CONSTRUCTION & PERFORMANCE TEST OF LPG GAS LEAKAGE AND FLAME ALARM SYSTEM

A thesis
By

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Abstract

In this project, we have tried to increase the level of safety system by combining new techniques and adding new concepts to develop a low-cost Global System for Mobile Communications (GSM) based LPG and Flame monitoring and detection system. In our day-to-day life or for industrial purposes, safety is a prime concern. Since all the people from home go to work daily, it is impossible to have check on the appliances available at home, especially LPG gas cylinder, wired circuits, etc. Also, in the industrial system, it is so difficult for the laborers to keep track of every second. So, to work on this problem, the system is developed which will keep track on various home status such as LPG gas cylinder and Flame. This system uses MQ6 gas sensor to detect inflammable gas leakage, there is also used a flame sensor to detect fire. This system contains a controller chip named Arduino which monitors the sensors status and sends SMS to the owner or authority for taking necessary action. This makes it easy for both the commercial as well as domestic sectors to keep track of problems faced on a daily basis. This system effectively tracks the problems that arise in day-to-day life.

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CHAPTER 1

Introduction

1.1 Introduction

Safety is the main concern for every industry. Every industry wants to work in safe and secure environment that are beneficial for the workers and especially for their production process, say for raw materials in the industry. Every industry wants their workers to keep safe and secured from various incidents like accidents caused due to LPG gas leakage or accidents due to fire in their go down or their machinery department. With advancements in technology, safety monitoring systems in both home and industry can be effectively deployed to extensively minimize safety hazards. Fire accident is a common incident in factories, houses, markets in every country [1]. Due to poor fire extinguishing arrangement, lack of adequate fire alarm and emergency exit, it increases death and wreck. When it comes to security issues, we cannot take it for granted. Security is the level of protection against danger and loss. Nowadays, in a world that is full of technology, people need the help of technology to provide early warning alert to ensure they have enough time to avoid danger. In designing this project, the dangerous sources that have been highlighted are gas leakage and fire. This is because both of these can become a huge disaster if the security procedure is not taken early. To minimize fire accident our project will act as a sentinel which is control from a central console room. For detection we used a highly sensitive smoke detector by which microcontroller will get high pulse at input pin which is preprogrammed for our desired output signal [2].

This project is about producing an alert warning system based on the Global System for Mobile (GSM) network. It will be used to detect the presence of natural gases as well as LPG. Whenever gas leakage occurs, the sensors used in the circuit will detect it and the GSM modem will send out an SMS alert to the user and also to the nearest fire station. With the system that provides real-time notification, it increases the response time of the owner. This will provide immediate aid to the situation occur. This system can be installed in kitchens, Liquefied Petroleum Gas (LPG) storage rooms, near the Natural Gas Vehicle (NGV) tank in mobile cursor any places think required [3].

1.2 Objectives

- To study LPG gas leakage and flame alarm system.
- To construction LPG gas leakage and flame alarm system.
- Performance test of LPG gas leakage and flame alarm system.

1.3 Methodology

The goal of the project is to develop a smart automatic gas leakage (like LPG) and fire flame detection system. The system is designed for homes, offices, industries etc. In this system, there will be an alert system for every individual floor. It is designed to detect sudden gas leakage and fire. It will contain necessary sensors for detecting gas leakage and flame. When the system detects gas leakage or appearance of fire in a room or any place, it will take the following steps.

- Scan Gas and Flame and Display in LCD After activation, the device will continuously scan gas or flame and show the result in the LCD display. If there is no gas or flame, then the display will show - 'Gas: Safe; or Fire: Safe'. If there is any gas or fire flame found, the display will show- 'Gas: Detected; or Fire: Detected'.
- Detection of Gas: If there is presence of any gas the display will show 'Gas Alert'.
- Detection of Fire: If there is any fire flame the display will show 'Flame Alert.
- Start Alarm with red LED
- When the sensor finds any gas leakage or flame in the room or where the device is installed, it immediately sends notification on mobile. There will be an automatic messaging system which will send SMS (Short Message Service) to cell phone number.
- Stop Alarm & Reset.

If the gas and flame sensors cannot find any gas leakage and appearance of fire, then it will show that there is no gas leaking and fire is safe. It will keep scanning for gas.

CHAPTER 2

Literature Reviews

2.1 Introduction

Liquefied Petroleum Gas (LPG) is a highly inflammable gas made up of the mixture of propane and butane, although butylene, propylene and other hydrocarbons are present in small quantities [4]. The gas is used as fuel for domestic, automobile and industrial purposes, including several heating applications. However, it has gained considerable use as a cooking gas. Ethanol is added as a powerful odorant to give it its characteristic smell since LPG is odorless, so that when there is gas leakage it can be detected through smell. It is very important that gas leakage is detected because of the flammable nature of the gas. If left undetected it can lead to fire outbreak, causing injuries, loss of property and sometimes death. There are several factors that can lead to gas leakage such as carelessness on the part of the user, the personnel that refilled and/or service the gas cylinder/burner or faulty hose and cylinder. Although gas leakage because of faulty cylinder is very rare because the cylinder can last more than two decades before it expires, it sometimes happens. To illustrate the danger of gas leakage, there was an incidence in Lagos, Bangladesh where a gas explosion in an apartment in a stored building resulted in a serious injury to 24 persons. This is just one of many examples showing the need for an efficient system of gas leakage detection.

2.2 Background

Liquefied Petroleum Gas (LPG) was first discovered in 1910 by the scientist Dr. Walter Snelling which is a combination of commercial grade gases like propane and the other butane which are having saturated and also the unsaturated hydrocarbons. Due to the usefulness of LPG, it is widely employed for many purposes such as industrial and domestic fuel, auto gas, heating, lighting etc. The wide demand in market for the LPG is also growing day by day. But when LPG is leaked, it may lead to serious fire accidents [5]. Also, the number of casualties due to such incidents has also risen in recent years. Therefore, there is purpose for a system to find and also prevent the leakage of LPG. But before the invention of electronic gas detectors for households in the 1980s, it was detected by a chemical dipped paper which will change its color in the presence of those gases. But after many inventions have been discovered to find, monitor and alert the spillage of dangerous gases. Also, in recent

days, booking aLPG gas cylinder is done by simply sending a text message. LPG companies have recently launched some customer friendly approaches like IVRS method for the people. Therefore, a reliable system to detect and display the leakage of any of the gases is very important for household purposes. In this paper, a microprocessor-based system with aLPG sensor MQ6 is proposed to detect the leakage of dangerous gases. The system is implemented with an LCD display to indicate the leakage. The LPG sensor used in this system has very good sensitivity and also has good response time at a low price. If any leakage is sensed, a SMS will be sent automatically to the corresponding persons or family member using GSM.

2.3 Literature Review

Home protection is the invention of the world. The electronics machine is the most necessary in the world, science and technology. The GOBAL SYESTEM MOBILE COMMUNICATION is one of them. The most vital object of work is basically a protection system. There are also many wireless communication strategies. Modern practical functions of wi-fi communications have to meet the challenges of modern challenges for our heirs and the ideas of this subculture improvement have to be clear in their ideas on radio communication and control systems. SMS / GOBAL SYESTEM MOBILE COMMUNICATION based security purposes are a proper choice such as a wireless connection. SMS / GOBAL SYESTEM MOBILE COMMUNICATION based protection functions are a good alternative such as a wi-fi connection. The fundamental thought of our task affords GSM-based protection, the owner will be away from the confined area. So, we concluded that these applied sciences are very clever for domestic security, which human beings are satisfied whilst going home.... For this reason, we have received wireless transmission modes via GSM., due to the fact we have chosen our venture due to the fact it is a budget-friendly solution in contrast to different strategies, we are very familiar with GOBAL SYESTEM MOBILE COMMUNICATION science and are effortlessly available. Home protection measures are an imperative way to defend our residences from illegal bases [6].

Several works have been done on the gas leakage detector.
J Tsado et al. developed a system of gas leakage detection system that used 555 timers to interface the MQ 6 LPG sensor with the microcontroller and then by means of relays activates the GSM module to alert the user. N. Harshada and B. Pawar developed a system

that directly interfaces the MQ 6 LPG sensor with the microcontroller. In addition to the GSM module sending an SMS to the user when it detects gas leakage, there is a buzzer to sound an alarm, the exhaust fan would be switched on and the sprinkler activated, to reduce the concentration of gas in the air [7].

V. Ramya and B. Palaniappan also implemented a similar design but without the sprinkler. Apart from detecting the gas concentration in the air, K. Abid, et al. included a means of booking a refill of the cylinder with their design so that the user would be automatically notified when the gas in the cylinder goes below a set threshold [8].

Others such as B. Didpaye and S. Nanda, T. Soundarya and J. Anchitaalagammai, S. Ashish, et al., and K. B. Vinoth, et al., implemented a system that detects the gas leakage and control the leakage by shutting off the source of the gas supply using either a solenoid valve or a stepper motor [9].

