



Automatic Gas Leakage Detection and Shut Off System

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Abstract: Gas leaks that cause deadly flames have become a major issue in homes and other places where domestic gas is handled and utilized. Gas leaks cause a variety of mishaps that result in financial damage as well as personal injuries and/or loss. The project's goal is to create a system that detects gas leaks and notifies the subscriber through alarm and status display, as well as shutting off the gas supply valve as the main safety precaution. The turning off of the supply valve prevents further gas flow to the cooker, preventing a fire breakout caused by an attempt to ignite the cooker. The device, which functions more like a first-aid kit, utilizes a usually closed solenoid valve to shut off the gas valve before asking for assistance via visual display and loud alert to anyone in the vicinity. The system is clever in that it does not cause a loud nuisance by constantly sounding the alarm, but rather the siren stops beeping once the concentration of the gas in the atmosphere after leaking falls below the predetermined value and the valve is opened again for regular operations. This effort will reduce injuries and losses caused by explosions caused by gas leaks, as well as enhance the safety of people and property while utilizing home cooking gas.

Index Terms - Raspberry pi, (LPG) Gas Detection, Solenoid Valve, UBIDOTS, Web Server, PYTHON, IoT

I. INTRODUCTION

Gas leakage is an important issue that is now seen in a number of locations, including homes, businesses, vehicles, etc. Dangerous events due to gas leaking have been reported. Liquefied oil gas (LPG) is an inflammable hydrocarbon mixture that is used for a wide variety of applications since it is of high temperature, less smoke, less soot and less environmental effects., including houses, hostels, factories, cars, and vehicles as fuel. LPG is very flame retardant and may catch fire even if it is a great distance from the source of the leak. The energy source consists primarily of the highly fuel-efficient propane and butane chemical molecules. The gases are very inflammable. LPG is used mostly for cooking in homes. The dumping gases may create an explosion when a leak occurs. Leaks in gas lead to a range of malfunctions that entail material loss and harm to people. Home fires have been increasingly widespread in recent years, putting human lives and property in greater danger. Physical properties like toxicity, flammability, and so forth determine the hazards of explosion, fire, and asphyxia. In recent years, the frequency of deaths resulting from gas cylinders has increased. The gas disaster in Bhopal is an example of a gas leak. The explosions have been caused by poor cylinders, outdated valves, frequent examination of gas cycling systems, worn-out regulating systems and an incomprehensibility of gas cylinder management. Gas leaks must thus be detected and controlled to safeguard humans. LPG includes the odorant that may detect leakage, such as ethane thiol. However, some people with weak olfactory senses may not be able to rely on this buildup. For the protection of humans from the dangers of gas leaking, a gas leak detector is necessary. In this article, the user is informed of a gas leak by SMS and the power supply is disabled. Real-time Leak detection and gas surveillance system The gas leak is controlled via an exhaust ventilator and monitored. The amount of LPG is also constantly monitored in the cylinder, according to the technique recommended, where the gas sensor detects leakage and the audible and visual results are generated. It provides a software and hardware design methodology. In the present method, several gas detecting technologies are used. A cost-sophisticated sensor-based gas leak detection, warning, and control system are proposed and discussed in this article. It is highly efficient, easy to use, portable, small, and economical in size.

II. LITERATURE SURVEY

- Rohan Chandra Pandey et al. created a novel gas warning system that makes use of the internet. This device detected the presence of hazardous LPG gas and alerted the user. This device constantly senses the gas level and shows the value on the LCD screen. If the gas level reaches the threshold, the buzzer activates and sends an email to the user over the internet via the ARM board. The major benefit of the suggested work was that it automatically sensed the gas level and provided an instantaneous reaction.

