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TECHNICAL ANSWERS FOR REAL WORLD PROBLEMS

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PROJECT REPORT FILE

Under the Guidance of
Dr. SIVABALAN S

INDUSTRIAL GAS LEAK DETECTION ,VENTILATION AND ALERT SYSTEM

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CERTIFICATE

We hereby declare that the report file titled " INDUSTRIAL GAS LEAK DETECTION ,VENTILATION AND ALERT SYSTEM" submitted by our teamfor the course – Technical Answers for Real World Problems to VIT university, Vellore as a record of bonafide work carried out by us under the guidance of Dr. SIVABALAN S. We further declare that the work done for this project work has not been used earlier and shall not be used further for any other courses inthis or any other university.

SIGNATURE

(Dr. SIVABALAN S)

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INTRODUCTION

Gas leakage is a serious problem that seriously threatens the safety, property and even life of building occupants. That is why gas detection, ventilation and alarm systems have become the main safety measures in residential and commercial buildings.

A gas detection system is the first line of defense against a gas leak. It usually consists of gas sensors strategically placed throughout the building to continuously monitor air gas levels. The sensors are designed to detect a variety of gases, including methane, propane, carbon monoxide, and hydrogen sulfide. Gas sensors are calibrated to give accurate gas level readings and trigger an alarm when the gas concentration exceeds a safe limit.

A gas detector system usually includes a microcontroller, gas sensors and a wireless communication module. The microcontroller reads the data from the gas sensor and compares it with preset safety levels. When the gas level exceeds the safe limit, the microcontroller sends a signal to the alarm system to alert the building occupants. The alarm system can be an audio signal or a visual indicator such as an LCD screen. In addition to the gas detection system, the ventilation system is also an important safety measure. The ventilation system is designed to remove dangerous gases from the air and replace them with fresh air, which reduces the concentration of gases in the air to a safe level. The ventilation system consists of fans and ducts that circulate air throughout the building.

The ventilation system is usually integrated with a gas detection system, which ensures that the fans automatically start in the event of a gas leak. The fans are designed to continuously supply fresh air to the building, reducing the gas concentration in the air to a safe level. The ventilation system is controlled by a microcontroller that receives data from the gas sensor and activates the fans when the gas level exceeds the safe limit.

In short, it can be said that gas sensor, ventilation and alarm are important safety measures that can save lives and prevent accidents. The effectiveness of the system depends on the accuracy of the gas sensors, the reliability of the ventilation system and the response speed of the alarm system. Therefore, it is very important to design and implement a comprehensive gas detection, ventilation and alarm system that quickly detects a gas leak, warns building occupants and lowers the gas concentration to a safe level.

PROBLEM STATEMENT

Gas leaks are a common safety hazard that pose a serious threat to residential and commercial buildings. Current gas detection, ventilation and alarm systems often suffer from reliability issues, false alarms and slow response times, leading to potential safety risks. Therefore, there is a need for an accurate, reliable and fast gas detection, ventilation and alarm system that can ensure the safety of building occupants.

The technical challenge in designing such a system is the integration of gas detection sensors, ventilation system and signaling. Gas sensors must be calibrated to give accurate readings and avoid false alarms. The ventilation system must be designed to work reliably and with fans that bring a continuous flow of fresh air into the building. The alarm system must be fast and sensitive, providing passengers with a quick warning of a gas leak.

In addition, the design must consider the structural constraints of the building, such as layout, size, and air flow patterns. The system must be designed to accommodate these limitations and ensure that gas sensors are strategically placed throughout the building to provide accurate readings.

The project must also consider the power requirements and energy efficiency of the system. The gas detection, ventilation and alarm system must be designed to operate at the lowest possible power, ensuring system reliability and responsiveness.

In short, the technical problem of a gas detection, ventilation and alarm system project is to design an accurate, reliable and fast system that can quickly detect a gas leak, warn building occupants and reduce the gas concentration to a level. safe level. The project must address the integration of gas detection sensors, ventilation system and alarm system, building design constraints, power requirements and energy efficiency.

