

# GSM based Gas and Fire Accident Avoiding System with Smart Management

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**Abstract:-** These days, gas leaks and gas cylinder explosions are common issues, particularly in developing nations. If a gas leak is not found quickly enough and no action is done, it might explode and seriously harm both the environment and human life. To detect gas and fire, this system has flame and gas sensors installed. To stop gas leaks, it has an exhaust fan system, and a solenoid valve to cut off the gas connection. With this it has water sprayer to extinguish fire and an MCB switch which turns OFF automatically if their will gas leakage or fire explosion. It is equipped with GSM modem to send information to owner through Short Message Service (SMS). This ensures preventive actions immediately even in the absence of people on-site. The compact design makes the system low cost and affordable and can even handled by normal persons. With its robust capabilities, the system provides various reliable settings, including residential, commercial, industrial areas and even in Offices.

**Keywords:-** Fire Sensor, Gas Sensor, GSM Module, LPG (Liquefied Petroleum Gas), Arduino NANO, servo motors.

## I. INTRODUCTION

The need for fuel is growing daily. Different types of fuel are utilized in the house, business, and other places. Worldwide, liquefied petroleum gas, or LPG, is one of the most widely utilized fuels. It is very concentrated and is in a cylinder. Sometimes the cylinder explodes. There are numerous reasons why a gas cylinder explodes.

The extremely flammable gas known as liquefied petroleum gas, or LPG, is mostly composed of propane and butane with trace amounts of butylene, propylene, and other hydrocarbons. LPG is used as fuel in homes, cars, and businesses for a variety of thermal applications, including welding and metal cutting. Nonetheless, its use as a cooking fuel in homes has grown significantly. Because LPG is used more frequently in daily life, LPG fire security is therefore a crucial component of contemporary dwellings. Since LPG has no smell, ethanethiol is added as a strong odorant to give it its distinctive fragrance, allowing for the detection of gas leaks through smell. It is crucial to find LPG leaks as soon as possible because

## II. LITERATURE REVIEW

The system's MQ6 gas sensor, fire sensor, load cell, node MCU, buzzer, relay, Hbridge, LCD display, and Bluetooth module were discussed by Pritam Ghosh and Palash Kanti Dhar [6]. The Arduino is linked to a MQ6 sensor, an IR fire sensor, and a load cell. These sensors

communicate with Arduino by exchanging signals with the surroundings.

This system includes a MQ6 gas sensor, fire sensor, load cell, buzzer, relay, Hbridge, LCD display, and Bluetooth module, according to Abhilasha D. et al. [1]. The Arduino is linked to a MQ6 sensor, an IR fire sensor, and a load cell. These sensors communicate with Arduino by exchanging signals with the surroundings.

Malathi, D. Gavaskar, et al. [3] When the smoke sensor in this detects an LPG leak in the first part, it signals the controller, which then turns on the exhaust fan and uses a solenoid valve to stop the gas flow. The LCD shows the value of the sensor. The solenoid valve and exhaust fan are turned on by the relay (switch), which receives the readings from the gas sensor as input.

Liolis, Konstantinos, and others [11] For combining data from several heterogeneous sources, including wireless environmental sensors, weather meteorological stations, and optical cameras with integrated fire and smoke detection probability.

In addition to Sabbani Hemanth[8], This technology sends out an SMS warning to the customer when it detects an LPG leak. The system will activate the alarm and cut off the power supply as an emergency precaution. Using a GSM module, an ARM 7 CPU, and simulation software, it will track the amount of LPG in the cylinder and automatically schedule a new one.

Khaldon Lweesy, Luay Fraiwan, et al. When the LPG concentration changes and rises above a certain threshold, the gas leakage detection and transmission module detects the change and sounds an alarm. To hear the alert, the receiver module is a portable device that may be placed anywhere in the house.

## III. SYSTEM REQUIREMENT

This system consists of an Arduino NANO, a Gas and Flame sensor to detect the gas and fire, a solenoid valve to cut off gas connection, a water sprayer and a MCB tripper mechanism. The security system consists of the exhaust fan for clearing the leaked gas from the room and a water sprayer when the explosion and fire incident occurs.