- Utkarsh Bharade et al. proposed a solution to the issue of gas booking. The primary advantage of this suggested technology was the ability to detect the gas level in the cylinder. When the cylinder's weight reaches the predetermined low level, the system immediately sends an order to the distributor through the GSM concept. The load cell was employed in this system to constantly measure the weight of the cylinder. The load cell is linked to the microcontroller. There are two sensors in this system. These sensors were used to detect the presence of gas and temperature. The MQ-2 (gas sensor) gas sensor was used to detect gas in the environment. The temperature of the environment was measured using an LM 35 sensor
- According to P. Kanaka Maha Lakshmi et al., gas detection is a tough job. Many studies were being conducted in this area. Many accidents have occurred as a result of the gas leaking issue. The general public is unaware of the dangers of gas leaking. The authors suggested a novel intelligent gas detection system. This technology will be utilized in homes, businesses, and industries
- Ramya et al. developed a novel method for automatically detecting gas levels and controlling gas leakage. This system was created for residential use as well as different industrial applications based on the utilization of gases. The suggested system is made up of two components. Gas detection and broadcast module & registration
- Shital I made ew et al. described the primary goal of the GSM idea. It simplifies life by acting automatically. GSM is also used extensively in safety and security applications. The issue of gas leakage was important in both open and closed settings. The authors utilized the novel GSM technology in their suggested system. This technology detects the gas level and sends a text notification to the individuals who are affected. The user information will be saved in the system. The data collected is also utilized to examine the issue. This system detected danger in its surroundings and delivered an alarm message by buzzer and text message to the user
- According to Chaitali Bagwe et al., GSM is an extension of the internet idea. GSM denotes that different physical devices are linked through the internet. Sensors are linked to physical devices. The detected data was transferred from one device to another over the internet. The authors developed a novel gas warning system utilizing the GSM idea. JOURNAL OF CRITICAL REVIEWS ISSN- 2394-5125 VOL 7, ISSUE 06, 2020 1987 The sensor data was gathered and kept in a database for analysis
- Zainal H. C. Soh and colleagues examined the causes of gas leakage. It occurred when the goods were not correctly fitted, there was no appropriate maintenance, and there was a lack of public knowledge. The issue of gas leaking in homes has resulted in serious accidents. The goal of this suggested system was to detect the amount of gas leakage using different sensors, and the data would be saved in Ubidots dashboard through the Internet of Things (GSM). It was utilized for both household and industrial purposes. The data is stored on the dashboard. In the event of a case leak, an alarm message was issued to the affected individuals through social media. This gas detection system was successfully built by connecting gas sensors through Intel Edison.
- D. Divyasree et al. describe smart houses from across the globe. In the present situation, the majority of goods use the GSM principle. One of the safety systems is a gas detection system. This technology was used to detect gas levels and automatically transmit them to the control room through GSM. When there was a gas leak, it made a buzzer sound. This kind of detection system was mostly utilized in sectors such as oil drilling, manufacturing, and so on. The primary goal of this study was to build a gas leaking system utilizing gas sensors and notify the user through GSM. The raspberry pi was used to link the whole system. The suggested system sensed the gas level and sent the data to the concerned individuals through the Blink App program.
- Gas leakage and gas sensing, according to Anandhakrishnan S et al., is a challenging issue in modern living. The vast majority of the gases are highly combustible. The goal of this suggested method was to prevent unwelcome issues in the kitchen. This technology was primarily used to monitor gas levels and send SMS alarm messages to individuals. Gas wastage in homes and businesses is also monitored using infrared sensors
- According to Shruti Bhoir et al., different kinds of flammable gases are utilized for their processes in industries, homes, canteens, hotels, manufacturing industries, and labs. The gas leakage causes harm to both property and lives. To prevent these situations, safety measures are placed in certain locations. The constant monitoring of the gas leakage issue by humans was a tough task. This suggested system was utilized to constantly measure and monitor the gas level in the environment. If a gas detection was detected, the user was alerted by a buzzer and the notification was sent through social media and e-mail via GSM.

III. EXISTING SYSTEM

Several methods for shutting off the gas supply in the case of a gas leak have been suggested, and they are described in the following section. Their benefits and disadvantages have been discussed in detail, and they have served as the foundation for the proposed system's goals.