LITERATURE SURVEY

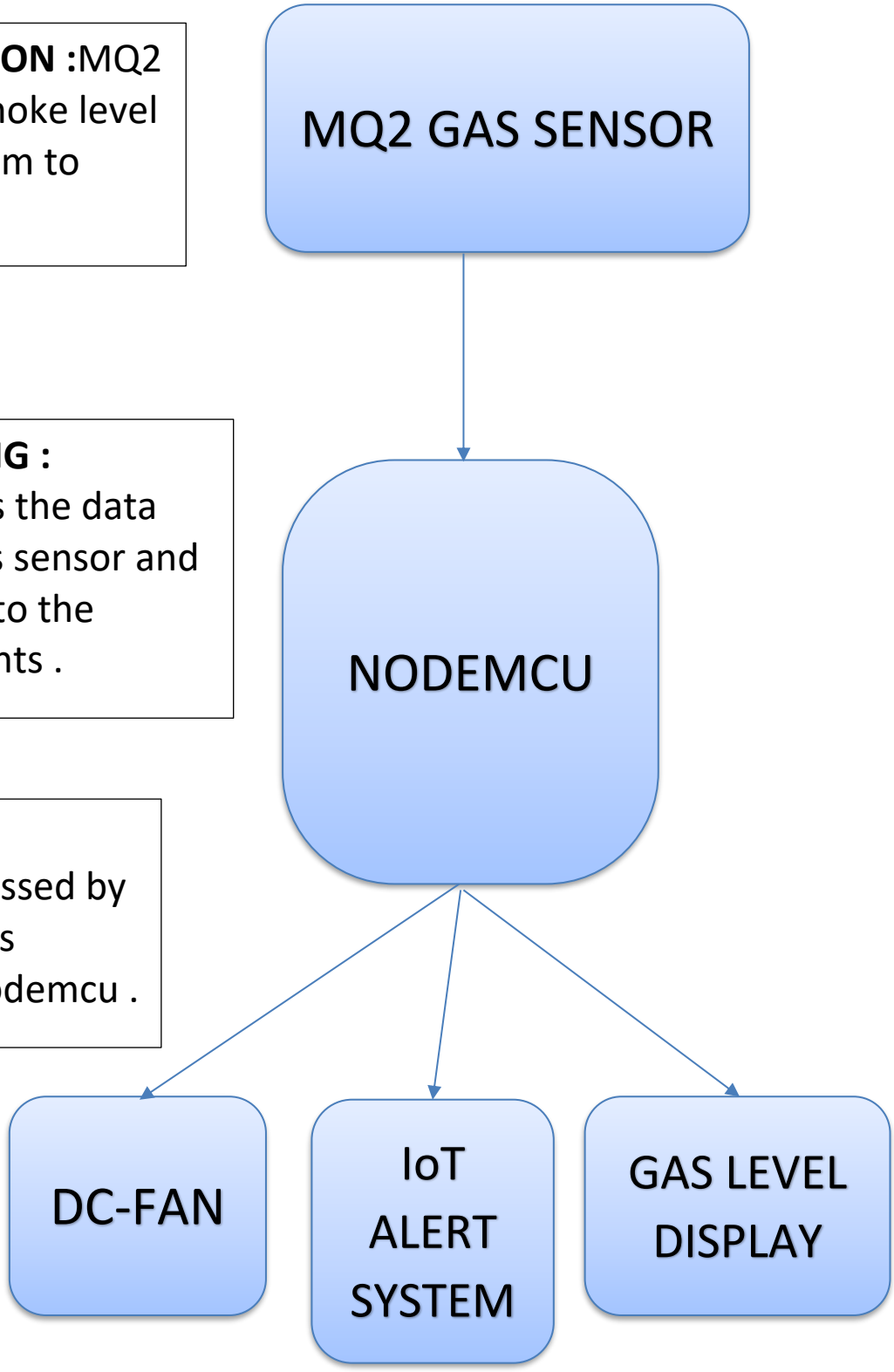
Gas detection, ventilation, and alert systems are critical safety measures designed to prevent gas leakage accidents in residential and commercial buildings. In recent years, numerous research studies have been conducted to improve the accuracy, reliability, and responsiveness of these systems. The use of Internet of Things (IoT) technology has revolutionized the field of gas detection, ventilation, and alert systems. IoT-enabled systems can provide real-time data on gas levels, occupancy, and energy consumption, enabling better control and management of the systems. During the research and analysis part we have gone through several research works. In [1] they have designed and develop a system in which alert will be sent through audio-visual warning signals. Simulation results and analog design for a complete system based on electronic discrete component is developed by [2]. In accordance to address this problem researchers of [3] have worked on measuring kitchen gas using a gas sensor and also propsed some automatic shutoff system. Gsm module has been used by researchers of [4] for monitoring and gas leak detection system. In [5] Lpg gas detection was kept in focus and microcontroller will recieve signal after detection. ATMega8 controller was used along with Lcd display and buzzer will sound in case of leakage detection. A wireless distributed gas leak algorithm is designed with high accuracy and also conserving energy in hand as sensors are duty cycled in time in [7]. In [8] Contam simulation was used for effectiveness of propsed system. Arduino and zigbee is kept in picture and auto-ventillate system is introduced in [9].Also the system is designed in Lab view GUI. In conclusion, the literature survey highlights the significant advancements made in the design of gas detection, ventilation, and alert systems. These systems are critical safety measures for preventing gas leakage accidents in residential and commercial buildings along with industries.

BLOCK DIAGRAM

DATA COLLLECTION :MQ2 reads gas and smoke level and converts them to analog values .

DATA PROCESSING :
Nodemcu process the data received from gas sensor and gives commands to the further components .

OUTPUT :
Output are processed by the component as received from Nodemcu .