Along with this, the system has an inbuilt battery backup, which will turn on when the electricity is cut off, this ensures that the circuit will not stop working in any situation as well as sends an alert message to the owner in both the cases gas or fire.

A. BLOCK DIAGRAM

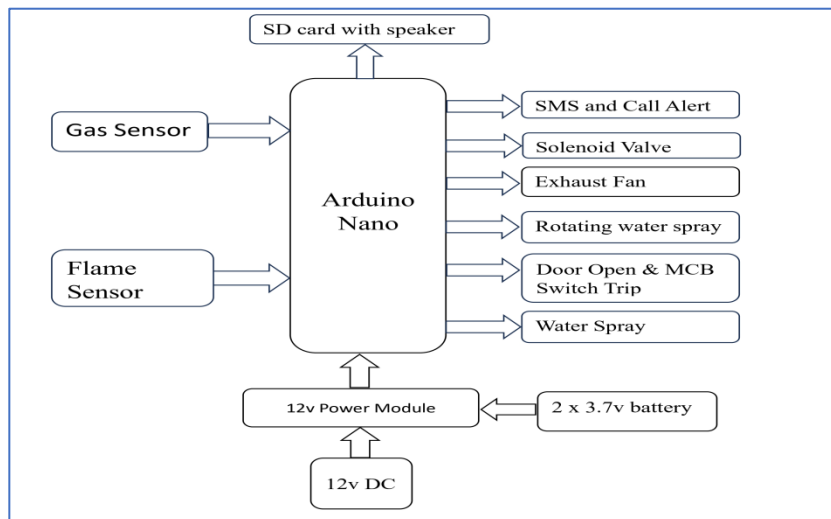


Fig. 1: Block Diagram of the system

B. COMPONENTS DESCRIPTION

➤ Gas Sensor



Fig. 2: MQ-6 Sensor

The MQ6 gas sensor is a Metal Oxide Semiconductor (MOS) type gas sensor that is mostly used in homes and industries to measure the concentration of butane and LPG in the air. This sensor has a detecting element that is mostly

made of ceramic with an aluminum oxide base, coated with tin dioxide, and housed in a stainless-steel mesh. The resistivity of the sensing element changes whenever gas comes into contact with it.

➤ Fire Sensor

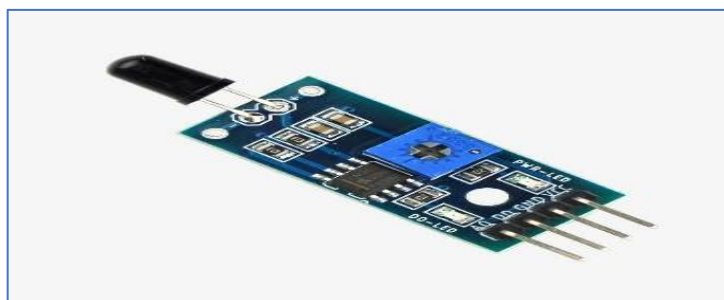


Fig. 3: Fire Sensor

The purpose of a fire sensor is to identify any flames or fire in the vicinity of its installation. Following a fire, the surrounding area will see a notable rise in temperature and an increase in the atmospheric levels of carbon dioxide and carbon monoxide [7]. By connecting it to several different

components, the user can then initiate multiple actions according to their needs. You can program a buzzer to sound when a fire is detected. In a similar vein, it is possible to deactivate a gasoline line and activate a fire suppression system.

➤ *Arduino NANO*

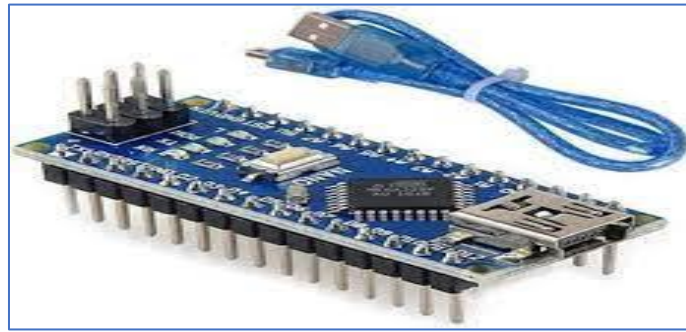


Fig. 4: Arduino NANO

A little Arduino board built around the ATmega328P or ATmega628 microcontroller is called the Arduino Nano. Similar to the Arduino UNO boards, there is the same connectivity. A sustainable, compact, reliable, and adaptable microcontroller board is known as a Nano board.

