WIRELESS HOME AND INDUSTRIAL AUTOMATION SECURITY SYSTEM USING GSM

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Abstract: Security and automation is a prime concern in our day-to-day life. The approach to home and industrial automation and security system design is almost standardized nowadays. In this paper, we have tried to increase these standards by combining new design techniques and developed a low cost home and industrial automated security systems. Everyone wants to be as much as secure as possible. The design of simple hardware circuit enables every user to use this wireless home security system with PIR sensor, Gas sensor, Smoke sensor and Main fuse Failure Detector at Home & Industries [6].

The system is fully controlled by the 8 bit P89V51RD2 microcontroller. All the sensors and detector are interconnected to microcontroller by using various types of interface circuits. The microcontroller will continuously monitor all the sensors and if it senses any security problem then the microcontroller will send the SMS to the user mobile through GSM modem.

The Microcontroller also turns ON and OFF the electrical appliances in home and industry based on SMS received from the user.

Keywords: Security Systems - PIR Sensor - Gas Sensor - Smoke Sensor - Fuse Failure Detector - RS-232 Interface Circuits SMS (Short Message Service) - GSM Communication.

INTRODUCTION

Home security is the most significant one for every homeowner either in an individual house or an apartment. To get the absolute peace of mind whether you are at first time home or out of home you must ensure that your home is installed with the perfect home security monitoring system. This wireless home and industrial automation and security system can be used to provide security system for residential, industrial, and for all domestic and commercial purposes using GSM technique [7]. Security systems are certain electronic devices which are used to detect intrusions in home or industry [9] [10]. The basic components of a home automation security system are motion detectors, LPGdetectors and smoke detector. In this paper we aim to overcome the flaws made by many other security device as it is most effective in security purpose. It is cheaper and can be maintained easily than any other security device. This device works in two way modes.

    a. Internal mode
    b. External mode

When the internal mode is selected by the user when they are inside the wireless security area, the entire sensor except PIR sensor will be activated and the buzzer connected with the microcontroller will give an alarm and the reason for the insecurity will be displayed in the LCD connected to the microcontroller. In this mode, the electrical appliances in the security area automatically change to the manual mode in which user will control it.

When the external mode is selected by the user when they are outside the wireless security area, all the sensor will be active and the security area address which is pre-programmed, along with the problem will be sent as SMS to the specified police station, fire station, security room and also to the user at the time of insecurity, fire accident, unwanted movement of persons etc. which is sensored by the respective sensor. In this mode, the electrical
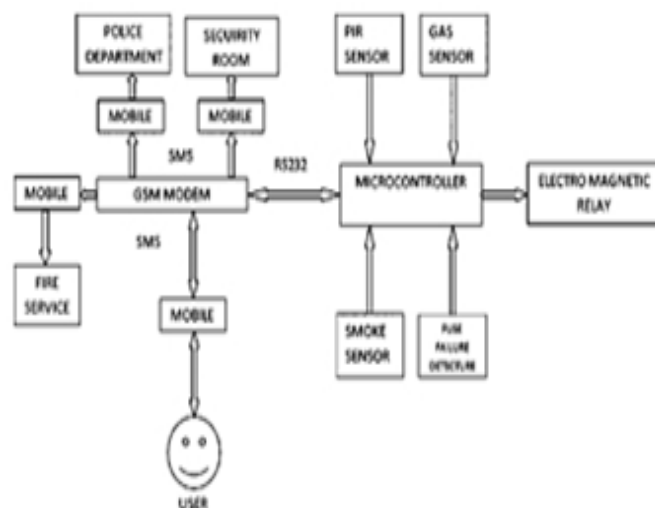

Figure 1: Block Diagram of Overall System

Appliances in the security area will automatically change to the automatic mode in which user will control it via SMS [8].

