

# Development of GSM Based Electronic Security System for Industrial Applications

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## ABSTRACT

During early days, in industrial sector the monitoring and controlling of various parameters for security purpose depicts human interface. Hence, the measurements as well as controlling process become less reliable. Now a day, with the help of atomization process the limitations are minimized. To ensure more security for industrial sector, the development of electronic security system is very important. Therefore, an embedded system is designed for security purpose in industrial sector based on GSM by deploying Arduino microcontroller. The sensors MQ-135, MQ-6 and PIR sensor are interfaced with Arduino to detect smoke, LPG leakage and unexpected motion in the industrial environment respectively. The smoke, LPG and motion dependent signals are applied as input to Arduino Microcontroller. The detection of input signal is ensured by interfacing the buzzer to the microcontroller. The GSM module is also wired about the Arduino for mobile communication. The firmware is developed in embedded C using Arduino IDE. The system is designed and tested successfully. The results regarding implementation of the system are interpreted in this paper.

**Keywords :** Smoke and LPG detector, Arduino, GSM Module, Buzzer, Embedded System.

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## I. INTRODUCTION

It is known that, many people are working in different industries regularly, wherein they may get into contact of various hazardous gases. Sometimes there may be accidental issues such as leakage of gas,

fire due to short circuit occurs in the industrial sectors. Due to such type of issues the employees may have to face very critical situation which causes serious problems for them. In some of the industries it is found that, the industry management is having less awareness about safety of the employees and hence

they are using traditional methods of the same where they check the different security issues through rather less skilled persons and act upon it manually. In the world of atomization, these security methods are not suitable for the industry workers as they are having limitations. A field of atomization reveals the deployment of embedded technology [1-2]. It is also found that in traditional security methods, the industry management is spending considerable amount of money for this issue. In early days, the sophisticated instrumentations are available in R & D Labs as well as in industrial sector. However, the industrial field is now becoming Hi-Tech and hence it needs the sophisticated electronic instrumentation. By using microcontrollers as a computing device an embedded system can be designed for dedicated applications. J. Lozano, J. Suarez, P. Arroyo, J. Ordiales and F. Alvarez have developed the system to monitor quality of indoor air based on wireless sensor network [3]. In this system the quality of indoor air sensed and monitored on the display. P. V. Mane-Deshmukh, D. M. Adat, S. K. Tilekar and Dr. B. P. Ladgaonkar have developed the system to monitor and control Gas Leakages of Industrial Sector using PIC 18f4550, Zigbee and wireless sensor actuator network [4]. It is possible to develop an electronic security system that can provide automatic alerts to the industry workers through loud buzzers as well as management through mobile calls or messages in

emergency case. An electronic system could be wired about one of the microcontrollers and sensors for respective issues along with the data acquisition system. Hence, Arduino based embedded system is designed to ensure industrial security by deploying smoke sensor MQ135, LPG gas sensor MQ6, PIR sensor, GSM module SIM900 and the details of the same are presented in this paper.

## II. DESIGNING OF THE SYSTEM

Based on Arduino microcontroller, an electronic security system is designed for industrial applications. The system is designed by using the hardware such as Smoke sensor MQ135, LPG sensor MQ6, PIR sensor, control unit, buzzer, GSM module, power supply circuit etc. and implemented successfully. The block diagram of the designed system is presented in figure 1 and schematic of the circuit designed for present embedded system is depicted in figure 2. For proper security inside the industrial campus, continuous monitoring or detection of smoke, LPG leakage and unexpected movement in restricted area is very important. Therefore, the sensors MQ135, MQ6 and PIR sensor are deployed in the system to detect smoke or fire, LPG leakage and unexpected movement in the industrial campus respectively.

