VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI-590 018

A REPORT ON MINI-PROJECT WORK

LPG GAS LEAKAGE DETECTION SYSTEM USING ESP32

Submitted in the partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

in

ELECTRONICS & COMMUNICATION ENGINEERING

Mini Project Associates

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Certificate

Certified that the Mini-Project work entitled **"LPG GAS LEAKAGE DETECTION SYSTEM USING ESP32"** carried out by, Ms. SHREYA BHANDAGE. USN 4BD22EC090, Ms. SINDHU M S. USN 4BD22EC092, Ms. SNEHA L HANCHIN. USN 4BD22EC094, Mr. SOMASHEKHAR JAVOORU. USN 4BD22EC096, bonafide students of this institution in partial fulfillment for the award of degree of **Bachelor of Engineering in Electronics & Communication by Visvesvaraya Technological University**, Belagavi during the academic year **2024-25**. It is certified that all corrections / suggestions indicated for continuous internal evaluation have been incorporated in the report.

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Course Learning Objectives:

This course will enable us to:

- Understand and analyze an engineering problem.
- Acquire technical knowledge and collect the information.
- Enhance communication, technical presentation and report preparation skills.
- Provide an opportunity to exercise the creative and innovative ideas in group.

ABSTRACT

This project presents the development of an LPG gas detection system utilizing the capabilities of the ESP32 microcontroller and email notification functionalities. Liquefied Petroleum Gas (LPG), a widely used fuel source, poses a significant threat due to potential fire and explosion hazards in case of leakage. This project addresses this concern by proposing a cost-effective and user-friendly solution for leak detection. The system employs an MQ-2 sensor designed for gas detection. The sensor's output voltage changes in response to LPG concentration in the surrounding air. This data is acquired by the ESP32 microcontroller and processed to trigger email notifications when gas levels exceed a pre-defined threshold indicative of a potential leak. This allows for remote monitoring and prompt intervention, potentially mitigating safety risks associated with LPG usage in homes and industries.

ACKNOWLEDGEMENTS

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Project Associates:

Shreya Bhandage

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CHAPTER 1
INTRODUCTION

Liquefied Petroleum Gas (LPG), also known as propane or butane, is a vital fuel source employed in various applications, including cooking, heating, and industrial processes. Its widespread use, however, necessitates robust safety measures due to the inherent flammability and explosion risks associated with LPG leaks. This project addresses this critical aspect by developing an LPG gas detection system utilizing the ESP32 microcontroller and email notification functionalities. The proposed system offers a cost-effective and user-friendly solution for early detection of LPG leaks, potentially mitigating the catastrophic consequences of such events. This project presents an alternative approach by leveraging the capabilities of the ESP32 microcontroller and sensor technology. This advancement allows for real time monitoring and prompt intervention in case of a gas leak, enhancing overall safety in LPG usage environments. LPG gas leakage detection systems are designed to monitor the air for the presence of combustible gases like LPG. By integrating a gas sensor with a microcontroller, the system can continuously measure the concentration of LPG in the surrounding environment. When a gas leak is detected beyond a certain threshold, the system can trigger an alarm, such as an audible sound, visual indicators, or even send notifications to mobile devices or a cloud server. The ESP32 microcontroller is the heart of this system, offering a wide range of features that make it particularly useful for IoT (Internet of Things) applications. With built-in Wi-Fi and Bluetooth connectivity, the ESP32 can seamlessly transmit data to remote devices, trigger alarms, and provide real-time updates via smartphone apps or cloud platforms. It has ability to connect to a local network or the internet allows for remote monitoring and control of the gas detection system. It can send notifications to mobile phones or control other connected smart devices in case of a detected leak.it is an affordable option compared to other microcontrollers with similar capabilities, making it ideal for both commercial and DIY projects. It offers excellent performance at a fraction of the cost of more complex systems.

CHAPTER 2
LITERATURE SURVEY

Paper 1: LPG Gas Leakage Detection and Alert System

Author: E. Jebamalar Leavline, D. Asir Antony Gnana Singh, B. Abinaya ,H. Deepika

Year of Publication: 2017

Technology used: It is battery operated and hence portable. It is designed in such a way that it can also be operated with ac power supply. To support the latter case, it has a bridge rectifier with a capacitor filter. This is followed by a regulator designed with IC7805 which provides +5V regulated power supply. To detect the LPG, MQ-6 gas sensor is employed. This sensor can be operated at +5V. The sensitivity of this sensor is very high and it has quick response time. It can detect the LPG concentration in the range of 200-10000ppm. The gas sensing layer of this sensor is made of Tin Dioxide (SnO2) and gold (Au) electrodes. The output of the gas sensor is given to LM358 dual operational amplifier where it is compared with the threshold value for gas density which is set using preset potentiometers and amplified. If the sensed voltage is greater than the preset threshold voltage, the operational amplifier output fires the driver circuit for LED and Buzzer. As a result, the LED will glow and the buzzer starts to produce alarm sound.

Keywords: Bridge rectifier, capacitor filter, operational amplifier, MQ-6 gas sensor

Citations:3

Paper 2:Gas leakage detector using Arduino.

Author: S. Lakshmi Lavanya **,** M. Devi vara prasad **,**A. Sravya ,Manjunatha R

Year of Publication: 2023

Technology used: “Gas Leakage Detector with SMS Alert using ARDUNIO and GSM module”, will be a great help in terms of preventing any danger caused by gas leakage. The purpose of this project is to detect the presence of Gas leakage in the homes and working places. Apart from sound alarm and SMS alert it will call the owner. which is used in case of the nobody is present when the leakage occurs and to prevent accidents and property damage. In this gas detector system it senses the gas leakage. If the gas in air is normal then the LED on the circuit will glow green giving a safe sign and whenever sensor senses the gas then the red led glow i.e., green goes off, sends a message and make a phone call to the owner and power goes off.

Keywords: Arduino UNO, MQ2 Gas Sensor, GSM

Citations:10

Paper 3: Gas Detection Using ESP32 and Fire Alarm

Author: M Abdullah Khan

Year of Publication: 2023

Technology used: The project scope encompasses the design, development, and implementation of a gas detection and fire alarm system. The system employs **ESP32** microcontroller along with **MQ-2, MQ 3, and MQ-135** gas sensors, as well as a fire sensor and a buzzer for alarm notification. The gas detection and fire alarm system consist of sensor modules, an ESP32 microcontroller, and an alarm mechanism. Gas sensors monitor the air for various harmful gases, while the fire sensor detects temperature changes associated with fire. The ESP32 processes data from the sensors and triggers the alarm if dangerous levels are detected.

Keywords: ESP 32, MQ sensors, alarm

Citations: 3

Paper 4: LPG gas leakage detection using ESP32

Author: OM Ghodke, Swapnil Kadam, Chaitanya Jhoshi, Shrinivas Shitole, Pandhare N.V.

Year of Publication: 2024

Technology used: Existing methods for LPG gas detection encompass a range of technologies. Commercially available gas detectors utilize electrochemical sensors that trigger audible alarms upon detecting LPG leaks. These systems are readily available and offer a basic level of safety. However, their limitations include fixed locations, potential for false alarms due to sensitivity to other gases, and the requirement for manual intervention upon alarm activation. Microcontroller-based systems can be developed to interface with these sensors, acquire data, and trigger alarms or notifications based on pre-defined thresholds.

