Implementation Of Real Time Home Surveillance and Automation Using GSM Modem For Dual Communication

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***Abstract*— the focus of this paper is to present the design and implementation of two ways communication based on GSM (Global System for Mobile) used hand phone Sony Ericsson E300 as a modem application for home security system. The motion, magnetic and vibration sensor are defined as input variables and the fan, lamp and buzzer is defined as output variable. This system offers a complete and user friendly way of 24 hours real time monitoring and controlling of a home security. The concepts of this system using two way communications are mobile-to-machine and machine-to-mobile communication. First, develop a general purpose electronic circuit design that can monitor and control a variety of home appliances with interface that can be plugged into GSM hand phone unit which is Sony Ericsson E300i. The design has been described using PIC (Programmable Interface Controller) comprises microcontroller, adaptation circuit, power circuit, MAX 232 and RS232 interface. Then, develop prototype home security as an application example of the designed PIC system. The system is completely built and tested and showed perfect operation.**

Keywords- SMS (short message service,), Programmable logic controller (PIC), GSM (Global System for Mobile), home security system

I. INTRODUCTION

Global system for Mobile Communication (GSM) has been one of the best trustable wireless communication systems that can be accessed and used very easily. It is cost effective either if we consider the price of its transceiver module (a simple cellular phone) or the subscription fees. With the trend of huge growing usage of GSM during the past decade, network services is extended beyond speech communication to so many other custom specified applications, machine automation and machine to machine communication.

This paper designs an intelligent home that can communicate with the user by using a mobile phone over GSM network. The interface and communication between home appliances the controlling circuit is the most important component in this process. The function is implemented by using a Programmable Interface Controller (PIC) that interfaced to a mobile phone. The user sends GSM data in the form of SMS (short message service) message to switch ON or OFF any appliances inside the home like light, fan, television, and video .The appliances may also send to the user its status and alarms. For instances, if some body tries to get into the home, then the home will automatically send alarm message to the user mobile phone or call the police station if required. The system can be improved to provide the user with the information about the status of each appliance, for example "is the television ON or OFF?"

In the literature, there are few contributions proposed in recent years in machine to machine, mobile to machine or machine to mobile communication. These include: designing prototype integrated mobile telemedicine system interfaced with the sensors to a patient's body using GSM simulation [Woodward, 2001]; designing mobile system with wireless LAN [Kugean, 2002]; implementing measurement system to monitor the ambient air quality using GPS, GPRS modem and advanced RISC machine [Aranguren, 2002]; and designing stand alone human temperature and blood pressure system using microcontroller with embedded software [Al-Ali, 2003]. In line with those works, we describe in this paper simple guideline procedures to build general purpose hardware circuit and software algorithm of home appliances system.

II. DESIGN METHODOLOGY

This paper consists of two major parts that are software and hardware. This section describes in details the major hardware components and software of design methodology in developing and completing the home security system based on GSM (Global System for Mobile).

A. Software Development

Figure 1 shows the flwchart of software implementation of the home security system operation. Two implementation scenarios are considered as:

i) Controlling the alarm (from user's remote mobile to the machine)
ii) Alarm notification (from machine to user's remote mobile)

