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Design, Development and Performance Study of a Microcontroller-Based Home Security System Using Mobile Phone

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Abstract - Security has been an important issue in the smart phone applications. Here, a security system has been developed that uses a sensor to detect a security violation and informs the owner by calling to his mobile. The system consists of a sensor, microcontroller IC, some relays and a mobile phone that operates when the sensor sense some unwanted breaking of doors, lockers etc. As soon as this occurs the system automatically calls the owner through the mobile phone used in the security system. The system has been designed and developed using locally available components and its performance has been studied. A program has been developed using Flow Code software to drive the system.

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Design, Development and Performance Study of a Microcontroller-Based Home Security System Using Mobile Phone

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Abstract - Security has been an important issue in the smart phone applications. Here, a security system has been developed that uses a sensor to detect a security violation and informs the owner by calling to his mobile. The system consists of a sensor, microcontroller IC, some relays and a mobile phone that operates when the sensor sense some unwanted breaking of doors, lockers etc. As soon as this occurs the system automatically calls the owner through the mobile phone used in the security system. The system has been designed and developed using locally available components and its performance has been studied. A program has been developed using Flow Code software to drive the system.

General Terms : Microcontroller based Security System (MSS), Home security system (HSS), Mobile keypad switch layout and Peripheral interface controller (PIC).

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I. Introduction

Homes without security systems are more likely to be targeted by a burglar and most of residential burglaries occur during the daylight. Under smart and intelligent home environment [1], numerous sensors, motion detectors, smoke detectors, water leakage detectors etc., and communication devices can be utilized for connection throughout the house, capable of monitoring and detecting the physical events. The output from these sensors can be used to alert the owner of any unauthorized intrusion or control home appliances such as lightings. Thus, maintaining seamless connectivity between devices and the main controller is very crucial. A lost connectivity can jeopardize the security of the home. It is also an important factor to ensure that, the devices being used operate in very-low power consumption so that they would last longer [2].

In previous years, different home security systems such as Zigbee based security system [3], PIC based security system, SMS based security system [4] etc. has been designed and implemented.

Real time security system based on GSM network [5-7] has also been devised. But the cost of the system is relatively high.

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II. Block Diagram of the System

The block diagram of the system consists of sensor, signal and control unit, interfacing unit and mobile unit.

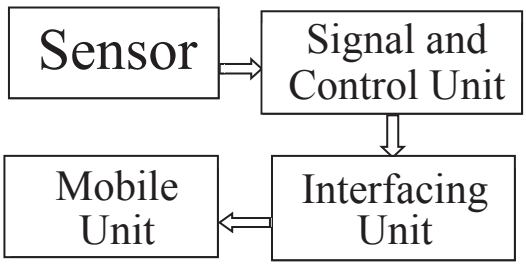

Figure. 1 : Block diagram representation of the Security System

III. System Overview

a) Mobile unit

The numbers of the mobile phone are usually in a row-column array matrix [8]. Numbers 1, 4, 7, 'yes' (a button to dial or receive a call) and * are in the left column. Numbers 2, 5, 8 and 0 are in the middle column and numbers 3, 6, 9 and # are in the right column [9]. The outer circle of the button work as negative terminal and the inner circle of the button work as positive terminal. The negative terminals of all the buttons are shorted to a common. When the positive terminal and the negative terminal are shorted the corresponding numbers are generated. Switching circuit has been used to generate the user number. Copper wires are soldered to keypad buttons which has been connected to relays. For the present research a Motorola mobile phone set have been used [10] which is shown in figure 2 .

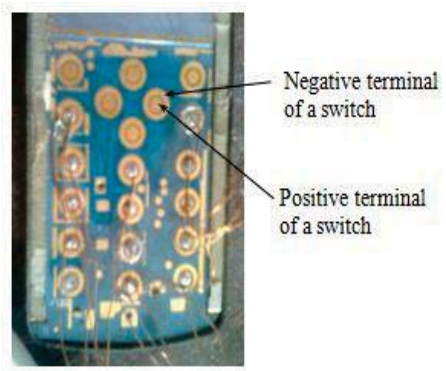

Figure. 2 : Mobile Keypad.

b) Interfacing Unit

As the numbers on mobile phone are in row column array matrix, thus relays [11] (SPDT type) have been used to generate the called number. Each common point of relay is connected to the negative terminal of the button and normally open point of relay is connected to the positive terminal of the button. For example, we want to generate 1, so we have connected negative of the 'yes' button (as negative terminals of same column are common) to the common point of relay and positive of 1 button to the normally open point of relay [11]. Like this way we have connected all the other digits to the relays.

Relay's coils are connected to the collectors of C828 transistors. Transistor has been designed as a switch. A diode is connected to the collector for protection of the transistor. Emitter is grounded and two resistances of 10k are connected to the base of transistor as shown in figure 3. The controlling signal generated by a microcontroller and is aplied to register R_1.