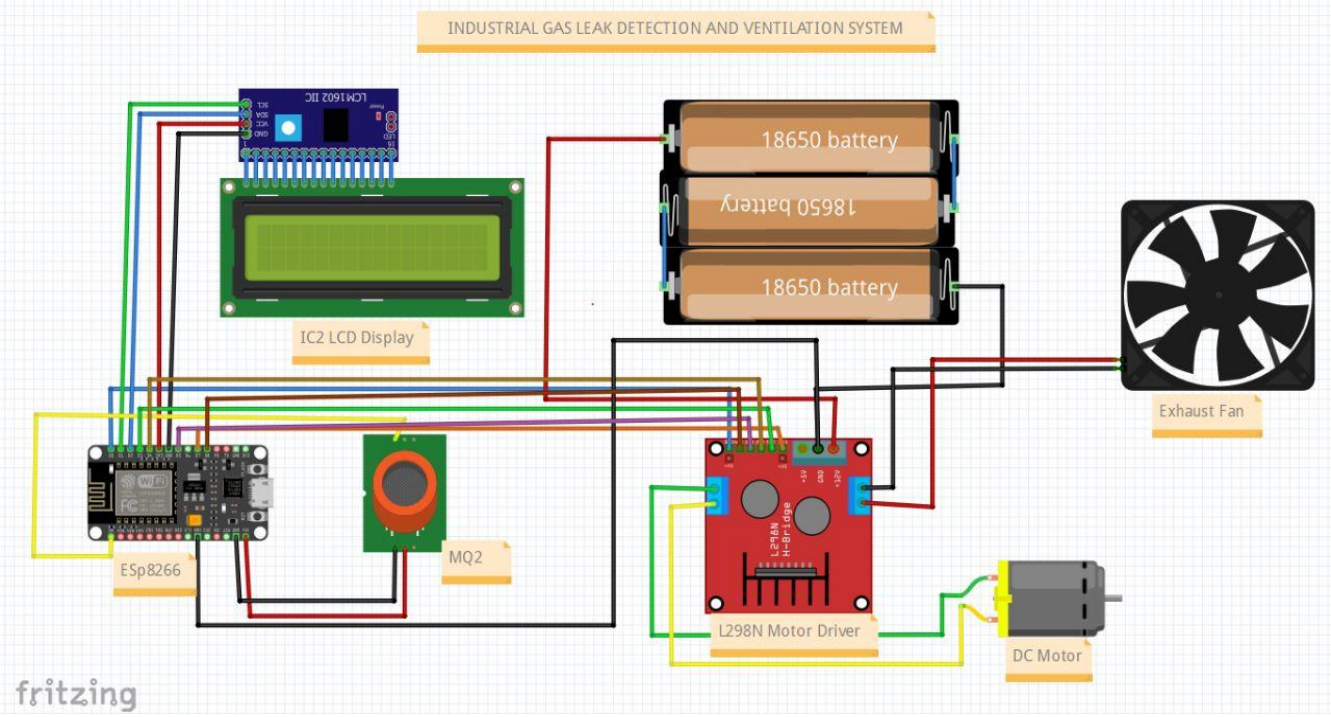
COMPONENTS USED : HARDWARE

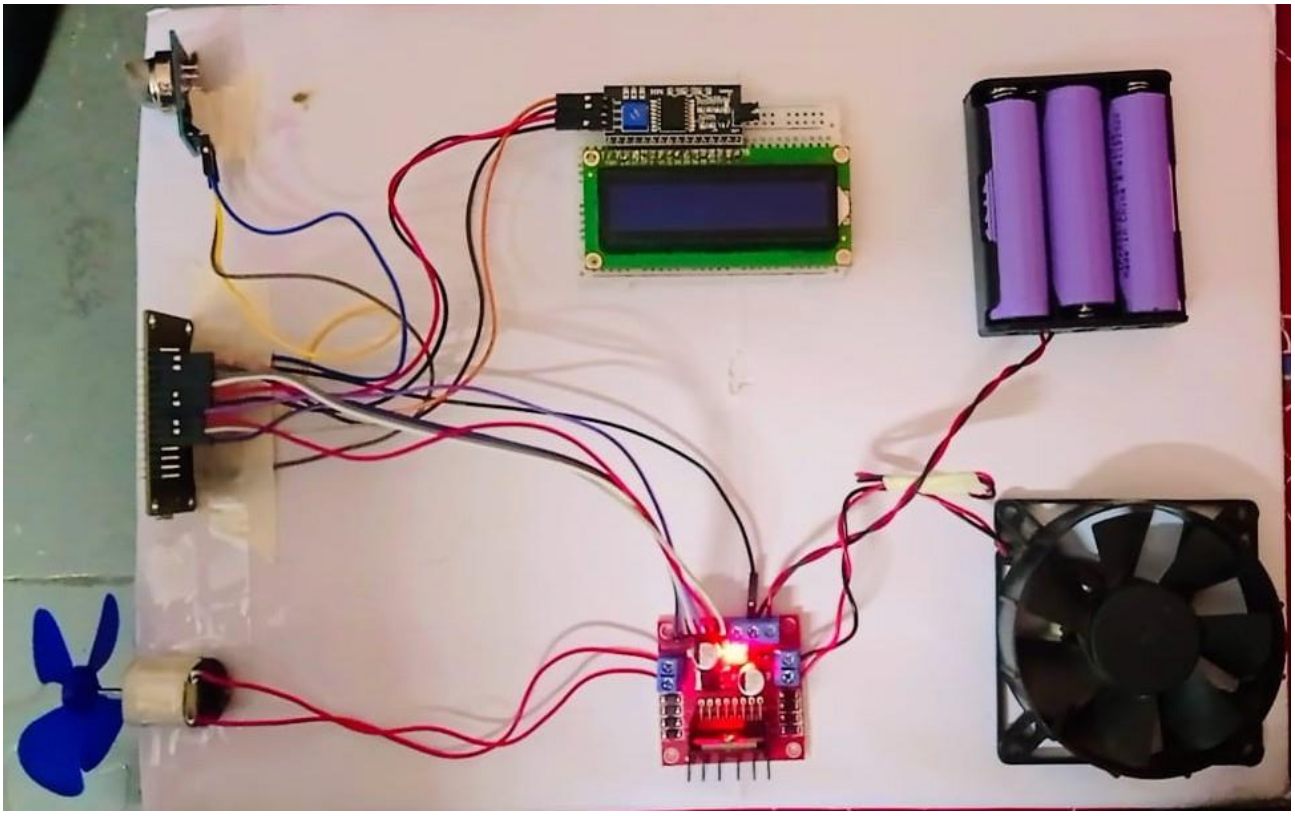
COMPONENTS	QUANTITY
NODEMCU	1
MQ2 GAS SENSOR	1
L298 MOTOR DRIVER	1
12V DC EXHAUST FAN	1
LCD	1
BATTERY	3
JUMPER WIRE	