Keywords: ESP 32, MQ sensors, alarm

Citations: 3

SUMMARY OF LITERATURE SURVEY

Paper Authors	Title of Paper	Remarks	Technology Used
1)E. Jebamalar Leavline, D. Asir Antony Gnana Singh, B. Abinaya ,H. Deepika	LPG Gas Leakage Detection and Alert System	This system triggers LED and buzzer to alert people when LPG leakage is detected.	Bridge rectifier, capacitor filter, operational amplifier, MQ-6 gas sensor
2) S. Lakshmi Lavanya , M. Devi vara prasad ,A. Sravya, Manjunatha R.	Gas leakage detector using Arduino.	Arduino detects the gas leakages with an alert and a make a phone call to the owner incase nobody is present.	Arduino, GSM module, SMS alert, MQ-2.
3) M Abdullah Khan.	Gas Detection Using ESP32 and Fire Alarm.	The integration of ESP32, gas sensors, and a fire sensor forms a cohesive system which enhances safety measures and environmental awareness.	ESP32microcontroller MQ-2, MQ 3, and MQ-135 gas sensors, Fire sensor,Email notification.
4)OM Ghodke, Swapnil Kadam, Chaitanya Jhoshi, Shrinivas Shitole Pandhare N.V.	LPG gas leakage detection using ESP32.	This research presents a approach to LPG gas detection using the ESP32 microcontroller with email notification capabilities	Electrochemical sensors, ESP 32 microcontroller, Email notification functionalities.

CHAPTER 3
OBJECTIVES

- Developing of a gas leakage detection mechanism using cost effective components.
- Providing real time monitoring and alerts for LPG gas leakage.
- Provide Immediate Alerts via Audible, Visual, and IoT-Enabled Notifications.
- Optimize Power Efficiency for Prolonged and Reliable Operation.
- Integrate Seamlessly with Smart Home and IoT Systems.
- Offer User-Friendly Configuration, Monitoring, and Control

CHAPTER 4
METHODOLOGY

4.1 BLOCK DIAGRAM

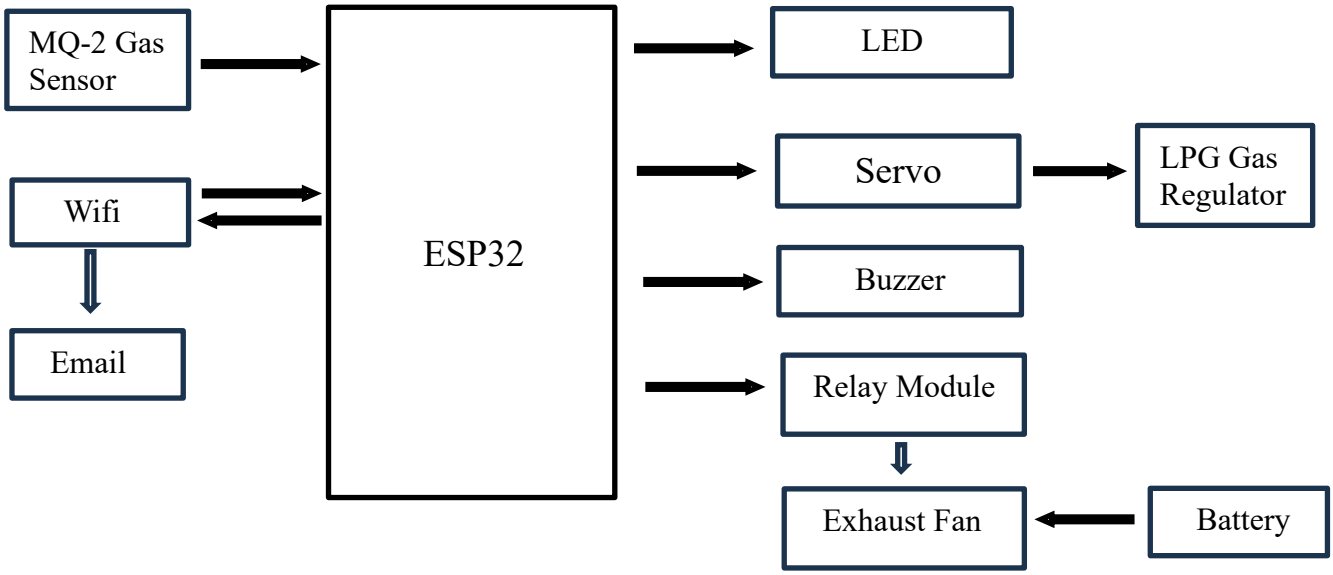

Figure 4.1.1: Block diagram of LPG Gas Detection System using ESP 32

4.1.1 BLOCK DIAGRAM DESCRIPTION:

The block diagrams shown in the figure 4.1.1 shows overall working of a LPG Gas Detection System using ESP32. Here's a breakdown of the system's components:

1. **MQ-2 Gas Sensor:**
   - Detects the presence of LPG gas in the surrounding environment.
   - Sends an analog signal to the ESP32 when gas levels exceed a threshold.
2. **ESP32 Microcontroller:**
   - Acts as the central processing unit for the system.
   - Processes signals from the MQ-2 gas sensor and controls the connected components (e.g., servo, buzzer, LED, etc.).
   - Uses built-in Wi-Fi capabilities to send email alerts when gas leakage is detected.
3. **Wi-Fi Module (Integrated in ESP32):**
   - Enables wireless communication for sending notifications via email to alert users of gas leakage.
4. **Email Alert System:**
   - Sends real-time email notifications to users when gas leakage is detected, ensuring timely actions.

5. **LED Indicator:**
    - Provides a visual alert by glowing when a gas leak is detected.
6. **Servo Motor:**
    - Controls the LPG gas regulator to shut off the gas supply automatically in case of a leakage.
7. **Buzzer:**
    - Emits an audible alert to warn nearby individuals about the detected gas leak.
8. **Relay Module:**
    - Controls the activation of the exhaust fan to disperse leaked gas from the area.
9. **Exhaust Fan:**
    - Helps to ventilate the area by removing leaked gas, reducing the risk of explosion.
10. **Battery:**
    - Provides power to the system for uninterrupted operation.

CHAPTER 5
HARDWARE DESCRIPTION

5.1 ESP32:

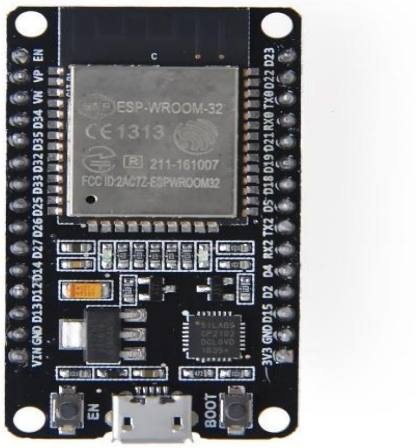

Figure 5.1.1: ESP32

- ESP32 is a powerful, generic Wi-Fi module that targets a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as voice encoding, music streaming and MP3 decoding.
- The integration of Bluetooth, Bluetooth LE and Wi-Fi ensures that a wide range of applications can be targeted, and that the module is all-around: using Wi-Fi allows a large physical range and direct connection to the Internet through a Wi-Fi router, while using Bluetooth allows the user to conveniently connect to the phone or broadcast low energy beacons for its detection

Core Functionality:

- **Microcontroller Unit (MCU):** It incorporates a dual-core Xtensa® 32-bit LX6 microprocessor. These cores can be individually controlled or powered off for optimized performance depending on the application's needs. The clock frequency is adjustable from 80 MHz to 240 MHz, allowing for flexibility in processing power.
- **Wireless Connectivity:**
  Wi-Fi: Supports Wi-Fi protocols like 802.11 b/g/n, enabling connection to local Wi-Fi networks for internet access or data transfer.
- **Bluetooth:** Offers classic Bluetooth capabilities for legacy device connections, supporting

profiles like L2CAP, SDP, GAP, SMP, and more.