PIR SENSOR

The PIR (Passive Infra-Red) sensor is a pyroelectric device that detects motion by measuring changes in the infrared level emitted by surrounding objects. This motion can be detected by checking for a high signal on a signal I/O pin. PIR sensor is a Electronic devices which is used in some security systems to detect an infrared emitting source [1]. All living beings whose temperature is anything above absolute zero (-273.15®C or -459.67®F), emits infrared radiation. This radiation (energy) is invisible to the human eye but can be detected by electronic device designed for such a purpose. The term "passive" in this instance means the PIR which does not emit any energy type but merely sits "passive" accepting infrared energy through the 'window' in its housing.

A) ***Working of Passive Infra-*** Red Sensor All PIR sensors will detect changes in infra-red radiation, in the form of heat emitted by a number of bodies including human being, cars and to a lesser extent like dogs and other small animals. The bigger the body, the more the infra-red radiation is emitted and it is easier for a PIR sensor to detect. The field of view is the area in which changes in infra-red radiation can be detected. The field of view can alter with changes in temperature and the size of the heat source. Each zone is constantly monitored by the sensor. When a person or other heat source enters any zone, the level of infrared radiation in that zone increases. This change is detected and processed by the sensor, by switching on the connected Transistor and starting the in-built 'Time' process. Providing the heat source (person) continues to move in the field of view, the PIR sensor will keep processing the changes in infra-red radiation and the lighting will stay on [2]. If a person stands still in the field of view or moves out of the detection area, the sensor will not detect any changes in infra-red radiation between the zones and the lights will go out after the 'Time' period is complete.
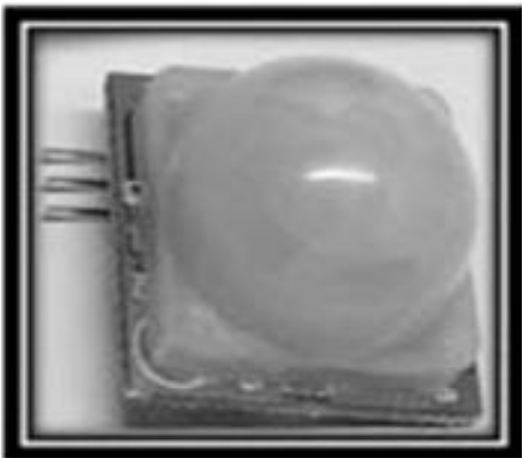

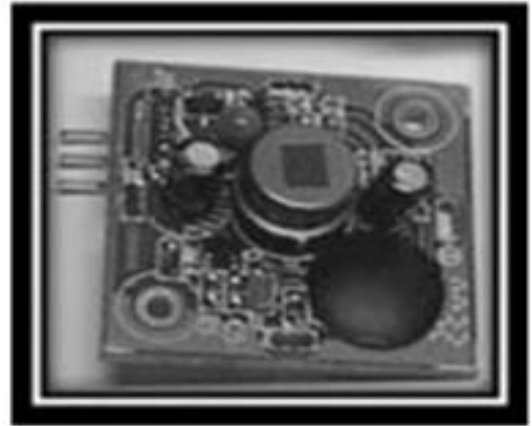Figure: 2 External View of PIR Sensor
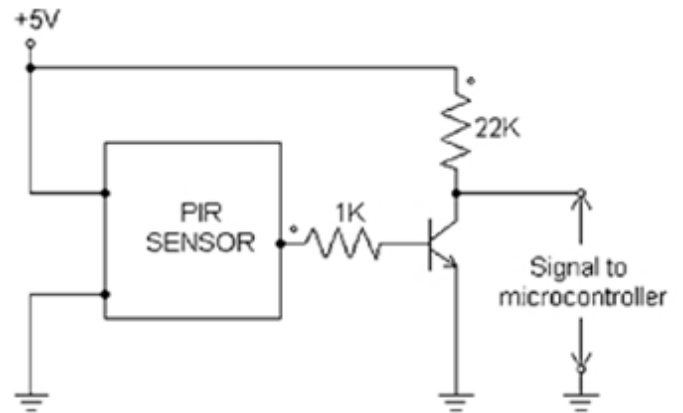

Figure: 3 Internal View of PIR Sensor

Figure: 4 PIR Sensors to Microcontroller Interface Circuit

In order for the sensor to be most effectively detecting changes in heat between zones, it is advisable to walk across the zones not up or along a zone [5]. PIR sensors are passive devices and they do not emit or radiate any energy or beams.

