MICROCONTROLLER BASED LIQUIFIED PETROLEUM GAS LEAKAGE AND LEVEL DETECTION USING GSM MODULE

OGBANU DAVID CHINECHEREM

2017/EN/5258

ITUMO ALOYSIUS IKECHUKWU

2017/EN/5730

EDEH CHIBUEZE GOODLUCK

2017/EN/4434

ABSTRACT

Liquefied petroleum gas (LPG) is a combustible hydrocarbon gas used as fuel. This project aims to develop a microcontroller-based LPG gas monitoring and leak detection system with a GSM alert system. The system consists of three sensors: a gas sensor, a load cell, and a solenoid valve. The embedded system is simulated using Proteus software, and when exposed to gas leaks, an alarm mechanism activates and a text message alerts the user. The system can be enhanced by switching from SMS alarm notifications to IoT for monitoring and control, and solar power can be included for constant electricity supply.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of Study

LIQUIFIED PETROLEUM GAS (LPG) is the contraction or short structure for melted petrol gas. Like every petroleum derivative, it's a non-renewable source of energy which is extracted from crude oil and natural gas. The major components in a Liquified Petroleum Gas are hydrocarbons containing three or four carbon molecules. The ordinary parts of LPG in this manner, are propane (C3H8) and butane (C4H10), little concentrations of different hydrocarbons may likewise be available or present. Depending on the source of the LPG and how it was produced, compositions other than hydrocarbon may also be present. At normal ambient temperatures and atmospheric pressure, LPG is a gas, this gas can be liquefied when a moderate pressure is introduced and the temperature is sufficiently reduced or decreased. It can be easily condensed, packaged, stored and utilized, making it an ideal energy source for a wide range of applications. (Nasir Hussain, 2022)

LPG was discovered in 1912 when Dr. Walter Snelling, an American Researcher, understood that these gases could be changed into liquids which can then be stored under moderate pressure. Due to the adaptable idea of LPG, it's utilized for some necessities, for example, domestic fuel, industrial fuel, automobile fuel, heating etc., bringing about a high demand of LPG domestically and also in the industry (Priya 2014). LPG is preferably used at homes, industry and also in automobiles because of its unique properties that helps produce a clean-burning fuel with less soot and very less smoke which produces less greenhouse gas emissions

throughout the whole fuel cycle than any other fossil fuel. Also, it's important to note that LPG burns to produce clean energy and does not cause much harm to the environment but whenever there is a leakage, this is a serious threat to life and properties.

The quality of the places we live has decreased as a result of the nonchalant attitude of the human race toward keeping our surroundings and environment pollution-free. There are several aspects of pollution which include soil, water, noise and air pollution. Air pollution can be said to be critical compared to others because others can be detected easily either visually or by taste, in the case of air pollution, it can be colorless, odourless and tasteless. LPG is normally a colourless, odourless and flammable gas but for safety purposes when sold and shipped, an odorant (such as Methyl Mercaptan) is added. LPG is usually stored in metallic cylinders as its boiling point is

lower than ambient temperature. LPG is heavier than any other gas in the air, it's an asphyxiant gas which may cause unconsciousness or death if the oxygen level in that particular area where its released is sufficiently reduced and this can cause rapid suffocation. It's also an extremely flammable gas, which may explode when heated. (J. Tsado et al, 2014)

Thus, LPG gas is becoming more popular among consumers and business owners, hence the requirement for a safe environment is the greatest amount of significance, the LPG gas leakage checking and controlling framework which sends SMS caution to the consumer about a gas leakage finds its wide application here. In this project work a proposed design was set in place using a micro controller-based LPG gas control and leakage detection system which will help to detect gas leakage and the level of gas in the system. Also, information about the status of the gas will be sent to the consumer through signals and SMS alert using GSM Module to the authorized number set in place, this design also helps to stop the continuous flow of gas along a particular pipe once a leak is detected along that particular pipe.

1.2 Problem Statement

With the rate of increase in demand of Natural gases such as Liquid Petroleum Gases (LPG) both at homes and in the industry, there is also a great increase in hazards associated with gas leakage. Currently, the use of natural gas instead of petroleum as the driving fuel for vehicles has also been on the increase.

Gas leakage can be very dangerous because it increases the risk of fire or explosion which can lead to loss of lives and properties. Natural gas does not have odour but gas company due to safety reasons adds a warning "rotten-egg" smell (mercaptan) that can be easily detected by the consumer. Nonetheless, individuals who have a diminished feeling of smell will most likely be unable to depend upon this safety measure. Also, a leak might occur when no one is present in the vicinity which increase the risk of an explosion therefore, with the use of a gas sensor with a GSM alert notifying system the rate of the safety measure consideration is increased

1.3 Aims and Objectives

1.3.1 Aims

The aim of this project work is to design and execute a micro-controller-based LPG gas level monitoring system, leakage detection system with a GSM alert system and automated valve control system.

1.3.2 Objectives

The major Objectives of this project are:

1. Construction of a Micro-controller-based gas level monitoring and leakage detection system in a particular vessel
2. Construction of a Micro-controller-based gas level monitoring system which will notify the consumer with the help of an SMS alert about the current gas level in the vessel
3. Construction of a Micro-controller-based gas leakage detection system which will notify the consumer if there is a leakage in the system.
4. Implementation of a Micro-controller based automated valve control system and,
5. Evaluation of the performance of the entire developed system.

1.4 Significance of Study

The utilization of SMS alert notification system for the design and implementation of a Gas leakage and level detector system using a micro-controller-based system will be helpful to its users in so many numerous ways, some of which include

1. General Control and Portability: The user will be able to fully determine the state of the gas system from their cell phone at any location.
2. Waste and Pollution Control: This project work is also designed in such a way that once a leak is detected; it will automatically stop gas flow along that particular pipe helping to reduce pollution and also controlling waste of resources
3. Better Observation and Correspondence System: this system is designed in such a way that there is a two-way communication between the device and the consumer at any time.
4. Economized cost and Efficiency: The sensors that was used in this project work has excellent sensitivity with a speedy response time therefore, we can say the system is highly reliable. Maintenance cost is less and it's possible to get a result with high accuracy.

Also, problem of exhausting your gas without been notified is solved because this system is designed to inform the consumer about the current status of the gas level in the vessel. This system is also designed in such a way to help reduce wastage of resources (gas) by halting the continuous flow of gas along the particular pipe where the gas leakage is detected

1.5 Scope of the Project

This project work is equipped to detect gas leakage and sending alert by means of SMS to the consumer likewise, it's capable of stopping the continuous flow of gas along a particular pipe once a leak is detected along the pipe. It also helps to monitor the gas level in a vessel and sending a feedback result if the gas level is low via SMS too.

CHAPTER TWO

2.0 LITERATURE REVIEW

Gas leaks can result in serious catastrophes that inflict both financial losses and human damage. The development of trustworthy methods for detecting gas leakage has received a lot of attention in an effort to prevent such occurrences.

The gas leak sighting technology has undergone extensive manipulation and miniaturization in an effort to combat the hazardous impacts of gas leakage. Many scholars have published their studies on the occurrence of gas leak-related accidents.

Huan Hui Yan et al, (2014) designed a monitoring system for gas leakage detection, using a combustible gas sensor (MQ9) to detect the present of methane (CH4) and carbon monoxide gas (CO). By utilizing the Arduino Uno as the microcontroller, this sensor will function in the alarm system, autonomous control system, and monitoring system to detect the gas concentration based on the voltage output of the sensor. The monitoring system that is displayed on the LabVIEW Graphical User Interface (GUI) will receive the data reading from the gas sensor through Zigbee. Users can respond immediately to the breach, and the system will automatically shut down in 10 minutes to stop the situation from getting worse.

In J. Tsado et al (2014), they proposed in their research article named "Design and construction of a GSM based gas leak Alert system. Two gas sensors (MQ-6) are utilized to identify gas leaks in a specific area, and the outputs of these sensors are interfaced with an assembly-language- programmed 8051 microcontroller. In order to allow timely necessary action, a specialized GSM phone with a line is linked to the microcontroller's output and set up to deliver gas leakage notifications through a short message service (SMS) message to another GSM phone.

Tamil Selvi et al (2018) designed and developed a system for monitoring and detecting liquefied petroleum gas leaks. Two sensor devices, two different alarm warning types, and an online monitoring system make up the system. Gas leakage is detected using a gas sensor, and the gas cylinder is weighed using a load cell sensor. In order to offer the system Internet of Things (IoT) technology, a non-physical alarm warning with email and notice delivered to the user through smartphone has been devised. This is for gas detection. Blynk is an IoT platform that is employed for monitoring purposes.

Users can remotely check on the status of their kitchen and receive alerts for both gas leakage and gas cylinder condition thanks to real-time data transmitted through WiFi.

Ankit. A Jaisswal et al, (2022) designed and proposed a project named "Automatic LPG Sensing Device with Switching Off Mechanism" The goal of this project is to install gas leak detection kits in high-risk locations to stop accidents caused by flammable gases like LPG and CNG. The main goal of the project is to create a functional prototype that can successfully identify a gas leak, in this instance liquefied petroleum gas (LPG),

in the environment. Once the leak has been discovered, the gadget should also respond automatically by implementing an alert system and an emergency shut-off valve.

In 2015 Prof.M.Amsaveni et al proposed a system called "GSM based LPG leakage detection and controlling system", In order to automatically identify, notify, and control gas leakage, this project proposes to deploy gas leakage detection kits at sensitive locations. To avoid fire incidents, the valve automatically closes when a leak is found, and the electricity is turned off. A gas sensor with great sensitivity to gases like propane and butane has been employed. A GSM module in the system sends an SMS to the user to alert them.

Ms.A.Preethi Vinnarasi M.E et al, 2021 developed a system named "LPG Gas Monitoring System Using Arduino", It is crucial to remember that LPG leakage poses a major risk to consumers and society, making it crucial to install a gas leak detector close to the source. This project suggests a flexible and trustworthy method for identifying LPG leaks, keeping track of how much LPG is left in the cylinder, and enabling cylinder reservations. Additionally, it has the ability to buzz the users and send an alert SMS notice to warn them to avoid serious mishaps. This suggested system's benefit is that it continually tracks the gas level and provides rapid reaction to incidents as well as accurate leak detection.

In. Lakshmana G. et al (2020), developed a system that will alert the user whenever any dangerous actions occur in the kitchen. It can continuously measure the weight of the cylinder by using a weight sensor (load cell) and send a message to the gas agency and user. This system regularly gives updated information about gas to the user, it also helps to notify the consumer and protect them from hazardous actions.

In 2017 Kumar Keshamoni and Sabbani Hemanth wrote a journal named "Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT", This journal discusses the common problem of a GAS container going empty and how to reduce the weight of the gas in the container using IOT. The gas booking/order is done with the help IOT and continuous weight measurement is done using a load cell interfaced with a Microcontroller. For security, the kit includes an MQ-2 (gas sensor), LM 35 (temperature sensor) and a siren (60db) to detect any change in any of the sensors.

Nwukor Frances Nkem (2021), explained that particularly in urban areas, liquefied petroleum gas (LPG) is a significant source of cooking fuel. It is a significant issue in both commercial and residential settings, and rising gas leakage has made home security a top priority. Installing a gas leak detecting system in sensitive areas is one of the preventative measures to avert mishaps. The design of a system that can automatically identify and notify users of gas leaks through SMS is discussed in this study. A notification system for users is also included in this suggested system..

Muhammad Siddik Hasibuan, Syafriwel, Iswandi Idris, 2020 developed a system named "Intelligent LPG Gas Leak Detection Tool with SMS Notification" where it was adequately described that gas is an unbound, formless, invisible molecule that may change into multiple forms at specific temperatures and pressures. Many fires are started by LPG gas because of a broken gas regulator. An intelligent Arduino-based gadget with MQ-

2, SIM800L, and buzzer gas sensors was developed to reduce fires. The device can transform sensor input data into short messages (SMS), and it also generates a buzzer-generated sound..

In 2014 P. Meenakshi Vidya et al designed a system which uses a sensor to detect LPG leaks, sending the information to the user through SMS and concurrently alerting the customer by GSM module, triggering the alarm, and turning on the exhaust fan. The method also has the advantage of using a load cell to continuously monitor the amount of LPG in the cylinder and a GSM module to book the cylinder automatically..