SOFTWARE USED :

- THINGSPEAK – LIVE MONITORING
- IFTTTT - FOR SMS ALERT
- ARDUINO IDE

CIRCUIT DIAGRAM





COMPONENTS

NODEMCU : The "ESP8266 Core for the Arduino IDE" was created by some ESP8266 enthusiasts as an Arduino core for the ESP8266 Wi-Fi SoC. For ESP8266-based modules and development boards, such as Node MCU, this has emerged as a top platform for software development. It is the brain of the project which taken input calculate and based on input provided, it take decision and give command to other part of the system .

MQ2 GAS SENSOR: The MQ2 sensor operates on the principle of the change in electrical conductivity of the sensing material when it comes in contact with the target gas. It consists of a sensing element made up of a tin dioxide (SnO2) semiconductor material, which is heated to a high temperature using an internal heater. It is a widely used sensor in the field of gas detection and air quality monitoring. Here, the sensor is tested with smoke and body spray (alcohol 95% v/v).

MOTOR DRIVER (L298): The L298 motor driver is a well-known and versatile integrated circuit that is used to control the movement of DC and stepper motors. It is a dual H-bridge driver capable of controlling two motors independently or combining them to control larger motors. It is controlled by a microcontroller or other digital circuits and has several input modes, including PWM, direction, and brake.

BATTERY: Lithium-ion batteries are 3.7-volt batteries that operate through a chemical reaction between a positive electrode (positively charged) and a negative electrode (usually made of lithium cobalt oxide). Over time, the battery can also experience aging, which is a gradual loss of capacity and increased internal resistance.

12V DC EXHAUST FAN: This is a miniature-size exhaust cooling fan. Its working voltage is 12V DC. It can work with a simple 12V battery without any difficulty. Lightweight and Durability are one of its key feature to introduce in this project.

LCD : A flat-panel display or other electrically modulated optical device that makes use of polarizers and the light-modulating capabilities of liquid crystals is known as a liquid-crystal display (LCD).In calculators, microwaves, and many other electronic products, data is frequently displayed on liquid crystal displays (LCDs).

WORKING

Industrial Gas Leak Detector works by monitoring different gas levels in the environment. This Project is battery-operated and safe. When the density level of smoke or harmful is higher than normal levels, the circuit alerts everyone in the industry and also implements counter measures against the leak .

In this project , MQ2 gas sensor is used to detect the gas and smoke , it is a semiconductor based gas sensor . It is used in various industries for the purpose of gas detection , it can detect the gas gas concentration from 300-10000ppm . MQ2 gas sensor is chosen for the project due to its low cost and easy availability .

Nodemcu is here the main controller of the project , it receive the analog value from the gas sensor based on which it decide the future action of the project which include the controlling ventilation and alert system .