In comparison to the UNO board, it is smaller in size. The Arduino (IDE), which is compatible with multiple systems, is used to arrange the Arduino Nano. IDE refers to the Integrated Development Environment in this context.

➤ *SIM 900a GSM Modem*



Fig. 5: SIM900A GSM Module

Using a mobile sim, the module provides GPRS/GSM technology for communication. Users can send and receive SMS messages and mobile calls using the 900 and 1800MHz frequency band. With its keypad and display

interface, developers can create customized applications. Additionally, it has two modes: data mode and command mode. The GPRS and GSM use several protocols and frequencies to function in each nation.

➤ *Solenoid Valve*



Fig. 6: Solenoid Valve (Gas valve)

A solenoid valve, sometimes referred to as an electrically powered valve, operates using electromagnetic force. A ferrous metal rod moves when an electrical current

flows through the solenoid coil, creating a magnetic field. This is the fundamental mechanism that opens the valve and affects air pressure either directly or indirectly.

➤ *Servo Motor*



Fig. 7: Servo Motor

One kind of motor that has extremely precise rotation is a servo motor. Typically, this kind of motor is made up of a control circuit that gives feedback on the motor shaft's present location. This feedback enables the servo motors to

rotate extremely precisely. A servo motor is used when you wish to rotate an object at a certain angle or distance. It consists only of a basic motor that is driven by a servo mechanism.

➤ *MCB Switch*



Fig. 8: Miniature Circuit Breaker

Miniature Circuit Breakers (MCBs) are electrical switches that protect homes and buildings from electrical faults. These devices are commonly used in homes to protect against electrical overloads, short circuits, and other

faults that can occur in the electrical wiring. MCBs are available in various types and sizes to suit different applications.

➤ *Power Module*



Fig. 9: Power control module

This is a XH-M601 12V Battery Charging Control Board Intelligent Charger Power Control Panel Automatic Charging Power.

➤ *Battery*

Fig. 10: 3.7v Li-ion Battery

One type of lithium ion battery that is a chemical battery is the lithium polymer battery, sometimes referred to as the polymer lithium battery. Its features include high energy, compactness, and small weight as compared to

conventional batteries. Due to its ultra-thin nature, batteries with a variety of capacities and forms can be created to suit the requirements of certain devices. The smallest thickness that is possible in theory is 0.4 mm.

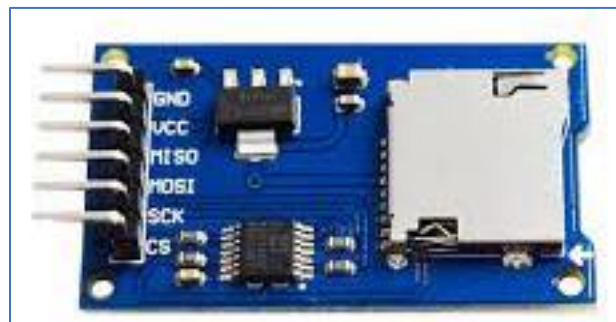
➤ *SD Card Reader*

Fig. 11: SD card Module

Dual I/O voltages are intended for use with the Micro SD Card Reader Module, also known as the Micro SD Adaptor. This module offers a straightforward method for moving data to and from a typical SD card.

The pinout can be utilized with various microcontrollers, although it is directly compatible with

Arduino. This module uses a 5V or 3.3V power source that works with an Arduino UNO or Mega, and it features an SPI interface that works with any SD card. Applications for SD modules include data loggers, audio, video, and graphics.

➤ *Speaker*

Fig.12: Speaker

Speakers are common output devices used in computer systems that provide a sound for the listener to hear. While some speakers may be connected to any kind of sound system, others are only useful once they are connected to a computer. The goal of the speakers, regardless of how they are made, is to produce audio output so that the listener may eventually hear the sound.