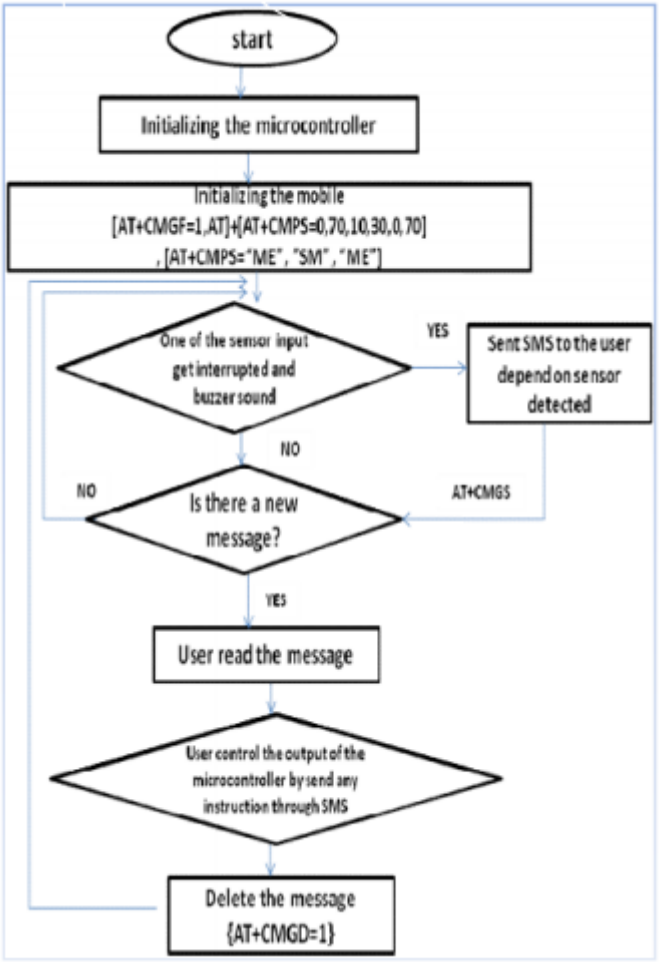

Figure 1. Flowchart of the software implementation of the home security system operation.

First scenario, user sends SMS message to the microcontroller. The microcontroller will then check for any new message. If there is a new message, the microcontroller sends AT command that is specified for reading the message. Consequently, the microcontroller will save the message in its memory. Then, the message will be compared with other message that is stored previously. Based on this comparison, the microcontroller will decide which output pins have to be low and which output pins will be high. The high signal will be go to the adaptation circuit (relay) and opens the switch causing the home appliances work. The received signal will be automatically deleted.

Second scenario, there are three input of the microcontroller which is magnetic, vibration and motion sensor, microcontroller input is connected to the switch. The switch is fixed on the door (magnetic input). When the door is opened, the switch is closed and there will be an input voltage to the microcontroller. The microcontroller will check its input and sends alarm message to the user. Same goes also to the other two inputs which is vibration and motion sensor.

B. Hardware Development

Figure 2 shows the block diagram of the connection between the main components of the PIC system. The machine in the block diagram can be either electrical or mechanical or any other type according to the user requirements. The machine includes all the necessary circuits and sensors needed to couple, apply input or output signals from the microcontroller to units to be controlled.

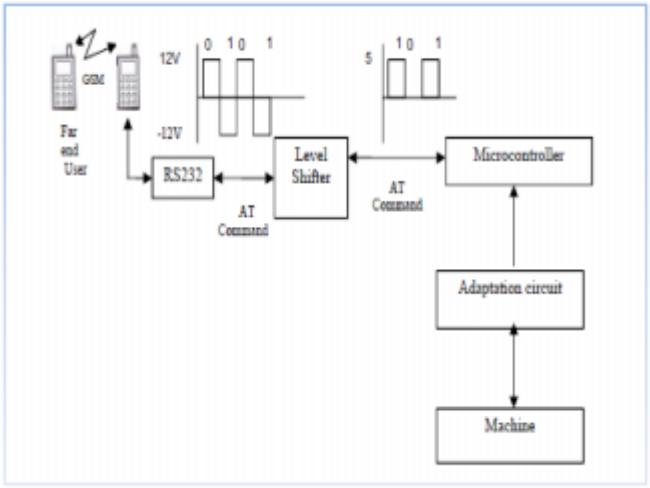

Figure 2. Block Diagram of the PIC System

Integrating the main controller input, output,(PIC16F73A), adaptation circuit, and power circuit as well as level shifter (MAX 232), RS 232 interface are illustrated in figure 3.The system is constructed to control and monitor many machines or home appliances.