In this paper we developed a system that can monitor the LPG in the air and simultaneously alert the user through an SMS so that appropriate actions can be taken to avert the danger. A unique feature of this design is that it can also be powered by batteries so that whether there is supply from mains or not the system will be fully functional [10].

2.4 Field of applications of gas flame detection

2.4.1 Nuclear power plants

Nuclear power plants must place safety concerns on the highest level of priority before other interests such as their business interests. Regular inspections of pipe systems need to be carried out and robots from INSPECTOR SYSTEMS are widely used.

2.4.2 Conventional power plants

By taking advantage of the NDT inspection methods that our robots offer, defects and faults can be avoided increasing the 'up and running' operational time of all kinds of pipe systems. Worldwide, many power plants already use our robots to do just this.

2.4.3 Refineries

The mineral oil industry can benefit from improved supply, transportation, processing and distribution of mineral oil as well as improved environmental protection. Our robots are helping to do just this.

2.4.4 Chemical and petrochemical plant

It is of course vital to continually reduce the risks brought about by the manufacture, transport and storage of chemicals. This means that the possible dangers need to be examined, and the necessary testing and inspections carried out in order to avoid or at least lessen and contain them. The use of our robots has become obligatory in many well-known companies.

2.4.5 Offshore

The technical demands of offshore rigs as well as safety and environmental requirements are very high and strongly controlled. This means that there is an enormous amount of required Non-Destructive Testing inspections. Our robots are used worldwide in offshore applications.

2.4.6 Long distance city heating pipelines

Leakages in long-distance heat conduits, caused through external corrosion, cause energy and water losses resulting in damage to, among others, subterranean constructions. Minimizing energy loss during the transport of heat from source to end user is one of the most important requirements in order to exclude danger to people and the environment. Our robots help in this important duty.

2.4.7 Food and drinks industries

The hygiene standard in the food and drinks industries is very high. The condition of the individual pipe networks is therefore decidedly important. Inspection robots from INSPECTOR SYSTEMS help to maintain and ensure this high level of hygiene.

2.4.8 Communal wastewater pipe systems

Subterranean sewer systems have been responsible for the collection and transport of wastewater since planning and construction began in 1842. With the Republic of Germany most of these sewage systems are owned by the cities and community districts. Regular inspection of the roughly 445 km of public sewage systems is therefore a complex and cost intensive process.

2.4.9 Gas pipelines

Within Germany the total length of the natural gas pipeline network is something like 335 km. At the moment it is run by 18 national companies and around 730 local ones. Robots from INSPECTOR SYSTEMS are deployed for inspection and maintenance. These flexible robots are well suited for carrying out inspections on pipe systems, especially those that have a lot of bends, vertical sections and pipe branches. These robots are mainly used in the nuclear power industry, refineries, chemical plants, petrochemical plants, the offshore industry, gas pipelines, the beverage industry and all types of pipelines up to 500m long. Three drive elements provide a speed of up to 200 m/h in both horizontal and vertical directions and allow for effortless bend taking.

2.5 Existing system

2.5.1 Definition

The existing system only detects fire and gas leakage in certain important areas only. In the existing system, the fire and gas leaks are measured, and communication is through wires to the control station. In case of faults like discontinuity in cables, damage to cables due to environmental conditions may lead to losing vital information related to plant safety.

Increase in the complexity of processing industry leads to an increase in the number of instruments to detect fire and leak. This increases the number of cables that run from industrial sensors to the control station which leads to messy wiring. This also increases the size of the duct. Troubleshooting the reduced insulation or any wire open is difficult because it is messy wiring and identifying the individual cable is very difficult along the duct. This also increases the project cost in terms of cable cost.

2.5.2 Field visit

An F&G safety system continuously monitors abnormal situations such as a fire, or combustible or toxic gas release within the plant; and provides early warning and mitigation actions to prevent escalation of the incident and protect the process or environment. By implementing an integrated fire and gas strategy based on the latest automation technology, plants can meet their plant safety and critical infrastructure protection requirements while ensuring operational and business readiness at project start-up. Throughout the process

industries and plant operators are faced with risks. For example, chemical facility normally has potential hazards ranging from raw material and intermediate toxicity and reactivity to energy release from chemical reactions, high temperatures, high pressures, etc.

According to international standards, safety implementation is organized under a series of protection layers, which include, at the base levels, plant design, process control systems, work procedures, alarm systems and mechanical protection systems. The safety shutdown system is a prevention safety layer, which takes automatic and independent action to prevent a hazardous incident from occurring, and to protect personnel and plant equipment against potentially serious harm. Conversely, the fire and gas systems are a mitigation safety layer tasked with taking action to reduce the consequences of a hazardous event after it has occurred. The F&G system is used for automating emergency actions with a high-integrity safety and control solution to mitigate further escalation. It is also important for recovering from abnormal situations quickly to resume full production.

An industrial safety system is a countermeasure crucial in any hazardous plants such as oil and gas plants and nuclear plants. They are used to protect humans, plant, and the environment in case the process goes beyond the control margins. As the name suggests, these systems are not intended for controlling the process itself but rather protection. Process control is performed by means of process control systems (PCS) and is interlocked by the safety systems so that immediate actions are taken should the process control systems fail.

2.5.3 ICSS

Process control and safety systems are usually merged under one system, called Integrated Control and Safety System (ICSS). Industrial safety systems typically use dedicated systems that are SIL 2 certified at minimum, whereas control systems can start with SIL 1. SIL applies to both hardware and software requirements such as cards, processors redundancy and voting functions. Fire and gas detection systems are designed to mitigate unexpected events. Designers need to know what is available in order to choose the correct systems for their plants.

The main objectives of the fire and gas system are to protect personnel, environment, and plant (including equipment and structures). The FGS shall achieve these objectives by:

- Detecting at an early stage, the presence of flammable gas,

- Detecting at an early stage, the liquid spill (LPG and LNG),
- Detecting incipient fire and the presence of fire,
- Providing automatic and/or facilities for manual activation of the fire protection system as required,
- Initiating environmental changes to keep liquids below their flash point.
- Initiating signals, both audible and visible as required, to warn of the detected hazards,
- Initiating automatic shutdown of equipment and ventilation if 2 out of 2 or 2 out of 3 detectors are triggered, and the exhausting system.

2.5.4 Limitations of existing system

Fire and gas systems are generally required to be independent of the control system. This is consistent with the fire and gas system normally having a higher integrity requirement than the control system. Some fire and gas systems have been integrated with emergency shutdown systems. This remains a contentious point.

As already mentioned, no single company can supply all the 'best in show' products for all the items described in this paper. There are normal interfaces between different suppliers. Minimizing interfaces, document sets and inspections can be achieved by procuring all products from one source at the cost of reducing choice of initiating devices and possibly increasing the initial purchase cost.

2.6 Others Safety System

2.6.1 Security Cameras

Security cameras are of many types with apparently many feature preferences. Deciding on the camera for use in a home-setting can be a daunting task given the numerous options. Although these cameras are available in a wide range of sizes, fields of view, the quality of images, and different ranges of motion, security cameras used in homes all provide video images of occurrences within a field of view. The cameras can display the actions taking place in real time or record everything for later view. Some of the camera systems enable users to observe and control their security cameras online. Security cameras are categorized into those used indoors and outdoors. Each of the categories has different camera styles.

Further differentiation, by and large, is not necessary because the variation is apparent during the evaluation of features. Security cameras can either come as stand-alone units with installed apps for monitoring the system or as part of a package which users subscribe to for provision of home security.

2.6.2 Indoor Home Security Cameras

Cameras used in indoor settings are the foundation of an efficient home security system. The following table 1 lists each of these cameras with corresponding resolution, pros, and cons. The cameras in table 1 above possess Wi-Fi abilities and allow online monitoring by use of a smartphone using the camera's matching app.

2.6.3 Outdoor Home Security Cameras

The outdoor security cameras are referred to as multi-camera surveillance systems. They monitor any out-of-doors area one chooses and are available either wired or wireless. Typical placements include walkways, entrances, and driveways. Outside cameras are purposely designed with a broader viewing angle to watch over large outdoor areas. Majority of these devices come with night vision to capture video and images during the dark. The cameras are designed to be weather resistant with durable protective housing to shelter the electronics from moisture and rain. The best stand-alone outdoor cameras are listed on the table below, each with resolution, pros and cons.

2.6.4 Sensors

A sensor is an electronic device which detects and responds to an optical or electrical signal. Sensors convert input from physical parameters, e.g. humidity, temperature, light, heat, motion, and other measured environmental phenomena to an electrical signal. The electrical signal is converted to a human-readable interface and displayed in computer monitors for reading, interpretation, and processing. Sensors provide whole-house protection entirely. Improvement in technology as regards modern security has enabled users of security systems to monitor and view alerts via their smartphones when sensors are triggered. Technology has increased the effectiveness of the security systems and reduced the time taken in response to security breaches. The common security sensors used include environmental sensors, smoke, glass-break sensors, door/window sensors which have been useful in enhancing the effectiveness of the security system.

