



DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY

PROJECT REPORT

Project Name: GAS LEAKAGE MONITORING AND ALERTING SYSTEM

Team ID: PNT2022TMID26860

Team:-

Team lead-SOPHIA GRACE R (310519106075)

Team member-1 ABINAYA.S (310519106001)

Team member-2 DHANUSHYA.D (310519106019)

Team member-3 VASANTHLS (310519106087)

PROJECT REPORT

Gas Leakage Monitoring and Alerting System



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Abstract :

Leakage of any kind of gas has been a concern in recent years, whether it is in a residential setting, a business, a cafe, or a canteen. In this paper development of an IOT based gas wastage monitoring, leakage detecting and alerting system is proposed. This paper elaborates design such an intelligent system that will help save gas and smartly prevent accidents. The system needs to be integrated with the cooker. The technology includes ultrasonic sensors that determine if the cooker is being utilized for cooking purposes or not. If it is discovered that the cooker is not in use, the system uses an automatic switching off mechanism to cutoff the gas supply. The moment gas leakage will probably be recognized, users will be informed via SMS through GSM, and so that user can solve the issue as soon as possible. The system will monitor flame and fire through flame sensor. When a fire is detected, the buzzer begins to sound. Aside from that, the system also has a cloud storage capability. The usage of gas for each user each day may be tracked with the aid of this cloud storage solution. At the end of the day, this procedure will assist in detecting per- user natural gas usage. The system has been tested and it is able to monitor gas wastage, leakage and send a SMS to the user. The resulting performance indicated its effectiveness toward saving a significant portion of the wasted gas in domestic.

Introduction :

Now a days the home safety detection system plays the important role for the security of people. Since all the people from the home goes to work on daily bases, it makes impossible to check on the appliances available at home specially LPG gas cylinder, wired circuits, Etc. Since last three years there is a tremendous hike in the demands of liquefied petroleum gas (LPG) and natural gas. To meet this access amount of demand for energy and replace oil or coal due to their environmental disadvantage, LPG and natural gas are preferred. These gases are mostly used on large scale in industry, heating, home appliances and motor fuel. So as to track this leakage gas, the system includes MQ6 gas sensor. This sensor senses the amount of leak gas present in the surrounding atmosphere. Through this, explosion or getting affected by the leakage of gas could be avoided.

Objective :

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed. This is an affordable, less power using, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere, but also wastage of gases will hurt our economy. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

Problem Formulation:

Gas leakage is nothing but the leak of any gaseous molecule from a stove, or a pipeline, or cylinder etc. This can occur either purposefully or even unintendedly. As we are aware that these kinds of leaks are dangerous to our health, and when it becomes explosive it could cause great danger to the people, home, workplace, industry and the environment.

Few of the major incidents that took place due to gas leakage include the Bhopal Disaster and the Vizag Gas leak. The Bhopal disaster is known to be the worst industrial accident ever. Approximately 45 tons of Methyl Isocyanate was leaked from this insecticide plant. Methyl Isocyanate is an organic compound and a chemical that could come from the carbamate pesticides. This colorless, poisonous and flammable liquid is something that human beings have to be away from.

Vizag Gas leak was a resultant of the escape of styrene that were unattended for a long period. This colorless oily liquid can spread in fumes. So, a detector must be made in such a way that could detect any kind of gas, fume, leak, smoke etc. However harmful and dangerous it can be, the detector could be attached with certain parameters that could help to prevent the issue.

List of Components :

S.No.	Name of the Component	Quantity
1.	Arduino UNO R3	1
2.	Breadboard	1
3.	LED	2
4.	Resistor	5
5.	Piezo	1
6.	Gas Sensor	1
7.	LCD 16*2	1

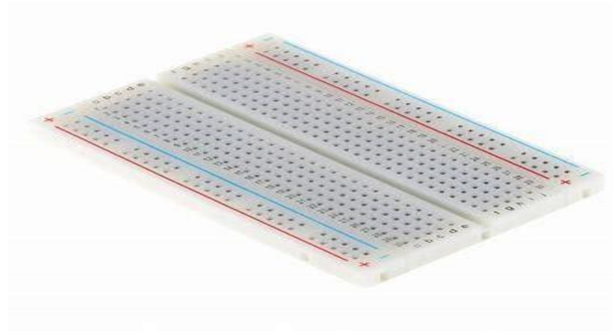
Arduino UNO R3 :