- A simple system FPGA, which utilizes the MQ6 sensor to detect LPG leakage, is investigated by Arpitha et al. When a gas leak occurs, the first response team receives an automatic warning call through GSM to prevent delays. The system has no remote control or other methods for protection of gas leaks, such as an automated gas delivery. A gas-related catastrophe solution is frequently offered to providers, although it can only minimize a potential disaster, not avoid the event entirely, because it lowers the danger of gas leakage rather than cut off.
- Infrared sensors (IR) are proposed by Yalmar et al. for detection of presence of stove utensils. The mechanism depends on the engines to turn the stove knob off the gas supply in the absence of any utensils. The procedure presumes that the gas leak is restricted to the oven burner and overlooks the possibility of a gas leak. Due to the absence of sensor devices, its capacity to detect gas escapes is restricted.
- Park et al. propose a smart home gas safety system based on wireless gas safety modularization. The system is based on the clever MiCom metres available on the market, with a built-in microprocessor and a cut-off valve that enhance traditional gas metres. The system focuses on the detection of fire outages and upgrading the existing gas metre to link to the external smoke and CO sensor and also to the fire removal modules, which are used to extinguish the fire when the temperature exceeds the threshold. This method has a drawback in that it does not have an independent application due to the requirement to utilize a current Micom metre build up improving gas and fire safety technology.

- Kareem provides a consolidated home-building applications system. Sensor nodes interact with a single centre node installed in various homes. An alarm is triggered in the case of a gas leak. In each sensor unit of the RF module the employees are recognised and informed by SMS using the given MAC address. Despite the lack of a closing mechanism the system offers an inexpensive, centralised and low-energy gas monitoring approach.
- Bhattacharjee et al provide a three-subunit wireless system: a baseline, a sensor array sensor, and a sensor alert. It includes the calibration of sensors or the identification of errors, the dynamic threshold fixing and the selection of sensors to improve sensing data accuracy. The system examines the development of sensory sensitivity over time and stresses the need for sensor calibration to increase data accuracy.
- Chengjun et al. proposed that gas leaks and safety in petrochemical manufacturing should be detected through wireless sensor networks. The system emphasises the necessity to develop central positioning software using data collected from RF sensors to accurately identify the gas leaking location and assist reduce reaction time. The system emphasises the need of internode communication in creating an effective leak detection system, despite the lack of remote monitoring and automatic shut-off.
- A case study doing polycarbonate for drinking water at a major business, Hermawan and Setiawan stress the need of automated systems to increase worker safety. Its technology has been developed to control LPG systems for gas leaks in the warehouse using an application from a distance. Although the work of Ghosh and Dhar³ was similarly carried out, our study shows that the installation of gas safety devices significantly enhances safety in workplaces and helps avoid gas-related disasters.
- The benefits of wireless gas detection, as well as improved safety, working conditions and production value, are also examined by Andrew Liptak. The study examines the advantages of wireless technology over conventional wired systems. Research performed by Central Valley Gas Storage LLC has demonstrated the benefits of wireless gas detectors (CVGS).
- Mardiyanto proposes a technique to monitor the consumption and generation of harmful gases during the manufacture of organic fertiliser in real time. The system monitors temperature, air and moisture, but analyses most critically the volume of hazardous gases, including the quantity of methane, carbon monoxide and nitrogen dioxide. The system must maintain the gas threshold and take suitable steps, such as switching the exhaust fan on when the limit is surpassed. The technology enables parameter monitoring through a graphical user interface remote monitoring (GUI).