- **Bluetooth Low Energy (BLE):** Supports BLE for connecting to low-power devices like smartphones and wearables. This technology is ideal for battery-powered applications as it consumes less energy compared to classic Bluetooth.

Additional Features:

- **Integrated Onboard Memory:** The ESP32 WROOM module typically includes built-in flash memory, allowing for program and data storage.
- **Rich Peripheral Set:** It offers a variety of peripherals like GPIO pins, ADC (Analog-to-Digital Converter), SPI (Serial Peripheral Interface), I2C (Inter-Integrated Circuit), and more. These features enable interaction with various sensors, displays, and other external components.
- **Low Power Consumption:** Designed with power efficiency in mind, the ESP32 WROOM module can operate in different power modes, allowing developers to optimize battery life for specific applications.
- **Compact Size:** The module is relatively small and lightweight, making it suitable for integration into space-constrained projects.

Applications:

The ESP32 WROOM module's versatility makes it ideal for various IoT (Internet of Things) applications, including:

- **Wearable electronics:** Smartwatches, fitness trackers, health monitoring devices.
- **Smart home devices:** Thermostats, light switches, security systems.
- **Industrial automation:** Sensor data collection, control systems, monitoring equipment.
- **Robotics:** Wireless control, data transmission.
- **Wireless communication projects:** Data logging, remote control systems

5.2 MQ-2 GAS SENSOR

Figure 5.2.1: MQ-2 GAS SENSOR

The MQ2 sensor is one of the most widely used in the MQ sensor series. It is a MOS (Metal Oxide Semiconductor) sensor. Metal oxide sensors are also known as Chemiresistors because sensing is based on the change in resistance of the sensing material when exposed to gasses. The MQ2 is a heater-driven sensor. It is therefore covered with two layers of fine stainless steel mesh known as an "anti-explosion network". It ensures that the heater element inside the sensor does not cause an explosion because we are sensing flammable gasses

SPECIFICATIONS

1.Operating voltage	5V
2.Load resistance	20 KΩ
3.Heater resistance	33Ω ± 5%
4.Heating consumption	<800mw
5.Sensing Resistance	10 KΩ – 60 KΩ
6.Concentration Range	200 – 10000ppm
7.Preheat Time	Over 24 hour

5.3 SERVO MOTOR

Figure 5.3.1: SERVO MOT0R

Role-The servo motor adjusts the solar panel's position to align with the sun based on Arduino commands.

Explanation -The servo motor is a key actuator in the solar tracking system, responsible for rotating the solar panel to the desired angle. Controlled by PWM signals from the Arduino, the motor provides precise and smooth movement. It adjusts the panel's orientation in response to changes in sunlight intensity detected by the sensors.

SPECIFICATIONS

- Average speed: 60 degrees in 0.20 sec (4.8V),60 degrees in 0.16 sec (6.0V)
- Operating speed: 0.1s/60°
- Gear Type: Plastic
- Rotation: 0°-180°
- Weight of motor: 9gm
- Power: 4.8V-6V DC max (typically 5V).

5.4 BUZZER

Figure 5.4.1: BUZZER

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren. A buzzer is an efficient component to include the features of sound in our system or project. It is an extremely small & solid two-pin device thus it can be simply utilized on breadboard or PCB. So in most applications, this component is widely used. t includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '-'symbol or short terminal and it is connected to the GND terminal.

Specifications

- Colour is black
- The frequency range is 3,300Hz
- Operating Temperature ranges from – 20° C to +60°C
- Operating voltage ranges from 3V to 24V DC
- The sound pressure level is 85dBA or 10cm
- The supply current is below 15mA

5.5 LED

Figure 5.5.1: LED

Light-emitting diodes are heavily doped p-n junctions. Based on the semiconductor material used and the amount of doping, an LED will emit colored light at a particular spectral wavelength when forward biased. As shown in the figure, an LED is encapsulated with a transparent cover so that emitted light can come out. The colour of an LED is determined by the material used in the semiconducting element. The two primary materials used in LEDs are aluminium gallium indium phosphide alloys and indium gallium nitride alloys. Aluminium alloys are used to obtain red, orange and yellow light, and indium alloys are used to get green, blue and white light. Slight changes in the composition of these alloys change the colour of the emitted light.

5.6 EXHAUST FAN

Figure 5.6.1: EXHAUST FAN

Its working voltage is 12V DC. It can work with a simple 12V battery without any difficulty. This fan has the ability to run at a speed of 6800 rpm. The body of the fan is built from a combination of resin and plastic material. The combination provides strength and insulation to the fan. Due to its manufacturing, It is light in weight and strong enough to bear some falls on the ground. So if you are looking for a perfect combination of strength and insulation in a single fan, then you are in the right place.

Specification:-

1. Model name: 12038
2. Working voltage: 12V DC
3. Power rating: 0.25A
4. Durable
5. Hard resin and plastic body
6. Dimensions of the fan : 120mm x 120mm x 38mm
7. It Comes with two red and black wires of 22cm attach

5.7 RELAY MODULE

Figure 5.7.1: RELAY MODULE

A **relay module** is an electrical device that acts as a switch controlled by an external electrical signal. It is widely used in electronic and electrical applications to control high-power circuits using low-power signals.

Key Components:

1. **Relay**: An electromagnetic switch that toggles between states when a control signal is applied. It typically includes:
    - **Coil**: Generates a magnetic field when energized.
    - **Armature**: Moves under the influence of the magnetic field.
    - **Contacts**: Change position (open or close) depending on the armature's movement.
2. **Driver Circuit**: Often includes a transistor or MOSFET to amplify the control signal.

3. **Protection Components**:

- **Diode (Flyback Diode)**: Protects the circuit from voltage spikes generated when the relay coil is turned off.
- **Optoisolator** (in some modules): Provides electrical isolation between the control circuit and the relay**.**

Key Features:

1. **Control Voltage**: The voltage required to activate the relay (commonly 3.3V, 5V, or 12V).
2. **Contact Ratings:** Defines the maximum voltage and current the relay can handle (e.g., 10A at 250V AC or 30V DC).
3. **Number of Channels**: Single-channel, dual-channel, or multi-channel modules are available to control multiple devices.
4. **Isolation**: Provides electrical isolation between the low-power control circuit and the high-power circuit.
5. **LED Indicators**: Many modules have an LED to show relay activation.

5.8 BATTERY

Figure 5.8.1: BATTERY

The battery provides the necessary power for the robot's motors and electronics. Separate power supplies may be used for the motors and control circuitry to ensure stable operation

Specifications:

1. Voltage: Typically, 9V or 12V for motors, 5V for control circuitry.
2. Capacity: Depending on the usage time required (e.g., 1000mAh to 2000mAh).