Arduino Uno R3 is one kind of ATmega328P based microcontroller board. It includes the whole thing required to hold up the microcontroller; just attach it to a PC with the help of a USB cable, and give the supply using AC-DC adapter or a battery to get started. The term Uno means “one” in the language of “Italian” and was selected for marking the release of Arduino’s IDE 1.0 software. The R3 Arduino Uno is the 3rd as well as most recent modification of the Arduino Uno. Arduino board and IDE software are the

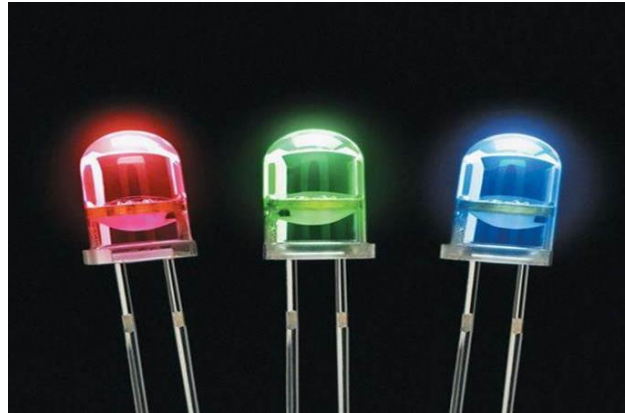
reference versions of Arduino and currently progressed to new releases. The Uno-board is the primary in a sequence of USB-Arduino Board, & the reference model designed for the Arduino platform.

Breadboard :



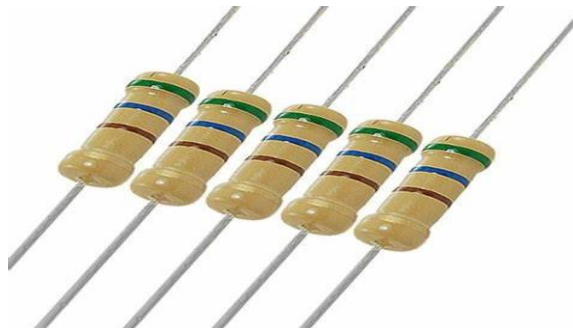
A breadboard is a widely used tool to design and test circuit. You do not need to solder wires and components to make a circuit while using a bread board. It is easier to mount components & reuse them. Since, components are not soldered you can change your circuit design at any point without any hassle. It consist of an array of conductive metal clips encased in a box made of white ABS plastic, where each clip is insulated with another clips. There are a number of holes on the plastic box, arranged in a particular fashion. A typical bread board layout consists of two types of region also called strips. Bus strips and socket strips. Bus strips are usually used to provide power supply to the circuit. It consists of two columns, one for power voltage and other for ground. Socket strips are used to hold most of the components in a circuit. Generally it consists of two sections each with 5 rows and 64 columns. Every column is electrically connected from inside.

LED :



LED (Light Emitting Diode) is an optoelectronic device which works on the principle of electro-luminescence. Electro-luminescence is the property of the material to convert electrical energy into light energy and later it radiates this light energy. In the same way, the semiconductor in LED emits light under the influence of electric field. The symbol of LED is formed by merging the symbol of P-N Junction diode and outward arrows. These outward arrows symbolise the light radiated by the light emitting diode.

Resistor :



A passive electrical component with two terminals that are used for either limiting or regulating the flow of electric current in electrical circuits.

Piezo :



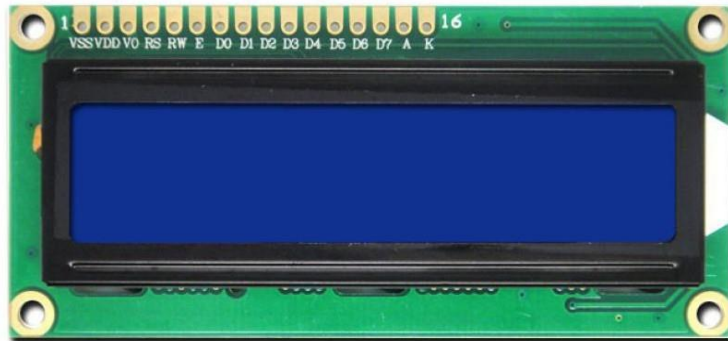
A piezo is a device that generates a voltage when force is applied or becomes deformed when voltage is supplied.

Gas Sensor :



A gas sensor is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated.