**C. SYSTEM FLOW CHART**

The Arduino NANO is interfaced with the Gas Sensor (MQ6 Sensor) and Fire Sensor in the proposed system. The system receives input from these sensors. Mobile data networks can be used to establish a connection with the interfaced GSM module.



A gas sensor finds gas leaks. As soon as a gas leak is discovered, buzzer will beep and owner will notified about it through SMS and the doors gets open through servo motors. With this, the Exhaust fan will start and Nitrogen Spray will turn ONN, because if the exhaust fan is not capable of excluding all the gas from the room and the doors are not able to open, then mixing nitrogen gas with LPG gas makes the LPG gas molecules less concentrated and less flammable as the nitrogen gas reduces combustion efficiency by absorbing the heat from the combusting cells and diluting it and the solenoid valve will turns OFF which is present in cylinder pipe.

The MCB switch will get turns OFF to cut the electricity of that area this ensures no short circuit will happens and this will prevent fire accidents. Also it has a

rotating fire extinguisher to spray water on small flaming object when gas is leaked to minimize the risk of gas explosion.

Same with Fire sensor, if it detects fire, then all the above processes will be same but in place of exhaust fan, Water spray will turn ONN and a Call will be dialed to the Fire Station along with a voice alert through speaker. This will helpful for fire station to find the location of the incident.

With this, the system will be keep running through battery backup even after cutting electricity supply.

The complete flow chart of how the system works is shown in fig 13.

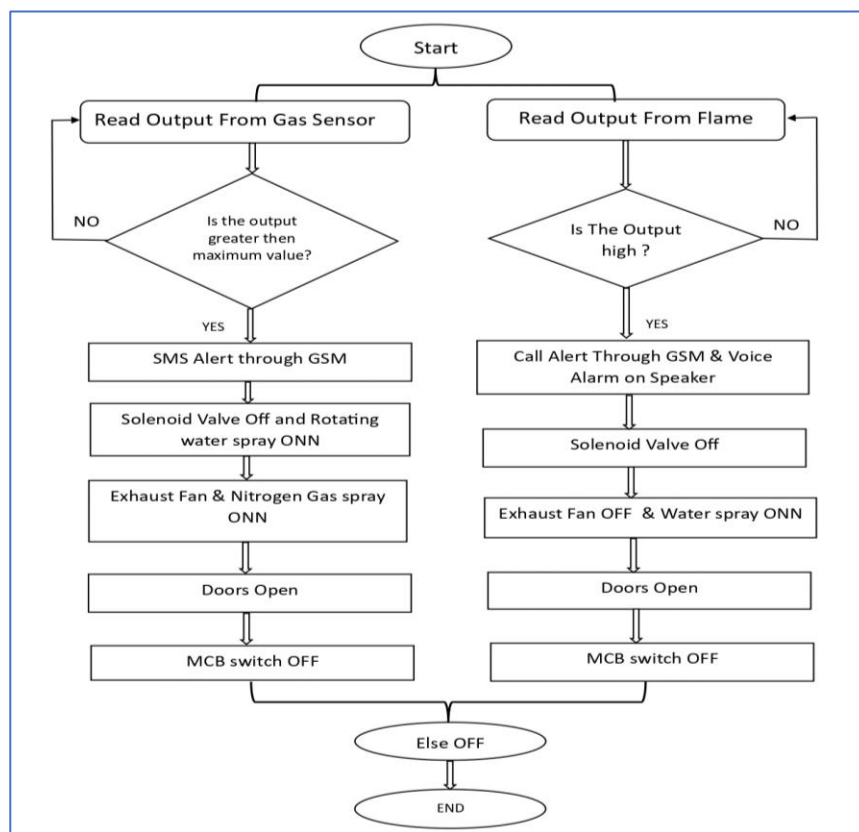


Fig. 13: Flow Chart for the proposed system

**IV. CIRCUIT SIMULATION**

Figure 12 shows how the Proteus simulating software has recreated the system's circuitry. Servo motors, DC fan, solenoid valve, MQ6 and fire sensor, GSM module, and other components are connected to Arduino NANO in the simulation.

A different Arduino is linked to a Sd card as well. Here, the Arduino NANO is used for the simulation rather than another development board. Since our system is entirely offline based, there is no usage of the internet in it.