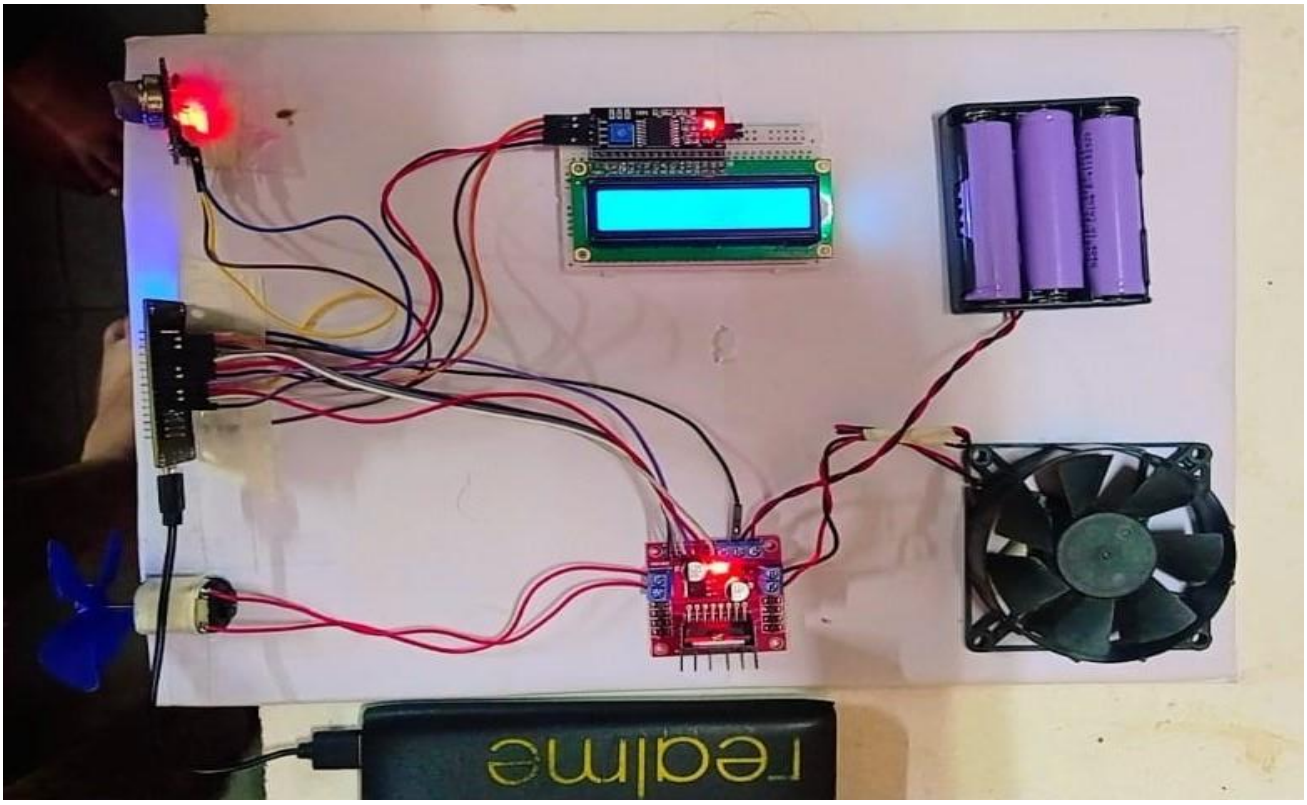
Firstly , the gas level is detected using sensor and displayed on LCD , also ThingSpeak is used to monitor the live gas level and plotted on the platform , along with gas level is constantly checked with already given threshold , if gas level is greater than threshold alert and ventilation system is activated which is explained in next phase of report .

Ventilation system : It is activated when gas level is above the threshold value. It consist L298 motor driver which is powered using 3.7 V*3 batteries to control 12V DC exhaust fan and a small dc fan . as soon as gas level crosses the threshold the ventilation system i.e the small dc fan starts and as the level crosses a certain value both the small dc fan and 12V DC exhaust fan starts . This step is key feature as it saves power by automatic operation based on gas level .

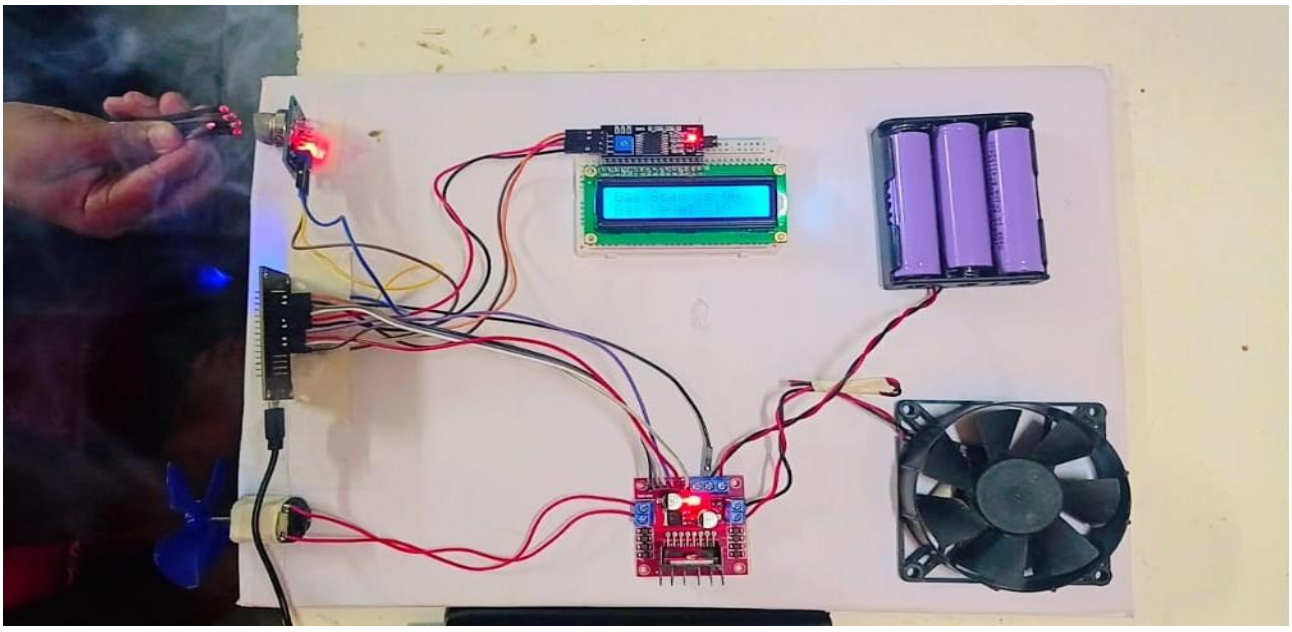
Alert System : This system is activated by nodemcu when gas level is above the threshold given in the system . It includes IoT based triggering system , as gas level crosses the threshold , webhook in IFTTT i.e IoT platform is triggered which further trigger the SMS part i.e SMS will be received to the number provide in IFTTT server . As it is IoT based server so the adaption of future and coming latest technology which make this system adaptable and easy update can be made in the system to improve performance and efficiency .