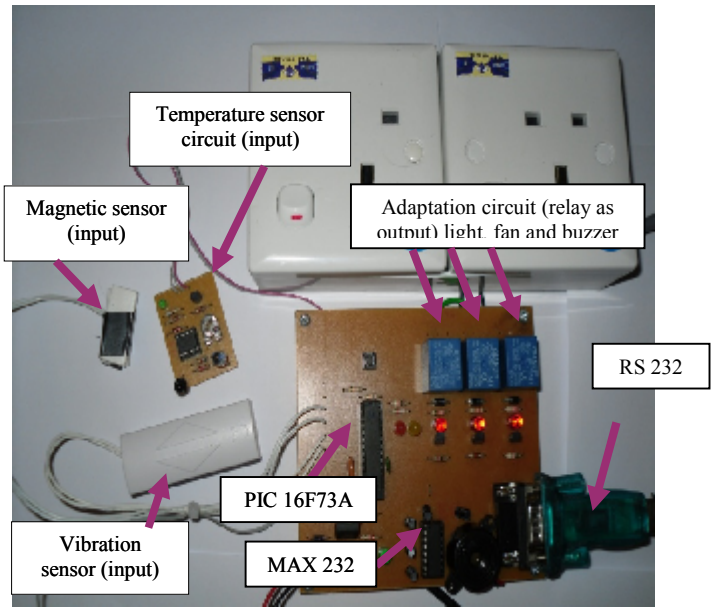

Figure 3. Hardware input output Circuit of the system

C. Component Details

a) Powers supply

The microcontroller and other devices get power supply from AC to DC adapter through 7805 5 volts regulator as shown in figure 4. The adapter output voltage will be 12V DC none regulated. The 7805 voltage regulators are used to convert 12V to 5v/12v DC.

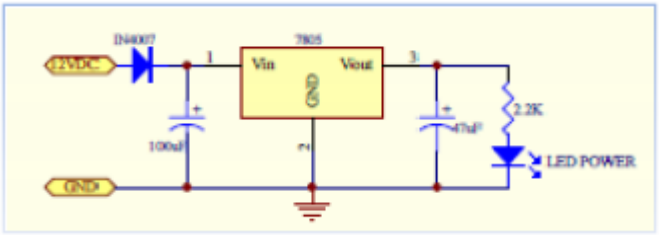

Figure 4. Power supply

b) Microcontroller - ***PIC16F73A***

The functions of the microcontroller in the system are:

- Initiate the attached GSM module and make it ready to communicate with other phone by sending a confirmation either through SMS. This is important to acknowledge the far end control unit that the system is ready. This step is done once when system power is turned ON, and each time the power is turned ON.
- Check the reception of any commands either in SMS and waiting the commands from the far end mobile set. This is including sending a confirmation that the message is received.
- Process the received commands and produce all signals needed to physically execute this command.
- Send a confirmation message to the far end mobile set and return again in waiting state for another commands.

c) RS 232 Interface

The GSM network provides full duplex link to support the user requirement. The user can access the application remotely through SMS service where his message read and decoded by the microcontroller attached to the mobile set through a suitable interface, usually RS232 is used.

d) MAX232 Convertor

This device is used to convert TTL/RS232 vice versa. RS232 was created for one purpose, to interface between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE) employing serial binary data interchange. So as stated the DTE is the terminal or computer and the DCE is the modem or other communications device.

e*) Sensors*

This project is using 3 types of sensors. PIR sensor (Passive infra red sensor) is used to detect the movement. Vibration sensor is used to detect vibration and magnetic sensor is used to detect the open door.

f) GSM modem

The used of hand phone Sony Ericson E300i as a modem.

g) Relay

The microcontroller can accept TTL level in its input or output but most of the external circuits work either 220 volt or 110 volt and thus the microcontroller can not operate these circuits. To overcome this, the adaptation circuit is used to convert the input or the output voltage level between the microcontroller and external circuit. Figure 5 shows the adaptation circuit suggested in this paper.

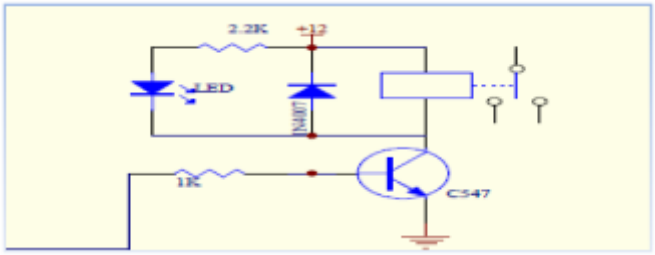

Figure 5. Adaptation circuit (Relay)

When the input to the adaptation circuit is low then the output will be 220 volt and the switch will be opened but when the input is high then the switch will be closed. The reason behind using this type of the circuit is to completely isolate the relay current from the microcontroller current. This method prevents the output voltage from dropping and prevents the microcontroller from producing a high current, which may damage the microcontroller.

D. Home Security System

A simple application of the above described system is a home security system as shown in figure 6. This system enables the far end user through SMS facility to monitor the safety of home door and detect any illegal intrusion by control the home lighting system to give impression for the outsiders that there is somebody inside the home.