Tanvira Ismail et al, 2014 wrote a journal named "GSM Based Gas Leakage Detection System With Preventive Measures" where it was detailed that gas sensor device can identify harmful and combustible gas leaks, including LPG leaks, in vehicles, gas stations, homes, and storage tanks. This device is simple to include into an alarm-sounding device. The sensor responds quickly and

with remarkable sensitivity. This sensor can also detect additional gases, including cigarette smoke, propane, and iso-butane. The sensor's output changes to LOW as soon as it detects a gas leak in the atmosphere. The microcontroller notices this and activates the buzzer. After a little interval, the main power supply is cut off and the exhaust fan is also turned on to expel the gas.

In 2014 Shivalingesh B.M et al wrote a paper where it was demonstrated on how to use a gas sensor to automatically schedule the installation of a new cylinder and identify gas leaks. Methane and propane, which are the two primary components of LPG, are particularly sensitive to the gas sensor MQ-6. Continuous weight measurements of the cylinder are made using a load cell. The weight of the cylinder is continuously shown, and several 4-5 MQ-6 sensors will be positioned throughout the room. When there is an LPG leak, the output of the sensor will increase. When the sensor output is high, a buzzer is activated, and a notification is sent by GSM to the consumer and the closest gas agency. A notification will also be sent to the agency to reserve a new cylinder when the weight of the cylinder reaches the threshold value.

M. Joshua Vinoth et al, (2016) described how to monitor LPG leakage so as to prevent fire accidents, providing home security features in areas where security has been a top priority, as well as alerting the customer through SMS of the leak and, as a last resort, cutting off the power while sounding the alarm. In this paper, we proposed an additional advantage of the system: it automatically books the cylinder using a GSM module and continuously monitors the level of the LPG present in the cylinder using a load sensor. If the gas level falls below the threshold limit of gas, which is approximately 2 kg, the user can promptly replace the old cylinder with a new one. The device ensures security and prevents explosions and suffocation caused by gas leakage.

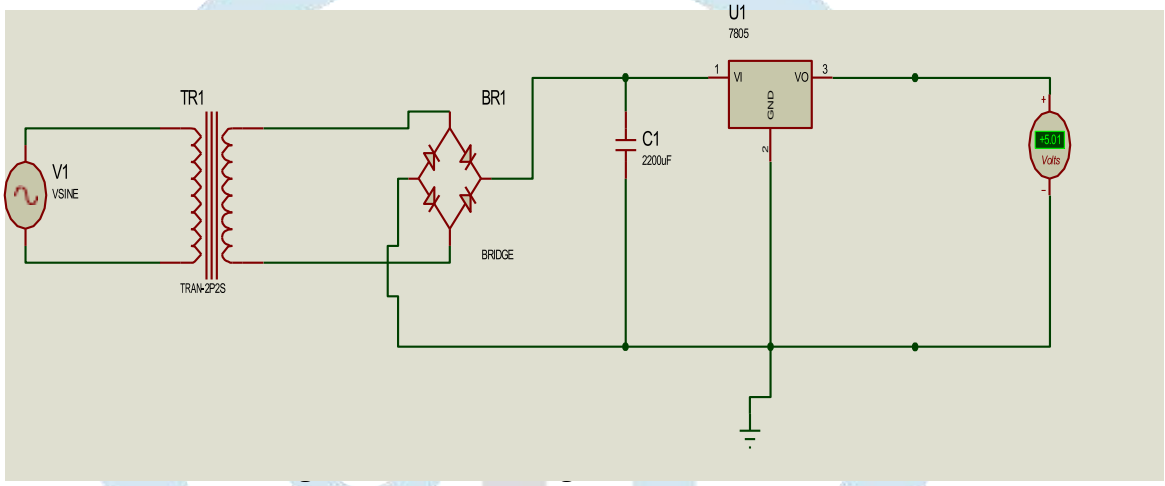
Our project work will provide a battery (DC) to the system to function even when the power is switched off and also the system should be able to tell us continuously the concentration of gas in the environment through the LCD display.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 POWER SUPPLY

Whenever we operate on circuits, we require a means of supplying electricity to the entire system. This is simple to accomplish with a battery. However, the issue with batteries is that they sometimes run out or deplete quickly. Therefore, we create an AC 220V to 5V DC steady power supply in this project.



Components used include:

- Transformer
- Diodes
- Bridge Rectifier AC to DC
- Capacitor
- Voltage regulator using LM7805

Transformer: To utilize a transformer is obvious. Power transformation is a transformer's primary function. In this situation, a step-down transformer is required. High power is converted to low power using a step-down transformer. You may be aware that the mains voltage in every country varies. like Nigeria, which has a rating of 220V–230V and a 50Hz frequency. Thus, a transformer with a 5v output rating won't always provide 5v. because input determines result. It may occasionally be greater or less than 5 volts. So, in this case I'll use a 14.18v output rated transformer.

A transformer is a piece of electrical equipment that uses electromagnetic induction to transfer electrical energy between two or more circuits. A fluctuating magnetic field created by a changing current in one transformer coil induces a changing voltage in a second coil. Without a physical connection between the two circuits, power can be transported between the two coils via the magnetic field. In electric power applications, transformers are utilized to raise or lower the alternating voltages.

It's important to note that mathematically the transformer rating is calculated using

L1/L2 = (N1/N2) ^2 .....eqn 1

Therefore (L1/L2) ^ ½ = N1/N2.....eqn 2

From Transformer equation

N1/N2 = V1/V2 ..... eqn 3

Therefore, combining eqn 2 and eqn 3

(L1/L2) ^ ½ = V1/V2 .....eqn 4

Where,

L1 = Primary Inductance = 1H

L2 = Secondary Inductance = 4.15mH = 0.00415H V1 = Primary Voltage = 220V

V2 (secondary voltage) =?

From eqn 4, we can make V2 subject of formula to get V2 = V1 / (L1/L2) ^ ½

Substituting each parameter, we have V2 = 220 / (1 / 0.00415) ^ ½

V2 = 220 / (240.964) ^ ½ V2 = 220 / 15.523

V2 = 14.1725v

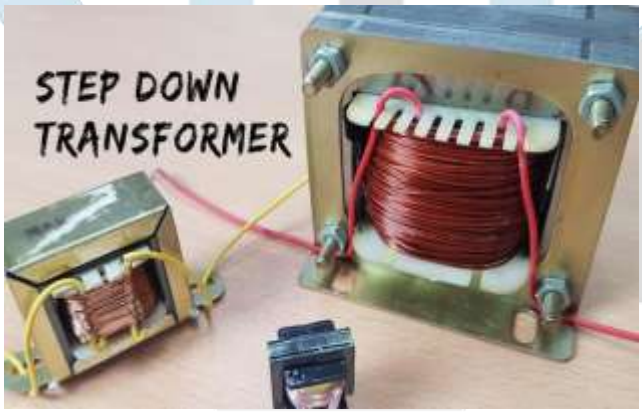


Fig 3.2: A Step-Down Transformer

Diodes: A diode is a semiconductor device having two terminals that usually only permits one direction of current flow. It denotes that current cannot flow in the opposite direction.

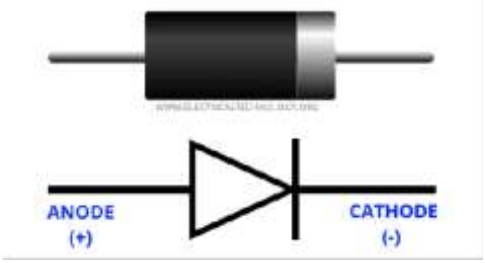


Fig 3.3: Diode diagram

Bridge Rectifier AC to DC: We must now create a bridge rectifier utilizing 4 diodes. A straightforward AC to DC rectifier can be created by appropriately arranging 4 diodes. However, it is unable to deliver DC power efficiently. The wave form is still pulsating.

Fig 3.4: Full Bridge Rectifier system

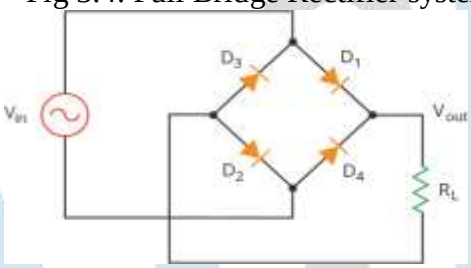


Fig 3.5: Full Bridge Rectifier Circuit Design

Capacitor: The wave is still pulsating. If the mains frequency is 50Hz, a simple fix for that is to use a filter capacitor of 2200uF.

Fig 3.6: Capacitor

Voltage Regulator using LM7805: A LM7805 voltage regulator with a 5 volt output will be used. I'll explain why I chose 14.18v over a transformer with a 5v output rating. If the input voltage is greater than 5 volts, the voltage regulator will continuously supply 5 volts. The output of your transformer is also influenced by its input. A LM7805 voltage regulator with a 5 volt output will be used. I'll explain why I chose 14.18v over a transformer with a 5v output rating. If the input voltage is greater than 5 volts,

the voltage regulator will continuously supply 5 volts. The output of your transformer is also influenced by its input. The output will be less than 14.18 volts if the input is less than 220 volts and will be greater than 14.18 volts if the input is greater than 220 volts. Had I used a transformer with a 5v output rating, the same thing might have happened. It occasionally wouldn't be able to supply 5 volts. It may occasionally be less than that. In a nutshell, a voltage regulator

maintains voltage. And even if your transformer has a 5 volt output, it might not always deliver that voltage.

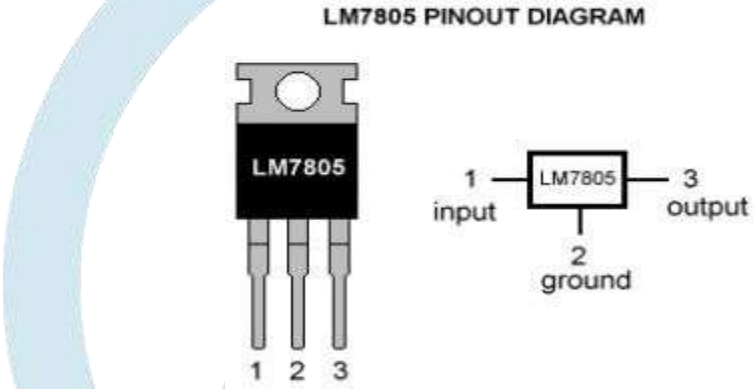
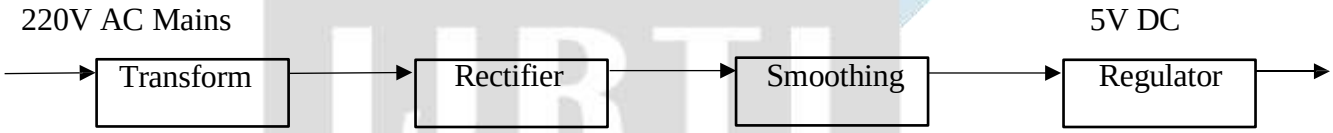


Fig 3.7: LM7805 Voltage Regulator

BASIC BLOCK DIAGRAM OF POWER SUPPLY



3.2 COMPONENTS USED IN THIS PROJECT INCLUDE

- Arduino Uno
- GSM Module (SIM 808)
- HX711 Weight Sensor
- Gas Sensor (MQ-2)
- Liquid Crystal Display (LCD)
- Solenoid Valve (Normally Open)
- Jumper Wires
- Light Emitting Diode (LED)
- Buzzer
- Proteus

MODELLING TOOLS INCLUDE;

ARDUINO UNO: This is a common microcontroller board used in many electronic and development applications is the Arduino Uno. The microcontroller used in it is an Atmel ATmega328P. The Atmel ATmega328P microprocessor serves as the basis for the Arduino Uno. The microcontroller is an 8-bit device having 32KB of flash memory for the program code, 2KB of SRAM for data storage, and 1KB of EEPROM for non-volatile data storage. The Arduino Uno's ATmega328P operates at a 16 MHz clock frequency. The microcontroller's ability to execute instructions quickly depends on its clock speed. The 14 digital input/output (I/O) pins on the Arduino Uno are identified by the letters D0 through D13. These pins can be set up as inputs or outputs to communicate with a variety of external components, including sensors, LEDs, motors, and more. The six analog input pins on the Arduino Uno are numbered A0 through A5. You can read analog voltage readings from sensors or other analog devices using these pins. The 10 bit resolution of the analog inputs offers 1024 potential values (0 to 1023). There are two ways to power the Arduino Uno. It can first be powered by a USB connection, which also makes it possible to program the board. Second, the DC power socket allows it to be powered by an external power source. The external power supply's recommended voltage range is 7 to 12 volts. The Arduino Uno can communicate with other devices using a variety of interfaces. It has a USB interface for serial connection and programming with computers. It also contains a TTL serial port (USART) for serial devices and other microcontrollers to communicate with. The Arduino Integrated Development Environment (IDE) can be used to program the Arduino Uno. Writing, building, and uploading code to the board is made simple and user-friendly by the IDE. This is an open-source hardware and software platform. It follows that anyone can create and alter Arduino-based creations because the design and specs for the board are publicly available to the public. The popularity and wide acceptance of Arduino can be attributed to its open-source design.