GAS AND SMOKE SENSOR

This sensor is used to detect the gas leakage and smoke occurring in home industry or in malls. This is used to detect gases like LPG/I butane/propane/methane/alcohol/hydrogen/ smoke. There are different types of gas sensor which detects different gases according to different concentration parameter. Here we are using MQ-5 & MQ-2 gas and smoke sensors which detect coal gas/ methane/ LPG and combustible gas/smoke respectively.

Table 1: Types of Gas & Smoke Sensor

Detecting Gas	Sensor Type	Calibrating Concentration
Combustible gas/Smoke	MQ - 2	1000ppm ± 30%
Natural Gas/Methane	MQ - 4	5000ppm ± 3%
Coal Gas/Methane/LPG	MQ - 5	2000/5000/2000ppm ± 30%
CO	MQ - 7	200ppm ± 30%
COAL Gas	MQ - 8	800ppm ± 30%

Types of Gas & Smoke Sensor:

The sensor is composed of micro Al2O3 ceramic tube. Tin dioxide sensitive layer, measuring electrode and heater are fixed into crush made by plastic and a stainless steel net. The heater provides necessary work condition for work sensitive component [10].
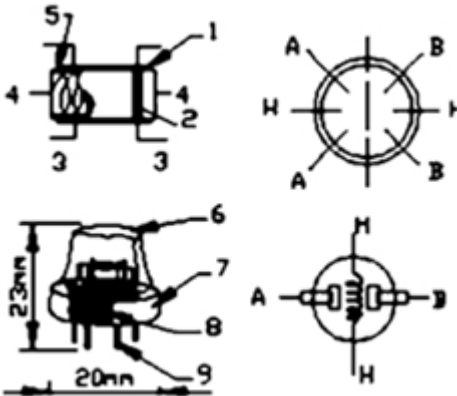

Figure: 5 Parts Description of Gas & Smoke Sensor

Table 2: Parts of Gas & Smoke Sensor

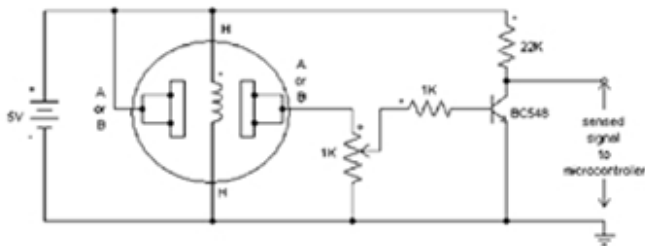| S.No.	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Resin base	Copper plating Ni

Figure: 6 Gas & Smoke Sensor to Microcontroller Interface Circuit

In gas/smoke sensor (MQ-2/ MQ-5) there are totally 6 pins among which 4 pins are used to catch the signal and two pins are used for providing heating current. Whenever the gas/smoke leakage is detected by the

sensor, the circuit starts working with 5 volts supply and current passes through the heater coil to heat it. At particular temperature the current passes through 1KΩ Variable resistor. Due to this effect voltage across Base-Emitter of NPN transistor which is increased at the time of NPN transistor start conduction, resultant collector voltage goes to zero. Microcontroller input pin is connected in collector of NPN transistor, so microcontroller senses the gas leakage.

FUSE FAILURE DETECTOR

Fuse failure detector is a special type of sensor, which will be activated when the security area's fuse breakdown by some unwanted person or by artificial means. During these conditions, fuse failure detector will send the active low signal to microcontroller. At normal condition the IC (MCT2E) between the pin 4 and 5 will be open and the microcontroller pin 36 will be high. When the failure of fuse occurs, the IC (MCT2E)pin 4 and 5 will be closed and microcontroller pin 36 will be zero.