5.9 SCHEMATIC DIAGRAM

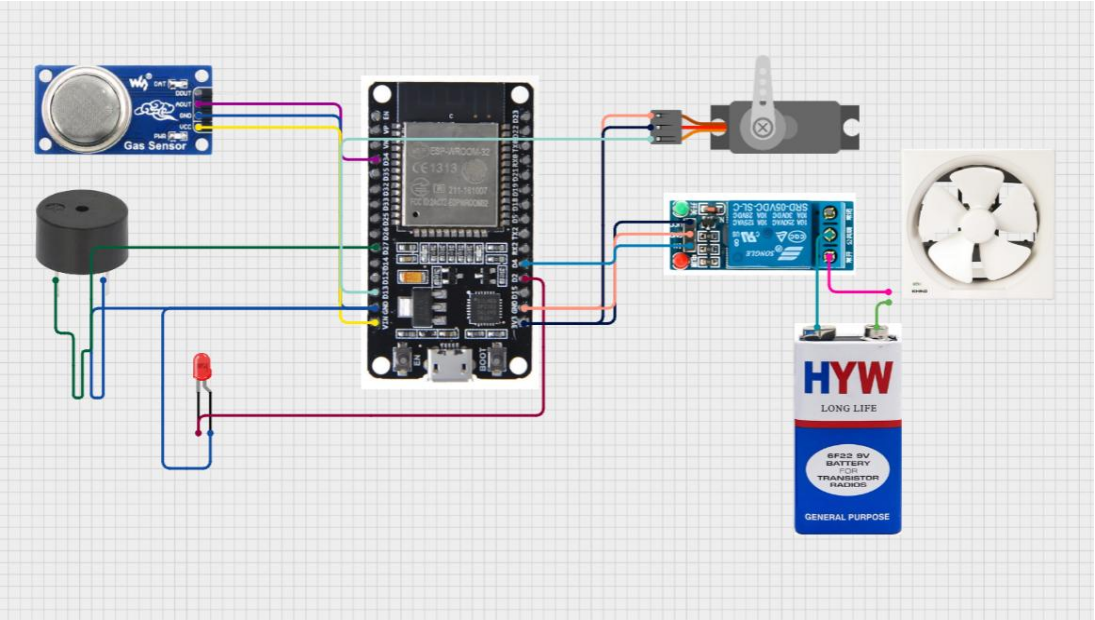

Figure 5.9.1: SCHEMATIC DIAGRAM

CHAPTER 6
SOFTWARE DESCRIPTION

6.1 Arduino IDE

Figure 6.1.1: Arduino IDE

Arduino uno for programming Arduino microcontroller. Arduino uno can be implemented within Windows, Mac and Linux operating systems. Most of its components are written in c language for easy editing and compiling. Users can modify internal layouts and schematics when required.

Integrated Development Environment "IDE" For Arduino

Arduino IDE is an open-source software that is mainly used for writing and compiling the code into the Arduino Module.

It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.

Tools

Auto Format This formats your code nicely: i.e., indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more. Archive Sketch Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch. Fix Encoding & Reload Fixes possible discrepancies between the editor char map encoding and other operating systems char maps. Serial Monitor Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.

Board Select the board that you're using. See below for descriptions of the various boards. This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu. Programmer For selecting a hardware programmer when programming a board or chip and not using the onboard USB serial connection. Normally you won't need this, but if you're burning a bootloader to a new microcontroller, you will use this. Burn Bootloader The items in this menu allow you to burn a bootloader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino board but is useful if you purchase a new ATmega microcontroller (which normally come without a bootloader). Ensure that you've selected the correct board from the Boards menu before burning the bootloader on the target board. This command also set the right fuses.

Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. Arduino IDE is used to control all the input and output devices that are connected to the Arduino uno with programming.

6.2 ZAPIER

Figure 6.2.1: ZAPIER

Zapier is a cloud-based automation tool that enables users to connect apps and services without requiring technical expertise. It uses triggers (events in one app) to initiate actions in other apps, helping users automate repetitive tasks. For example, when a new lead is added in Google Sheets, Zapier can automatically create a contact in Salesforce or send a notification in Slack.

Key Features of Zapier:

1. **Multi-Step Zaps**: Create workflows that involve multiple steps, such as collecting data, processing it, and sending it to different apps.

2. **Conditional Logic (Paths)**: Execute different actions based on conditions, such as splitting workflows depending on whether a lead is from one region or another.

3. **Filter:** Set specific conditions for Zaps to execute only when certain criteria are met.
4. **Data Formatting**: Use built-in tools to format dates, numbers, or text, and prepare data for other apps.
5. **App Extensions**: Integrations cover various domains, including project management, email marketing, CRM, social media, and more.
6. **Webhooks:** Advanced users can trigger Zaps or send data to apps that support webhooks.

Benefits in Details:

1. **Increased Productivity:**

Automates repetitive tasks like data entry, email notifications, and syncing information across

apps, saving time for higher-value activities.

2. **No Coding Required:**

Zapier's intuitive interface enables anyone to set up workflows, making automation accessible even for non-technical users.

3. **Scalable Automations:**

From single-trigger workflows to complex multi-step Zaps with filters and logic, it accommodates businesses of all sizes.

4. **Improved Accuracy:**

Eliminates manual errors by automating routine tasks.

5. **Integration with a Wide Range of Tools:**

Zapier supports over 5,000 apps, including popular tools like Gmail, Slack, Trello, HubSpot, and Shopify.

6. **Custom Workflows:**

Build workflows tailored to unique business processes without needing custom software development.

Limitations in Detail:

1. **Pricing and Task Limits:**

   - Free plans have limited Zaps and monthly tasks (100 tasks per month).
   - Paid plans can be expensive for businesses requiring a high volume of tasks or advanced features like multi-step Zaps and webhooks.

2. **Dependency on Triggers:**

Workflows are reactive, meaning they only activate when a trigger event occurs.

3. **Learning Curve for Advanced Users:**

While simple tasks are easy to set up, complex workflows involving conditions, multi-step

actions, or API/webhooks may require technical knowledge.

4. **Data Security Concerns:**

As a cloud-based tool, data is transferred through Zapier, which could raise concerns about privacy and compliance with regulations like GDPR or HIPAA.

5. **Limited Offline Capabilities:**

Requires a stable internet connection, and offline workflows are not supported.

6. **Limited Functionality of Some App Integrations:**

Some app integrations do not support all features available in the app itself. For example, Zapier might allow creating new entries but not retrieving or modifying existing ones.