IV. PROPOSED SYSTEM

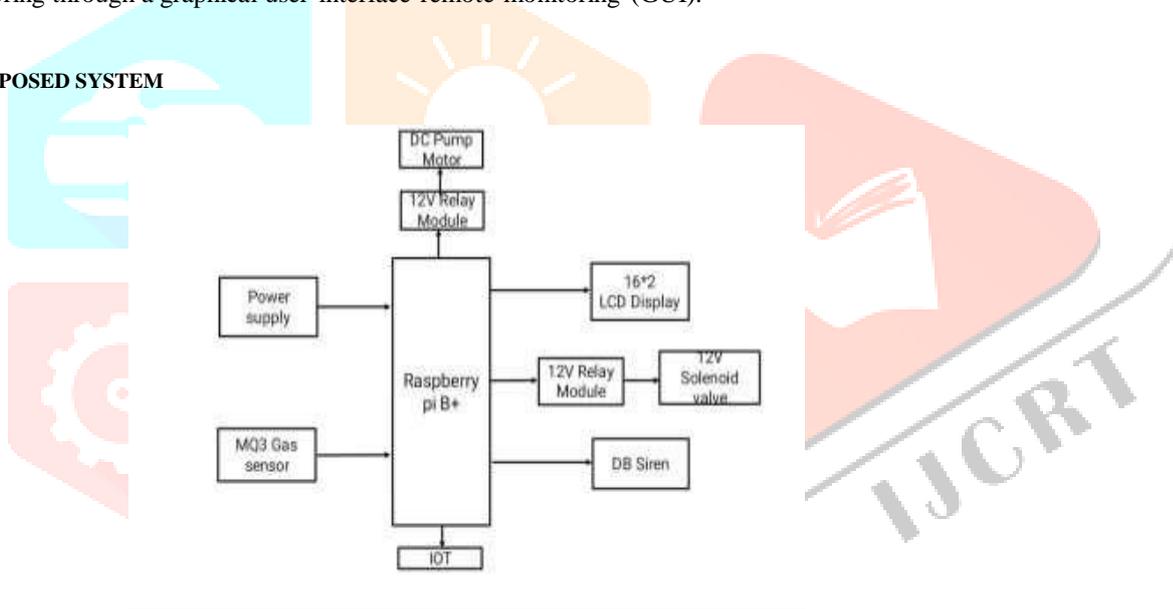


Fig. 1. Block Diagram of Proposed System

This suggested model is built using a variety of sensors. This system will be utilized in a variety of settings, including homes, businesses, and schools. The suggested architectural design for a gas warning system is shown below. The Raspberry pi is used to link the different sensors and hardware components in this alert system. The MQ-3 sensor detects methane, butane, propane, liquefied petroleum gas (LPG), and smoke. The MQ-3 sensor detects alcohol, grain alcohol, and smoke. The LCD is used to constantly show the detected data. The motor portion is activated automatically when the cylinder valve is opened. The wifi module's function is to establish communication between the user and the system. Potentiometers are used to test the sensitivity of sensors. This newly built system not only sends the warning message to ubidots web interface, but it also saves the data for future use. The flow of the suggested system is shown in the picture below. The purpose of the wifi module is to create communication between the user and the system. This proposed model is constructed by using various sensors. This system will be used in any place like houses, industries, schools, etc. The following diagram shows the proposed architecture diagram for a gas alert system. Detection of gas leakage is the process by which sensor leaks and flames are identified as potentially harmful. These sensors notify users to the WEB server by sending a message. The gas sensor (MQ3) interfaced to the Raspberry pi may be used for such detection. Whenever the sensor detects gas, a voltage is produced and the raspberrypi is supplied as an input. If the gas is detected the pump motor gets turned ON and buzzer will get to beep to give an alert and turned off when corrected, the notification is sent via UBIDOTS Webservice. Through a python code and the necessary sensor libraries, the whole operation of the system may be accomplished.

V. HARDWARE COMPONENTS

The suggested system is made up of seven core modules that process data and interface to other applications, making the system user-friendly. These are some examples.

1. Microcontroller (Raspberry pi B)
2. Display Module
3. Buzzer Module
4. MQ3 Gas sensor
5. Solenoid Valve
6. 12V Relay Module
7. DC Motor Pump

5.1 Microcontroller (Raspberry pi B)



Fig. 2. Raspberry pi-4 B

The Raspberry Pi is a series of small single-board computers designed by the United Kingdom Raspberry Pi Foundation to promote basic education in schools and impoverished countries. The Pi 4 Model B was launched in June 2019[2]. With a 1.5 GHz 64-bit ARM Cortex-A72 CPU, Bluetooth, 802.11ac Wi-Fi, 5 full gigabit Ethernet, two USB 2.0, two USB 3.0 ports, and a pair of micro HDMI (HDMI TypeD) interface connectors enabling a resolution of up to 4k. The Pi4 may also be operated via a USB-C connection when used in combination with the appropriate power supply to enable the downstream devices to get more power. The initial Raspberry Pi 4 card is designed inappropriately to detect and refuse to provide power, as is the case with third-party e-marked USB connectors such as those used on Apple MacBooks. Tom's hardware checked 14 wires and found that 11 of them had activated and powered the Pi satisfactorily. In Board version 1.2, released in late 2019, the design problem was discussed. Figure 5.1 depicts the Raspberry Pi board. It features a BCM2387 Chipset, four USB ports, a Micro SD card slot, an HDMI connection, an RCA video/audio jack, a camera connector, a Micro USB connector for power, and Ethernet port, and a 40-pin GPIO header, among other things. The Raspberry Pi has WiFi and Bluetooth modules built-in. In the lower left corner of the board, the Pi has a 5 V USB micro power port. A Raspberry Pi is an advanced module intended for industrial usage in a more flexible physical form. The Calculation Modul has the Raspberry Pi guts as well as a 4GB eMMC Flash device (BCM2835 cpu and RAM 512MB) (which is the equivalent of the SD card in the Pi).