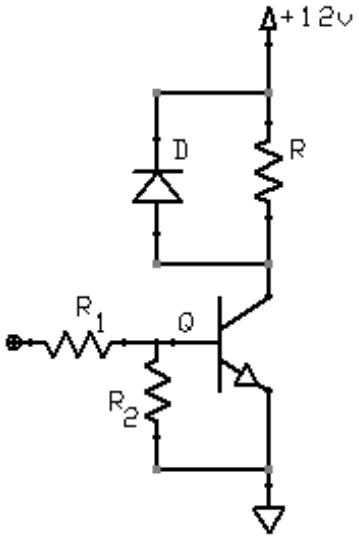

Figure. 3 : Mobile Keypad

c) The Signal and Control Unit

The control system can sense the opening of a door. In this system a very thin wire has been used to detect the condition of the door. The wire will be attached with the door and when the door is opened the wire will be disconnected from the circuit and will be sensed. One end of the pin RA0 (pin 2) of the microcontroller and the other end to ground [12]. A 1kΩ resistor is connected from pin RA0 to 5 volt. Hence, when the wire is connected in the circuit the logic level of pin2 will be zero and when the wire is detached the logic level of pin2 will be 1. Microcontroller always checks the logic levels of this pin [13].

When the pin is at zero level, the controller waits a few seconds and checks. The loop will be continued until the wire is detached and that the door has been opened. When the door is opened the wire will be detached and the microcontroller will find a logic 1 at pin RA0 and it will start to call a particular (set by user) mobile phone number.

In this work, PORT-A of the microcontroller has been chosen as an input port and PORT-B and PORT-C has been chosen as output port [14].

The transistor switch has been connected to the output of the microcontroller. Microcontroller is operated at 5 volt whereas the relays work with 12V. For this reason we have used a regulator IC to generate 5 volt from 12 volt. The 7805 IC was used as a regulator IC.

To generate common numbers we have used diode at the output of the microcontroller. A switch at pin 1 of microcontroller has also been used for refreshment purpose.

IV. Working Diagram

Fig. 4 shows the complete circuit diagram where mobile phone section has not been added.

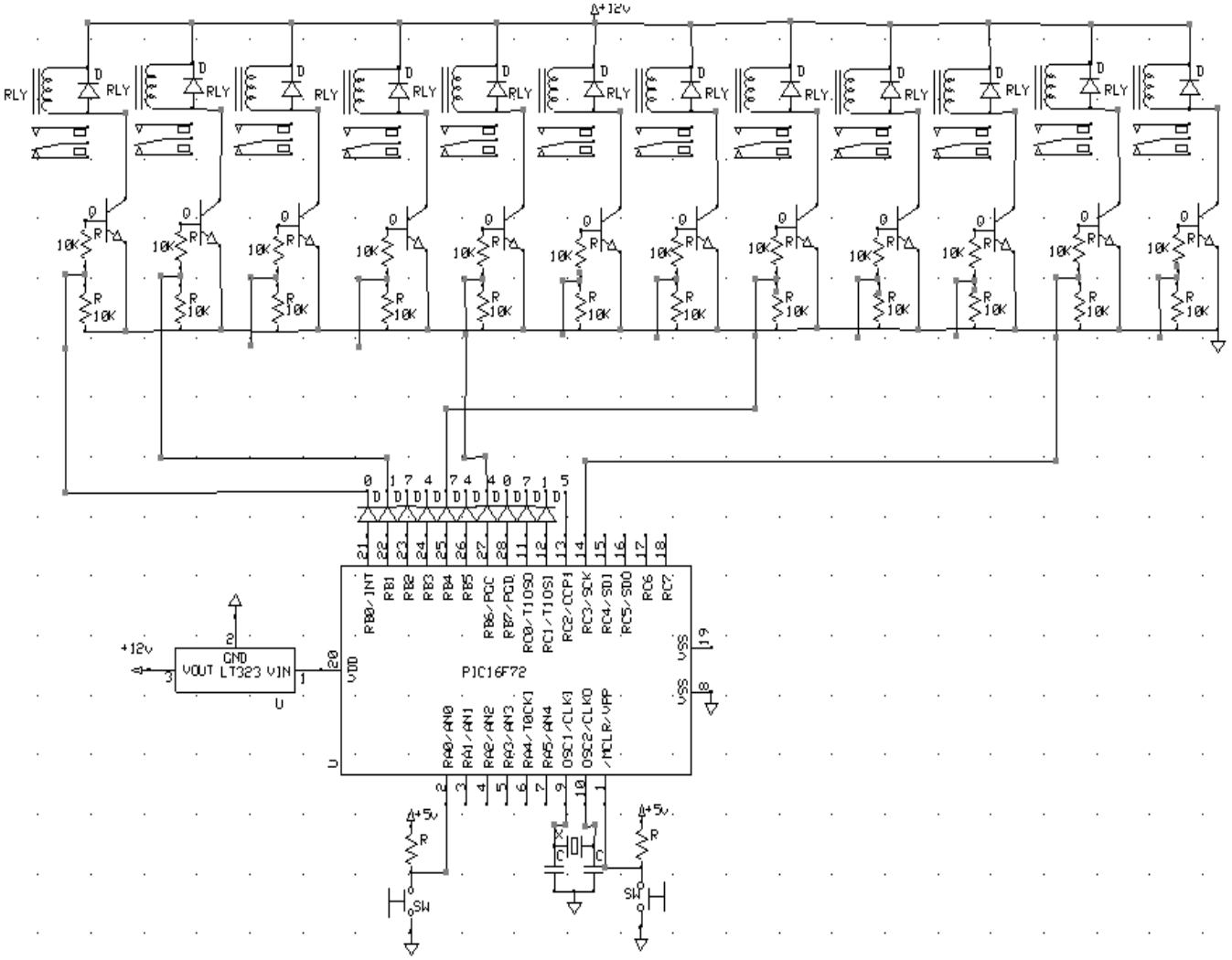

Figure. 4 : working diagram of MSS.

