# PASSWORD PROTECTED GSM BASED SENSOR STATUS MONITORING ALERT AND DEVICE CONTROL SYSTEM FOR HOME AND INDUSTRIES

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## Abstract

*Security has become an important issue everywhere. Homes, industries, assets and vehicle security are becoming necessary nowadays as the possibilities of intrusion are increasing day by day. Conventional security systems keep home and industry owners and their property safe from intruders by giving the indication in terms of alarm. However, these are of no use when the owner is away from the place and industrial areas away from cities. Safety from accidental situations like leaking of toxic, inflammable gas and fire are the most important requirements of industrial and home security systems. The new and emerging concept of smart homes and security monitoring offers a comfortable, convenient, and safe environment. Monitoring remote sensors presents a unique set of challenges to remain cost effective, safe and secure with installations in all different types of environments and distances.*

*Here, we have tried to increase these standards by combining new design techniques and developed a low cost automated home and industrial security monitoring and emergency alert systems. The design of simple hardware circuit enables every user to use this wireless home security system with IR Sensor, PIR sensor, Gas Leakage Sensor, Fire/Temp Sensor and Door/Window open sensors at Home & Industries. The sensors can be of domestic or industrial use. The system is controlled by the 8 bit P89S52 microcontroller. All the sensors and detector are interconnected to microcontroller by using various types of interface circuits. The microcontroller in this system will continuously monitor all the sensors and if it senses any emergency or security problem, the system will send the SMS to the user mobile through GSM modem. Here, GSM modem is used to send the SMS whenever there are changes are noticed in the protected environment. This system detects if any person is entering inside the house. This feature is helpful at night time or whenever we are out of our home. It also senses door-latch opening using a password entered through keypad. As well as sending this data to a GSM modem through serial port. This module also turns on buzzer if wrong passwords are entered. This instrument can also be used for remotely controlling industrial or domestic appliances by sending a SMS from any corner of the world. It turns ON and OFF the electrical appliances in home and industry based on SMS received from the user. This system lets you remotely control equipments by sending plain text messages consisting of a password and the control command in the form of simple bit pattern. Additionally, we have provided another feature of locally controlling the same devices also from a matrix keypad when the user is near this system. This feature avoids the unnecessary wastage of SMS messages when we are near the system i.e. at home or industry and can directly control devices. Any appliance or gadget which works on AC mains can be connected to this system.*

*This is an embedded microcontroller based system makes the task of the various operators easy as they can sit anywhere and control the status of the various loads by sending a SMS and also to know the present status of all connected sensors and devices using the convenience of SMS.*

***Keywords:*** *Embedded microcontroller, dual band GSM modem, modem interface and level converter, IR based intrusion sense system,door or window open sensor, fire(temperature)sensergas leakage senser, vibration senser,matrix keyboard LCD display unit, buzzer driver and buzzer, power supply.*

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## 1. INTRODUCTION

The explosive growth in cellular mobile communications in the recent decade is changing the way people live and work. With the rapid development of mobile communication technology, a mobile phone is evolving from a wireless device for voice only communications to a truly portable personal terminal for data communications and networking. Mobile handsets today are essentially handheld computers with integrated mobile radio communication capabilities. This opens the door for introducing a vast variety of functionalities to the mobile phone and making the mobile a

real intelligent device. A typical application of such system is home, office, industry or farming field environment monitoring with a wide variety of sensors and security alert.[1]

In the modern industrial world, protection of information, assets and vital installations from accidents like fire, theft and other unexpected things is very essential. Now with a dynamic change in the techniques adopted by the fraudsters, it requires a hi-tech man-machine interface to protect an organization. [2] Although it is always a battle of wits between a criminal and security agencies, many a times the criminals have taken the lead. Lack of expertise to handle hi-tech crimes, carelessness and ignorance are some of the causes that have led to loss of valuables.