5.2 Display Module

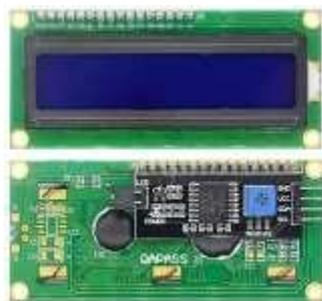


Fig. 3. LCD Display with 16x2 Alphanumeric Lines

The LCD Module is used to show interactive messaging. We investigate an intelligent LCD with two lines and 16 characters per line that is linked to the controllers. The LCD, or Liquid Crystal Display, is extremely useful for providing user interface as well as troubleshooting. The HITACHI 44780 is the most popular kind of LCD controller, and it offers a simple interface between the

controller and an LCD. These LCDs are both easy to connect with the controller and inexpensive. The display module is designed to offer a user interface through which system users may interact with the system either via the LCD or through various apps for the user and system.

5.3 Buzzer Module

This module needs a buzzer as an output device, which produces an alert only when the condition is met about the threshold value. That is, the password, OTP, and fingerprint are all more than the threshold value is shown in Fig.4.



Fig. 4. Piezoelectric buzzer

5.4 MQ3 Gas Sensor



Fig. 5. MQ3 Gas Sensor

The MQ3 gas and smoke flammable sensor monitors gas levels in the air and transfers them as analogue voltage. The sensor can detect fuel gases of between 300 and 10,000 ppm. At temperatures between -20°C and 50°C the sensor works and draws at 5V under 150 mA. MQ-3 gas sensors have excellent LPG, propane and hydrogen sensitivity and may also be used for detecting methane and other fuel vapours is shown in Fig.5, It is cost-effective and suitable for a number of applications. The sensor is placed in a plastic and rust-filled stainless steel net formed crust and is composed of a small AL_2O_3 ceramic tube, a sensitive Tin Dioxid (SnO_2) layer, a measurement electrode as well as a heater. For sensitive components the heater produces the necessary operating conditions. The MQ-3 is wrapped and consists of six pins with four for signal collection and the other two for heating. The low-cost sensor is a semi-conductor that can detect gases of alcohol from 0.05 to 10 mg/L. The sensitive material of this sensor is SnO_2 whose clean air is less conductive. As alcohol gases increase in concentration, their conductivity also increases.

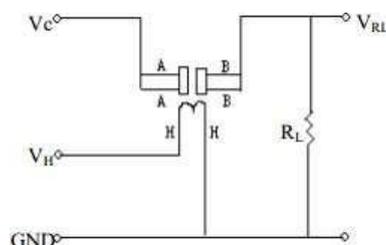


Fig. 6. Circuit for MQ3 Gas Sensor

5.5 Solenoid Valve



Fig. 7. Solenoid Valve

The purpose of a solenoid valve is to open or close an aperture in a valve body, allowing or preventing flow through the valve is shown in fig.7, By energizing the coil, a plunger opens or shuts the aperture by raising or lowering it inside a sleeve tube. Solenoid valves are made up of a coil, a plunger, and a sleeve assembly.

5.6 12V Relay Module



Fig. 8. Relay Module

Due to its low current flow system, the 12V DC relay shown in fig.8 switches an excellent option for the use of full-voltage applications. They regulate high-current flow systems such as the horn, headlights, auxiliary lighting, fan motors, blower engines and many other contemporary equipment.

5.7 DC Motor Pump

DC-powered pumps shown in fig.9 transfer fluid in several ways by using direct current from a motor, battery, or solar power. Motorized pumps are usually powered by 6, 12, 24, or 32 volts of direct current (DC). In solar powered DC pumps, photovoltaic (PV) panels with direct current generated by sunshine are utilised.



Fig. 9. DC Motor Pump

VI. SOFTWARE REQUIREMENTS

Python is an all-round language of interpretation, high-level programming. It was designed and first released in 1991 by Guido van Rossum. As demonstrated by its frequent uses of whitespace, Python design philosophy prioritises code readability. The programmers should be helped to write clear logically code for both small and large-scale projects using their language features and object-oriented approach.