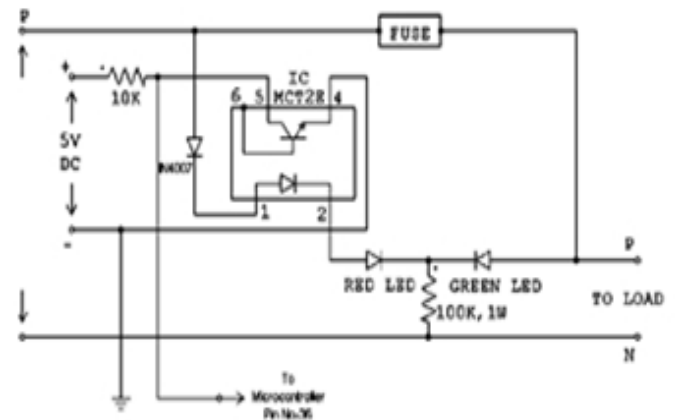The IC (MCT2E) will also provide isolation between power and control circuits.

Figure: 7 Fuse Failure Detector Circuit

GSM MODEM

GSM (Global system for mobile communication) is a cellular network. GSM network operate in four different frequency ranges. Most GSM network operates in 900 MHz or 1800 MHz bands. The transmission power in the handset is limited to a maximum of 2 watts GSM 850/900/300 and 1watt in 1800/1900. The longest distance the GSM specification supports in practical use is 35Km (22 mi). In this paper we use SIM300 based GSM modem to receive and send short message to user and system[3].

Figure: 8 Photo Image of SIM300 GSM Modem

GSM modem is interfaced with microcontroller through RS232 protocol. Microcontroller receives and sends messages by using standard AT commands.

CONTROL AND INTERFACE CIRCUITS

Nowadays, microcontrollers are so cheap and easily available that it is common to use them instead of simple logic circuits like counters for the sole purpose of gaining some design flexibility and saving some space. Some machines and robots will even rely on a multitude of microcontrollers, each one dedicated to a certain task. Most recent microcontrollers are 'In System Programmable', meaning that you can modify the program being executed, without removing the microcontroller from its place. In this paper a PHILIPS made P89V51RD2 Microcontroller is used. It has 8-bit data bus, 16-bit address bus, 32 general purpose registers each of 8 bits, 16 bit timers, 3 internal and 2 external interrupts, Bit as well as byte addressable RAM area of 16 bytes. Four 8-bit ports, (short models have two 8-bit ports). 16-bit program counter and data pointer, 64K Flash memory and UART for serial communication. The microcontroller is programmed by using Flash Magic software. In the circuit, the PORT 0 is assigned as input of sensors; PORT 1 is assigned as display control, PORT 2 is assigned as electromagnetic relay control and PORT 3 UART is used to communicate with GSM modem.
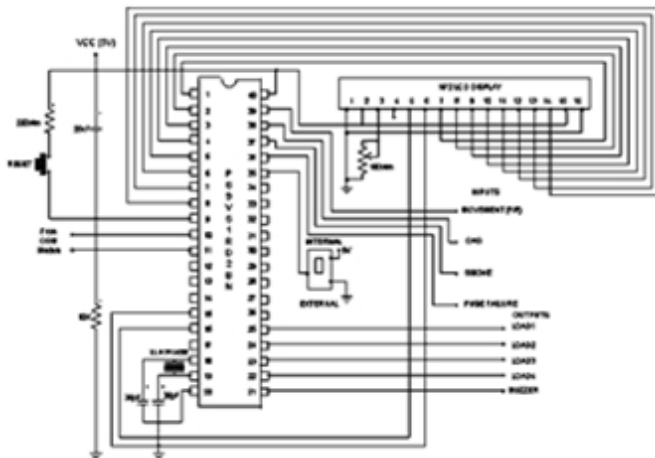