6.3 FLOW CHART

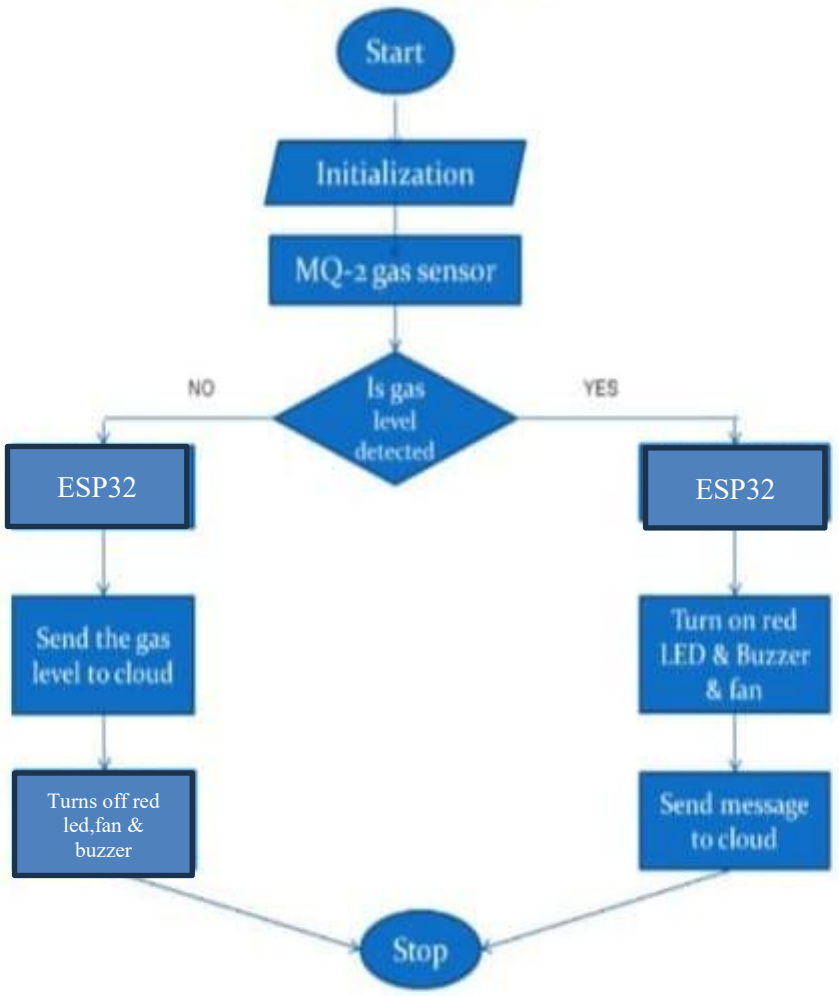

Fig 6.3.1: Flow Chart of the LPG Gas Detection system using ESP32

CHAPTER 7
RESULTS AND DISCUSSION

The results of this project LPG gas leakage detection using ESP32 are discussed in the following cases in detailed manner as explained in the methodology.

After uploading the code, open the monitor. The Monitor will display the initialization message.

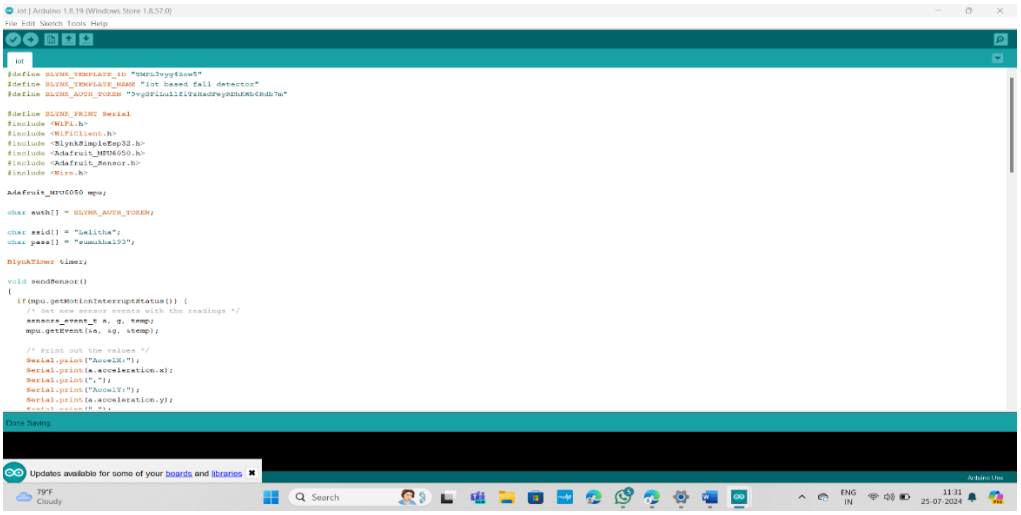

Figure 7.1.1: Arduino IDE software with Embedded C code and Initialization

When gas is detected by MQ-2 gas sensor ,the following events take place:

- the servo motor turns off the LPG regulator.
- LED blinks as a visual indicator of the leak.
- Buzzer or beeper beeps when there is leak.
- Exhaust Fan turns on
- Triggers email notification.
- Below figure 7.1.2 Shows the circuit connections and figure (7.1.3 , 7.1.4) shows mobile app notification.

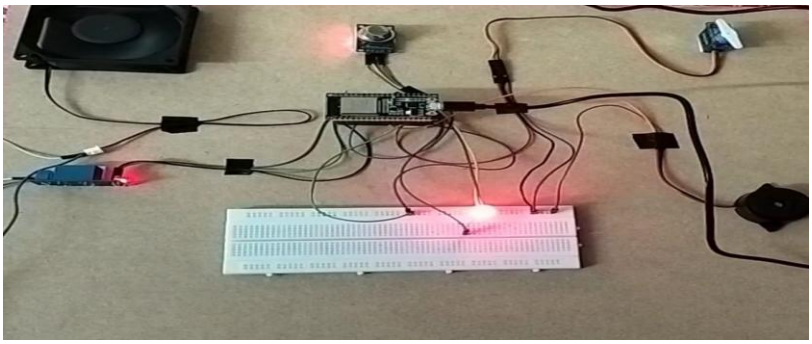

Figure 7.1.2: Interfacing of ESP32

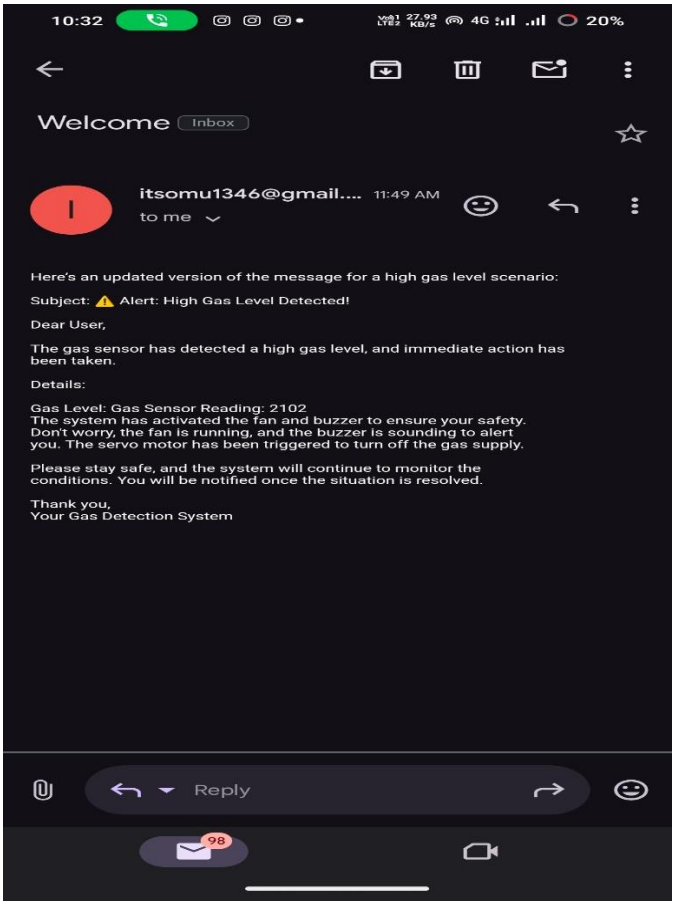

Figure 7.1.3: email notification when high gas level is detected.