6.1 Installing OS in RPi3

To get started with your Pi, you'll need an operating system. An operating system is a piece of software that serves as a computer manager. Six operating systems are available for download to help you set up your Pi.

6.2 Accessing Pi remotely using Putty

On Windows, you'll need to install an SSH client. PuTTY is the most frequently used client. The name "PuTTY" does not have an official meaning. SSH is an abbreviation for Secure Shell. A shell is a user application that allows for user interaction. Shell is a command language interpreter that runs commands from the normal input device or a file.

6.3 Web Interfacing

To create a WEB Page in Python, we must utilize or import the Flask web Framework.



Fig. 10. PuTTY Configuration

6.4 Flask

It is a microframework based on Python. It is referred to as a microframework since it requires no tools or libraries. Flask Framework may be used to create Web servers on Raspberry Pi (RPI).

6.5 Web Framework

An Online Framework has been designed with the aim of helping to create web apps, such as Web services, Web resources and Web APIs. (Application Program Interface). On-line frameworks offer a standardized method for developing and deploying web applications.

6.6 Internet of Things (IoT)

The Internet of Things (IoT) refers to the growing network of physical items with an IP address and which can connect to the web. The Internet of Things extends the internet connection to a broad range of devices and ordinary objects which use embedded technology to communicate and interact with the outside world via the internet, through conventional devices such as desktop and laptop computers, smartphones and tablet devices.

6.7 IoT Service Provider - UBIDOTS

IoT solutions for remotely monitoring, manage and automated operations for the healthcare clients as well as well-funded startups and Fortune 1,000 in Southeast America and throughout Latin America are being developed with the support of their partners and co-founding company Netux.

6.8 Starting with Ubidots

We must first register with ubidots. Then, following the ubidots website, build widgets to control or monitor the objects.

6.9 Installing ubidots

The ubidots library must be installed in Python using the methods below.

```
sudo apt-get install python-setup tools Sudo easy install pip
```

```
sudo pip install ubidots
```

Pip is a package management system for installing and managing Python authored software packages.