2.6.5 Glass Break Detectors/Sensors

Glass break sensor is used in electronic burglar alarms and detects if a piece of glass is shattered or broken. The sensor works by monitoring vibration and sound thus complimenting the door/window sensors. When glass shatters, the sensor detects the frequency, or shock waves and sounds an alarm. Glass break detectors remain armed at all times and enhance the efficiency of the security systems. The glass sensors are ideal for rooms with sliding doors and large windows. The limited range associated with the detectors requires a homeowner to fix multiple glassbreak sensors to enhance efficiency. Illustrated in fig 1 are glass Break detectors. There are two types of glass break sensors, acoustic and shock sensors. Acoustic sensors are designed to detect the exact sound waves of breaking glass while shock sensors detect vibrations when glass breaks. Shock sensors are likely to trigger false alarms because of slamming doors which could have similar vibrations as breaking glass. To overcome these limitations, a homeowner should opt for glass break detectors that rely on acoustic sensors which are fitted with small microphones capable of detecting specific frequencies associated with breaking a glass.

2.6.6 Window and Door Sensors

Home security systems are ensured by the defence employed on secure windows and doors. Most burglaries reported annually are a break-in in residential homes as a result of entry through doors and windows. Security of a home is guaranteed by installing door and window sensors to prevent entry and potential danger. These sensors are placed on the doors and windows of buildings. When the door or window is broken, the sensor transmits a signal to the central control system triggering an alarm. Window or door sensors are easy to set up since no wiring is required. Their operating range is up to 150 feet away from the Choice Alert Wireless Control Centre and it has a long-lasting, weather-resistant design.

2.6.7 Smoke Detectors

Smoke detectors are devices that sense smoke, a common indicator of fire. These devices sense combustion of gases like carbon dioxide and carbon monoxide. Smoke detectors for homes, also called smoke alarms, issue a visual or an audible alarm. They reduce the risks associated with dying in a home fire.

2.6.8 Motion Sensors

Motion sensors use infrared sound and vibration to detect moving objects or people. The sensors gather data as regards the acceleration, velocity, and position of the object. When motion sensors are attached to a home security system, they can detect motion alerting the homeowner of any breach of security. Motion sensors use one or several technologies to sense movement in an area. The use of multiple technologies, microwave technology and passive infrared sensor (PIR) technology, helps to reduce the possibility of false alarms and increase the efficiency of the surveillance security system. The sensors are sensitive to an individual's skin temperature and are designed to use mid-infrared wavelengths in the detection of movements.

2.6.9 Environmental Sensors

An environmental sensor is a device used for measuring or detecting key environmental parameters like temperature, humidity, gas, moisture, or other environmental content. These sensors then provide comprehensive and consistent data which is converted to analogue or digital representation. Environmental sensors alert any moisture in a home as a result of flooding, burst pipes, leaks, and extreme temperatures in places like kitchens and bathrooms, laundry rooms and basements. The sensors can also detect elevated levels of carbon monoxide gas, enabling homeowners to take the necessary precautions. Environmental sensors are installed in leak-prone areas of the home, for example, under sinks and behind water heaters to minimize damages associated with dangerous conditions. Environmental monitoring applies to specific conditions in a home security system. The system combines and tracks measurements of both internal and external parameters.

CHAPTER 3

Theoretical Aspect

3.1 Block Diagram

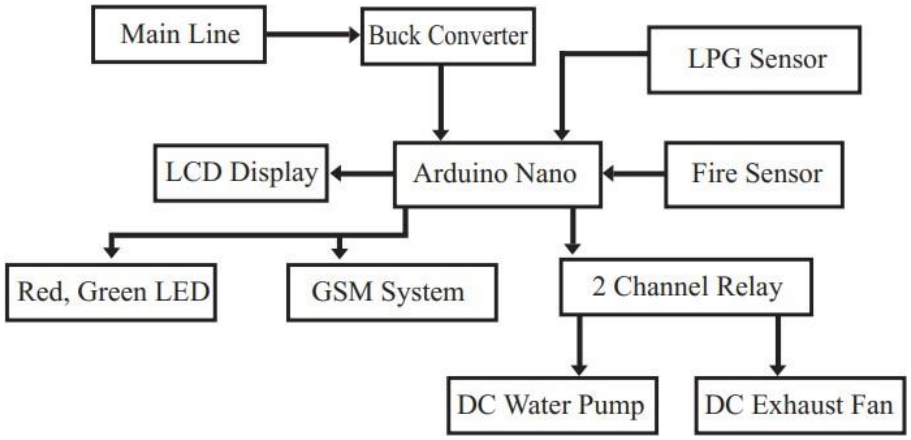


Figure 3.1: Block Diagram

Fig 3.1 shows the block diagram of the implemented project. Arduino Nano is connected to the source by the help of a power adapter and sensors and LCD display are also connected to the microcontroller.

3.2 Working Principle

- The LPG sensor is connected to pin no. D8 of Arduino.
- Fire sensor is connected to pin no. D7 of Arduino.
- LCD Display is connected to A4 & A5 of Arduino.
- GSM is connected to the A0 & A1 of Arduino.
- Arduino always monitors sensor status.
- If gas or flame found, a red LED & buzzer will be on.
- GSM module sent a sms if gas or fire found.
- An LCD will display flame and gas status continuously.

3.3 Circuit Diagram

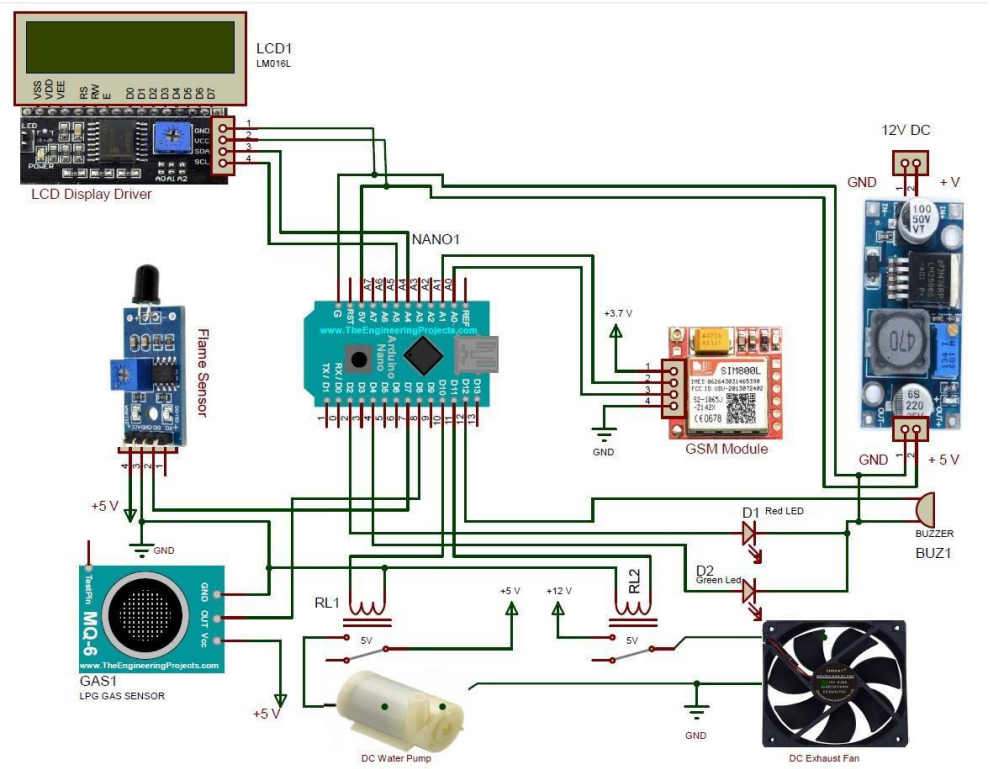


Figure 3.2: Circuit Diagram

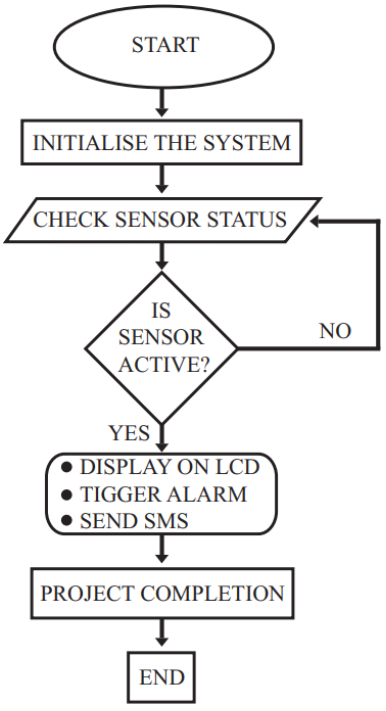


Figure 3.3: Program Flow Chart

CHAPTER 4

Design and Construction of an Apparatus

4.1 Introduction

Hardware is the most important part of any project. In this chapter we explain the component used for our project. In our project the hardware used is given below,

- Arduino Nano
- LPG gas sensor
- Flame Sensor
- GSM Module
- LCD Display

4.2 Arduino Nano Microcontroller

This part is Brain of this project. The Arduino Nano is a microcontroller board based on the ATmega328p. Arduino is an open-source, prototyping platform and its simplicity makes it ideal for any types of projects to use as well as professionals and Students. Arduino Nano has great advantage that it has built-in chip which work as a USB-to-serial converter. In this project we use Arduino-Uno which consists of ATmega328p Microcontroller with 16MHz crystal. It works upon the signal which gets from IR Sensor. There are data signal from IR Sensor. The CPU decides what to do in which condition. In this project we use Pin No. 2, 3, 4, 5, to get output. If Arduino-UNO gets signal via Pin 0 (Rx) it analyzes the signal and give output signal through the output pin.