Industries, business houses and corporate agencies expect and demand comprehensive security solutions for their wide-ranging operations. But human limitations will persist and only intelligent electronic devices and security personal can overcome these problems. Unfortunately, in most industries, security is considered a low-priority area. However this attitude needs to be changed. A comprehensive solution includes various related aspects of an organization, pertaining to security of all its assets including personal, equipment, process information, intellectual property, business logistics etc. The security system should also cater to natural calamities such as fire accidents, release of toxic gases from a manufacturing plant etc. Quick, accurate and timely information about an accident, intrusion, crime or attempted burglary is vital. Apart from industries, a home, office, high security zones, farming filed etc also demand for an effective environment monitoring and security alert system.[3]

The **"Environment Monitoring And Intrusion Sensing Alert System For Home And Industries Through SMS On GSM Network "** chosen as project by us has been designed such that, after sensing any mishap at the place of its installation, sounds a loud alarm and automatically sends a concise SMS to the predetermined mobile phone number. It can intelligently choose and send SMS to different phone numbers, chosen by the system, based on the kind of mishap i.e. which sensor is active at that time. Thus it can send an SMS to a fire station in the event of fire and smoke and can send to police station to prevent theft and robbery. It can send an SMS to the owner of the house or any other number as preferred by the owner of this instrument. It can also be used by the seriously ill patients to get medical help from the doctors and seek help of police or neighbors in the event of a robbery and even to inform about the failure of critical machine or equipment in industries and hospitals. The phone number to which the SMS has to be sent for different sensor activation can be different and chosen by the owner according their convenience. This could be a GSM phone number or a CDMA mobile phone number. Infrared Motion Detector can be used to detect the entry of unwanted persons into any premises by the change in infrared radiation.[4].

This project is aimed at developing an advanced security alert system to detect and allow only the authorized persons into a high security zone like the vital defense establishments, nuclear installations and power plants, parliament house, legislative house, military installations, corporate office or any other such important place where the entry of unauthorized people has to be strictly avoided. The "Environment Monitoring And Intrusion Sensing Alert System For Home And Industries Through SMS On GSM Network " chosen as project by us has been designed such that, after sensing any mishap at the place of its installation, it automatically sends a concise SMS to the predetermined mobile phone number. It can send SMS to different phone numbers. It can send an SMS to the security personal or the owner of the house or any other number as preferred by the owner of this instrument. The phone number to which the SMS has to be sent can be chosen by the owner according their convenience. This could be a GSM phone number or a CDMA mobile phone number. This system employs four layers of detection for sensing the entry of intruder into the guarded area. It uses Passive Infrared Motion (PIR) Detector and also Infrared (IR) light barrier. The next level uses vibration sensor to sense the knock or impact on door and magnetic sensors to sense forcible opening of the door or windows.[5],

It produces a trigger whenever there is change in the infrared radiation level in the vicinity of its installation. This trigger pulse is applied to the microcontroller. The IR transmitter together with IR receiver acts as a barrier. The IR transmitter will transmit a continuous invisible (IR) light beam towards the IR receiver. The receiver receives this light when there is no obstruction in the path of this transmission. [6] Whenever the intruder passes between the IR source and receiver, the light beam is obstructed and hence the receiver sends a trigger signal to the microcontroller. When a knock or impact is sensed, a vibration sensor gets activated and provides a trigger signal to the microcontroller. Magnetic sensors to sense forcible opening of the door or windows and provides a trigger signal to the microcontroller.

Whenever a trigger is sensed from any of the sensors, the microcontroller activates the buzzer and produces a occasional beep sound to allow authorized person to enter their password through the matrix keypad. If the person fails to enter correct password in a predetermined time period, it produces continuous buzzer sound and sends SMS containing the details of security breach.
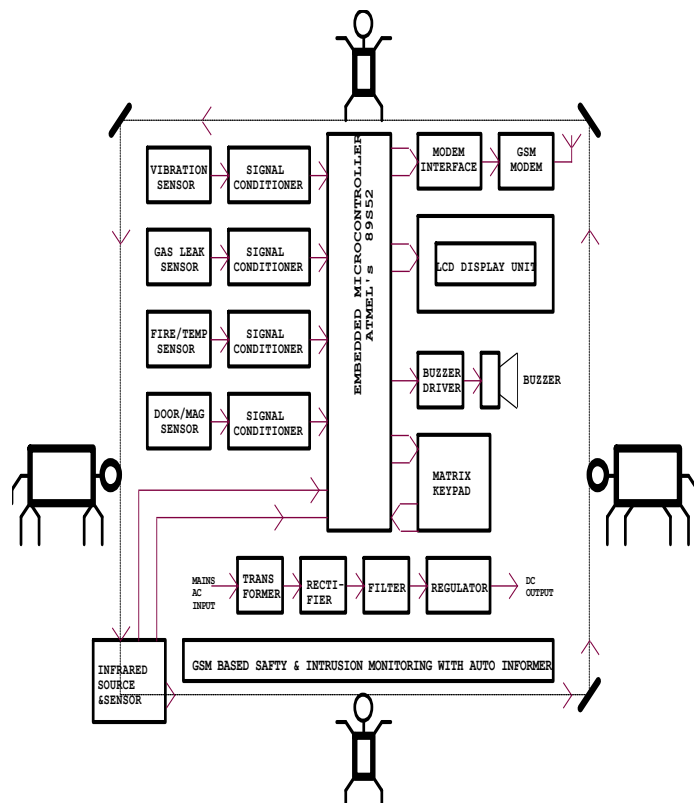
## 2. SYSTEM ARCHITECTURE