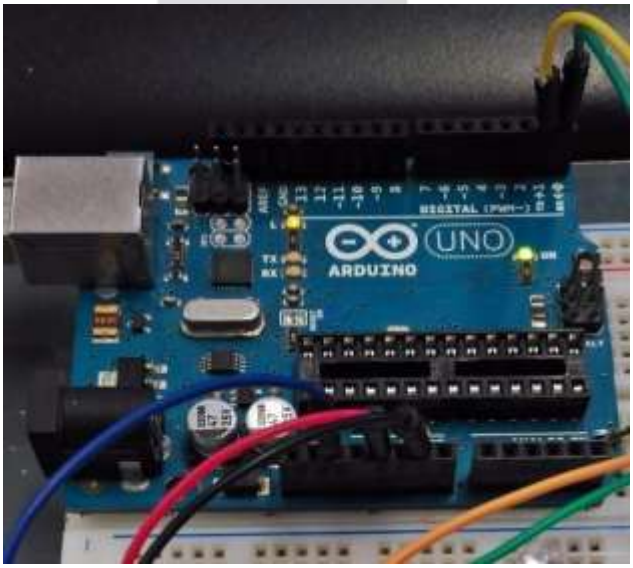


Fig 3.8: Arduino Uno

GSM MODULE: An electronic gadget that's capable of communication via a GSM network is called a GSM (Global System for Mobile Communications) module. It offers a method for devices to wirelessly send and receive data, voice, and SMS messages. They are frequently utilized in systems like remote monitoring systems, security systems, car tracking systems, and IoT (Internet of Things) devices.

Key components and functionalities of a typical GSM module include:

- GSM Chipset: This is a chipset, which contains all the hardware and software required to connect to and maintain a connection with the GSM network, this is the brain of the GSM module. The chipset has an RF transceiver for sending and receiving signals as well as a baseband processor for managing communication protocols.
- SIM Card Slot: A SIM (Subscriber Identity Module) card is necessary for a GSM module to authenticate the device on the network. Information like the user identification, network authentication key, and mobile number are all stored in the SIM card. It is placed inside of a specific slot on the GSM module.
- Antenna: The GSM module has an antenna to transmit and receive radio signals. It is usually an external component that needs to be properly connected for optimal signal strength.
- Power Supply: GSM modules typically require a power supply to operate. They can be powered by a direct current (DC) source, such as a battery or an external power adapter. Some modules also support power-saving features to reduce energy consumption.
- Communication Interfaces: In order to link with external devices like microcontrollers, computers, or other embedded systems, GSM modules provide a variety of communication interfaces. UART (Universal Asynchronous Receiver-Transmitter), SPI (Serial Peripheral Interface), and I2C (Inter-Integrated Circuit) are examples of common interfaces used.
- AT Commands: GSM modules communicate with external devices using AT (Attention) commands. These commands are simple text-based instructions that control the module's behavior, such as making calls, sending SMS messages, or establishing data connections. Developers can send AT commands to the module through the communication interface to perform specific operations.
- Voice Calls: Voice communication is supported by GSM modules, enabling phone calls to be placed and received by devices. They can connect with speakers and microphones and use audio codecs to encode and decode voice signals.
- SMS Messaging: GSM modules can send and receive SMS (Short Message Service) messages. They provide APIs (Application Programming Interfaces) or AT commands to handle text-based communication, enabling applications to send alerts, notifications, or other textual information.
- Data Connectivity: GSM modules offer data connectivity capabilities, enabling devices to establish a network connection and transfer data over the internet. They support various protocols such as TCP/IP and HTTP, allowing devices to communicate with remote servers or exchange data with

cloud platforms.

- Network Communication: GSM modules use common cellular network protocols to connect to the GSM network. The communication is then forwarded to the desired location after they establish a connection with the closest base station. GSM modules can operate globally in a variety of countries thanks to their support for several frequency bands.

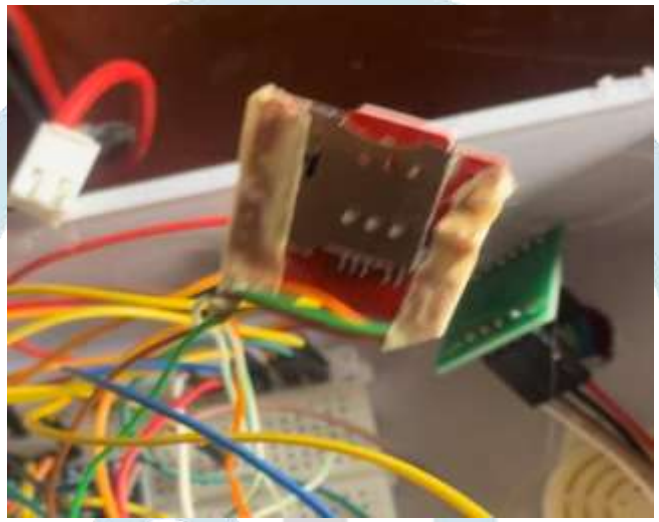


Fig 3.9: GSM Module

HX711 WEIGHT SENSOR: HX711 is a customized integrated circuit (IC) created for purposes involving weight monitoring. Precision electronic weighing scales are frequently made using it in conjunction with load cells. It is simpler to connect load cells with microcontrollers or other digital devices thanks to the HX711's analog-to-digital conversion and amplification features.

key components and features of the HX711 weight sensor include:

- Load Cell Interface: The HX711's main function is to connect to load cells. A transducer called a load cell transforms weight or force into an electrical signal. The Wheatstone bridge arrangement, which consists of four strain gauge resistors and is frequently used with load cells, is supported by the HX711. The HX711's IN+ and IN- pins are used to attach the load cell to the device.
- Amplification: The HX711 includes a high-precision, low-noise amplifier that amplifies the small electrical signals generated by the load cell. Weight measurements are made more precise and with more resolution thanks to this amplification.
- Calibration: It is necessary to calibrate the HX711 in order to get precise weight readings. Finding the correlation between the load cell's output and the corresponding weight is the goal of calibration. This is normally accomplished by

  loading the load cell with known weights, recording the resulting measurements, and using those results to develop a calibration curve or equation.

- Serial Communication: The HX711 uses a serial interface to communicate with other devices like computers or microcontrollers. The two-wire interface between the HX711 and the attached device uses clock (SCK) and data (DAT) to send data.
- Gain Selection: In order to suit various load cell sensitivities and measurement ranges, the HX711 offers configurable gain levels. The gain selection pins (GAIN_A and GAIN_B) can be controlled to set the gain to 128, 64, or 32. The gain level impacts the resolution of the weight measurements and establishes the maximum weight that may be measured.
- Analog-to-Digital Conversion (ADC): The amplified analog signal from the load cell is converted into a digital signal that can be handled by a microcontroller or computer via the HX711's integrated 24-bit delta-sigma ADC. Precision weight readings are possible because of the 24-bit ADC's high-resolution measurement capabilities.

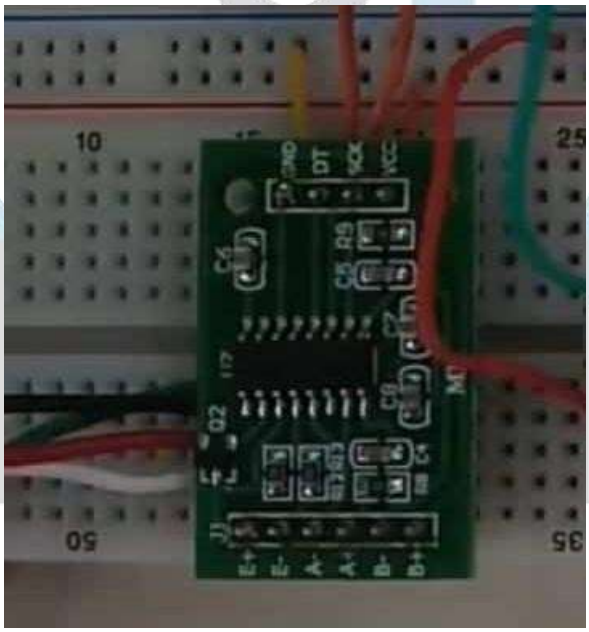


Fig 3.10: HX711 Weight Sensor

GAS SENSOR: The MQ-2 gas sensor a well-liked and frequently employed sensor for spotting and measuring different kinds of smoke and flammable gases in the air is. It is frequently utilized in applications including air quality monitoring, industrial safety, gas leak detection, and fire detection systems. The sensor is capable of detecting combustible vapors and gases such as smoke, alcohol, LPG, propane, methane, hydrogen, and other.

A detailed explanation of the MQ-2 gas sensor include:

- Sensor Principle: The MQ-2 gas sensor operates based on the principle of metal oxide semiconductor (MOS). It is composed of a metal oxide sensing element whose resistance varies as it comes into contact with the target gases. An electrical signal that can be monitored and evaluated is then created from the resistance change.

- Sensor Structure: The MQ-2 sensor is included in a tiny module with pins for simple circuit integration. Usually, a heating element and a sensing element are placed on a ceramic substrate. Tin dioxide (SnO2) or a combination of tin dioxide and other metal oxides make up the sensing element most frequently.
- Heating Element: An embedded heating element, often a tiny coil of wire, is present in the sensor. This heating component is in charge of increasing the sensing element's operational temperature to the ideal level so that it may react with the target gases in a productive manner.
- Sensing Element: The sensor's sensing component is its most important component. It is a metal oxide coating that changes its electrical conductivity characteristics depending on the gas it is exposed to. Target gas molecules that come into contact with the detecting element's surface set off a chain of chemical reactions that alter the metal oxide film's resistance. The amount of the target gas present in the air directly relates to this change in resistance.
- Load Resistance and Circuitry: Typically, load resistor and related electronics are used in conjunction with the MQ-2 gas sensor. A voltage divider circuit is created by connecting the load resistor in series with the sensor. Variations in this voltage are utilized to calculate the gas concentration. The output voltage from the sensor is measured across the load resistor.
- Sensitivity and Calibration: Different gases are sensitive to the MQ-2 sensor at different amounts. For the particular gas being detected, the sensor must be calibrated. During calibration, the sensor is exposed to known concentrations of the target gas, and the measuring circuitry is modified as necessary. Gas detection is accurate and dependable thanks to calibration.
- Signal Processing: To acquire useful gas concentration readings, the sensor's analog voltage output, which is its raw output, must be processed. The analog signal is transformed into a digital form suitable for further processing or display using signal conditioning and amplification techniques.

Fig 3.11: MQ-2 Gas Sensor

LIQUID CRYSTAL DISPLAY (LCD): An LCD is a flat electronic display technology that uses the light-modulating properties of liquid crystals. It is made up of several layers, including electrodes, a liquid crystal layer, and two polarized filters. The liquid crystal molecules align when an electric current is applied, allowing or inhibiting light to flow through and producing readable characters or images. The size and configuration of the display are indicated by the notation "16x2". In this instance, the display contains two rows with a capacity of 16 characters for each row. This means that a total of 32 characters can be seen at once when you display up to 16 characters in the first row and another 16 characters in the second row. A 16x2 LCD display typically has 5x8 pixel-sized characters. A matrix of 5 columns and 8 rows of pixels make up each character. The 8 rows are used to represent a character's height, and the 5 columns are used to represent a character's width. A controller is needed to connect an LCD display to a computer or microcontroller. The controller controls numerous control operations, character production, and memory management for the display. For 16x2 LCD displays, controllers like the HD44780 or equivalent types are frequently utilized. A standard 16x2 LCD display uses a parallel or serial interface to talk to the display controller. While serial interfaces rely on fewer data lines and a specialized protocol (such as I2C or SPI) to communicate information, parallel interfaces use several data lines to send commands and data. For better visibility, many 16x2 LCD displays include built-in illumination. Typically, an LED (Light-Emitting Diode) is used as the backlight and is mounted behind the display. It can be individually regulated to change its brightness or turned off if not needed. Although various variations may support a range of voltages, 16x2 LCD displays normally run at a voltage of 5 volts. To avoid damage, it's crucial to make sure the display is powered with the appropriate voltage. The use of 16x2 LCD panels is common in many technological products and projects. Consumer electronics like digital watches, calculators, and tiny appliances frequently contain them. They are also often used in DIY projects and embedded systems as a way to show crucial information or offer visual feedback.