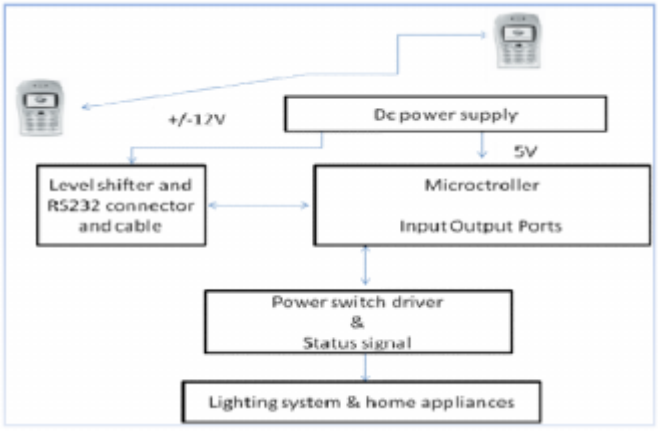

Figure 6. Block Diagram of Home Security System

The intrusion detector is a simple infrared LED, magnetic and vibration sensors.These three elements are fixed around house's area, across the door and at the house's main gate respectively.The sensor will be connected to the microcontroller and act as a switch. The sensors are read by the microcontroller that decodes their reading and send it to the far end user through the GSM network as SMS

III. RESULTS AND DISCUSSION

Figure 7 shows the result of LED for the relay number 3 of buzzer ON when any three of the input sensors was detected and the buzzer will directly sound, then the system will automatically sending SMS to the user to inform about the security risk at their home. The tabulated results are presented in table 1 and 2.

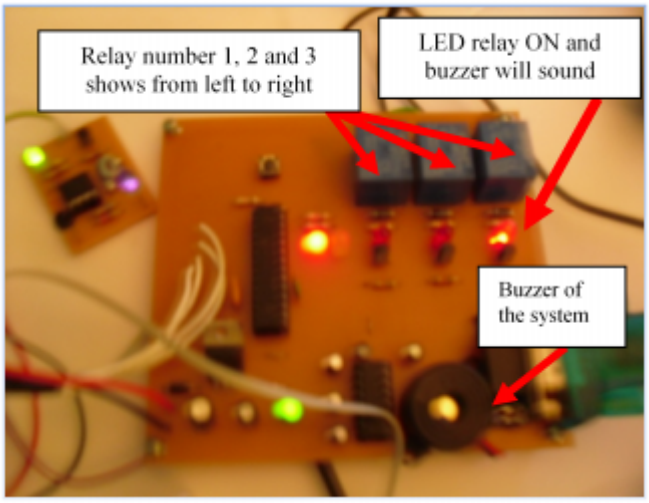

Figure 7. LED ON for the relay of buzzer.

A. *Table 1: results of Security Alert Sub-system:*

TABLE I. RESULTS OF SECURITY ALERT SUB-SYSTEM:

APPLIANCE	**SYSTEM ACTION**	SMS RESPONSE BY THE SYSTEM
Motion sensor detected (Nearby of house area)	Intrusion detected on nearby of house area, SMS generated to user	SMS received "Breach on nearby house area"
Vibration sensor detected (Main Gate)	Intrusion detected on main gate, SMS generated to user	SMS received "Breach on the main gate"
Magnetic sensor detected (Entrance Door)	Intrusion detected on entrance door, SMS generated to user	SMS received "Breach on the entrance door"

B. *Table 2: Appliance Control Sub-system:*

TABLE II. RESULTS OF APPLIANCES CONTROL SUB-SYSTEM

APPLIANCE	**SMS INTRUSION BY USER**	**SMS RESPONSE BY THE SYSTEM**
Safety Device System	On: DON	On: System Device On
	Off: DOFF	Off: System Device Off
Light	On: RLMP	On: LIGHT ON
	Off: SLMP	Off: LIGHT OFF
Fan	On: 1FAN	On: FAN ON
	Off: 0FAN	On: FAN OFF
Alarm	Off: RSTA	Off: Alarm Sound Off

Achieved analytical results:

- System sent SMS to far end user hand phone when system device is in ON or OFF condition.
- System sent SMS alert when the intrusion and any three input sensor was detected.
- Remote (far end user hand phone) controlling capability of the system allowed user to switch ON or OFF any home appliances such as fan, light, television or any devices at home through simulating the appliance as directed by sending SMS.