Features of the Arduino UNO:

Microcontroller: ATmega328p
Operating Voltage: 5V
Input Voltage (limits): 6-20V
Digital I/O Pins: 14 (of which 6 provide PWM output)
Analog Input Pins: 6
Flash Memory: 32 KB
SRAM: 2 KB (ATmega328)
EEPROM: 1 KB (ATmega328)
Clock Speed: 16 MHz

4.2.1 Arduino Platform

Arduino is open-source electronics prototyping platform based on flexible hardware and software. The Arduino is a simple yet sophisticated device which is based on Atmel's ATmega microcontrollers. The Arduino software is supported by Windows and Linux operating systems despite the fact that most microcontrollers are limited to Windows operating system. The software language is based on AVR C programming language and can be expanded through C++ libraries. There are various types of Arduino micro controller board available in the market including the Arduino kits and Arduino shields.

4.2.2 Arduino Nano Board

Arduino Nano is one of the microcontroller boards manufactured by the Arduino and it is a microcontroller board based on Atmel's ATmega328P microcontroller. "Uno" means one in Italian and the Nano board is the latest in a series of USB (Universal Serial Bus) Arduino boards which is the reference model for the Arduino platform. The Arduino Nano board has a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, a reset button, 6 analog inputs and 14 digital input/output pins (of which 6 can be used as PWM outputs). It uses the Atmega16U2 programmed as a USB – to-serial converter instead of FTDI USB – to–serial driver chip which was used in all the pre-ceding boards. The board has 32 KB flash memory of which 0.5 KB is used by bootloader, 2 KB of SRAM, 1 KB of EEPROM and 16 MHz clock speed.



Figure 4.1: Arduino Nano

Reprinted from the Arduino Board Nano Fig 1 shows the Arduino Nano Board manufactured by the Arduino in Italy. It can be powered via a USB connection or with an external power supply. As can be seen in Fig 1, pins A0 to A5 are the analog input pins, pins 0 to 13 are 14 digital input/output pins and the pins with a "~" sign can be used as digital pins PWM o can be used as input or output pins by selecting the mode by using the function Pin-Mode() and

then using the function digital Read () or digital Write() according to the ne-cecity. Pins 0(RX) and 1(TX) are used for serial communication while pins 10(SS), 11(MOSI), 12(MISO) and 13(SCK) are used for SPI (Serial Peripheral Interface) communication. In addition to pin 0 and 1, a Software Serial library allows serial communication on any of the Uno's digital pin.

4.2.3 ATmega328PMicrocontroller

The microcontroller is a low-power CMOS (Complementary Metal Oxide Semiconductor) 8-bit microcontroller based on the AVR enhanced RISC (Reduced Instruction Set Computer) architecture. The powerful execution of instructions in a single clock cycle leads to the achievement of 1 MIPS per MHz throughputs allowing the designer to optimize power consumption versus processing speed. Reprinted from Datasheet of ATMega328 the internal architecture of the microcontroller is shown in Fig 2.2.3 (02). The central processing unit (CPU) is the brain of the microcontroller which controls the execution of the program.

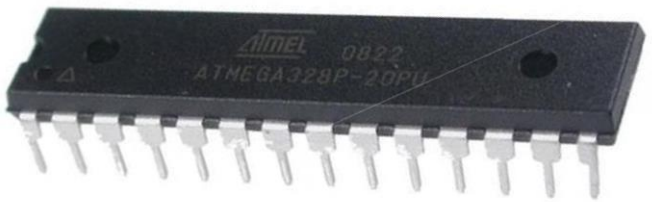


Figure 4.2: ATmega328P Microcontroller

The MCU (Microcontroller unit) consists of 4K/8K bytes of in-system programmable flash with read-while-write capabilities, 256/412/1K bytes EEPROM along with the 512/1K/2K bytes of SRAM. Along with this, the MCU consists of many other features14 general purpose I/O lines and 32general purpose working registersflexible timer/counters with compare modes, internal and external interrupts and a serial programmable USART

A byte-oriented 2-wire serial interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable watch-dog timer with an internal oscillator and 5 software-selectable power saving modes. The five, software selectable, power saving modes are idle mode, Power-down mode, Power-save mode, ADC

Noise Reduction mode and Standby mode. As mentioned in section 2.1.2, the CPU is the brain of the microcontroller which controls the execution of the program.

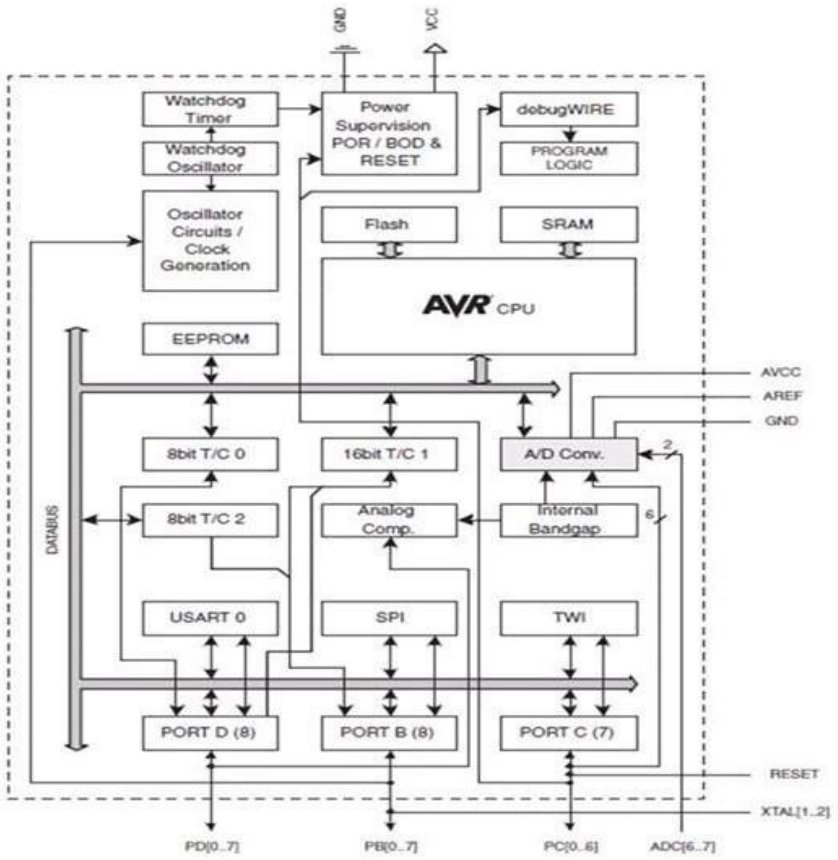


Figure 4.3: ATmega328 Microcontroller Architecture

Therefore, the CPU can access the memories, perform calculations, control peripherals and handle interrupts. The AVR uses the Harvard architecture with separate memories and buses for program and data to maximize the performance as well as parallelism. The principle of execution of instructions in the program memory is the single-level pipelining. The concept of pre-fetching the next instruction while executing one instruction enables the instructions to be executed in every clock cycle and the program memory is in the System Reprogrammable Flash memory.