Fig 3.12: Liquid Crystal Display (LCD)

SOLENOID VALVE: A solenoid valve is an electromechanical device used to open or close a valve by activating an electromagnetic coil in order to control the flow of liquids or gases. It is frequently utilized in many different applications, such as Industrial processes, automation systems, and fluid control systems.

The structure and components include:

- Valve Body: Brass, stainless steel, or other enduring materials are frequently used to make valve bodies. It offers a route for the flow of fluid or gas and houses the internal components.
- Valve Seat: A sealing component located inside the valve body is the valve seat. The seat of the valve blocks the passage of the fluid or gas when it is closed.
- Solenoid Coil: An electrical coil made of a wire twisted around a metallic core is called a solenoid coil. A magnetic field is produced when an electric current flows through the coil.
- Plunger: The armature, often known as the plunger, is a moving part that is housed inside the solenoid coil. Typically, it is constructed with ferromagnetic substances like iron or steel.
- Spring: When the solenoid is not activated, the spring exerts a restoring force on the plunger, forcing it back into its default position.

Working Principle of a Solenoid Valve:

The spring force holds the plunger against the valve seat while the solenoid valve is in its deactivated state (no current is flowing through the coil), thereby closing the valve. The fluid or gas flow is stopped in this position.

An electric current is passed through the solenoid coil to open the valve. The plunger is drawn to the coil by a magnetic field that is produced by the current. The valve seat separates from the plunger as it advances, allowing fluid or gas to pass through the hole. This is known as the open or energized state of the solenoid valve.

When the current is turned off or eliminated, the magnetic field vanishes, forcing the plunger back into the valve seat to close the valve and stop the flow of gas or liquid. This is the solenoid valve's closed or de-energized condition

Types of Solenoid Valves include:

- Direct-acting: The plunger directly regulates the opening and closing of the valve seat in direct-acting solenoid valves. They are frequently applied in low-pressure situations.
- Pilot-operated: In pilot-operated solenoid valves, the flow of a larger valve is controlled by a smaller pilot valve. They work well in high-pressure and high-flow situations.
- Normally closed (NC): When de-powered, normally closed solenoid valves are closed; when activated, they are opened.

- Normally open (NO): When de-powered, normally open solenoid valves are open; when activated, they are closed.

Numerous industries and applications make considerable use of solenoid valves, including:

- Industrial automation and control systems
- Water treatment and purification systems
- HVAC (Heating, Ventilation, and Air Conditioning) systems
- Medical and laboratory equipment
- Automotive systems, such as fuel control and emissions control
- Irrigation systems
- Pneumatic systems and compressed air control

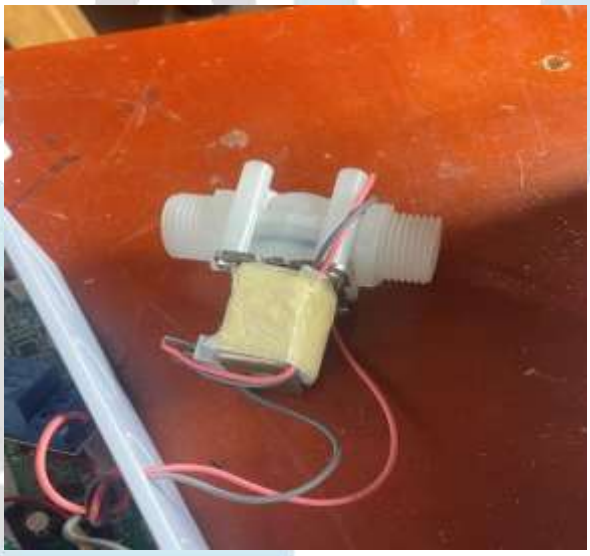


Fig 3.13: Solenoid Valve

JUMPER WIRES: Integrated circuits (ICs), breadboards, and other prototyping platforms are examples of electronic components that are temporarily connected to one another using jumper wires. Typically, they are constructed from insulated copper wire with connections or pins at either end. Jumper wires are employed in electronic circuits to create electrical

connections between different components. They make it easier for data, power, and electrical impulses to go across various components in a circuit. At each end, they typically feature connectors or pins that make it simple to join them to components. The connections are available in single-pin, dual-pin, and multi-pin configurations and can be either male or female. Copper stranded wire, which is pliable and simple to deal with, is frequently used to make jumper wires. Typically, insulating material like PVC (Polyvinyl Chloride) is placed on the wire to prevent short circuits and for safe handling. In order to suit varied circuit layouts, jumper wires are offered in a variety of lengths. A few millimeters to several inches or greater are typical lengths. Additionally, they frequently come in various colors, making it simple to

organize and identify connections. When prototyping and testing electronic projects, jumper wires are essential. Without the requirement for long-lasting soldered connections, they offer rapid and temporary connections that make it simple to modify and troubleshoot circuits. Jumper wires are made to work with a variety of electronic interfaces and components. Among other things, they can be used to link sensors, switches, LEDs, resistors, capacitors, and microcontrollers. It is crucial to take into account aspects like wire gauge (thickness) and current-carrying capacity while employing jumper wires. Higher currents can be carried by thicker wires with larger gauge numbers without overheating or lowering voltage. Jumper wires can be purchased commercially in pre- assembled sets

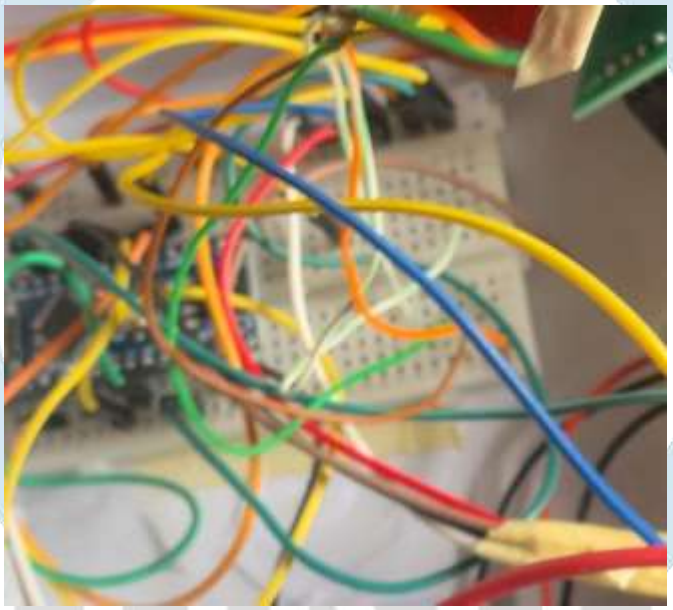


Fig 3.14: Jumper Wires

LIGHT EMITTING DIODE: Light-Emitting Diode (LED) is a semiconductor device that produces light after being exposed to an electric current. Due to their energy efficiency, extended lifespan, and small size, LEDs are widely employed in a variety of applications. They have revolutionized lighting technology and are utilized in a wide range of gadgets, such as lighting fixtures, electronic displays, automobile lighting, and several other consumer and industrial applications.

A semiconductor material, which are the III-V compound or a combination of elements from groups III and V of the periodic chart, is used to make LEDs. Gallium arsenide (GaAs) is the substance that is utilized the most frequently. Depending on the desired light wavelength, other materials including gallium nitride (GaN) and indium gallium nitride (InGaN) are also widely utilized. LED's basic structure is made up of numerous layers. The P-type (positive) layer and the N-type (negative) layer, which are sandwiched together to form a junction known as a P-N junction, are the two most crucial layers. The P-N junction controls how the LED function.

Current begins to flow through the LED when a voltage is put across it, with the positive terminal attached to the P-type layer and the negative terminal attached to the N-type layer. Moving in the direction of the junction are electrons from the N-type layer and holes (electron deficits) from the P-type layer. The electrons and holes join again at the P-N junction, releasing energy in the form of photons (light).

The term "electroluminescence" refers to this phenomena. Compared to conventional incandescent or fluorescent lighting, LEDs are significantly more efficient. They lose very little heat because they transform a significant amount of electrical energy into light. The efficacy of an LED, which is expressed in lumens per watt (lm/W), is what determines the LED's efficiency. More light is produced per unit of electrical power when effectiveness is higher. The bandgap energy of the semiconductor material determines the color of an LED. Light waves of various wavelengths are corresponding to various bandgap energies. LEDs can be made to emit any color, including red, green, blue, yellow, white, and even ultraviolet, by choosing the right material.

Fig 3.15: Light Emitting Diode (LED)

BUZZER: An electrical device that makes a buzzing sound is called a buzzer. It frequently serves as an audio alarm, notification, or warning in a variety of applications. Although buzzer technology has developed over the years to encompass various types and designs, its fundamental principles have remained the same.

Typically, a buzzer includes the following parts:

- Electromagnetic coil: It is the main element in charge of producing sound. A wire is twisted around a core material, which is often ferromagnetic, to create the coil.
- Diaphragm or membrane: Attached to the coil is a thin, flexible material that is frequently composed of metal or plastic. When an electrical current flows through the coil, it vibrates, creating sound waves.
- Housing: Typically, a protective housing composed of plastic, metal, or another material encloses the coil and diaphragm.

Based on how they work, buzzers come in a variety of forms:

- Piezoelectric buzzers: The capacity of some materials to produce an electric charge when mechanically deformed is known as the piezoelectric effect, and piezoelectric buzzers make use of this property. When an electric current is delivered, a piezoelectric crystal or ceramic disc inside of them deforms, creating sound waves.
- Magnetic buzzers: These buzzers make use of a diaphragm and an electromagnetic coil. The diaphragm is drawn to the coil as an electrical current passes through it, producing a magnetic field in the process. Rapid back and forth motion of the diaphragm causes sound waves to be produced.
- Mechanical buzzers: These buzzers make sound when a mechanical contact, like a clapper or striker, makes contact with a resonant surface. Nowadays, they are less frequent in applications.

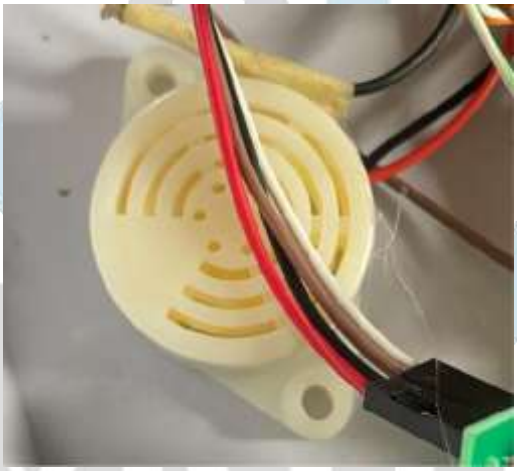


Fig 3.16: Buzzer

Calibrating the MQ2 Gas Sensor

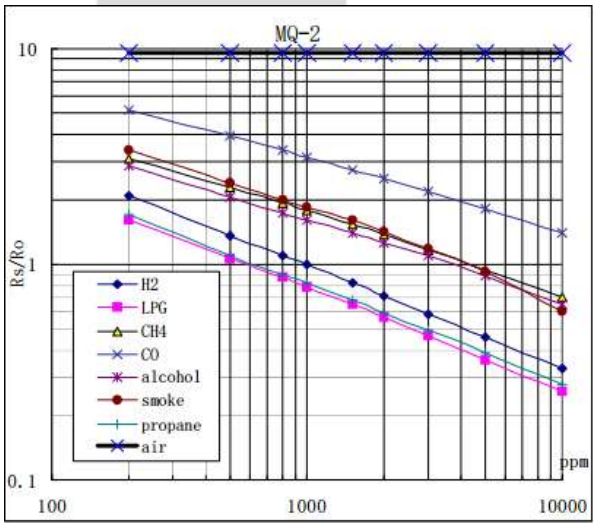


Fig 3.17: MQ-2 Sensitivity Characteristics

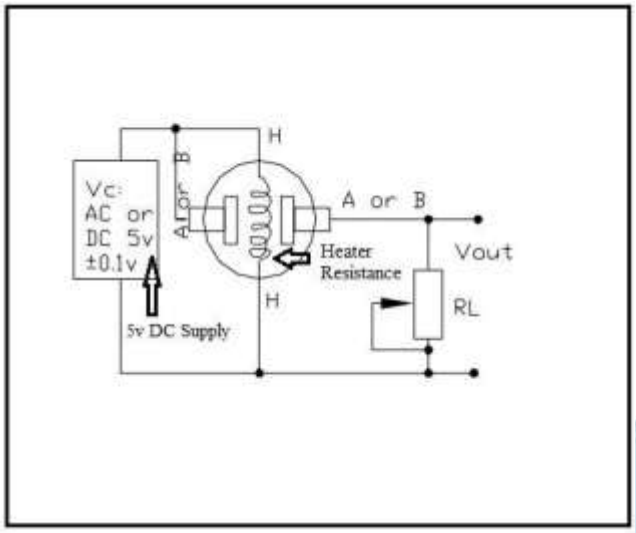


Fig 3.18: Schematics of MQ-2 Gas Sensor

The resistance ratio (RS/R0) is used to calculate the concentration of gases (ppm).