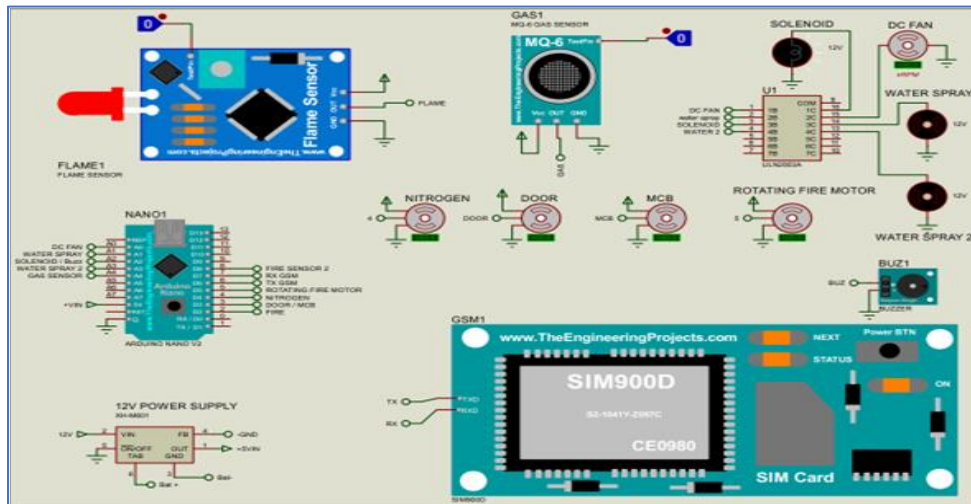


Fig. 14: Design of the System

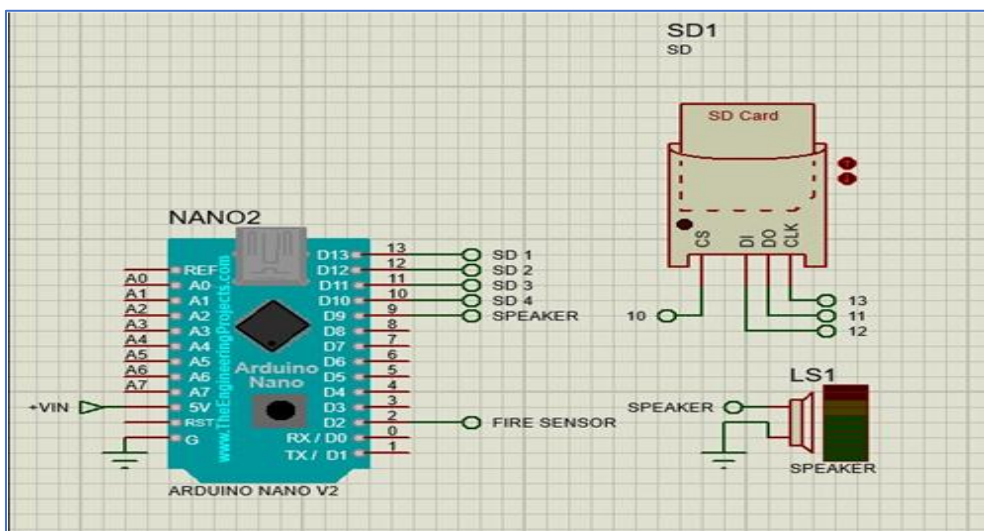


Fig. 15: Design of SD card Player

**V. PCB DESIGN**

The PCB layout design of the integrated circuitry in the device is displayed in Figures 16 to 18. The copper wire width used in the PCB design of the device circuit is 40

mm, and the clearance gap between two wires is also 40 mm. Proteus Professional 8.13 version software was used to create the single layer PCB layout design for this system.