V. Operation of the Whole System

In the present design, a wire has been used as a sensor which is connected to the main circuit. When the wire is cut, according to the program the output will be activated one after another.

According to the output of microcontroller the transistor switch is then activated and mobile button is pressed. Thus a call has been made.

To generate each number one second is required. That means, to generate eleven numbers eleven seconds is required. Microcontroller IC has been programmed for this purpose. Here we use yes button to generate the call. For this purpose we use 12 relays which are connected to the mobile phone keyboard pad.

In case when it is necessary to generate the mobile number 01749757937, then the relay contacts are connected to keys 0, 1, 7, 4, 9, 7, 5, 7, 9, 3 and 7.

When the yes button is pressed, the number will be started to generate. After generating the number, we have wait for few seconds for generating the call. It is a continuous process.

That means the call is repeatedly generated as long as the user will not disconnect it.

a) Timing calculation

For generating each number, one second is required. So the time to generate 11 numbers is 11 seconds. Time taken to press the 'yes' button is 1 second. So, time taken to dial a number is 12 seconds.

Considering 8 seconds as time required to generate a call, about 20 seconds is required to ring the owners mobile. Thus it performs quite well.

VI. Cost Analysis

For the proposed system, components of the system are available in local market. The recent cost for entire the system is given below.

Table.1 : Production cost of MSS system.

Name of the Components	Type/ Model No.	Quantity	Total Prices in TK.
Microcontroller	PIC16F72	1	100
Crystal Oscillator	4.00 MHz	1	20
Switches	Mega Size	2	40
Transistor	C828	12	60
Resistors	470Ω, 1KΩ	21,6	10
Decoder IC	SN74LS47	3	60
Counter IC	DM74LS90	2	40
Power Supply	5V	1	45
PCB	----------		20
Connecting Wire	----------	-- -----	20
7 Segment Display	Common Anode	3	45
Others	----------	--------	50
			Total amount = 475

The above data clearly shows the cost superiority of import system to locally developed system.

a) Low Cost

The MSS (Microcontroller based Security System) is a security system for homes, offices, shops, banks etc. It is developed to make offices and especially homes much more secure. Although there are existing security systems for that place, the MSS differ from them in many ways. The system was designed using locally available components and it is very cheap. Accessibility from mobile devices makes the MSS is really different from existing security system. The MSS has lots of beneficial effect on society. Its social impact will be very important, because people far away from their home need not to be worried about it. In the time of emergency they will be warned by the system.

It is a law cost security system, and it really easy to make a home secured with MSS.

b) Future work

The system was an experimental platform; which have successfully implemented and tested all the main functions that the system is intended to meet. In its commercial release, the system may lead to great achievements in home and office security and prevention of different dangerous situations such as fire and theft.

In further release of the HSS, the system can be extended to transmit camera view of home to the users via their mobile phones and other mobile devices like PDA [15].

The system may consist of a gas/smoke sensor, an aqua sensor, a temperature sensor, a microcontroller module, a number of cameras, a GPRS modem and a PC. Sensor can be wired to the microcontroller module, and this module can be connected to PC via its serial port. These sensors can cause corresponding actions to be taken by the main software on PC. The cameras placed rooms by the users, connected to PC from USB port. GPRS modem, used by software to send SMS to users and call police and fire departments, can be connected to the PC via its serial port (COM1). The microcontroller, cameras and GPRS modem can be connected to this PC. Figure-5 shows the components and structure of the future work of a Security System.

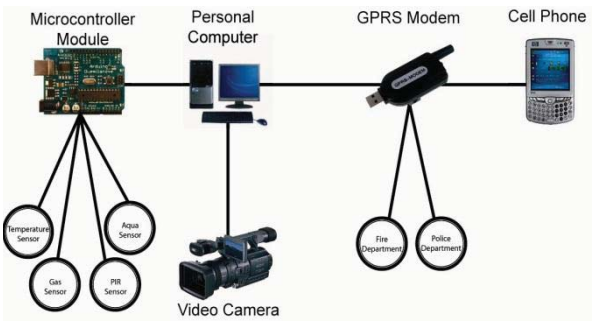

Figure-5 : Future work

VII. Conclusion

The MSS (Microcontroller based Security System) is a security system for homes, offices, shops, banks etc [10]. It is developed to make offices and especially homes much more secure. Although there are existing security systems for that place, the MSS differ from them in many ways. The system was designed using locally available components and it is very cheap. Accessibility from mobile devices makes the MSS is

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