Where,

RS = Measured change in resistance whenever the sensing mechanism detect gas R0 = stable sensor resistance in fresh air or no gas presence

Resistance of sensor (Rs): Rs = [(Vin x RL) / Vout] – RL ..... eqn 6

VC = Voltage current (in this case 5V from the Arduino) Vout = output voltage

RL = Load Resistance

Also, R0 can also be calculated using

R0 = RS/Fresh air ratio (value can be obtained from the datasheet.) ..... eqn 7

To convert the digital signal to concentration units, the datasheet chart will be referenced again the MQ-2 gas sensor calibration line or graph is not linear, thus a log-log scale is used to calculate our y = mx + c, therefore we now have it as

log(y) = m*log(x) + c.....eqn 8

where m = $log\ (y\ /y0)\ /\ log\ (x\ /x0)$.....eqn 9

and

c = $\log(y) - m * \log(x)$.....eqn 10

after getting our values for m and c respectively, it is then easy to calculate the concentration of the gas using,

$x(ppm)$ = 10 ^ [$\log(y)$−c]⁄m.....eqn 11

Note that,

y = RS/R0.....eqn 12

from analysis Vin = 5v

RL = 10k ohms

It is important to note that in clean air, resistance ratio in clean air is a constant from the graph we have;

RS / R0 = 9.8.....eqn 13

From eqn 13, we must determine the value of the RS in the fresh air in order to calculate R0. This will be accomplished by translating the sensor's analog average readings to voltage. The RS formula will then be used to determine R0. Therefore we have,

R0 = RS / 9.8

To calculate for the ppm of the gas, we would consider the data for gas concentration which only ranges from 200 ppm to 10000ppm.

Two points from the graph is picked, in our case we chose the value (200, 1.6) at 200 ppm and at 1000ppm the values are (1000, 0.8)

From eqn 9, we have the slope to be; m = log (0.8 / 1.6) / log (1000 / 200) m = log (0.5) / log (5)

m = -0.3010 / 0.69897

m = -0.4306 approximately -0.43

To get the y – intercept (c), (1000, 0.8) is considered with our value for the slope (m)

Therefore from eqn 10, we have the value of y – intercept as c = log (0.8) – (-0.4306 * log (1000))

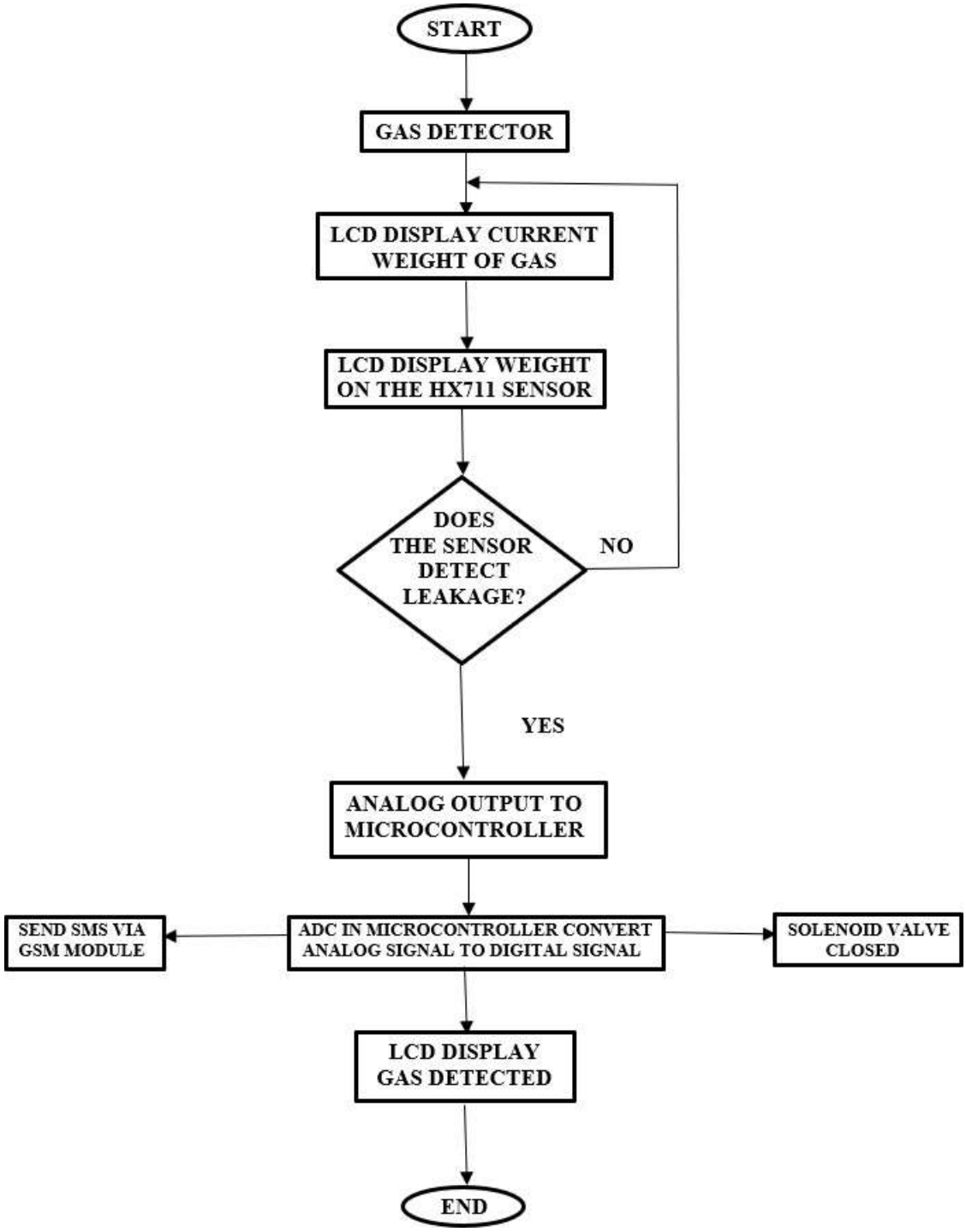
c = -0.0969 – (-0.4306 * 3)

c = -0.0969 + (1.2918)

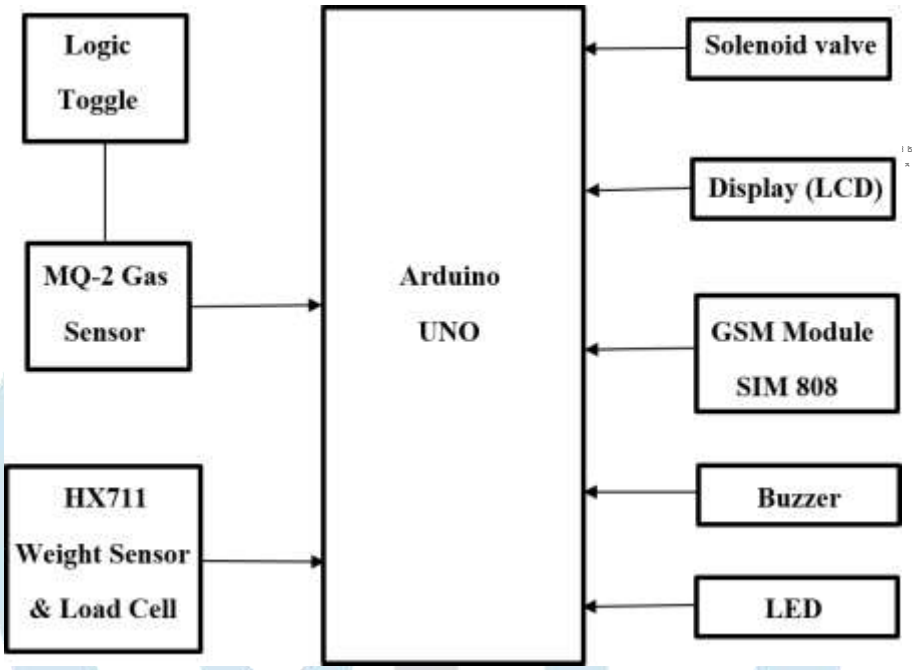
c = 1.1949 approximately 1.2

Therefore eqn 11 can be used to get different value of y which is (RS / R0) at different concentration

3.3 The System Flowchart Diagram



3.4 Block diagram for the system monitoring and control system



3.5 Software Implementation

Proteus 8.13 was used; It is among the greatest simulation programs for different microcontroller circuit designs. It is a widely used simulator since it has practically all microcontrollers and electronic components readily available in it. Before actual hardware testing, it can be used to evaluate software and embedded designs for electronics. Proteus allows for the simulation of microcontroller programming. Its simulation also helps to reduces the possibility of hardware damage from poor design.

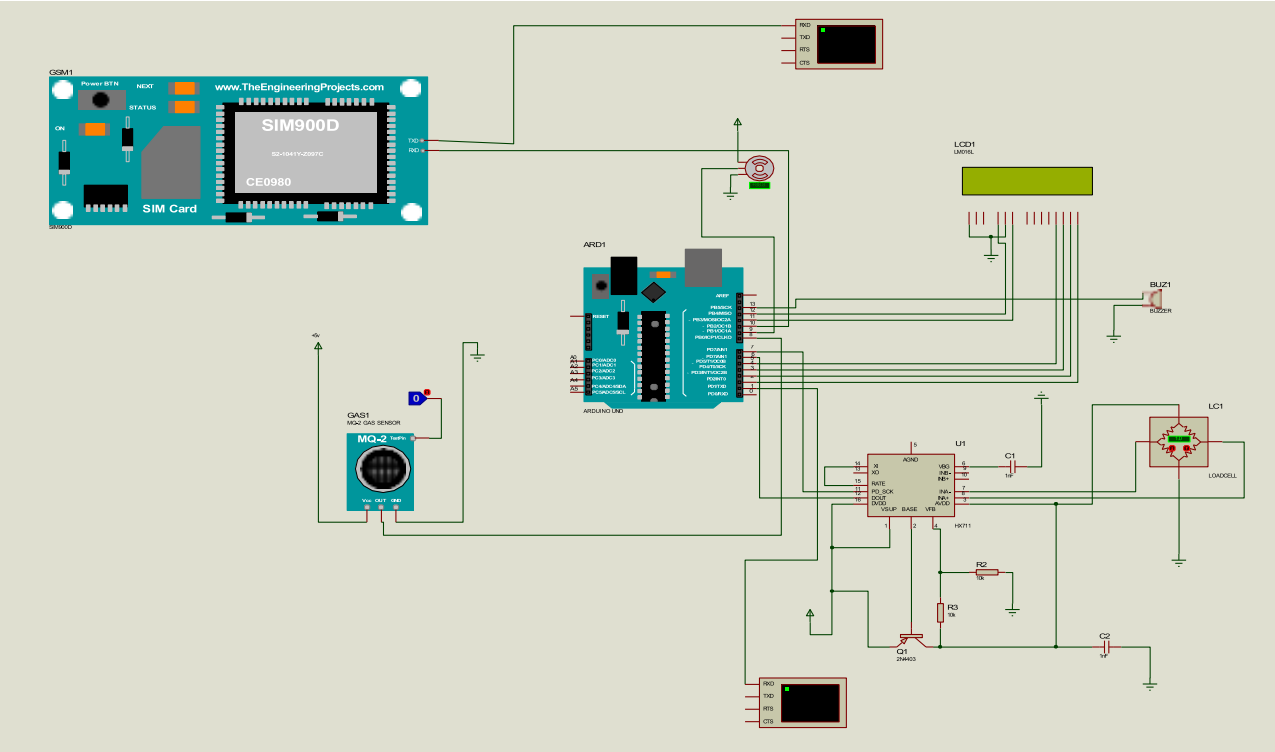


Fig 3.19: Circuit Diagram of the System

The connection for this project are very simple and easy to understand. Here a Liquid Crystal Display is used to display the status of current gas weight in the environment, it's also used to display the current weight of the LPG vessel placed on the load cell connected to a HX711 weight sensor, the LCD also helps in displaying the status of the environment, i.e whenever gas is detected it displays GAS DETECTED. The 16 X 2 LCD is connected to a PCF8574 microcontroller as shown in fig 18 above, which is later connected to pin A4 and A5 of the Arduino Uno board.