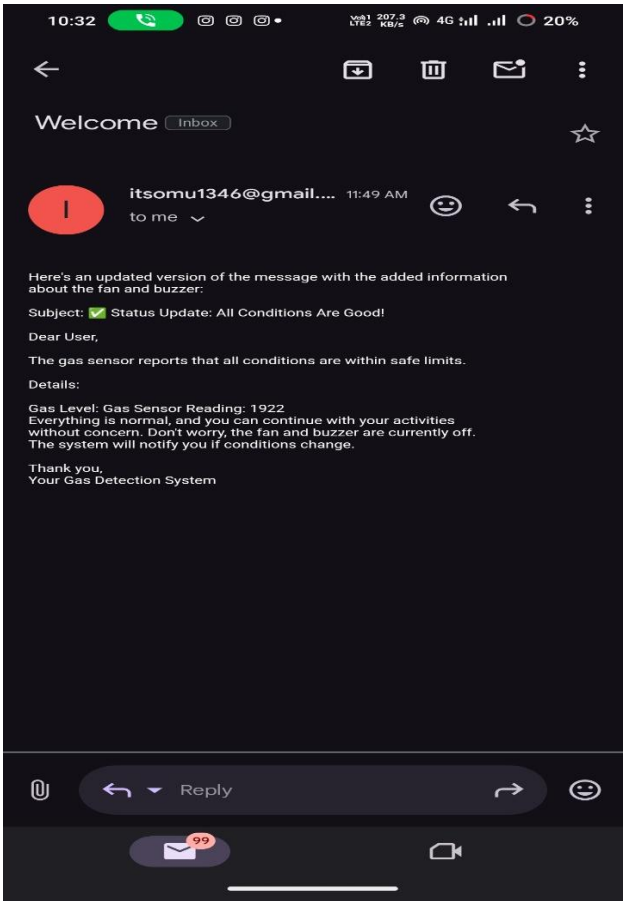

Figure 7.1.4: email notification when all conditions are good

Email Notifications from the LPG Gas Leakage Detection System

Figure 7.1.3: Email Notification When High Gas Level is Detected:

This figure displays an email notification sent by the system when a high gas level is detected. The notification includes the following details:

- Subject: " Alert: High Gas Level Detected!
- " Message Body: It informs the user that the gas sensor has detected a high gas level and outlines the immediate actions taken, such as activating the fan, sounding the buzzer, and triggering the servo motor to turn off the gas supply.
- Gas Sensor Reading: 2102
- A safety assurance message and a note that the system continues to monitor the situation.

Figure 7.1.4: Email Notification When All Conditions Are Good

This figure shows an email notification indicating normal system conditions. The notification contains:

- Subject: " Status Update: All Conditions Are Good!"
- Message Body: It reports that all conditions are within safe limits, provides reassurance that no further action is required, and specifies that the fan and buzzer are off.
- Gas Sensor Reading: 1092.
- A confirmation that the system will notify the user if conditions change.

These email notifications enhance safety by promptly alerting the user in both emergency and normal conditions, ensuring real-time monitoring and control of the environment.

CHAPTER 8

8.1 APPLICATIONS

1. **Gas Storage Areas:**
    - Homes: Protects households by detecting LPG leaks in kitchens and storage rooms, minimizing the risk of fire and explosion.
    - Factories and Industries: Useful in industrial facilities where gases like propane, butane, or other volatile compounds are stored or used in processes.
    - Hotels: Ensures the safety of staff and guests by monitoring gas usage in kitchens and maintenance areas.
2. **Fire Hazard Prevention:**
    - Effective in early detection of gas leaks that could lead to explosions or fires, enabling swift action to prevent large-scale property damage and loss of life.
3. **Harmful Gas Detection:**
    - Detects not just flammable gases but also toxic gases (e.g., methane, carbon monoxide) in various environments, improving safety standards in workplaces and living spaces.
4. **Domestic Gas Leakage Detection:**
    - Aims to reduce the increasing number of kitchen-related accidents caused by LPG leaks. The system alerts residents via alarms, SMS, and phone calls.
5. **Portable Gas Detector:**

- Compact and lightweight, the device is easy to transport and deploy in various locations, such as:
    - Construction sites
    - Temporary storage units
    - Outdoor environments where gases are used or stored

6. **Industrial Combustible Gas Detection:**
    - Provides safety in industries like:
        - Chemical manufacturing: Ensures processes involving volatile chemicals are monitored for leaks.
        - Petrochemical refineries: Detects gas leaks in high-risk areas.
        - Automotive: Monitors compressed natural gas (CNG) systems in vehicles.

8.2 ADVANTAGES AND LIMITATIONS

Main advantages of our project are:

1. High Sensitivity and Accuracy:

The system uses advanced gas sensors like the **MQ2** for precise detection of even small gas leaks, ensuring no harmful gas presence goes unnoticed. This high sensitivity is crucial for early detection in both domestic and industrial settings. Helps prevent life-threatening accidents caused by gas leaks, including explosions, fire outbreaks, and suffocation hazards. It significantly reduces material loss and human injuries

2. Rapid Response Mechanism

Equipped with real-time alert systems such as:

- Audible alarms (buzzers) for on-site alerts.
- **Email notifications** to notify the owner, even when they are off-site.

3. Improved Safety and Risk Mitigation

Helps prevent life-threatening accidents caused by gas leaks, including explosions, fire outbreaks, and suffocation hazards. It significantly reduces material loss and human injuries.

4. Lightweight and Portable

The system is compact and portable, allowing flexible use in various locations, such as homes, workplaces, hotels, and vehicles.

5. Cost-Effective Solution

Designed with affordability in mind, it provides advanced safety features at a low cost, making it accessible for both individual households and large-scale industries.

6. Ease of Use and Installation

The system is easy to install and operate, requiring minimal technical expertise. It can integrate with existing infrastructure, like smart home systems, to enhance automation

Limitations:

The limitations of LPG gas leakage detection using ESP32 are::

- **Limited Detection Range** The gas sensor, such as the MQ2, has a specific sensitivity range and may fail to detect leaks in larger or open areas where the gas may dissipate quickly before reaching the sensor.
- **False Positives:** The system may generate false alarms due to:
    - Detection of non-hazardous gases or fumes similar to the targeted gases (e.g., cooking odors or smoke).
    - Environmental factors like high humidity, dust, or temperature fluctuations, which can affect sensor accuracy.
- **Dependency on Power Supply:** The system relies on an uninterrupted power source to function. In case of power outages, the gas detector and its alert mechanisms may fail unless equipped with a backup power supply (e.g., battery or UPS).
- **Maintenance Requirements:**Sensors require regular calibration and maintenance to maintain accuracy. Over time, the sensor's sensitivity may degrade, leading to reduced performance or false readings
- **Space Requirements:** Solar trackers often require more space for movement and to avoid shading, making them less suitable for areas with limited land.
- **Lack of Advanced Data Integration:** The current system may not integrate well with advanced analytics or cloud-based systems for real-time monitoring and trend analysis, which are critical for industrial applications.
- **Initial Installation and Costs:** While cost-effective in the long run, the initial installation, including purchasing multiple sensors and integrating them into existing infrastructure, may be expensive for larger setups.