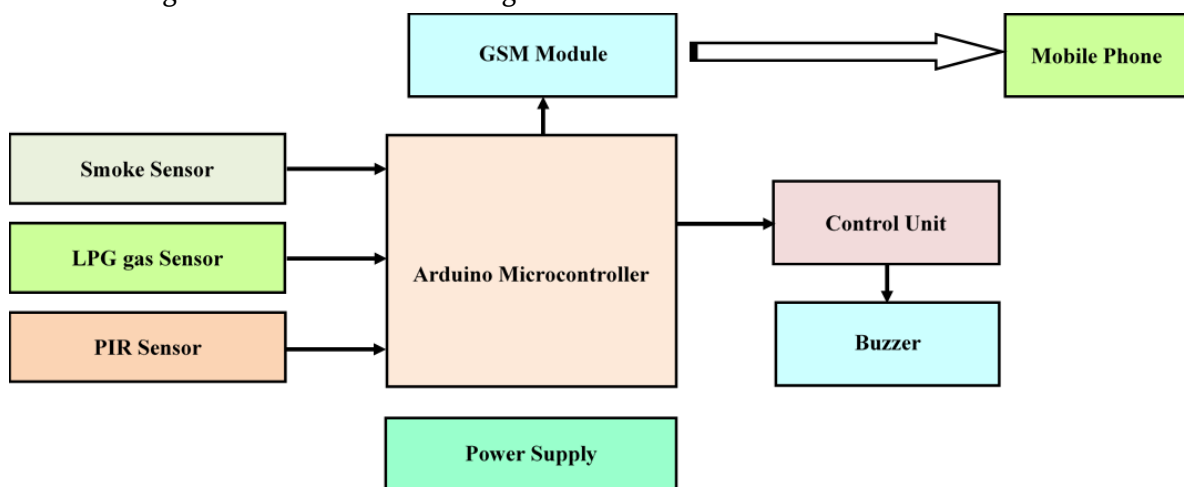


Figure 1: Block diagram of electronic security system.

The output signals of these sensors are relatively proportional analog output voltages, which are applied as input to the Arduino microcontroller. The smoke sensor MQ135 is semiconductor sensor [5] and highly sensitive for ammonia gas, sulfide, benzene series steam, smoke and other toxic gases as well. It is excited with +5V power supply and having the current consumption about 150mA. MQ6 is a sensor having high sensitivity to LPG, propane and isobutene [6]. It is excited with +5V supply and having current consumption of about 150mA. The operating temperature of MQ6 is -10 to 50°C. The circuit connections of the present system are depicted in figure 2. The output of MQ135 is applied to digital pin-2 of Arduino. When smoke is detected, logic high pulse is generated at pin DO of the sensor, which makes digital pin-2 HIGH. The output of PIR sensor is connected to digital pin-3 of Arduino. When the PIR sensor detects any type of motion, a high pulse is generated at OUT pin and sends to digital pin-3 of the Arduino controller. Similarly, the output of MQ6 is connected to digital pin-4 of Arduino. When LPG gas is detected, logic high pulse is generated at pin DO of the sensor and sends to digital pin-4 of the Arduino controller. The outputs of all the sensors are then processed for further action as per the software program. Upon detection of smoke, LPG leakage or unexpected movement in restricted area, the buzzer connected to digital pin-5 of Arduino using relay will be turned ON and starts to sound loudly. The GSM module is deployed in the system using digital pin-0 (RX) and digital pin-1 (TX) of Arduino to communicate the alert signal on registered mobile number [7].