All the time , gas level is continuously monitored and presented on LCD screen along with the plot from ThingSpeak which give a better understanding of the gas level and sudden changes in the level can be detected easily .

WORKING MODEL AND SIMULATION



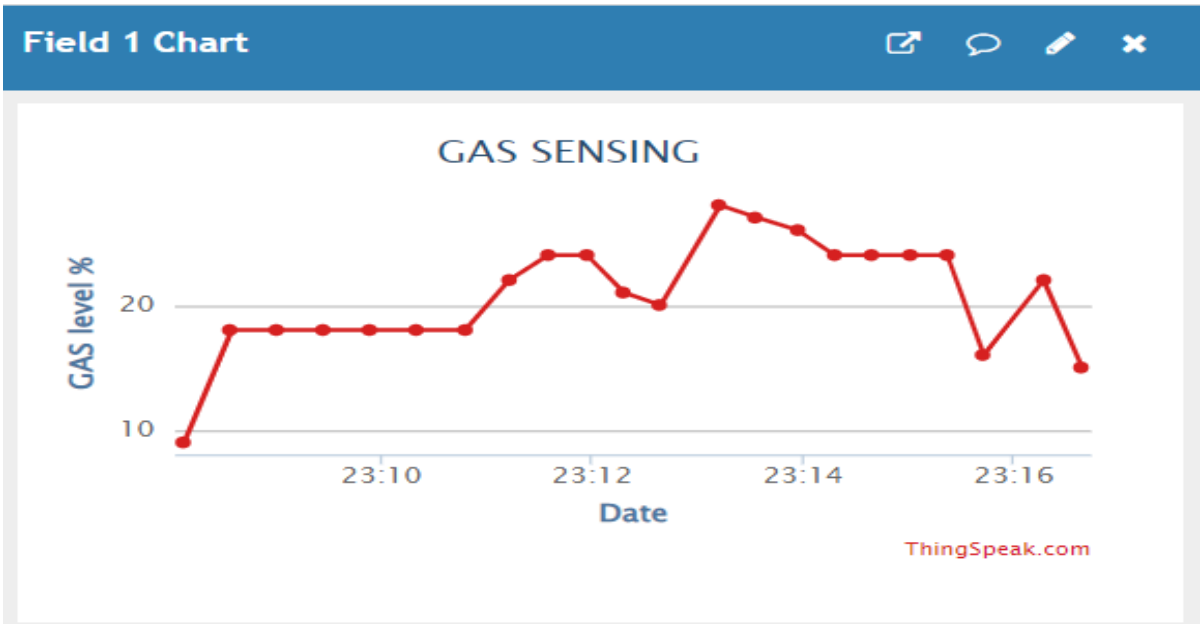
CIRCUIT (ON MODE)



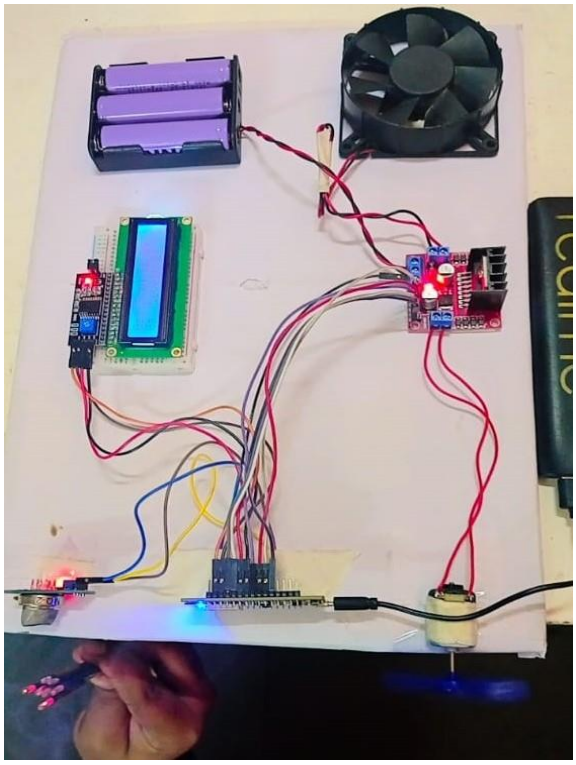
CIRCUIT (SMOKE TEST)