Reprinted from Datasheet of ATMega328, the block diagram of AVR CPU Core architecture is shown in Fig 2. The fast-access Register File contains 32 x 8-bit general-purpose working registers with a single cycle access time which results in a single-cycle ALU operation. The arithmetic and logical operations between the registers or between the constant and a register

are supported by ALU. The status register is updated to reflect information about the result of the operation after an arithmetic operation. The boot program section and the application program section are the two main sections of the program flash memory. Stack stores the return address of the program counter during the interruptions and subroutine calls which is allocated in the general data SRAM. The size of the stack is limited by the total size and usage of SRAM. The data SRAM is accessible through five different addressing modes supported in the AVR architecture while the stack pointer is read/write accessible in the I/O space. The memory spaces in the AVR architecture are all linear and regular memory maps

4.2.4 Power supply, inputs and outputs

Either Arduino is supplied with USB connection or with an external power supply (recommended with 7-12V), outputs are going to have a continuous voltage due to voltage regulators and stabilization capacitors present on the board. These power supply pins are:

- **VIN:** it is the input power supply that will have the same voltage that we are supplying the Arduino with the external power supply
- **5V:** power supply of 5V, this voltage may come from VIN pin Anda voltage regulator or from the USB connection.
- **3.3V:** power supply that will provide 3.3V generated by an internal regulator, with a maximum current of 50 mA.
- **GND:** grounding pins

4.2.5 Digital inputs and outputs

Each of the 14 digital pins can be used as an input or output. Besides, each pincan supply or receive a maximum of 40 mA and has a pull-p resistance from 20 to50 kOhm. In addition, some pins have specialized functions such as:

- Pin 0 (RX) and 1 (TX). They are used to receive (RX) and transmit (TX)in TTL serial communication.
- Pin 2 and 3. External interruptions. Pins in charge of interrupting the sequential program established by the user.
- Pin 3, 5, 6, 9, 10 and 11. PWM (pulse width modulation). They form 8output bits with PWM with the function analog Write ().

- Pin 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI (Serial peripheral interface) communication.
- Pin 13. LED. There is an LED connected to the digital pin 13. When the pin value is HIGH, the LED is on, and when the value is LOW, the LED is off.

4.2.6 Analog inputs

Arduino UNO has 6 analogical inputs, from A0 to A5, and each one offers a resolution of 10 bits (1024 states). By default, there is a voltage of 5V, but that range can be modified using the pin AREF and using the function analog Reference (), where the user introduces the DC external signal he wants to use as reference.

4.3 Gas Sensor

Gas sensor MQ-6 is highly sensitive to LPG, isobutene and propane. This sensor is used in gas leakage detecting equipment in domestic and industrial applications. It is suitable for LPG detection and the important thing is, it avoids the noise signal of alcohol, cooking fumes and smoke. In clean air it has lower conductivity. If combustible gas is detected, the sensor conductivity increases with an increase in gas concentration. Higher sensitivity to LPG, low cost and long life are the main features to select this gas sensor. Voltage variation obtained is from

0.5 volts in clean air to 0.9 volts when leakage detected. Hence 0.7 volts is considered as threshold level indication of gas leakage. If output voltage of 0.7 volts is detected, the gas leakage system will be operated.



Figure 4.4: LPG Gas Detector

4.3.1 Arduino and LPG sensor Connection

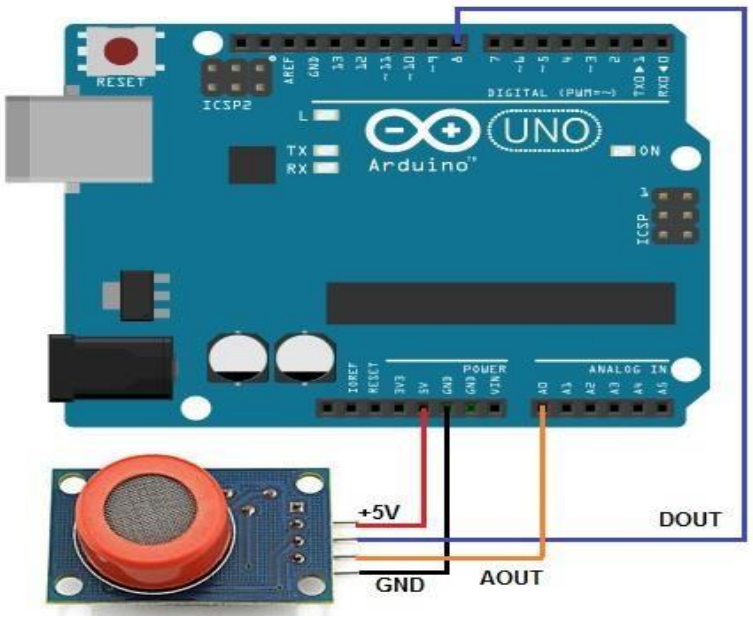


Figure 4.5: Arduino and LPG sensor Connection

4.4 GSM Module

A number of signal detecting devices are available in the market. These devices include:

- Ethernet Module
- WIFI Module
- Bluetooth Module
- SIM / GSM Module

All of the devices have their own advantages and disadvantages, but we will be targeting that particular device which best suits our requirement. There are certain features that should be considered when choosing the GSM module for use. The features are

- Long Distance Coverage
- Function description
  - Supply voltage: 3.5V - 4.2V
  - Power consumption: sleep mode < 2.0mA, idle mode < 7.0mA
  - GSM transmission (avg): 350 mA
  - GSM transmission (peek): 2000mA
  - Module size: 25 x 23cm

- SIM card socket: micro-SIM
- Antenna connector: IPX
- Status signaling: LED
- Working temperature range: -40 do + 85 ° C

➢ Has high-performance

➢ Low Cost

This GSM module can easily achieve data. Its operating frequency is among the 900/1800/1900 MHz frequency band. In SIM800L signal transmit time of different devices stands at a 0.5 seconds interval so that the workload of SIM chip can be reduced substantially and more sleeping time can be saved for GSM module. This module is set with serial interface, which is easy to use and simplifies the overall design.

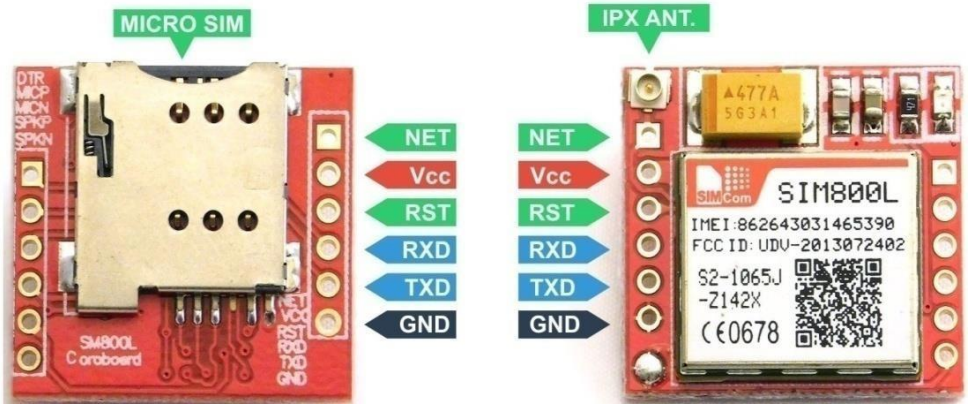


Figure 4.6: SIM800L GSM Module

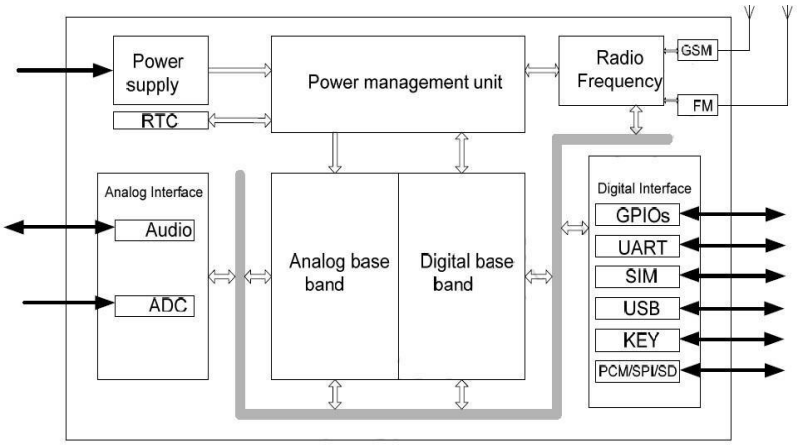


Figure 4.7: Schematic Diagram of SIM800L GSM Module

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.

GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables a higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc.) for computer. GSM/GPRS MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also, they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

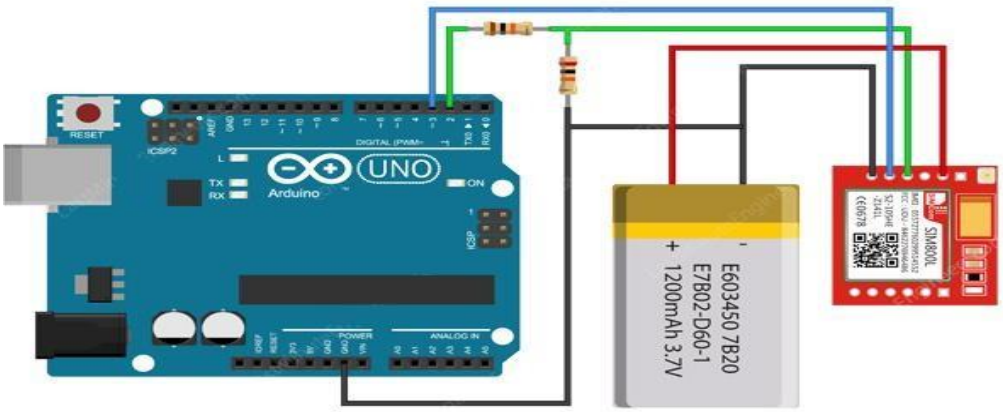


Figure 4.8: Arduino and GSM module Connection.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

4.5 Flame Sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; in these cases, they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.