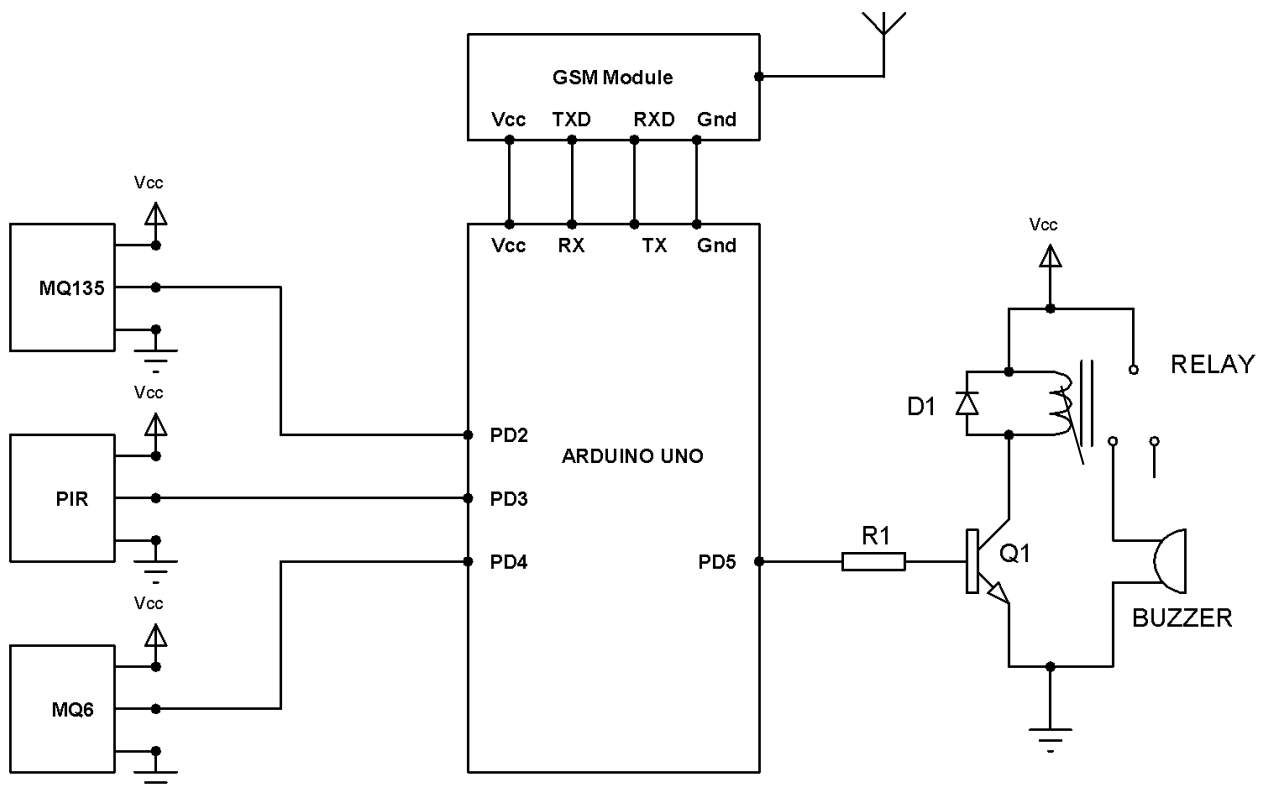


Figure 2 : Circuit schematic of the system.

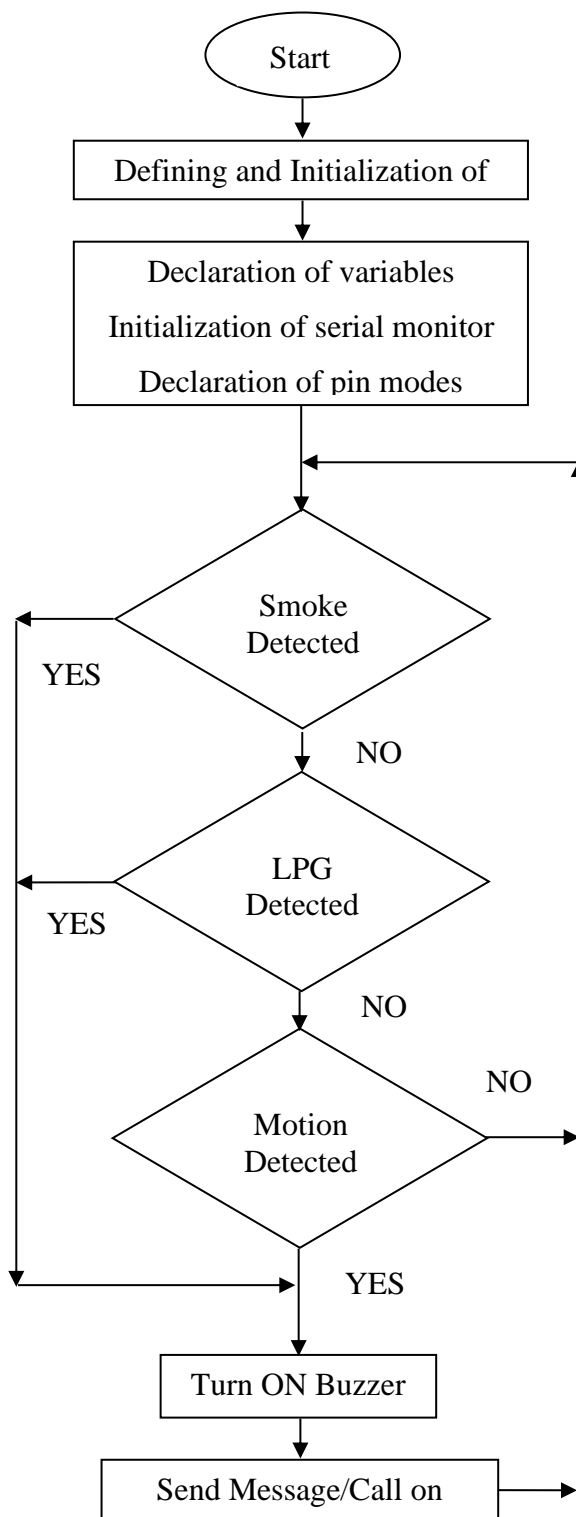


Figure 3 : Flow chart of the firmware

To run the embedded system as per design considerations, the hardware and software are two inherent things. The previous paragraph illustrates