RESULTS

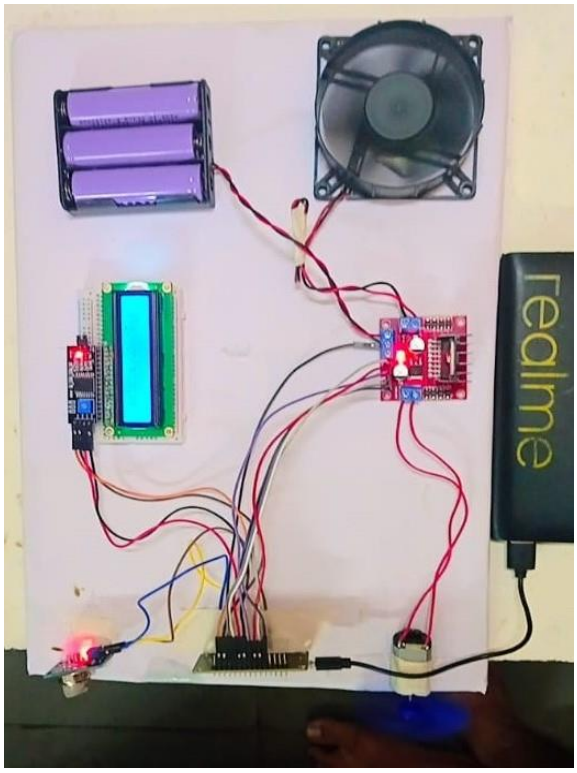
1. The gas data value is uploaded to the cloud to ThingSpeak .