Figure 4.9: Flame Sensor

The flame sensor module has the following features:

- The operating voltage is from 3.3 – 5V.
- It gives us both analogue and digital output.
- It has a led indicator, which indicates whether the flame is detected or not.
- The threshold value can be changed by rotating the top of a potentiometer.
- Flame detection distance, the lighter flame test can be triggered within 0.8m, if the intensity of the flame is high, the detection distance will be increased.
- The detection angle of the flame sensor module is about 60 degrees.

4.6 Buzzer

A buzzer is an electrical device that makes a buzzing noise and is used for signaling. A buzzer has a piezo disc and an oscillator inside. When the buzzer is powered, the oscillator generates a frequency around 2-4 kHz and the piezo element vibrates accordingly to produce the sound. As soon as the gas leak is detected, the buzzer automatically rings to alert the users about the gas leak.



Figure 4.10: Buzzer

4.7 Jumper Wire

A jump wire (also known as jumper wire, or jumper) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a bread board or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.



Figure 4.11: Jumper Wire

4.8 LCD Display

A liquid crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers.



Figure 4.12: LCD Display

Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock. Ituse the same basic technology, except that arbitrary images are made from a matrix of small pixels, while other displays have larger elements. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement. For example, a character positive LCD with a backlight will have black lettering on a background that is the color of the backlight, and a character negative LCD will have a black background with the letters being of the same color as the backlight. Optical filters are added to white on blue LCDs to give them their characteristic appearance**.**

4.9 Arduino Software

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

4.10 The research Instrument

Tools like a digital multimeter, set of screw drivers and pliers, soldering iron, etc will be needed to conduct the study.

- **Buck converter (step-down converter)**

The buck converter, also referred to as a step-down converter, is a popular topology in power electronics that converts a higher input voltage to a lower output voltage. It is crucial in various applications, from portable devices to automotive systems, where specific components or subsystems require a lower voltage level to operate. The primary advantage of the buck converter is its simplicity, which enables efficient voltage conversion using a relatively small number of components.[20]



Figure 4.13: Buck Converter

- **Relay**

  A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or such combinations thereof.[21]

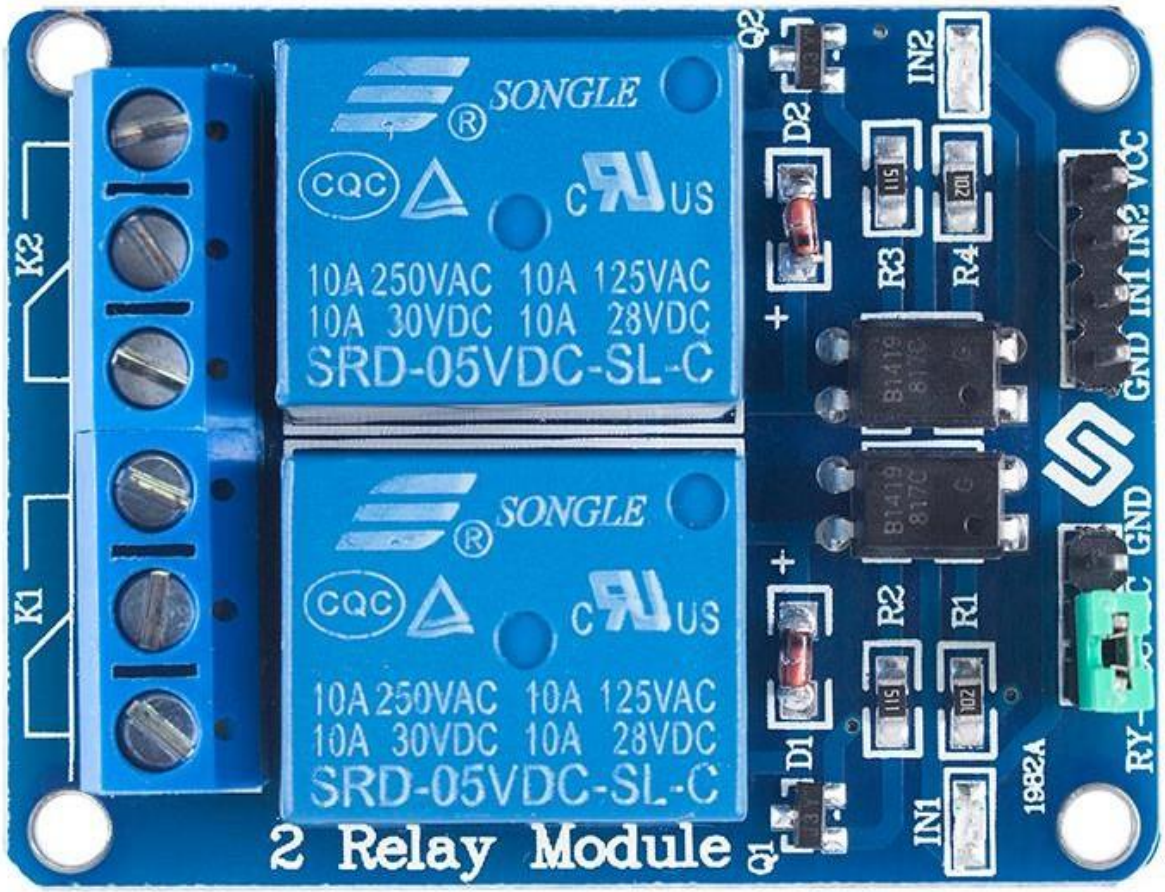


Figure 4.14: Two channel Relay

- **Water Motor Pump**

  A water motor pump is a mechanical device that moves water from one place to another using a motor to create a pressure difference. [21]

  How it works

  - A motor drives a spinning impeller or rotor inside a sealed chamber.
  - The impeller creates a low-pressure area at the inlet to draw in water.
  - The impeller creates a high-pressure area at the outlet to push water out.
  - Water enters through an inlet valve or pipe and exits through an outlet valve or pipe.

- **Dc Water Pump**

DC pumps use direct current electricity to power a motor, which drives an impeller to move fluid from one place to another. Here's how a DC pump works: The operator connects the DC water pump to a power source and switches it on. Electricity flows through the motor, causing it to turn.

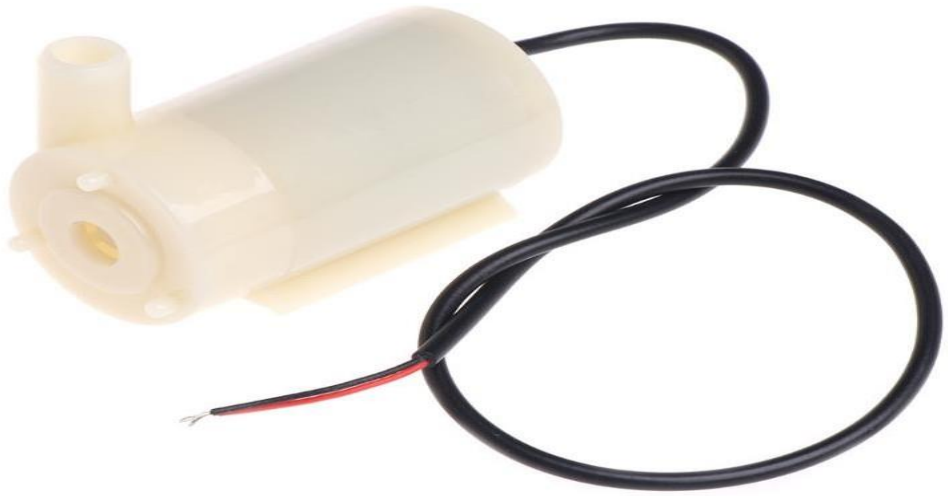


Figure 4.15: DC Water Pump

- **Exhaust Fan**

An exhaust fan is a specific type of fan that is used to regulate the interior temperature and environment. There are several types of exhaust fans available which help in combating undesirable occurrences, smoke, particulates, moisture, and other contaminants in the air.



Figure 4.16:Exhaust Fan

- **Multimeter**

A multimeter also known as VOM (Volt-Ohm meter) is an electronic measurement instrument that combines several measurement functions in one unit. A typical multimeter would include basic features like the ability to measure voltage, current, capacitance and other electronic parameters in a circuit. A digital multimeter displays the measured values in numerals.



Figure 4.17: A digital multimeter.

- **Set of screw drivers**

Every threaded fastener needs a way of turning it. It may have a head with a shape that a driver can engage. A screwdriver is designed to increase the hand's turning motion to the small, specially designed tip that is inserted into the screw. The two most common screwdrivers tips available are the Standard (or Flat tip) screwdriver used for screws with slotted heads, and the Phillips (or Crosshead) screwdriver which is used for screws with cross shaped recesses in the head. Screwdriver handles are most commonly made from a plastic resin or wood and can sometimes even have a rubberized covering to improve grip. Some fasteners can be turned either by Standard or Phillips tips. Choosing the right

The screwdriver for the job allows you to complete your project successfully and eliminate stripped screws.