LCD 16*2 :



16×2 LCD is one kind of electronic device used to display the message and data. The term LCD full form is Liquid Crystal Display. The display is named 16×2 LCD because it has 16 Columns and 2 Rows. it can be displayed (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots. These displays are mainly based on multi-segment light-emitting diodes. There are a lot of combinations of display available in the market like 8×1, 8×2, 10×2, 16×1, etc. but the 16×2 LCD is widely used. These LCD modules are low cost, and programmer-friendly, therefore, is used in various DIY circuits, devices, and embedded projects

Project Design & Planning :

● Ideation Phase :

● literature survey :

A system was designed to identify and measure methane gas in the zones of flammable gas stockpile sites. The device measures the air and water quality, including every parameter that can have deviation as the result of gas leakage in the water or air. The sensors measure the amount of CH₄ and CO₂ gas in the air while the temperature, pH, and electrical conductivity of the water are monitored. The device is controlled by an Arduino UNO microcontroller that transmits measured data to the database on Raspberry Pi 3.

Different advancements in pipeline leakage detection were put forward. This includes acoustic emission, optic fiber sensor, ground penetrating radar, Vapour sampling and infrared thermography. A system with sensors are connected to arduino for data collection and it uses LabVIEW as the GUI (graphical user interface).

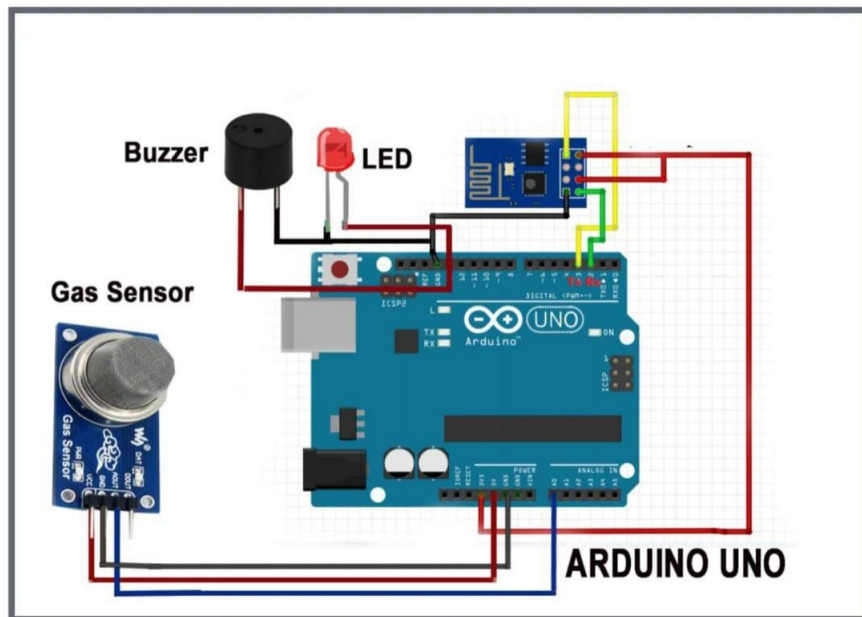
A detailed sensor list for flammable toxic and combustible gases and their possible advantages and disadvantages has been compared. One such example is the SB-95 sensor, which detects sequentially the variation on the methane and carbon monoxide gas concentration and modifies its resistance accordingly. The variation in the filament resistivity is transmitted as a voltage variation on the load resistor. At the same time, metal oxide sensors have a long response time and even longer recovery time. These sensors need to extract the gas by making a hole into the pipe for the gas concentration measurement. Making holes can cause danger such as leakage or explosion of the toxic gas.

On the other hand, ultrasonic sensors are free from the above disadvantages for the measurement of gas concentration with fast response time and the device is compact and inexpensive too.