8.3 CONCLUSION AND FUTURE SCOPE

The LPG gas leakage detection system using the ESP32 microcontroller represents a significant advancement in safety technology for both residential and industrial environments. It addresses the growing need for effective gas leak detection and prevention, which is crucial given the potential hazards posed by LPG, such as fires, explosions, and poisoning. The system utilizes a highly sensitive MQ-series sensor that detects LPG concentrations in the air. This data is processed by the ESP32 microcontroller, which triggers real-time email notifications when gas levels exceed a predefined threshold, alerting users immediately and allowing for prompt intervention. This email notification system provides a key advantage, as it enables remote monitoring of gas levels, reducing the need for physical presence and enhancing safety.

In conclusion, this research highlights the potential of a safety systems to improve public safety and reduce the risks associated with LPG usage. By leveraging affordable, accessible technology, this system offers a practical solution to a widespread problem. The system's ability to detect gas leaks early and provide real-time alerts is a vital step toward creating safer living and working environments. As technology advances, further improvements and integrations will likely expand the system's capabilities, offering even greater safety and convenience for users across different industries

Future scope:

The future of LPG gas leakage detection using ESP 32 holds exciting possibilities for enhancing safety and promoting well-being. Here are some key areas of exploration:

1. **Multi-Gas Detection:**The system currently focuses on LPG detection. However, integrating additional sensors for other hazardous gases such as carbon monoxide (CO), methane (CH4), and hydrogen sulfide (H2S) could provide more comprehensive safety coverage, especially in industrial environments where multiple gases may be present. This would enhance the system's ability to detect a wider range of risks
2. **Improved Sensor Technology:** The performance of the gas sensors could be enhanced with the development of more sensitive and durable sensors that can detect lower concentrations of gases. Future sensor technology may offer higher accuracy, faster response times, and better resistance to environmental factors such as humidity, dust, or temperature fluctuations.
3. **Energy-Efficient and Solar-Powered Options:** For remote or off-grid locations, the system could be upgraded with **solar-powered solutions** or energy-efficient sensors, reducing dependence on the electrical grid. This would make the system suitable for rural areas, outdoor applications, or locations with limited access to power

REFERENCES

1. OM Ghodke, S. Kadam, C. Jhoshi, S. Shitole, and N. V. Pandhare, "LPG gas leakage detection using ESP32," International Scientific Journal of Engineering and Management, vol. 3, no. 4, pp. 1–3, Apr. 2024, doi: 10.55041/ISJEM01434
2. S. Lakshmi Lavanya, M. D. V. Prasad, A. Sravya, C. D. Prasad, A. Seshadri, and R. K. S. Kumar, "Gas Leakage Detector Using Arduino," International Research Journal of Engineering and Technology (IRJET), vol. 10, Special Issue, pp. 350–353, Apr. 2023.
3. M. Abdullah Khan, "Gas Detection Using ESP32 and Fire Alarm," Department of Electrical and Electronic Engineering, United International University, Project Report, Sept. 2023, doi: 10.13140/RG.2.2.18846.31041
4. E. Jebamalar Leavline, D. Asir Antony Gnana Singh, B. Abinaya ,H. Deepika, “LPG Gas Leakage Detection and Alert System”, International Journal of Electronics Engineering Research. ISSN 0975-6450 Volume 9, Number 7 (2017) pp. 1095-1097 © Research India Publications

APPENDIX-A
DATASHEET

DATA SHEET OF ESP32

Category	Items	Specification
Microcontroller	Cores	Xtensa LX6 (dual-core)
	Clock Frequency	80 MHz to 240 MHz
Memory	Flash	32 Mbits SPI flash
Wireless	Wi-Fi	802.11 b/g/n, up to 150 Mbps
	Bluetooth	v4.2 BR/EDR, BLE
Interfaces	UART	Yes
	SPI	Yes
	I2C	Yes
	SD Card	Yes
	Other	Capacitive touch sensor, ADC, DAC, GPIO, and more
Power Supply	Voltage	3.3V
Power Consumption	Sleep Current	< 5 μA
Dimensions	(L x W x H)	18 mm x 25.5 mm x 3.1 m

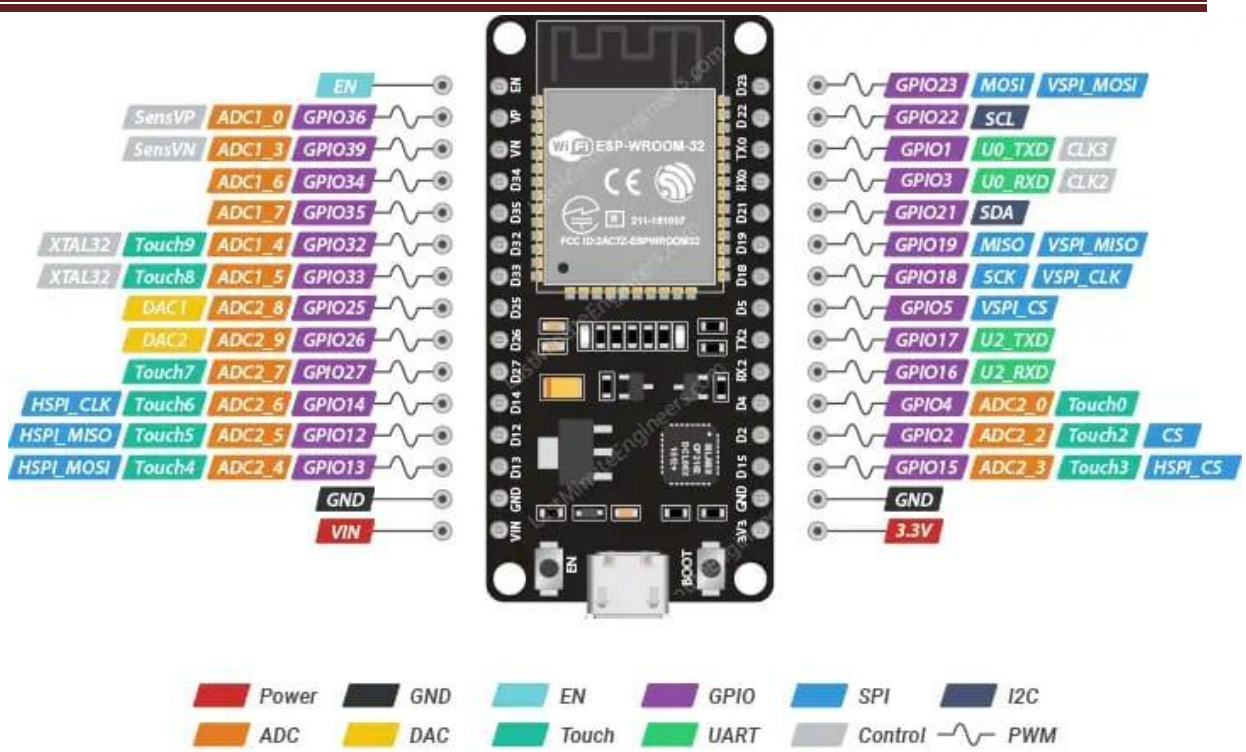

Figure: ESP32 Pin Configuration

DATA SHEET OF SERVO MOTOR SG90

Part/Item	SG90 Servo Motor
Operating Voltage	4.8V to 6.0V
Torque	1.8 kg/cm (4.8V), 2.5 kg/cm (6.0V)
Operating Speed	0.12 sec/60° (4.8V), 0.10 sec/60° (6.0V)
Rotation Angle	0° to 180°
Dimensions	22.2 mm x 11.8 mm x 31 mm
Connector Pins	VCC, GND, PWM Signal