Figure 4.18: Set of screw drivers

- **Pliers**

A very simple and ancient invention, pliers are basically two pieces of metal, joined together near the center. One side is the handle; the other side is the nose. When you squeeze the handle side, the nose squeezes accordingly. There are several types of pliers, and the most common are flat-nose and needle-nose. Pliers are used to grab and "ply" (manipulate) a thing. You are most likely to use them to bend or "crimp" a wire; or to squeeze or hold something that is too small, too sharp, too hot, or too corrosive for your fingers. You might also use pliers to reach into a place where your fingers can't — electronic devices, water pipes, etc.



Figure 4.19: A Pliers

- **Soldering Iron**

A soldering iron is a tool with a metal tip that gets hot. We're talking like 800-degree Fahrenheit, though you can adjust the temperature on a good iron. Its job is to transfer heat to things like wires, transistor leads, and pads on PCBs. After the appropriate areas are heated properly, soldering is applied. Also, there is a longer-lasting tool that will work for a much wider variety of applications and a proper heat control to boot. There are also soldering guns available, but you should only use these when repairing thick cables and never on PCBs, as the tips have a live voltage running through them that can damage sensitive electronics.



Figure 4.20: Soldering iron

CHAPTER 5

Experimental Data

5.1 Introduction

Fire incident is totally unexpected, but we could protect or minimize its happening frequency and devastating effect by using an automatic control system. Gas leakages resulting in fatal inferno have become a serious problem in household chores and other areas where household gas is handled and used. Gas leakage leads to various accidents resulting in financial loss as well as human injuries and loss. This system can be used in the industrial areas (Substation, Boiler-room, dying room, power control room), shopping malls, hospitals, housing areas, ships, universities, garments factories etc. The work aims at designing a system that detects Temperature and gas leakage and alerts this describer through alarm and cell phone message besides turning off the gas supply valve as a primary safety measure.

5.2 Result

The experimental model was made according to the circuit diagram and the results were as expected. Testing was carried out by releasing LPG into the atmosphere around the sensor and fire in front of the sensor. The gas detector's response units are there to detect it. The results of test carried out on the device at different times and days for concentration gas in the air around the sensors. The last four values are the case of an endless loop due to high gas concentration. The device was tested to be placed near to the LPG device at different distances from the gas source. It was observed that when the LPG device was tested by placing it at different distances from the gas source, the response time of the LPG system decreased as the distance from the gas source increased. Also, it was observed that the sensitivity of the gas sensor was very high in clean air. The gas sensor sensitivity varied with temperature while the reference voltage remain constant over time.

Observation No.	Fire Detection	LPG Detection	Alarm and LED Indication	SMS Notification
1	Yes	Yes	Yes	Yes
2	Yes	No	Yes	No
3	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	No
5	No	Yes	Yes	Yes

Table 5.1: Experimental Data

1. **Test Conditions Table**

Test Condition	Gas Type	Concentration	Sensor Response Time (s)	Flame Detection Status	Alarm Triggered	System Response Time (s)	Time to Reset (s)
Test 1	LPG (Butane)	5%	3	Detected	Yes	2	30
Test 2	LPG (Propane)	3%	4	Detected	Yes	3	28
Test 3	LPG (Butane)	10%	2	Not Detected	No	5	25
Test 4 (Flame)	-	-	-	Detected	Yes	4	27
Test 5 (Flame)	-	-	-	Not Detected	No	6	29

Table 5.2: Test Condition Data

2. Performance Data Over Time (for monitoring system response)

- **X-Axis**: Time (seconds/minutes)
- **Y-Axis**: Sensor Output/Alarm Status (e.g., 0 = No leak, 1 = Leak detected)

Time (sec)	Sensor Output (Gas)	Flame Detection (Yes/No)	Alarm Status (0/1)
0	0	No	0
30	0.2	No	0
60	1.0	Yes	1
90	1.2	Yes	1
120	0	No	0

Table 5.3: Performance Data Over Time

3. System Reliability/Accuracy Graph

This graph shows the accuracy of the system in detecting gas leaks and flame presence over multiple test cases, which might be based on the data collected:

- **X-Axis**: Test Number or Time Interval
- **Y-Axis**: Accuracy Rate (%) (measured as the proportion of correctly detected gas leaks or flame presence)

Test Number	Gas Leak Detection Accuracy (%)	Flame Detection Accuracy (%)
1	98	100
2	95	100
3	100	95
4	97	100
5	100	100

Table 5.4: System Reliability data

Performance Metrics Example

- **Detection Accuracy**: The percentage of successful detections for gas leakage and flame detection.
- **Response Time**: The time it takes for the system to respond (e.g., trigger an alarm) after detecting a leak or flame.
- **Alarm Trigger Efficiency**: Whether or not the alarm system activates appropriately.

Test No.	Gas Type	Concentration (%)	Leak Detection Accuracy (%)	Flame Detection Accuracy (%)	Alarm Triggered Correctly (Yes/No)
1	Butane	5	98	N/A	Yes
2	Propane	3	95	N/A	Yes
3	Butane	10	100	N/A	Yes
4	Propane	6	97	N/A	Yes
5	None	-	N/A	100	No

Table 5.5: performance metrics Example data

Accuracy and Alarm Trigger Efficiency Table

This table would evaluate the **accuracy** of the gas leakage detection system and whether it triggered the alarm appropriately for each test.

- **Leak Detection Accuracy**: The system's ability to correctly identify a gas leak.
- **Flame Detection Accuracy**: If flame detection is tested, this would show the accuracy of identifying the flame.
- **Alarm Triggered Correctly**: Whether the alarm was activated appropriately based on the detection