The MQ-2 Gas sensor consist of three pins which are Vcc, OUT, GND, the Vcc is connected to a 5V power supply, while the GND is grounded, the OUT pin is connected to pin A0 of the Arduino board, also the MQ-2 Gas sensor has a Test pin which is connected to a Logic State which displays 1 and 0 i.e if 1, it means there is presence of hazardous gas in the environment else it displays 0, meaning the environment is safe from hazardous gas. The GSM Module TXD and RXD pin is connected to pin 7 and 8 respectively on the Arduino board. The Relay circuit is connected to pin 9 of the Arduino board, also the weight sensor circuit which consist of the load cell and HX711 sensor circuit PD_SCK and DOUT is connected to pin 5 and 6 respectively on the Arduino board.

The alarm system (Buzzer) is connected to pin 3 of the Arduino board, also we have the white LED light which is connected to pin 2 of the Arduino board.

It's important to note that a 5v power supply is used directly on the Arduino board.

3.6 SYSTEM IMPLEMENTATION

In respect to the implementation, the above sensors as shown in fig 18 which are the MQ-2 gas sensor which helps to detect or sense smoke, gas in the environment and the HX711 weight sensor accompanied with a load cell to take weight readings placed on the load cell. These readings will be continuously displayed on the LCD to show the current reading of the gas vessel placed on it.

Also, whenever the MQ-2 gas sensor detect presence of hazardous LPG gas in the environment the weight of normal air increases from 160-180 for normal air in the surroundings to about 200 which is used as the threshold from the Arduino code. Once it meets this requirement the LCD displays GAS DETECTED on the screen with the buzzer making an alarming sound. Also the GSM module immediately send out a message to the recommended phone number assigned to it while the solenoid valve immediately shutdown the process to avoid free passage of the gas through the pipe

CHAPTER FOUR

4.0 RESULT AND DISCUSSIONS

4.1 SIMULATION RESULTS

When the simulation of the Gas leakage detector was completed with the help of the Proteus 8.13 Simulation tool, and the LCD display of the system design displayed the outcome “GAS DETECTED” once the Logic Toggle is selected to be 1 i.e., presence of gas in the surroundings. This indicate that the GSM module will send an update to the mobile device that has been designed to function with it and that the software is compliant with the system architecture.

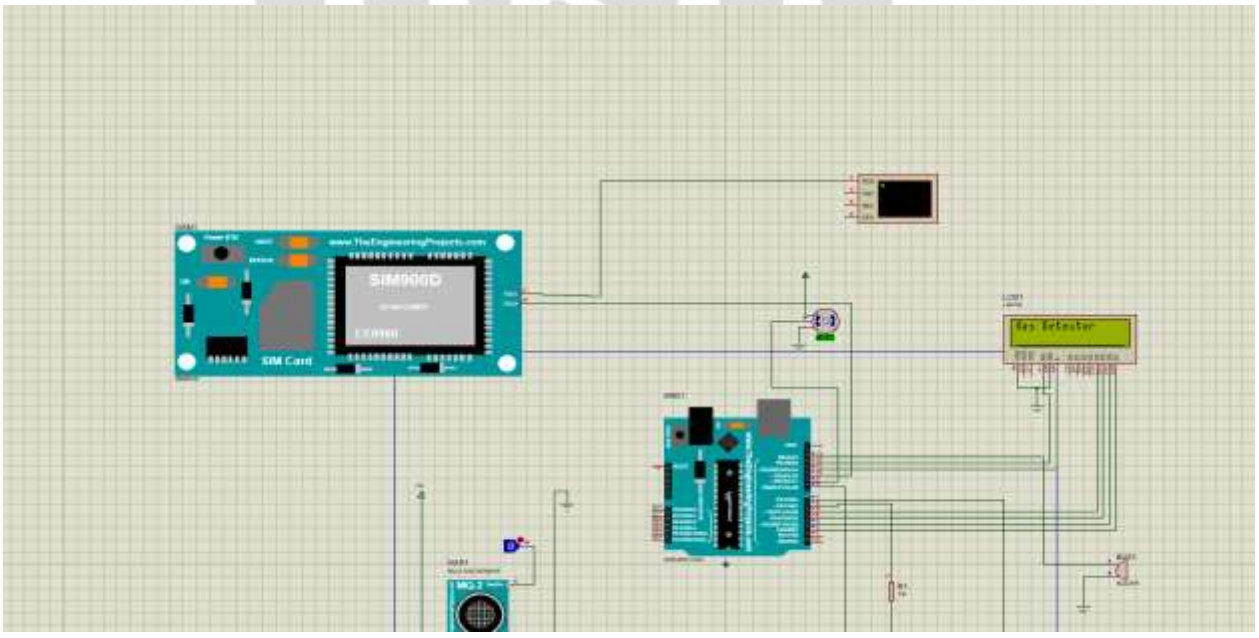


Fig 4.1: Starting of the Simulation Result

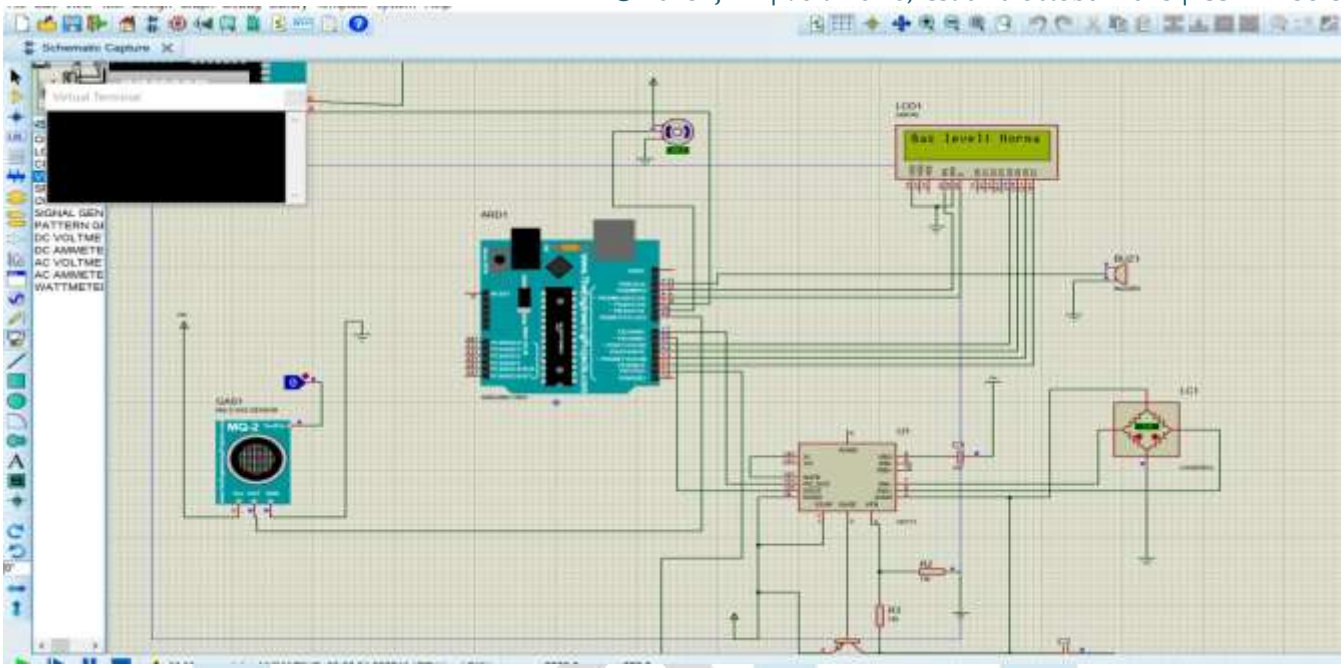


Fig 4.2: when Logic Toggle is at “0” i.e. No gas detected

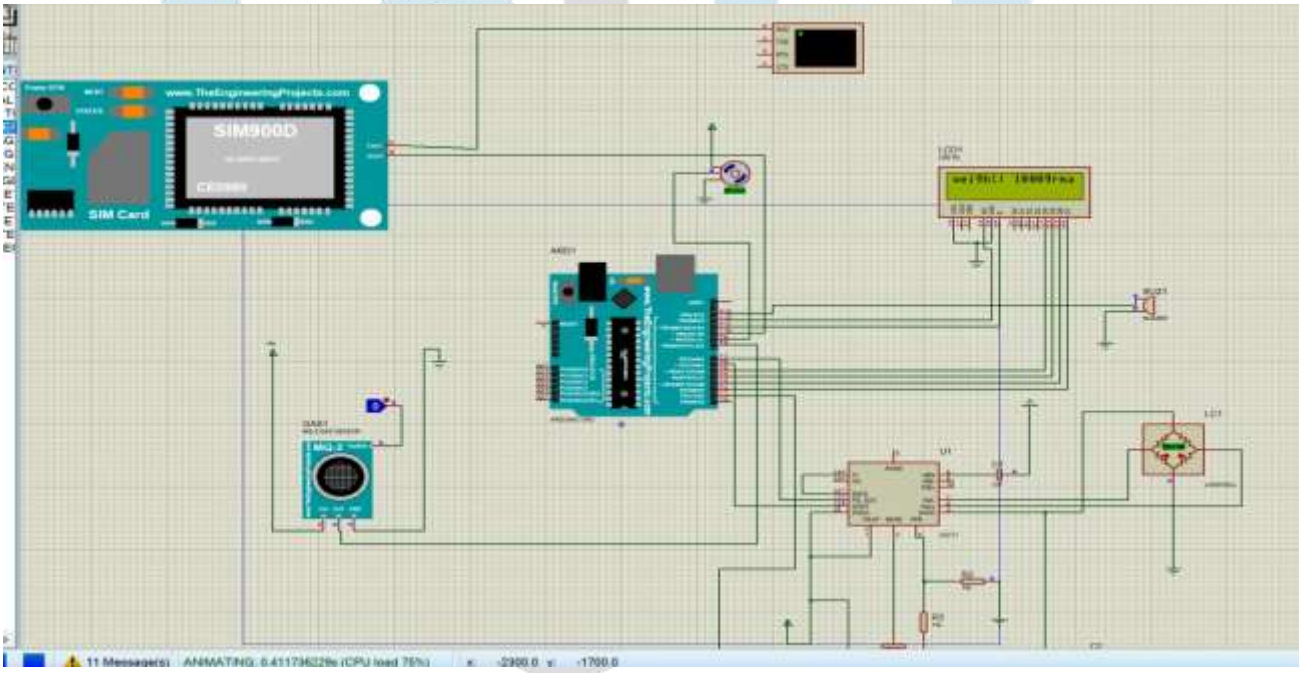


Fig 4.3: when it reads the weight on the load cell

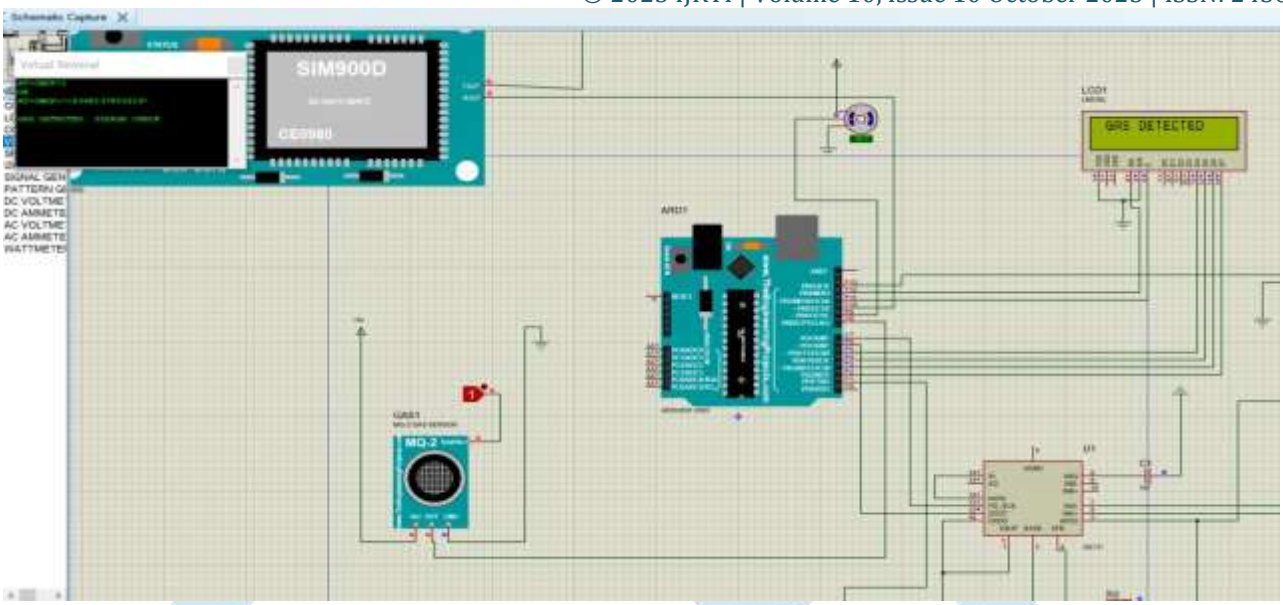


Fig 4.4: When the logic toggle is "1" i.e. Gas is detected in the enviroment

4.2 DISCUSSIONS

4.2.1 COMPONENTS IMPLEMENTATION

The system design components were first implemented onto a solderless experiment board (breadboard), then the components were moved from the solderless experiment board to the development board, and finally the components were permanently soldered on the development board. Additionally, the power source for the development board was connected, and the system was tested to make sure it was functioning properly and producing the desired results. The concept was finally brought together into a casing.