2. Ventilation system is activated when smoke is detected.

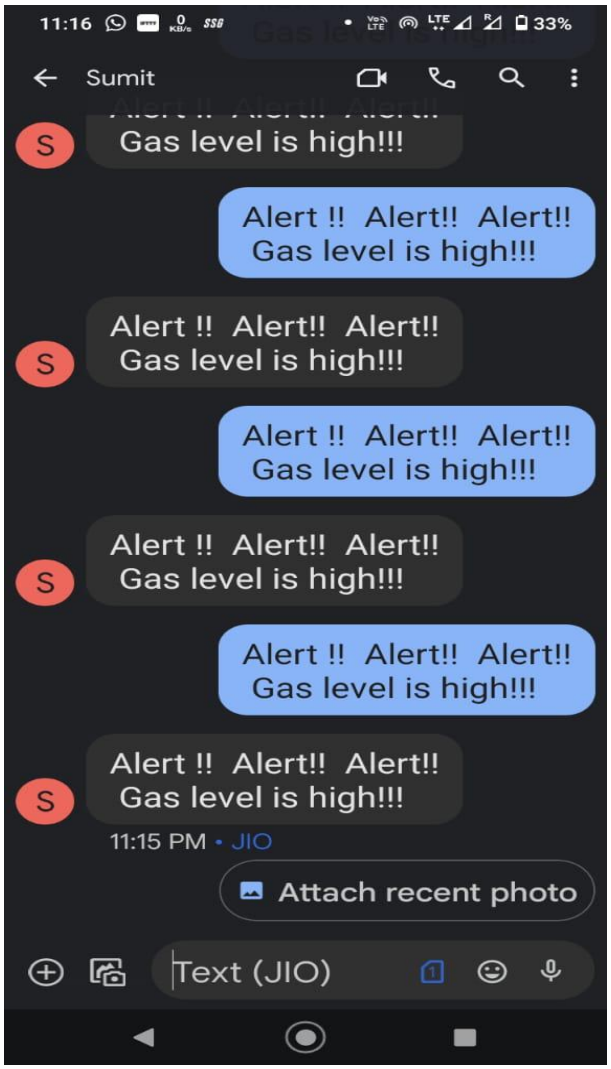


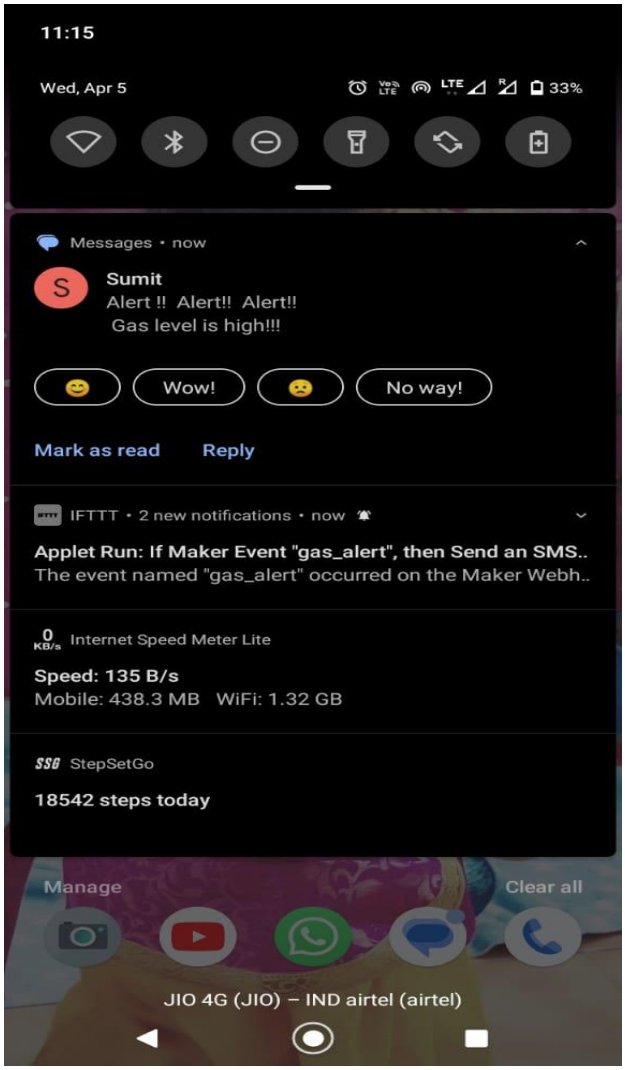
MOTOR ON (20<GAS<35)



EXHAUST FAN ON(GAS > 35)

3. Alert System is activated and SMS is received .





SCOPE AND FUTURE SCOPE OF THE PROJECT

Application and viability of the Industrial Gas Leak Detector Project are almost without bounds. This project's applicability in various industries is due to its capacity to identify not just one but several gases, including ammonia, benzene, sulfur, carbon dioxide, alcohol, and general smoke.

This project seems like the ideal way to accurately detect and immediately implement life-saving safety measures in areas with a high likelihood of gas leaks, including but not limited to Household and Various industries.
Many industries, including the petrochemical, pesticide, and air conditioning industries, use a significant quantity of hazardous gas mixtures that, if left unchecked, can harm the environment, the economy, and the population.

Our project can precisely identify an unwelcome gas's existence or fire smoke in the environment and its concentration levels. When those concentration levels in a gas leak reach an unfavourable level, not only are the people notified but safety measures are also started, which reduces the likelihood of human casualties. Additionally, because the populace is almost instantly informed, action can be taken right away to stop the gas leak.

A display displaying the current gas levels in the region ensures that people don't approach a space that is unsafe for them to be present in during a household or industrial gas leak. Both an alerting message and the activation of the exhaust system also make the leak situation highly controllable.

The general household can adopt this project to ensure safety from potential LPG gas leaks in general kitchens.
Additionally, the project's application in sectors where MQ-2 gas sensors can detect ammonia, benzene, sulfur, carbon dioxide, and general smoke guarantees protection against harm to human life and the economy.

CONCLUSION

A better grasp of hazardous gas levels and high air quality are becoming more and more in demand. Industries must accurately pinpoint every factor that contributes to minor or significant gas leaks in order to increase the safety of the output and the people who work there.

In order to preserve biodiversity, maintain economic stability, and address health issues, gas leak detection is essential. Contrary to common belief, gas leaks can cause explosions if they are not discovered in time. To take further action, such as closing gas valves and halting any processes that might increase the quantity of the hazardous gases in the environment, it is essential to find gas leaks.

As soon as the sensor notices a significant leak, the owner or manager of the facility where the gas leak is most likely to happen must be informed. All of the aforementioned details and circumstances were essentially taken into consideration when developing this endeavour. This project's primary component, which serves as the circuit's control unit, is a gas sensor MQ2, which has exceptional sensitivity in a subtle manner. It was programmed using an Arduino microcontroller.

The user was effectively informed via SMS that "GAS LEVEL IS HIGH !!!" Initiate a novel improvement to an existing concept, namely the ventilation system to pump the hazardous gases out of the area, in this project. Exhaust is started" and displays levels of hazard gas concentration in the environment on the LCD/ Serial Monitor.

As soon as a gas leak is discovered, the ventilation system kicks in, and the Arduino sends every signal it can muster to the motor driver. The motor driver then activates the exhaust system, which uses a DC motor and propellers to push the gas out and reduce the hazardous gas concentration. In order to decrease compound fatalities, the exhaust system of the DC motor is crucial.

When used in a facility, our detector and ventilation system can track any gas leaks, including LPG leaks and other gas leaks (detected by the MQ-2 sensor), and send an SMS alert to the compound owner. The demand for this system is gradually rising in businesses or facilities where gases are produced during the production of goods. At locations where our detector and ventilation system can function, there is a danger of potential gas leaks.

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