**Fig.1**–Basic Architecture

The block diagram of the "Environment Monitoring And Intrusion Sensing Alert System For Home And Industries Through SMS On GSM Network" is shown in the figure above.

The above figure consists of the fallowing.
- Embedded Microcontroller.
- Dual band GSM Modem.
- Modem interface and level converter.
- IR based intrusion sense system.
- Door and window open sensor.
- Fire (temperature) sensor.
- Gas leakage sensor.
- Vibration Sensor.
- Matrix Keyboard.
- LCD Display Unit.
- Buzzer driver and Buzzer.
- Power Supply.

- ***Embedded Microcontroller: -*** The Embedded microcontroller is the most important part of this system. The microcontroller does all controlling activities of the system by executing a program stored into its memory. The microcontroller chosen for this project is ATMEL's 89S52.It is an 8-bit microcontroller with 8-K Bytes of internal flash program memory, 256-Byte Data memory and four 8-bit I/O ports, one serial port, two timers and 5 interrupts. Its instruction set is compatible with Intel's 8051 microcontroller. It is an ideal choice for compact embedded system design. The program

for the microcontroller can be developed in assembly language or embedded 'C'. The tools like Kiel, Ride, SPJ or UMPS or the similar one can be used for developing and assembling/compiling the program and then the generated hex file can be downloaded to the internal flash program memory of the microcontroller by using flash programmer instrument. The microcontroller in this system controls all subsystems like Sensors, Matrix Keyboard, LCD panel, GSM Modem, Relays, and Buzzer etc which are present in this prototype.[7]

- ***Dual Band GSM MODEM: -*** A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem sends and receives data through radio waves. It uses two different frequencies, one for uplink (900 MHz) and another for downlink (1800 MHz).A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer or a microcontroller through a serial cable. GSM modems can be a quick and efficient way to get started with SMS, because a special subscription to an SMS service provider is not required. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. In most parts of the world, GSM modems are a cost effective solution for receiving SMS messages, because the sender is paying for the message delivery. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. Computers or the microcontrollers use AT commands to control modems. GSM modems support a set of standard AT commands. These AT commands are defined in the GSM standards. With the AT commands, you can do things like Reading, writing and deleting SMS messages, Sending SMS messages, Monitoring the signal strength, Monitoring the charging status and charge level of the battery, Reading, writing and searching phone book entries etc.[8]

- ***Modem interface and level converter: -*** The 8051/8052 microcontrollers and their derivatives have two pins that are used for transferring and receiving data serially. These two pins are called TXD (Pin11) and RXD (Pin10) and they are part of the port3 group (P3.0 and P3.1).These pins are TTL compatible. The GSM Modems work on RS 232 standard. The RS 232 standard is not compatible to TTL, therefore, it requires a line driver such as the MAX232 chip to convert RS232 voltage levels to TTL levels, and vice versa. One major advantage of the MAX232 chip is that it uses a +5V power source which is the same as the source voltage for the microcontroller.