Figure: 9 Interface circuit for Microcontroller with 16*2 LCD Display

RELAY AND BUZZER INTERFACE CIRCUIT

An electromagnetic relay is a type of electrical switch controlled by an electromagnet. Electromagnetic relay is used to control electrical appliances presented in home based on user instruction. The buzzer is used to make warning sound against gas and smoke detection. The microcontroller does not have sufficient drive capability on its output to drive the relay, so there are a number of ways to drive relays. Relays are usually controlled by transistor or driver IC like ULN2003. Driving current for each relay and buzzer is then needed about 60mA at+12V supply.

A Darlington transistor array, ULN2003 is used to increase driving capacity of the microcontroller. The ULN2803 is of 12V TTL, CMOS devices. It internally employs high voltage, high current. Each Darlington arrays contains seven open collectors. The Darlington pairs with common emitters, each channel rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite to the outputs to simplify board layout.
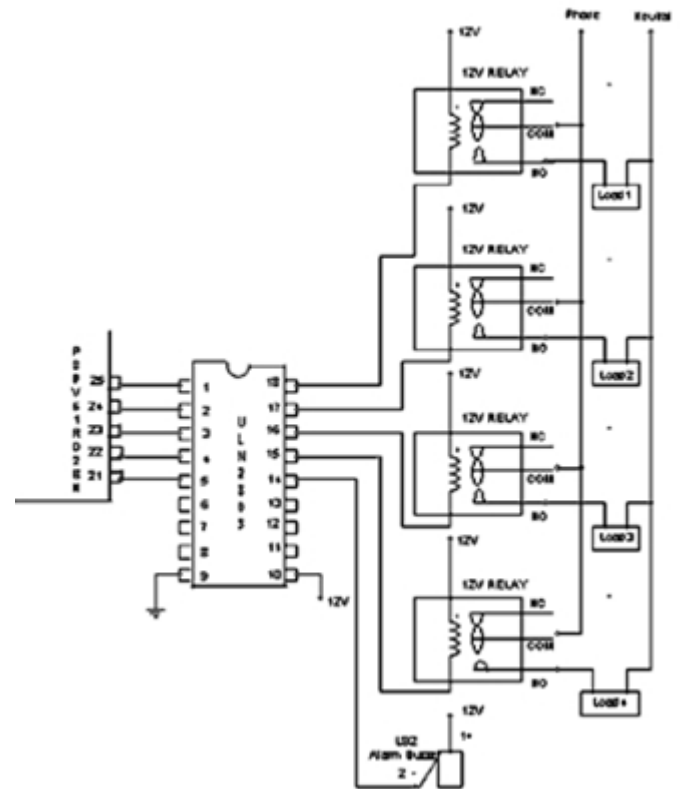

Figure: 10 Interface Circuit for Microcontroller with Relays and Buzzer

WORKING OF THE SYSTEM

The system is fully controlled by the microcontroller and the microcontrollers will continuously monitors the sensors, detector and GSM modem. If the voltage level of sensor input pins goes to zero then it will send the "AT + CMGS ="USER MOBILE NUMBER" to GSM

modem through serial port [4]. The GSM modems will response with the character ">". After receiving ">" Character microcontroller again send the type of security problem SMS + CTRL Z to GSM Modem. GSM modem will send the type of problem to user. For example any moment detected in security area at the time microcontroller pin number 39 goes to logical zero. Microcontroller sensed the change and immediately send AT + CMGS = '+888888888888' to GSM modem, GSM modem give ">"character to microcontroller. After receiving ">" Character microcontroller again sends the"MOMENT DETECTED" SMS to GSM Modem. GSM modem sends the SMS to user.