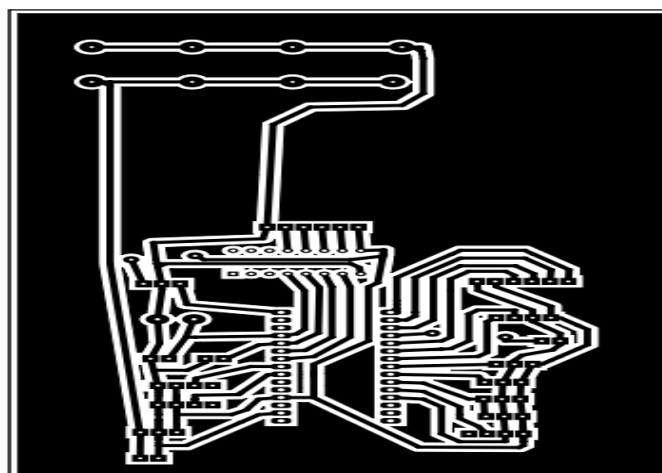


Fig. 16: PCB design of system

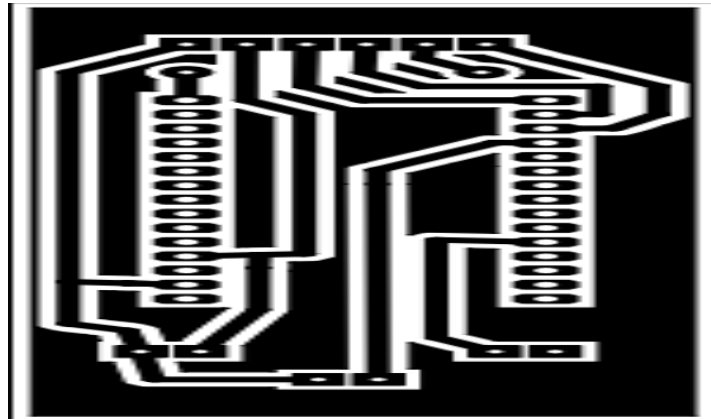


Fig. 17: PCB of SD card Module

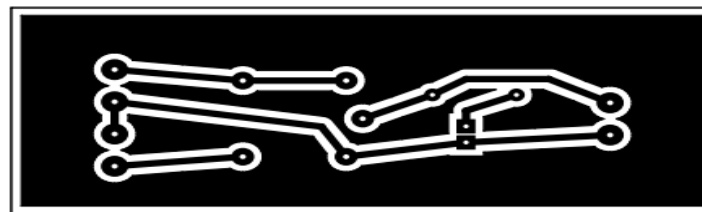


Fig. 18: Power Switching Circuit PCB

### VI. PRICE CHART

Table 1: The Total Approximate Cost

Item Name	Units Required	Total Unit Price in Rs.
Arduino NANO + USB	2	700
MQ-6 Sensor	1	170
IR Flame Sensor	2	200
SIM 900a Modem + MIC	1	1050
12v charging module	1	350
DC-DC converter	1	120
Servo Motor	4	600
DC Fan	1	90
Solenoid Valve	1	350
MCB switch	2	200
12v Adaptor	1	150
PCB board	2	90
3.7v 3800mah Battery	2	260
SD card module	1	120
Water pump + pipe	2	160
Wires	30	90
Amplifier + Speaker	1	120
Other Accessories	-	1000
<b>Total Amount</b>		<b>Rs 5,900</b>

These are the expected costs; the actual cost of the components for the intended product has varied.

Appropriate ranges are intended for this system's design. Several sensors can be used to expand this system. It is inexpensive and simple to handle because only the necessary parts are used. It can provide the user's phone with excellent output and detect gas leaks and fire incidents. Therefore, given the readily available material and its affordable price of approximately Rs 3,150, it is a very effective tool that is simple to assemble and operate. were satisfied because the system functions well.

### VII. HARDWARESETUP

The implemented circuitry of GSM based Gas and Fire Accident Avoiding System is shown in Figure 17-18 that are devices side by side connected to their dedicated position. And LED's indicates the total situation of the area by turning ON and OFF.

It gives proper Message and Call function as described also other applications worked as expected.



