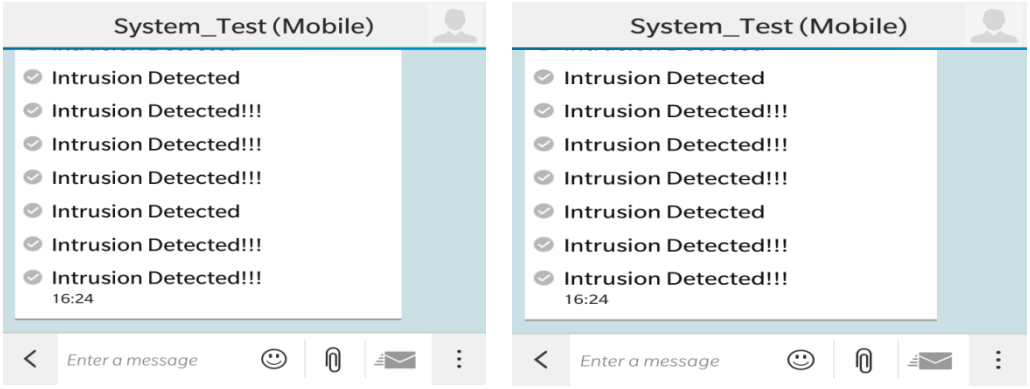


Fig 1. Showing the flow chart of the system

8. RESULTS



9 CONCLUSIONS

This security home feature is expected to draw much attention in the next decades. People are getting more and more concerned about how to protect themselves and their houses from emergencies. These emergencies include not only thief intrusion, butalsofireattack.Thisdevicprovidesameansforbeingabletos ecure-ly monitor a house by use of sensors integrated with a microcontroller and a GSM unit. SMS provides an economical and convenient way to alert users of a possible intrusion into the property. The use of mobile handsets as a client device to receive warning messages on implies that the user will not have to carry an additional piece of equipment as most people already have a mobile phone with them most of the time. By using this system the security services like police and fire brigade of a nearby region also be informed about the intrusion instantly and they can take steps rapidly. So this system is safe and cost effective as well.

10. REFERENCE

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