necessary hardware development of the system. However, by using 'Arduino' Integrated Development Environment (IDE), the firmware is consequently

designed in embedded C [8]. The flow chart of the firmware is depicted in figure 3. After successful building of the program, it is loaded into the memory of Arduino which ensures the synthesized embedded system for automatic electronic security of industrial campus against various issues as discussed previously.

### 3. EXPERIMENTAL

In the present research work, an embedded system is developed for industrial security issues such as smoke detection, LPG leakage detection and unexpected movement detection. As depicted in figure 4, a system prototype is developed in the laboratory and results of testing are discussed. As the issues mentioned above are important for industrial security, various sensors are used along with Arduino controller for development of the system. To detect the smoke, MQ135 sensor is used. For the detection of LPG leakage, sensor MQ6 is used. Also the PIR sensor is deployed for the detection of movement. For proper functioning of the system, an embedded C program is developed by using 'Arduino' IDE [9].

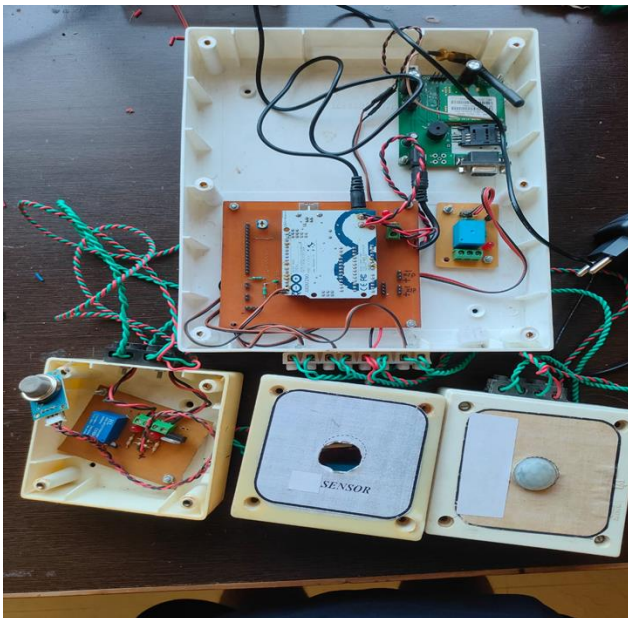


Figure 4 : Prototype of developed System

To ensure the accurate functioning of the system, it is tested in the laboratory. At first, performance of the system is tested only for smoke detection. The incense smoke is released on MQ135 sensor. Upon detection of the smoke, the buzzer started to sound immediately and at the same time message related to fire detection is sent on registered mobile number. Secondly, performance of the system is tested only for LPG leakage detection. LPG gas is released on MQ6 sensor and upon its detection the buzzer started to sound as well as the message is sent on the mobile number. Also performance of the system is tested for antitheft security issue by making some movement in front of the PIR sensor. In this test the system has shown same performance as previous issues. Finally, overall functioning of the system is tested for all the issues commonly by developing suitable software in embedded C with the help of 'Arduino' IDE. From the system performance, it is observed that the system is accurately working for the purpose for which it has been developed. The overall performance of the system can be expressed by following table. For validation, the system is also implemented in one of the industry and observations are recorded [10].

Sr. No.	Security Issue	Buzzer	Message
1	No detection of any issue	OFF	No message
2	Detection of smoke	ON	Message on mobile
3	Detection of LPG leakage	ON	Message on mobile
4	Detection of movement	ON	Message on mobile

Thus, Arduino based embedded system is developed and tested successfully for industrial security issues of fire and LPG leakage detection along with antitheft alarm.

### III. CONCLUSION

By emphasizing embedded technology, an electronic system is designed about Arduino microcontroller for industrial security applications. The system is tested successfully for the purpose for which it has been developed. Experimental results shown by the present system about detection of smoke, LPG leakage and unexpected movement in the restricted area are more precise which reveal the preciseness in the development of the system. Thus, it can be concluded that the system can be implemented for security applications in different type of industries.

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