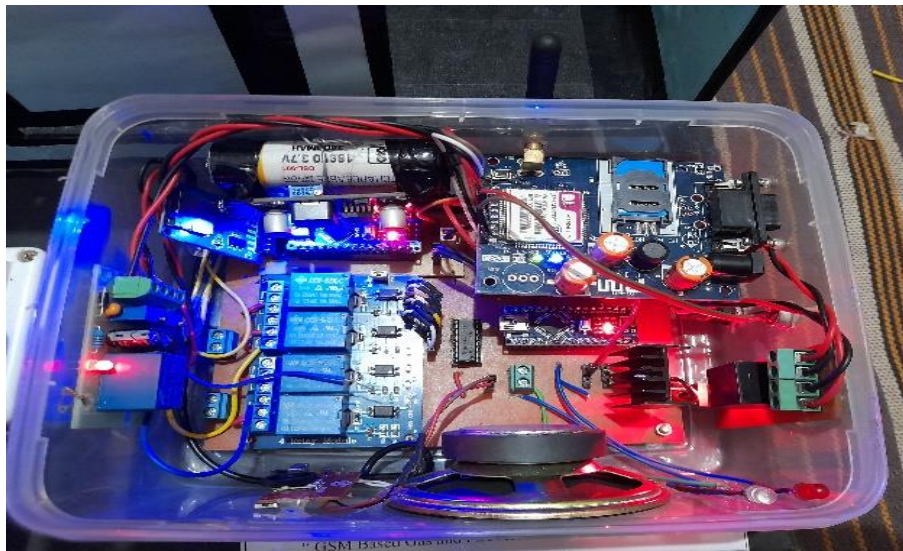


Fig. 19: Total Circuitry Box



Fig. 20: Final Model Presentation

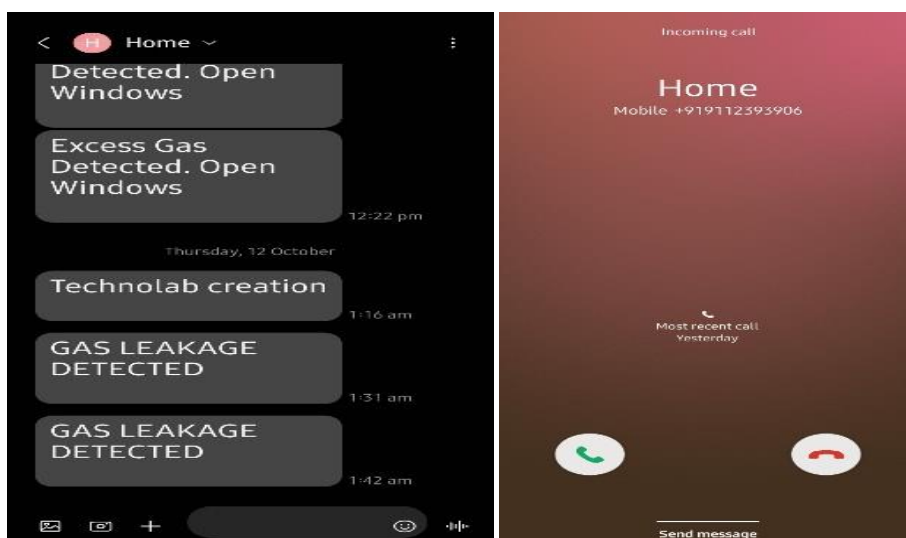


Fig. 21: Message and Call Received when accident occurs.

## VIII. RESULT & CONCLUSION

In this work, an effort has been made to design an efficient gas and fire alarm system using an Arduino Nano, MQ-6 flame sensor, and effective electricity management. This project will readily save human lives while also assisting in the reduction of severe risks. Additionally, it will aid in lowering the death rate, accident percentage, and maximum likelihood of gas explosions caused by electric appliances.

The measurement's results demonstrate that the system operates effectively in every scenario. This project's primary goal has been to create a circuit that can detect LPG gas and fire and, in turn, sound an alarm, turn off the electricity, send the user an SMS message, make a call, and provide security and can operate on battery when no electricity supply is available.

## IX. FUTURE SCOPE

The prototype created for this project allows users to automatically control gas leaks and fire explosions, even when their homes are empty. This is beneficial to the user in the event that they are not at home or are not even aware of an emergency. By using this prototype, unanticipated or potentially dangerous situations won't arise in residential settings without the residents' knowledge. It was discovered that using a connected gas and fire sensor was more practical and real-time.

Even though the prototype was able to put out the fire, a more effective integration of the various elements might greatly increase portability. Additionally, this system needs to ensure that every module should be replaced easily.

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