Figure: Servo Motor

DATA SHEET OF MQ-2 GAS SENSOR

Parameter	Specifications
Sensor Type	Semiconductor Gas Sensor
Sensing Material	SnO2 (Tin Dioxide)
Target Gases	LPG, Methane, Butane, Hydrogen, Smoke, Alcohol, Propane, Carbon Monoxide
Output Type	Analog and Digital (via onboard comparator)
Heater Voltage (VH)	5V ± 0.1V
Circuit Voltage (VC)	5V ± 0.1V
Load Resistance (RL)	Adjustable (2kΩ–20kΩ, typical)

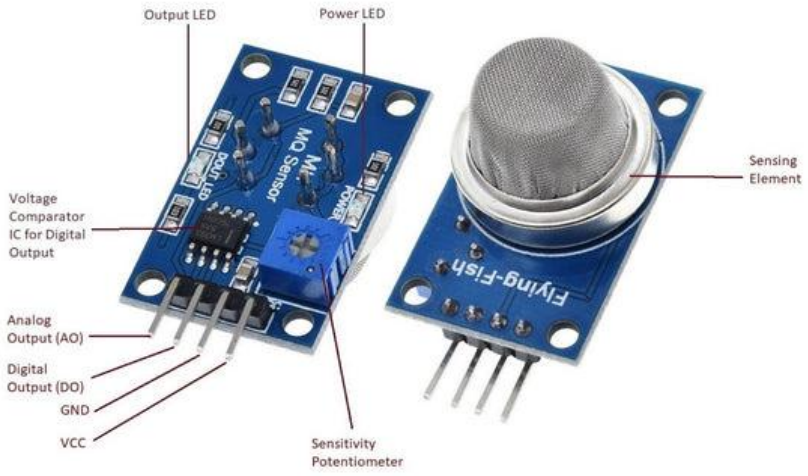

Figure: Pin Configuration of MQ-2 gas sensor

APPENDIX-B
SOURCE CODE

```
#include <WiFi.h>

#include <ESP32Servo.h>

#include <HTTPClient.h>  // HTTP client for making requests


// Pin configuration

const int gasAnalogPin = 34;  // GPIO34 for gas sensor AO

const int relayPin = 4;       // GPIO4 for relay module

const int servoPin = 13;      // GPIO13 for servo motor PWM control

const int buzzerPin = 27;     // GPIO27 for buzzer

const int ledPin = 2;         // GPIO2 for LED


// Wi-Fi credentials

const char* ssid = "IQOO Z7 PRO 5G";

const char* password = "12345678";


// API endpoint URLs

const char* highAlertURL = "https://hooks.zapier.com/hooks/catch/20921963/2i0rprj/"; // Replace with your server's URL

const char* normalAlertURL = "https://hooks.zapier.com/hooks/catch/20921963/2i0rd2y/"; // Replace with your server's URL


// Threshold value
const int thresholdValue = 1000;


// Servo motor object

Servo gasValveServo;
```

```
// State tracking for HTTP notifications
bool gasAlertSent = false;
bool gasNormalSent = false;

void setup() {
  Serial.begin(115200);

  // Initialize pins
  pinMode(relayPin, OUTPUT);
  pinMode(buzzerPin, OUTPUT);
  pinMode(ledPin, OUTPUT);

  digitalWrite(relayPin, LOW);
  digitalWrite(buzzerPin, LOW);
  digitalWrite(ledPin, LOW);

  gasValveServo.attach(servoPin, 500, 2500);
  gasValveServo.write(0); // Start servo in open position (0 degrees)

  connectToWiFi();

}
          void connectToWiFi() {
            Serial.print("Connecting to Wi-Fi...");
            WiFi.begin(ssid, password);
            while (WiFi.status() != WL_CONNECTED) {
              delay(1000);
```

```
    Serial.print(".");
  }
  Serial.println("\nConnected to Wi-Fi");
}

void sendHttpAlert(const char* url, const String& message) {
  if (WiFi.status() == WL_CONNECTED) {
    HTTPClient http;
    http.begin(url);  // Specify the endpoint
    http.addHeader("Content-Type", "application/json"); // Set content type to JSON

    int httpResponseCode = http.POST(message);

    if (httpResponseCode > 0) {
      Serial.print("HTTP Response code: ");
      Serial.println(httpResponseCode);
    } else {
      Serial.print("Error in sending request: ");
      Serial.println(http.errorToString(httpResponseCode).c_str());
    }
    http.end();
  } else {
    Serial.println("Wi-Fi not connected. Cannot send HTTP request.");
  }
}

void loop() {
```

```
  int gasValue = analogRead(gasAnalogPin);


  Serial.print("Gas Sensor Value: ");
  Serial.println(gasValue);


  if (gasValue > thresholdValue) {
    // Gas detected - Take actions
    digitalWrite(relayPin, HIGH);    // Turn on relay
    digitalWrite(buzzerPin, HIGH);  // Activate buzzer
    digitalWrite(ledPin, HIGH);     // Turn on LED
    gasValveServo.write(90);        // Close gas valve


    Serial.println("Gas detected! Fan ON, Buzzer ON, LED ON, Gas valve CLOSED.");


    // Create high gas alert message
    String highGasMessage = "{\"value1\":\"Gas level high! Immediate action
required.\",\"value2\":\"Gas Sensor Reading: " + String(gasValue) + "\"}";
// Send high gas alert only once
    if (!gasAlertSent) {
      sendHttpAlert(highAlertURL, highGasMessage);
      gasAlertSent = true;
      gasNormalSent = false; // Reset normal alert state
    }
  } else {
    // No gas detected - Reset actions
    digitalWrite(relayPin, LOW);    // Turn off relay
    digitalWrite(buzzerPin, LOW);  // Deactivate buzzer
    digitalWrite(ledPin, LOW);     // Turn off LED
```

```
    gasValveServo.write(0);        // Open gas valve


    Serial.println("No gas detected. Fan OFF, Buzzer OFF, LED OFF, Gas valve OPEN.");


    // Create normal gas alert message
    String lowGasMessage = "{\"value1\":\"All conditions are good.\",\"value2\":\"Gas Sensor Reading: " + String(gasValue) + "\"}";


    // Send normal gas alert only once
    if (!gasNormalSent) {
      sendHttpAlert(normalAlertURL, lowGasMessage);
      gasNormalSent = true;
      gasAlertSent = false; // Reset alert state
    }
  }


  delay(1000); // Check every second
}
```

COURSE OUTCOMES (BEC586)

On completion of this course, we are able to,

1) Solve the identified problems.
2) Analyze the available resources and their utilization.
3) Present the work carried out and prepare the report.
4) Work in a team to find the solutions for societal and technical problem.

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