When a new sms arrived, the GSM modem would send the AT + CMTI: "SM", 1 byte stream to microcontroller, To read the message, The microcontroller send the command AT + CMGR = 1 to GSM modem. The GSM modem will respond with something similar to the following: + CMGR: "REC UNREAD", "+888888888888", "08/08/09 18:20:35 + 00", + CR + LF USER SMS OK. The first part is the command + CMGR, the second part is the status of the message, the third portion is the sender's mobile number, the forth portion is the base station time-stamp, followed by the carriage return and line feed characters, the message content, and finally the "OK" terminating character. After receiving SMS, the microcontroller take necessary action based on user SMS [9]. For example user send the sms "Light One On"to GSM modem number, GSM modem receive the sms and send AT + CMTI: "SM" to microcontroller. After receiving the command microcontroller will send text message read command "AT + CMGR = 1" to GSM modem, after receiving read command microcontroller send received message in the format of + CMGR: "REC UNREAD", " + 888888888888", "08/08/0918:20:35 + 00", Light one on OK. After receiving original message, microcontroller will skip all the character before the six inverted comma, then will read the original message and verify with pre loaded user message then make pin number 25 to high.
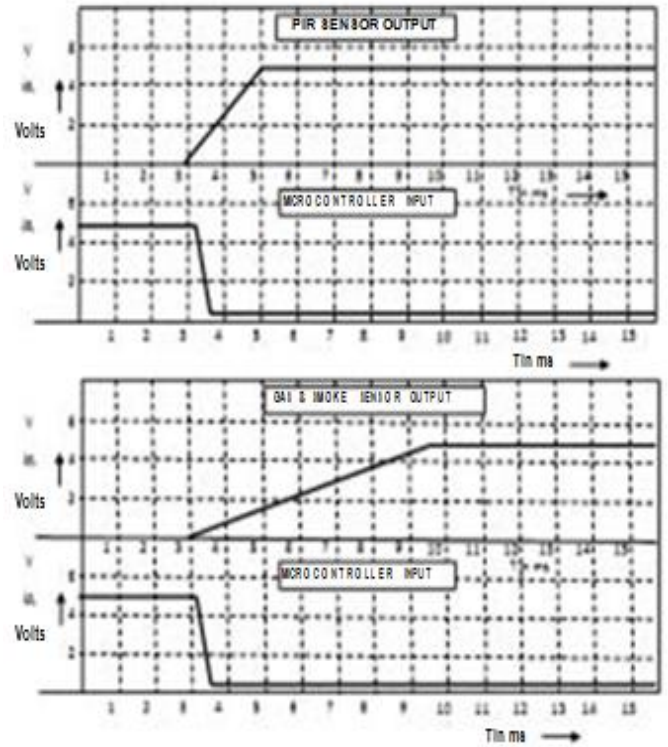

Figure: 11 Waveform of Sensors and Microcontroller input

In the graph shown in figure 11 is clear that when the sensors are in ideal position, the input of the microcontroller remains nearly 5V which is considered as logical one by microcontroller. When the sensors are activated, the voltage across base emitter (V_{BE}) of the transistor increases which makes transistor to turn on. Now the voltage across the collector emitter (V_{CE}) of the transistor is 250mv, which in turn serves as a input for microcontroller. As the logical low value of the microcontroller is 800mv but the input from the transistor is of low range, it is considered as logical zero.

Figure: 12 Photo Images of Working Model

CONCLUSION AND FUTURE WORK

This paper presents mobile controlled user friendly and low cost home and industrial automation and security systems. After a through study of literatures of all the topics that include home automation design and wireless networks. A simple system to improve the standards is developed. It is a real-time monitorable and remote controlled system developed with simple hardware which simplifies the possibility of error free security system. This system can be easily implemented with maximum reliability and the high security with low cost is a special enhancement from the existing systems for Home security.

The main control program is developed by using embedded C language and converted to exe file by using Keil package. This program enables the interaction between all hardwares connected in microcontroller and sends appropriate signal to the User through GSM.

System. In future this application can be extended to monitor "N" number of locations using Zigbee for error free data transmission.

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