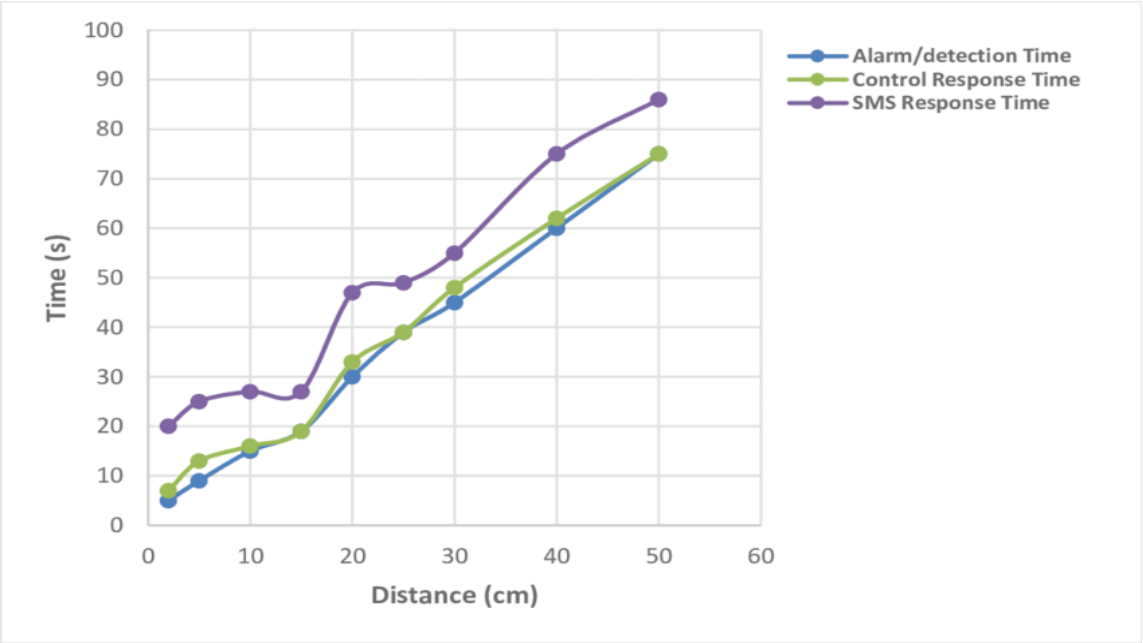


Fig 5.1: Graph of Alarm detection Response SMS alert

5.3 Project Picture

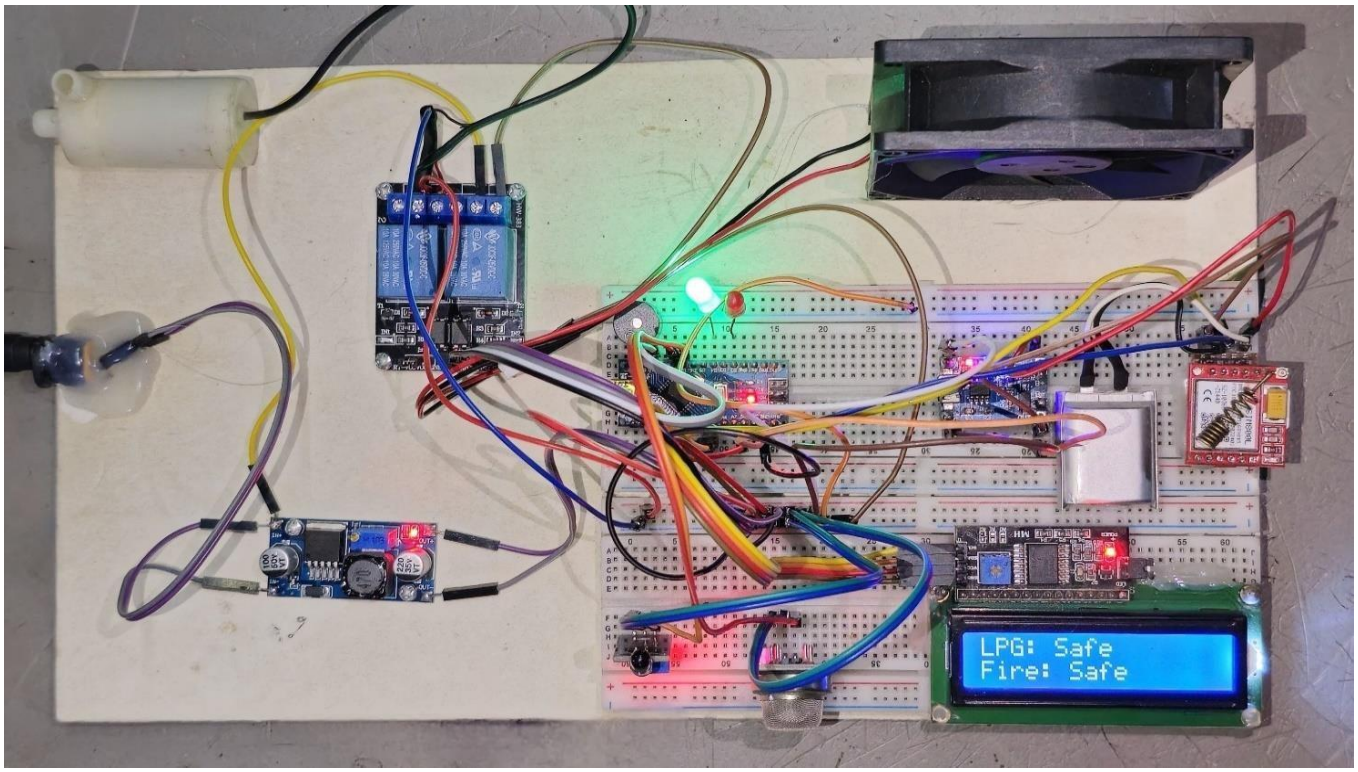


Figure 5.2: Project Picture

5.4 Application

This project can be used at

- Home.
- Industry.
- School.
- Factory.
- Commercial office.
- Corporate office.
- This project can be used in the home and hotel utility (kitchen) area for safety purpose.
- Useful in domestic LPG water heater.
- It is very useful in LPG/CNG fitted car to avoid measure accident.
- Prevent measure accident in gas agencies (gas station) where multi cylinder stored.

5.5 Advantage of Safety Monitoring System

- It is Compact and easy to install.
- The sensor has excellent sensitivity combined with a quick fast response time.
- The system is highly reliable and secure.
- In the long run the maintenance cost is very little when compared to the present system.
- It is possible to get instantaneous result and with high accuracy.
- Inform the owner via message to ensure more safety.

CHAPTER 6

Conclusion

6.1 Conclusion

This project is very useful to prevent accident due to gas leaks and fire. If we implement this in a broad way, it will be very successful. We can get message remotely at a fraction of time. This detection system is not costly, so that everyone can use it.

6.2 Future work

In addition to the developed system, the system can be enhanced by adding an exhaust fan and door control element which controls the gas leakage rapidly if it exceeds the specified upper explosive level for the various gases in the plant area. This can be achieved by any gas leakage indication in any part of the plant alerts the control room and then the control valve is shut off. Therefore, preventing any hazard arising due to gas leakage. IOT can be implemented by which all leakage information is transmitted to website via internet.

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Appendix

```
#include<SoftwareSerial.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27,16,2);
SoftwareSerialmySerial(A1,A0);

#define redLed 2
#define greenLed 4
#define Buzzer 12
#define lpg 8
#define fire 7

String number ="01602852658";
int sms_f=0;
char incomingByte;
```

```
String inputString;
int lflag;
int fflag;



void setup() {
Serial.begin(9600);
mySerial.begin(9600);
lcd.init();
lcd.backlight();
pinMode(redLed, OUTPUT);
pinMode(greenLed, OUTPUT);
pinMode(Buzzer, OUTPUT);
pinMode(water, OUTPUT);
pinMode(Exhaust, OUTPUT);
pinMode(lpg, INPUT);
pinMode(fire, INPUT);
digitalWrite(redLed, LOW);  // Make sure led is off
digitalWrite(greenLed, HIGH);  // Make sure led is off
digitalWrite(Buzzer, LOW);
digitalWrite(water, HIGH);  // Make sure led is off
digitalWrite(Exhaust, HIGH);  // Make sure led is off
lcd.setCursor(4, 0);
lcd.print("WELCOME");
delay(2000);
lcd.clear();
lcd.setCursor(2, 0);
lcd.print("Fire & LPG");
lcd.setCursor(0, 1);
lcd.print("Detection System");
delay(4000);
lcd.clear();
```

```
gsmInit();
lcd.setCursor(0, 0);
lcd.print("LPG: Safe       ");
lcd.setCursor(0, 1);
lcd.print("Fire: Safe        ");

}



void loop() {
int lpg_sensor = digitalRead(lpg);
int Fire_sensor = digitalRead(fire);

if (Fire_sensor==LOW || lpg_sensor==LOW)
{
digitalWrite(redLed, HIGH);  // Make sure led is off
digitalWrite(greenLed, LOW);  // Make sure led is off
digitalWrite(Buzzer, HIGH);
 }


if (Fire_sensor==HIGH &&lpg_sensor==HIGH)
{
digitalWrite(redLed, LOW);  // Make sure led is off
digitalWrite(greenLed, HIGH);  // Make sure led is off
digitalWrite(Buzzer, LOW);
 }



if (lpg_sensor==HIGH)///No LPG
{
```

```
lcd.setCursor(0, 0);
lcd.print("LPG: Safe         ");
lflag=0;
}


if (lpg_sensor==LOW &&lflag==0)///LPG Found
{
lcd.setCursor(0, 0);
lcd.print("LPG: Detected       ");
Serial.println ("Sending Message");
sendSMS("Alarm !!!  LPG Detected, Please take action");
lflag=1;
delay(2000);
 }

if (lpg_sensor==LOW &&lflag==1)///LPG Found
{
lcd.setCursor(0, 0);
lcd.print("LPG: Detected       ");
delay(2000);
}









if (Fire_sensor==HIGH)///No LPG
{
lcd.setCursor(0, 1);
```

```
lcd.print("Fire: Safe          ");
digitalWrite(water, HIGH);  // Make sure led is on
fflag=0;
}

if (Fire_sensor==LOW &&fflag==0)///LPG Found
{
lcd.setCursor(0, 1);
lcd.print("Fire: Detected     ");
Serial.println ("Sending Message");
sendSMS("Alarm !!!   Fire Detected, Please take action");
fflag=1;
delay(2000);
}


if (Fire_sensor==LOW &&fflag==1)///LPG Found

{
lcd.setCursor(0, 1);
lcd.print("Fire: Detected     ");
delay(2000);
}

}




void sendSMS(String msg)
{
mySerial.println("AT+CMGF=1");
delay(100);
```

```
mySerial.println("AT+CMGS=\"" + number + "\"\r"); //Mobile phone number to send message
delay(100);
mySerial.print(msg);
delay(100);
mySerial.print((char)26);// ASCII code of CTRL+Z
delay(100);
}



void gsmInit()
{
lcd.clear();
lcd.print("Finding GSM .... ");
booleanat_flag=1;
  while(at_flag)
  {
mySerial.println("AT");
while(mySerial.available()>0)
    {
if(mySerial.find("OK"))
at_flag=0;
    }
delay(1000);
  }
mySerial.println("ATE0");
lcd.clear();
lcd.print("Searching Network..");
booleannet_flag=1;
while(net_flag)
  {
mySerial.println("AT+CPIN?");
```

```
while(mySerial.available()>0)
   {
if(mySerial.find("READY"))
net_flag=0;
     break;
   }
delay(1000);
  }
mySerial.println("AT+CNMI=2,2,0,0,0");
delay(1000);
mySerial.println("AT+CMGF=1");
delay(1000);
mySerial.println("AT+CSMP=17,167,0,0");
lcd.clear();
mySerial.flush();
}
```