➢ **IR based intrusion sense system: -** This is placed at the entrance of the building to sense the arrival of any intruder. It uses invisible light beam as a barrier and consists of a IR Transmitter and a IR Receiver. IR Transmitter is placed at one side of the gate and the IR Receiver is placed on the opposite side. They are placed face to face, so that the IR light falls straight on the receiver. The IR transmitter transmits an invisible modulated (38 KHz) IR light beam pointing towards the IR receiver unit. It consists of a 38 KHz oscillator and IR Light Emitting Diode and Sensor section consists of 3-terminal IR Sensors. These sensors are sensitive to 38 KHz. They produce TTL compatible signals when a coded IR light beam is incident on them. This signal is sensed by the microcontroller and used for further processing. [9]The IR receiver is un-affected by the surrounding natural light. When any person tries to enter the building, he/she, unknowingly interrupts this invisible light beam. The sensor then sends a signal to the microcontroller. If the person happens to be an authorized person, the system prompts the person to enter their password through the matrix keyboard. If the password is genuine, the system allows the person to enter the premises, otherwise it sends an alert SMS and sounds buzzer to catch attention.

➢ **Door and window open sensor: -** Door and window open sensors are used to sense when anybody tries to forcibly open the doors/windows. It consists of a magnetic reed switch mounted on the frame and a bar magnet mounted on the door/window. They are mounted such that when the door/window is in closed position, the magnet and the reed switches are in close contact and the switch remains closed. When the door/window is opened, they move away from each other and the switch opens. This sends a signal to the microcontroller.

➢ **Fire (temperature) sensor: -** Fire always increases the temperature of the surrounding area. Hence, a temperature sensor can be used effectively for determining fire. The temperature sensor chosen for this project is LM35D.It is an industry standard semiconductor, temperature transducer; suitable for the temperature range of -50°C to +150°C. It is a voltage o/p device. It produces a DC Voltage proportional to surrounding temperature. This Voltage is internally calibrated to provide 10mVolts/degree centigrade. This signal is amplified and fed to a comparator to check whether the temperature has risen above the threshold value.

➢ **Gas leakage sensor: -** It is used to sense the leak of domestic cooking LPG gas. Figaro TGS 8-series sensors are a type of sintered bulk metal oxide semiconductor, which offers low cost, long life, and good sensitivity to target gases while utilizing a simple electrical circuit. The TGS813 displays high selectivity and sensitivity to Liquefied Petroleum Gas (LPG) and methane. The sensing element of Figaro gas sensors is a tin dioxide (SnO2) semiconductor, which has low conductivity in clean air. In the presence of a detectable gas, the sensor's conductivity increases depending on the gas concentration in the air. A simple electrical circuit can convert the change in conductivity to an output signal, which corresponds to the gas concentration. The **TGS 813** has high sensitivity to methane, propane, and butane, making it ideal for natural gas and LPG monitoring. The sensor can detect a wide range of gases, making it an excellent, low cost sensor for a wide variety of applications. This produces an analog signal proportionate to ppm concentration of the gas. This signal is amplified and fed to a comparator to check whether the gas concentration is above the threshold value. Comparator sends a signal to the microcontroller accordingly.

➢ **Vibration sensor:** - the peizo-electric property is a reversible phenomenon. Whenever an electric excitation (voltage) is applied across the opposite faces of quartz crystal, it starts to vibrate and hence produces mechanical oscillations. Whenever mechanical vibrations are applied to the crystal, it produces electric potential across opposite faces of the crystal. Thus a crystal can be used for the construction of vibration sensor. The mechanical vibrations are applied to a thin diaphragm. The diaphragm vibrates in accordance with the applied mechanical vibrations and applies pressure to the crystal. The crystal generates a voltage in accordance with the vibrations. These voltages are of very low amplitude. Hence these signals are fed to an op-amp amplifier. The amplified signals are fed to a monostable multivibrator for producing pulses of fixed duration. The microcontroller routinely checks the outputs of the monostable multivibrator. If more than one sensors are activated, the microcontroller sends a wireless warning the receiver unit.[13]