4.2.2 COMPONENTS IMPLEMENTATION ON SOLDERLESS EXPERIMENT BOARD (BREADBOARD)

The Arduino Uno (after it has been programmed), the GSM module, the MQ-2 gas sensor , HX711 weight sensor and load cells, Solenoid Valve and the 5V DC power source were all setup on a breadboard and interconnected to each other. Interconnections were done using jumper wires and a multimeter was used to test every component to verify whether or not they are in good conditions. The multimeter was also used to measure the voltage and current that gets to every component present in the connection.

4.2.3 COMPONENTS IMPLEMENTATION ON DEVELOPMENT BOARD

After a successful component's layout and testing on the breadboard, the components were then transferred to the development board and were permanently soldered to the development board as seen in Figure * below. The Arduino is powered by a 5v Dc supply also the solenoid valve is powered by a 12v Adapter

4.3 DEVICE TESTING

It will be required to link the development board with the power supply using connecting wires when the components have been successfully laid out on the board. Fig 4.5 and Fig 4.6 below shows the working process of the system.

There are two situations upon which the buzzer alarm makes an alarming sound i.e whenever there is no load on the weight balance and whenever a leakage in hazardous gas is detected or sensed in the surroundings. It's also very important to note that whenever a gas leakage is detected the 16 X 2 LCD displays GAS DETECTED on the screen with a quick response from the solenoid valve to stop flow of gas through the pipe, at this point too, a message is sent across to the defined or recommended phone number through the GSM Module to update the personnel about the current status of the flow station.

But if all parameters are in place and in good condition without a leakage that could cause threat to life and property. The 16 X 2 LCD displays the current weight of gas in the environment (air) and also displays the current weight of the tank placed on the HX711 weight sensor.

Fig 4.5: System Working Stage 1

Fig 4.6: System Working Stage 2

4.4 TESTING OF PROTOTYPE OF DESIGNED SYSTEM

After a successful components' interconnection, the entire connection is examined to see whether it is in excellent working order following successful component connections. If the connections carry out the intended function, coupling the parts into a case is required. For this project, a box- shaped piece of plastic was used as the casing. The components were then carefully arranged within the box and fastened with screws. To be the initial point of contact anytime a user needs to use the system, the LCD is positioned in front of the planned system. Additionally, the power supply is placed inside the box.

The different stages in the system are:

STAGE 1: This is the power supply stage, it consists of a 220V AC mains supply which is converted by undergoing different steps such as Transformation, Rectification, Smoothing and Regulation to a direct DC 5V supply which is used to power the Arduino board, also a 12V adapter is required to power the Solenoid valve

STAGE 2: This consist of our system which consist of the MQ-2 gas sensor for detecting the gas leakage in the environment, it also have the GSM Module which help to send message to the personnel whenever the MQ-2 gas sensor detect a leakage in the environment. Also we have the buzzer, LED and the LCD display, all plays important role which include making alarming sound whenever there is a leakage also whenever no weight is

detected on the load cell. The LCD help display status of the condition the system is currently at, if no gas is detected it displays current weight of gas in the surroundings and also displays the weight of the tank on the load cell, but once gas is detected it displays GAS DETECTED.

STAGE 3: This is the Solenoid valve, we make use of a normally close solenoid valve, it opens and allows flow of gas once its powered on, its powered by a 12v power adapter. Once gas is detected it closes which helps to stop flow of gas through the pipe

STAGE 4: This is the load cell connected to a HX711 weight sensor, this helps to measure the current weight of tank placed on the load cell and it can be read digitally on the LCD display to see the current weight of the tank. Once the weight is at Zero the buzzer makes an alarming sound with the LED showcasing a warning signal that the weight of the tank is empty.

Fig 4.7: System Power Source

Fig 4.8: Working Stage 3, LED alarming the personnel

Fig 4.9: Prototype Connection

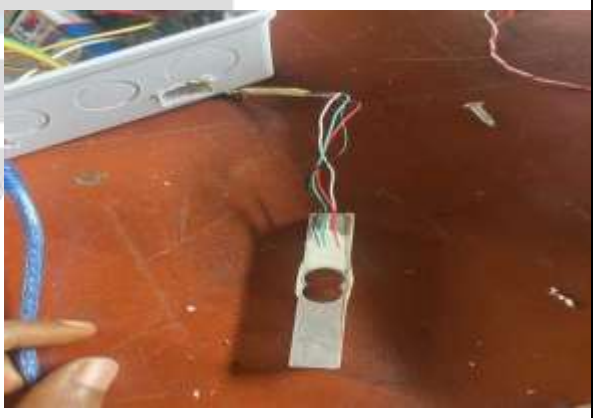


Fig 4.10: Load Cell

Fig 4.11: Working Stage 4, showing the concentration of gas in the environment

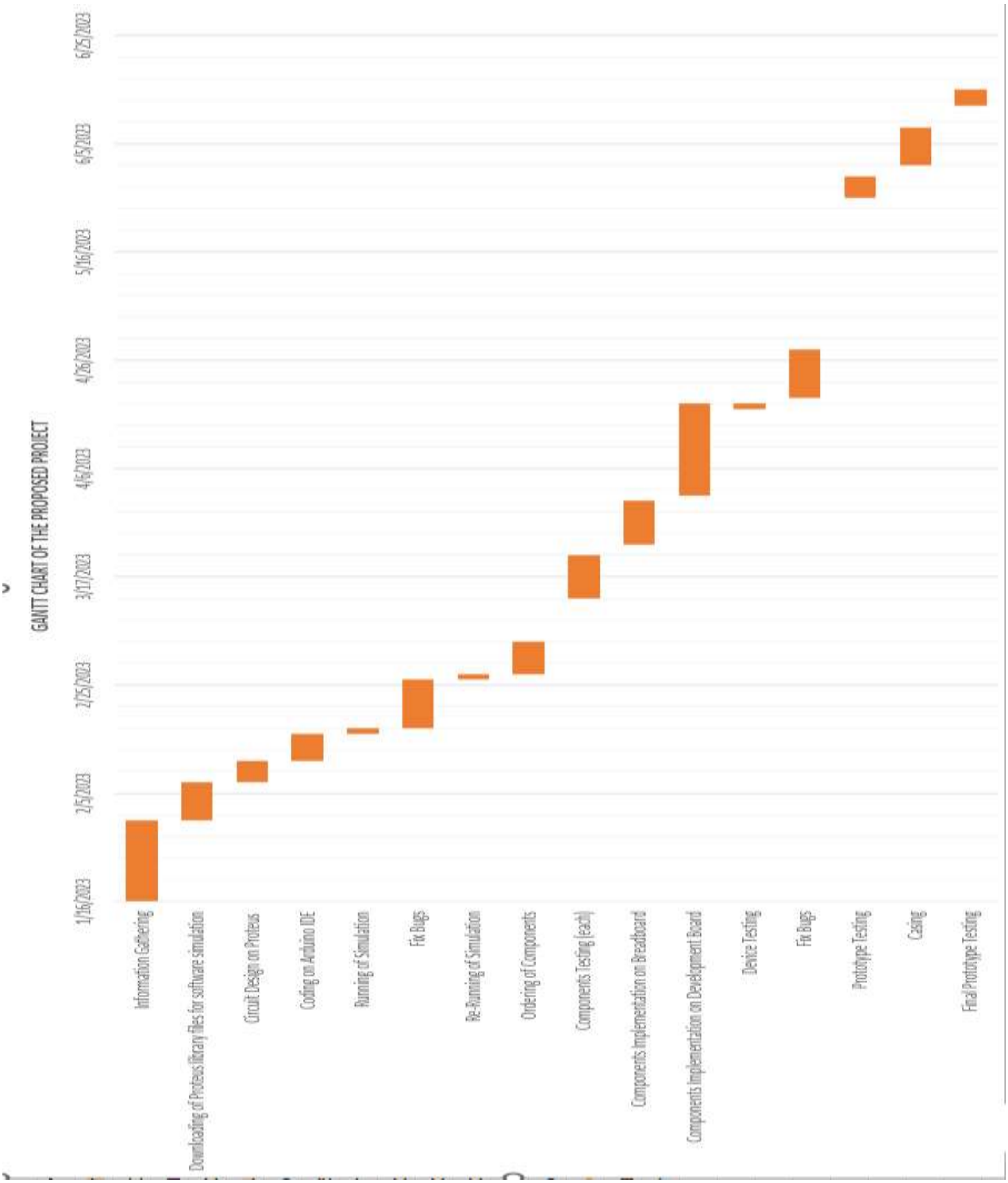
Fig 4.12: Working Stage 5, showing the weight of gas on the load cell