From figure 7 and 8 shows below, the graph line illustrates the resullts of runtime taken to switch ON and OFF home devices of light and fan. This result was produced by running 5 samples of each relay to ON and OFF the home devices. The process runtime taken were compared to look at the performance of both of home devices which are light and fan. As shown from the graph, the runtime taken by all number of testing is too long either to switch ON or OFF the home devices. From the figure 7 the shortest time taken to switch ON the light was 23 seconds while to OFF was 12 seconds while from figure 8, the shortest time taken to ON and OFF the fan was 18 seconds and 28 seconds respectively.

The process runtime up drastically to OFF the both devices fan and light when last of testing sample taken,which is 1714 seconds for light and 849 seconds for fan. The long time taken might occur because of the microcontroller compared the message instruction received by the far end user to switch ON or OFF any home appliances with other message that is stored previously in the microcontroller chip. Based on this comparison, the microcontroller will decide which output pins have to be low and which output pins will be high. The high signal will be go to the adaptation circuit and opens the switch causing

the machine work., this process causes the program to run slower and takes more time to run to completion.

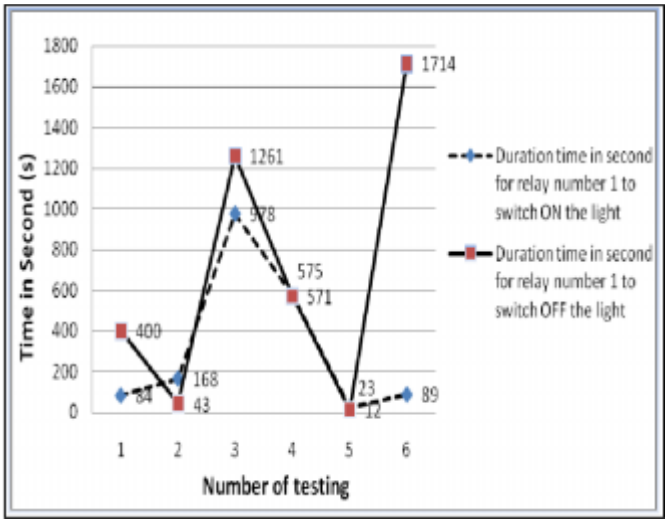

Figure 8. Graph time in second (s) versus number of testing to switch ON and OFF light

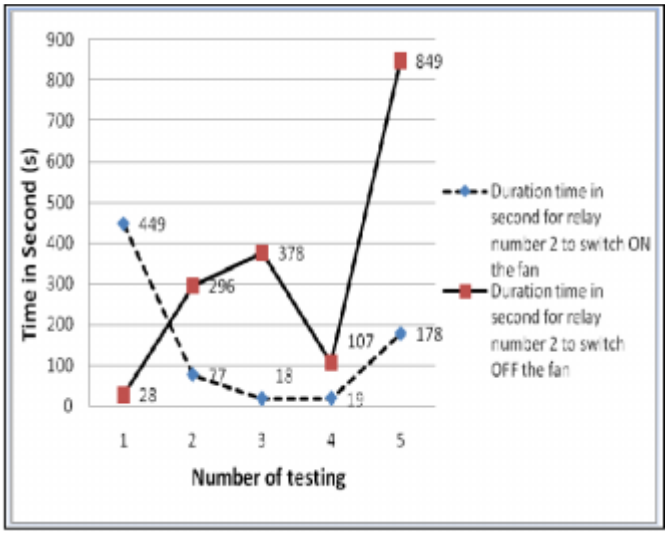

Figure 9. Graph time in second (s) versus number of testing to switch ON and OFF fan

IV. CONCLUSION

In this paper, an integrated PIC system has been developed. The system is intended to be used in many applications where the user can monitor and control target machine remotely using GSM network. The system was applied to an example of home security notification to monitor and control the home security. GSM technology capable solution has proved to be controlled remotely, provide home security and is cost-effective as compared to the previously existing systems. This system is easy to implement and it has become one of the modern wireless privacy system. Hence we can conclude that the required goals and objectives of this project have been achieved. The system has been implemented in laboratory and proved to be feasible by experiments. As results, consumer do not worried about the security of their home while they are at home.

V. FUTURE RECOMMENDATION

The recommendation for the future work is we can add a multimedia camera to see what is going inside the home by sitting in the office or some where, we can voice recorder for IR sensor's detection and the system will be small box combining the PC and GSM modem. The hardware will be self contained and cannot be prone to electric failure.

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