➢ **Signal conditioner and Comparators: -** The output signal from a transducer is very small; hence it needs to be amplified. Amplification is done in the signal conditioner. Its design depends on the type of transducer connected to it. It is usually an instrumentation amplifier. It also has a filter to remove the undesired signal from the original signal. In electronics, a comparator is a device that compares two voltages or currents and switches its output to indicate which is larger. An operational amplifier (op-amp) can be used as comparators in many applications in theory a standard op-amp operating in open-loop configuration (without negative feedback) may be used as a low-performance comparator. When the non-inverting input (V+) is at a higher voltage than the inverting input (V-), the high gain of the op-amp causes the output to saturate at the highest positive voltage it can output. When the non-inverting input (V+)

drops below the inverting input (V-), the output saturates at the most negative voltage it can output. The TTL logic level signals are fed to the ports of microcontroller.[11]

- *Matrix Keyboard: -* When the authorized person wants to enter into the premises, he/she has to enter their password in order for the system to recognize them and also to prevent any false alarm or unwanted SMS being sent. The user interaction is through the Hex keypad. There is a keypad suitable for the user interaction with the system. This keyboard is used to receive password and device status required for various nodes. A 4 x 4 matrix keypad is constructed using 16 soft tactile switches. This keypad can produce hex codes from 0-9 and A-F. The switches are arranged as 4-rows and 4-columns.the columns can connected to 4-port pins on any port and the rows on the remaining 4 pins of the same port.[14] The microcontroller scans the keyboard to find out the key pressed and receives the ASCII code for the particular key pressed and uses it for further processing.

- *Buzzer and drive circuit:* - when any abnormality is sensed by the microcontroller through the sensors, an audio tone produced by a buzzer. The microcontroller controls the sound produced by buzzer through a drive transistor. The buzzer driver consists of a NPN transistor operated in CE configuration. It supplies current to the buzzer element connected in its collector. The microcontroller sends TTL level signals, a logic '1' to turn on the buzzer and a logic '0' to turn it off. [10]

- *LCD display panel:* - it has a LCD module for displaying various position parameters and the code received. A 2-line, 16 character type LCD module with backlit facility is used. The microcontroller sends the signals to LCD module through its ports.

- *Power supply:* - power supply section has to provide a regulated D.C supply to all sections of the system. As already mentioned, the entire system is designed work on batteries. It consists of rechargeable batteries, filter capacitors and voltage regulators.[12]

## 3. CONCLUSION

This system is designed using embedded microcontrollers. The system was implemented by first designing the hardware and later the software. It was rigorously tested for its proper operation and reliability.

The design of simple hardware circuit enables every user to use this wireless home security system with IR Sensor, PIR sensor, Gas Leakage Sensor, Fire/Temp Sensor and Door/Window open sensors at Home & Industries. Whenever any of the sensors value becomes abnormal, it checks exactly which sensor is active at that moment to know which parameter is abnormal. If gas leakage, fire accident or door/window broken is sensed, it sends the SMS which contains the information about type of emergency to the pre-programmed owner's number immediately. If the sensor activated is either IR based intrusion sensor or vibration sensor due to knocking on door, it will ask for the PASSWORD. The owner or the authorized person has to enter the PASSWORD through the matrix keypad attached to P0 port, within a stipulated time. If no PASSWORD is entered in that time limit or wrong PASSWORD is entered, it turns on the buzzer by sending logic '1' on P3.2 port pin. If the PASSWORD matches with the internally stored PASSWORD, it turns off the buzzer by sending logic '0' on P3.2 port pin and allows the person to enter and ignores the sensor status and goes back in normal monitoring loop.

Hardware design began by designing individual circuits and their testing. Suitable modifications were carried out at various stages as necessary. After the confirmation of the proper operation of each circuitry, the Printed Circuit Board (PCB) was designed using Protel PCB making software. PCBs are fabricated by the manual process using screen printing and chemical (FeCl) etching technique. After the holes are drilled, the mounting of components and soldering was carried out. The circuit was rigorously tested once again after mounting of all components on the PCB. Voltage levels and signals ware checked for their correctness at various stages. Some minor modifications were carried out as needed.

Software design was started after the hardware was fully fabricated and tested successfully. Programs ware written in 8051 assembly language for individual modules and tested independently. After each module was tested, integration of all software modules and trouble shooting and debugging was carried out. Full functionality of the entire system with all interface modules was finally carried out to test the system for its full functionality and features. The instrument functioned as expected and the desired results were produced.

The prototype functioned well for types of parameter abnormalities and alarms. It has been successfully implemented all features as mentioned in the introduction.

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