Fig. 11. Ubidots Login page

VII. SOFTWARE REQUIREMENTS

7.1 Flow Chart

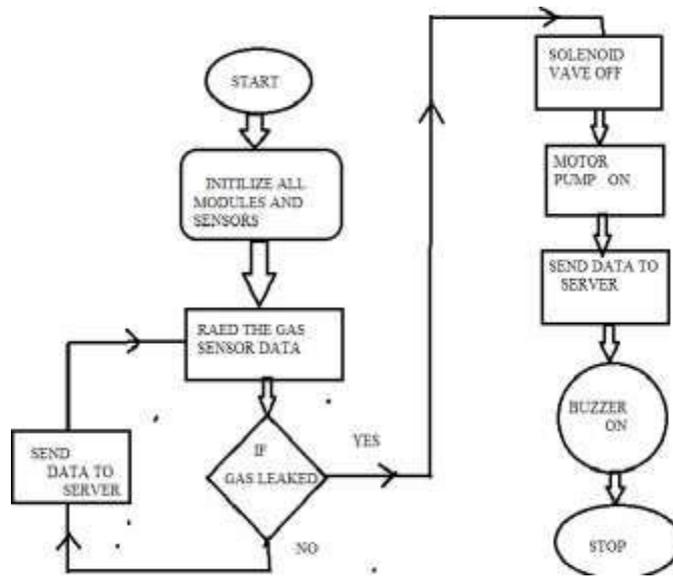


Fig. 12. Flow chart of Proposed System

7.2 Schematic diagram

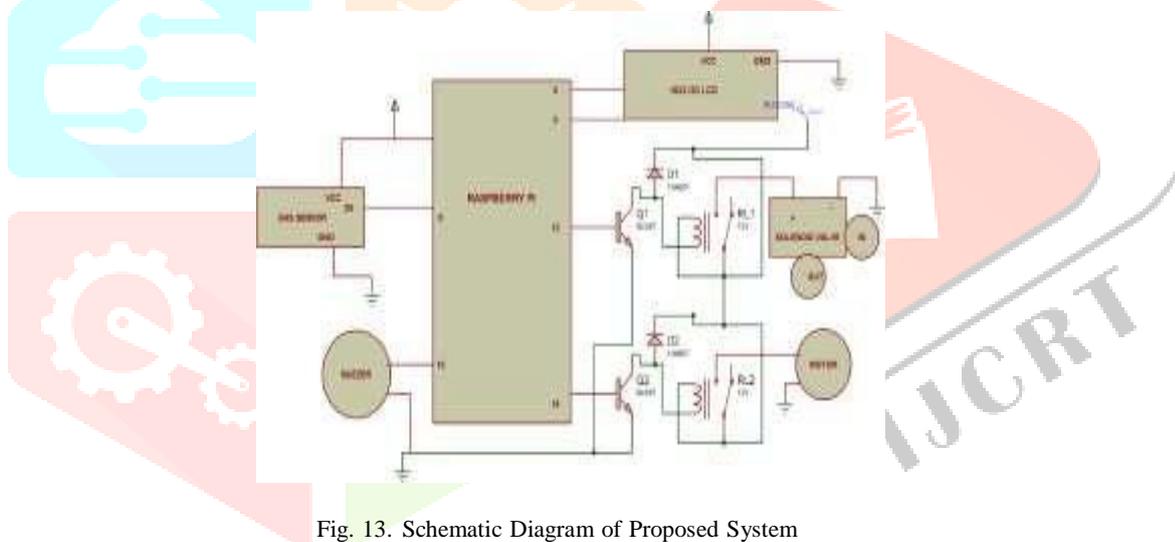


Fig. 13. Schematic Diagram of Proposed System

VIII. SOFTWARE REQUIREMENTS

- Industries based on gas
- Nuclear power plants
- Gas distribution in municipalities.

IX. RESULTS & CONCLUSION

Gas leaks cause serious mishaps that result in material losses and human injuries. Gas leakage is caused mostly by poor equipment maintenance and a lack of public knowledge. As a result, detecting LPG leaks is critical for avoiding accidents and saving lives. This article described a method for detecting and alerting LPG leaks. When LPG leakage is detected, this device activates an LED and a buzzer to warn people. This method is basic yet dependable. As a result, detecting GAS leaks is critical for avoiding accidents and saving lives. This article described a method for detecting and alerting GAS leaks. When LPG leakage is detected, this device activates an LED and a buzzer to warn people. This method is basic yet dependable. Snyder and Casten's (1985) hydraulic oil press machine was found to have poor oil expression efficiency, and oil recovery was improved by decreasing press cylinder diameter. Pressing seeds in a hydraulic oil press machine at 20.8 MPa resulted in a maximum oil recovery of 57.5 percent of seed oil. Seed moisture content, the maximum pressure applied, and cake thickness are all variables that influence oil recovery (amount of seeds pressed per batch). To extract more than 50% of total oil from *Jatropha* seeds, the design pressure should be more than 20 MPa and the cake thickness should be modest. Manual jack retraction should be enhanced to speed up the operating cycle by replacing the motor vehicle jack with a double-action hydraulic power cylinder that can be retracted hydraulically.

Fig. 14. Gas Detection Status in Display



Fig. 15. Notification of Detection System on Serial Monitor

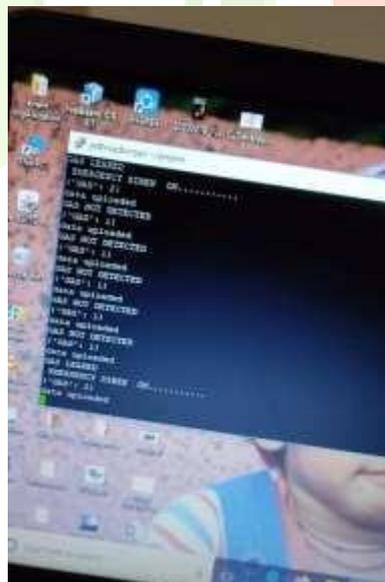




Fig. 16. Coding Program in Raspberry pi.OS



Fig. 17. Gas detected Notification on LCD Display

- The sites which were used while doing this project:
 1. www.wikipedia.com
 2. www.allaboutcircuits.com
 3. www.microchip.com
 4. www.howstuffworks.com
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