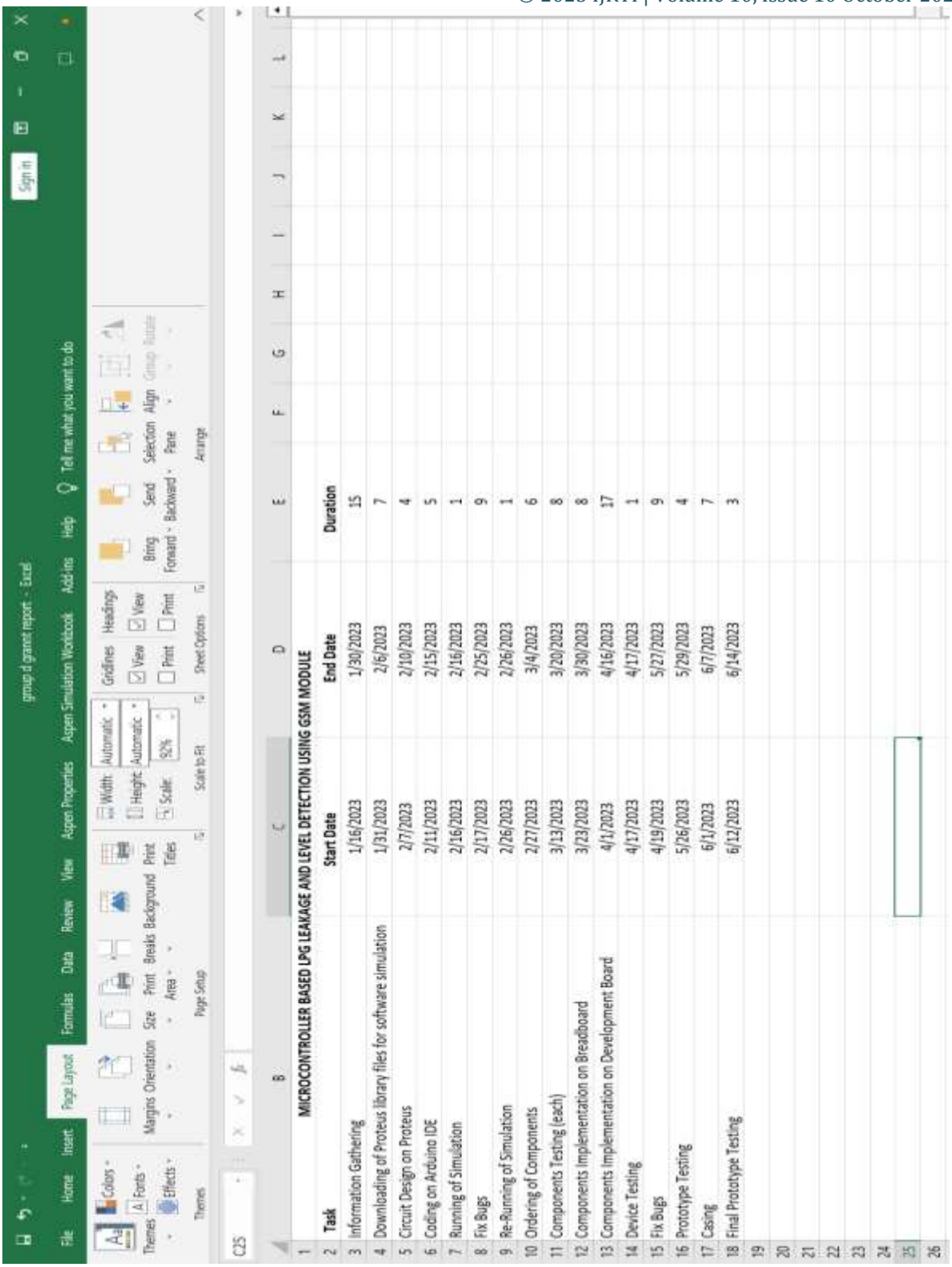
4.5 BILL OF QUANTITIES

S/N	COMPONENTS	QUANTITY	PRICE (₦)
1	Arduino Uno	1	15,000
2	GSM Module	1	19,000
3	HX711 Weight Sensor with load cell	1	8,000
4	MQ-2 Gas Sensor	1	2000
5	Step-Down Transformer	1	13,000
6	Diode	4	3,000
7	Capacitor	2	3,500
8	12V Power Adapter	1	12,000
9	Voltage Regulator (LM7805)	1	2000
10	Liquid Crystal Display (LCD)	1	8,000
11	Solenoid Valve	1	13,000
12	Jumper Wires	50	4,000
13	Light Emitting Diode (LED)	1	1,000
14	Buzzer	1	2,000
15	Lithium-ion Battery	6	10,000
16	Plastic Casing with Wooden Base	1	8,000

Therefore the Total Estimated Cost of this project work = ₦123,500

4.6 GANTT CHART





	B	C	D	E
1	MICROCONTROLLER BASED LPG LEAKAGE AND LEVEL DETECTION USING GSM MODULE			
2	Task	Start Date	End Date	Duration
3	Information Gathering	1/16/2023	1/30/2023	15
4	Downloading of Proteus library files for software simulation	1/31/2023	2/6/2023	7
5	Circuit Design on Proteus	2/7/2023	2/10/2023	4
6	Coding on Arduino IDE	2/11/2023	2/15/2023	5
7	Running of Simulation	2/16/2023	2/16/2023	1
8	Fix Bugs	2/17/2023	2/25/2023	9
9	Re-Running of Simulation	2/26/2023	2/26/2023	1
10	Ordering of Components	2/27/2023	3/4/2023	6
11	Components Testing (each)	3/13/2023	3/20/2023	8
12	Components Implementation on Breadboard	3/23/2023	3/30/2023	8
13	Components Implementation on Development Board	4/1/2023	4/16/2023	17
14	Device Testing	4/17/2023	4/17/2023	1
15	Fix Bugs	4/19/2023	5/27/2023	9
16	Prototype Testing	5/26/2023	5/29/2023	4
17	Casing	6/1/2023	6/7/2023	7
18	Final Prototype Testing	6/12/2023	6/14/2023	3

CHAPTER FIVE

5.0 CONCLUSION AND RECOMENDATION

5.1 CONCLUSION

The objective of this project was to create and design a device that effectively detects gas leakages using a gas sensor and alerts people either by using GSM to send a message to their mobile phones or by turning on the LED and buzzer. Additionally, the designed system is capable of informing the user about the level of the gas in the cylinder through the weight sensor. The objectives were achieved with admirably positive outcomes, and the concept is now readily available.

A method of stopping the gas flow was created through an open and close valve to help with such operation if the gadget should sense a gas leak. This would prevent the operator from having to go back and forth once the alert is delivered. The design has not caused any sort of disturbances to the user, it only alerts the user to take necessary action when it's convenient. The system is so user friendly that even individuals with less electrical understanding may operate the system because of how user-friendly it is.

5.2 RECOMMENDATIONS AND FUTURE RESEARCH

The system can be enhanced in a number of ways to increase its effectiveness as a detecting system. For the correct monitoring and control of the system, some upgrades include the use of Internet of Things (IOT) alert notification rather than SMS alert notification, and the capacity of the load cells can also be expanded for industrial application. Solar energy can be used to ensure an uninterrupted power supply.

REFERENCES

- Ed, George E. Totten, ed. (2003). Fuels and lubricants handbook: technology, properties, performance, and testing (2nd printing. ed.) West Conshohocken, Pa.: ASTM International. ISBN 9780803120969. Archived from the original on 4 June 2016
- LPG – Liquified Petroleum Gas (https://edugreen.teri.res.in/explore/n_renew/lpg/)
- Properties of LPG (Liquified Petroleum Gas) The Petro Solutions (https://thepetrosolutions.com/properties-lpg-liquified-petroleum-gas/)
- Liquified Petroleum Gas – Wikipedia (https://en.m.wikipedia.org/wiki/Liquified_petroleum_gas) Huan Hui Yan and Yusnita Rahayu (2014). *Design and Development of Gas leakage Monitoring System Using Arduino and ZigBee.* Proceeding of International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2014), Yogyakarta, Indonesia, 20-21 August 2014
- Tamil Selvi a/p Sitan and Aimi Syamimi Ab Ghafar (2018). *Liquified Petroleum Gas (LPG) Leakage Detection and Monitoring System.* Journal of Science and Technology, Vol. 10 No. 3 (2018) p. 46-53. https://doi.org/10.30880/jst.2018.10.03.007
- Ankit. A Jaisswal, Ajay. B. Thakur, Rohit. D. Gawade, Kaustubh. S. Kamble, Md Saqib Ansari (2022). *Automatic LPG Sensing Device with Switching Off Mechanism.* International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 10 Issue IV Apr 2022
- Prof.M.Amsaveni, A.Anurupa, R.S.Anu Preetha, C.Malarvizhi, M.Gunasekaran (2015). *Gsm based LPG leakage detection and controlling system.* The International Journal of Engineering and Science (IJES) ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805 Pages || 112- 116
- Ms.A.Preethi Vinnarasi M.E , Elumalai R M, Jerry Jenish, Karthik Raj.T (2021). *LPG Gas Monitoring System Using Arduino.* International Journal of Innovative Research In Technology, April 2021| IJIRT | Volume 7 Issue 11 | ISSN: 2349-6002
- G. Lakshmana, N. Priyanka, P. Abhi Nandhini, M. Neelima, G. Gowthamy (2020). *Automatic Lpg Cylinder Leakage Detection and Booking System Using Arduino.* International Research Journal of

Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 07 Issue: 04 Kumar Keshamoni and Sabbani Hemanth (2017). *Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT*. 2017 IEEE 7th International Advance Computing Conference

- 978-1-5090-1560-3/17 IEEE https://doi.org/10.1109/IACC.2017.70

- Nwukor Frances Nkem (2021). *Gas Leakage Detector System With Sms Alert.* Global Scientific Journals GSJ: Volume 9, Issue 10, October 2021, Online: ISSN 2320-9186 www.globalscientificjournal.com

- Muhammad Siddik Hasibuan, Syafriwel, Iswandi Idris (2020). *Intelligent LPG Gas Leak Detection Tool with SMS Notification.* 2nd International Conference on Advance & Scientific Innovation,1424 (2019) 012020 IOP Publishing https://doi.org/10.1088/1742- 6596/1424/1/012020

- Mr. M. Joshua Vinoth, Mr. S. P. Santhoshkumar, Ms. G. Maria Dhyana Latha, Dr. V. Sujatha (2016). *Habitual Booking System for LPG with Leakage and Fire Sensing Sanctuary*. International Journal of Advanced Engineering Research and Science (IJAERS) Vol-3, Issue-3 , March- 2016] ISSN: 2349-6495

- Shivalingesh B.M, Ramesh C, Mahesh S.R, Pooja R, Preethi K. Mane, Kumuda S (2014). *LPG Detection, Measurement and Booking System.* (www.rsisinternational.org/IJRSI.html), Volume I, Issue VI, November 2014 IJRSI ISSN 2321 – 2705

- Tanvira Ismail, Devoleena Das, Jyotirmoy Saikia, Jyotirmoy Deka (2014). *GSM Based Gas Leakage Detection System with Preventive Measures.* International Journal of Electronics and Communication Engineering & Technology (IJECET), ISSN 0976 – 6464(Print), ISSN 0976 – 6472(Online), Volume 5, Issue 5, May (2014), pp. 122-135 © IAEME

- P.Meenakshi Vidya, S.Abinaya, G.Geetha Rajeswari, N.Guna (2014). *Automatic LPG Leakage Detection and Hazard Prevention for Home Security.* An International Journal of Advanced Computer Technology, proceeding of 5th National Conference on VLSI, Embedded, and Communication & Networks on April 17, 2014.

APPENDIX

Program of Instructions #include <Arduino.h> #include<LiquidCrystal.h> #include <SoftwareSerial.h> #include <Servo.h> #include "HX711.h"

```
// HX711 circuit wiring
const int LOADCELL_DOUT_PIN = 6; const int LOADCELL_SCK_PIN = 7; Servo servo;
SoftwareSerial mySerial (9,10);
LiquidCrystal lcd(12 , 11 , 5 , 4 , 3 , 2); int Gas = 8;
int buzzer = 13;

void setup() { mySerial.begin(9600); Serial.begin(9600); pinMode(Gas , INPUT); pinMode(buzzer,
    OUTPUT); servo.attach(9);

}
{
 Serial.begin(57600); Serial.println("Gas Deector"); Serial.println("Gas level: Normal");

 scale.begin(LOADCELL_DOUT_PIN, LOADCELL_SCK_PIN);
 scale.set_scale(36.059);
 //scale.set_scale(-471.497);                    // this value is obtained by calibrating the scale with known
weights; see the README for details
 scale.tare();              // reset the scale to 0

 Serial.print("read: \t\t"); Serial.println(scale.read());

 Serial.print("read average: \t\t"); Serial.println(scale.read_average(20));

 Serial.print("get value: \t\t"); Serial.println(scale.get_value(5));

 Serial.print("get units: \t\t"); Serial.println(scale.get_units(5), 1);

 Serial.println("Readings:");
}
void loop() {

    if (digitalRead(Gas) == HIGH){ lcd.setCursor(0,0);
      lcd.print(" GAS DETECTED "); delay(200);
      digitalWrite(buzzer , HIGH); delay(200);
```

```
      digitalWrite(7 , HIGH); digitalWrite(6, LOW); SendMessage ();
      if (mySerial.available()>0) Serial.write(mySerial.read());
      servo.write(90); delay(10);
      if (servo.read()==90) digitalWrite(buzzer , LOW); delay(200);
      lcd.setCursor(0,0); lcd.print("Gas Detector");
     }
     else{ lcd.setCursor(0,0);
      lcd.print("Gas Detector"); lcd.setCursor(0,0); lcd.print("Gas level: Normal"); delay(200);
      digitalWrite(6, HIGH); digitalWrite(7, LOW); servo.write(0); delay(10); lcd.setCursor(0,0);
      lcd.print("weight: 1000g");
     }
   delay (200); lcd.clear();
}
{
 Serial.print("Weight in grams:\t"); Serial.print(scale.get_units()/1000, 1); Serial.print("\t| average:\t");
 Serial.println(scale.get_units(10), 5);

 delay(5000);
}
void SendMessage ()
{
 mySerial.println("AT+CMGF=1"); delay (200);
 mySerial.println("AT+CMGF=\"+2348137810214\"\r"); delay(200);
 mySerial.println("GAS DETECTED. PLEASE CHECK "); mySerial.println((char)26);
}
```