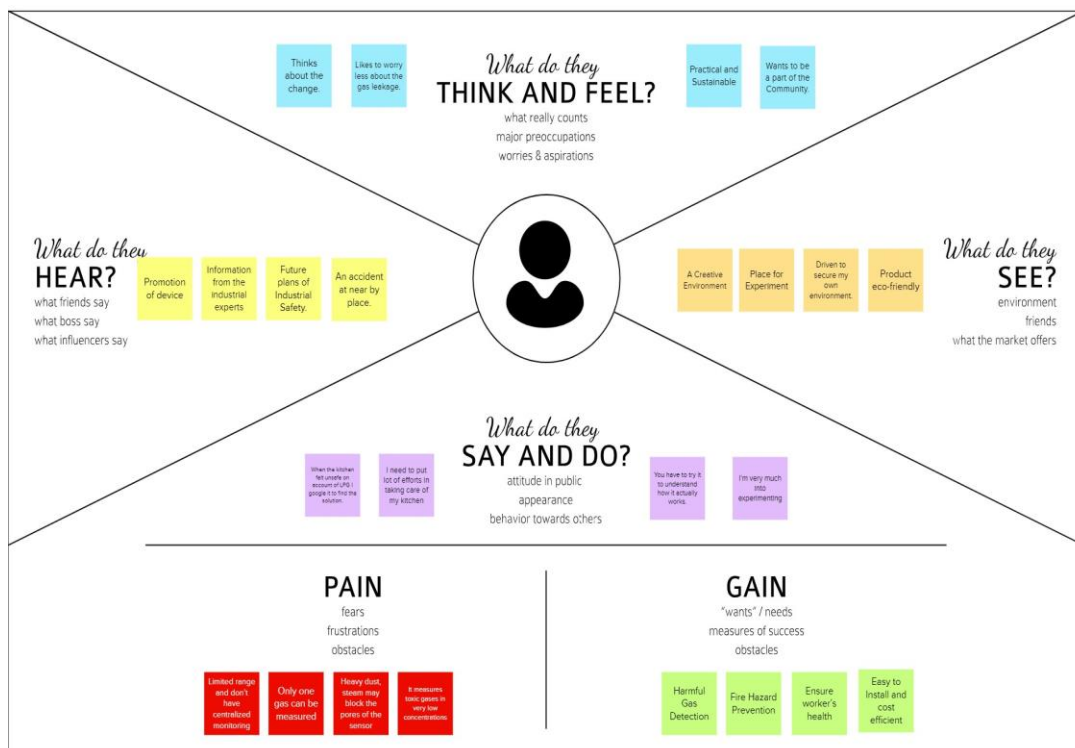
A detailed study of health issues related to gases like hydrogen sulphide, Carbon monoxide and methane has been done. Activation of optical alarms and buzzers when the sensed values of SB-95 sensor goes above the threshold along with the working of the sensor is explained in detail. Table gives a reference about the sources and flammable limits of Hydrocarbons and Hydrogen Sulphide gas. Even though the sources of leaks of both the types of gases are common, the lower range of flammability of hydrocarbons are less than hydrogen sulphide which makes their leaks vulnerable to explosions. At the same time the toxicity of hydrogen sulphide is seen as 50ppm which can really cause lots of health issues in humans and continuous exposure may even lead to death.

● Ideation :

System consists of gas detector sensors, Arduino board, ESP8266 and Cloud server. One Society authority person can register the all flat member user to our system. Society admin can add the details of per flat user such as user name, mobile number, per user flat sensor details information. Society admin can configure the threshold value of each sensor. System hardware can be deployed on each flat. Sensors can sense the value per time. System can send the values to cloud server. Server can Check that the sensor values was existed the threshold value. If sensor value can cross the limit the server can send the command to hardware for buzzing the alarm. Server also sends the notification message to user



● Empathy Map :



Project Design Phase I :

● Proposed Solution :

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs a way to monitor their gas pipelines continuously and detect early if there is any leakage of gas in their surroundings so that they can work efficiently on major crises rather than worrying about monitoring or leakage of gas, this will indeed reduce the manpower of that industry and create a peaceful environment.
2.	Idea / Solution description	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs a way to monitor their gas pipelines continuously and detect early if there is any leakage of gas in their surroundings so that they can work efficiently on major crises rather than worrying about monitoring or leakage of gas, this will indeed reduce the manpower of that industry and create a peaceful environment.
3.	Novelty / Uniqueness	Even though there are many existing solutions for this problem they failed to satisfy the needs of customer. Some of the solutions are only detecting some particular gases where some others

		<p>failed to alert the main department and other solutions are with some delays.</p> <p>Our solution not only notify the industry person but also notify the fire fighters so that can take control over the situation and our solution will alert the workers even there is a small leak of gases.</p>
4.	Social Impact / Customer Satisfaction	<p>Our solution will be very helpful for the workers and the society which is associated or located nearby the industries. Our solution will prevent great disasters like Bhopal Gas Tragedy so that so many lives can be saved. Through this project the workers mental pressure will be reduced so that they can concentrate on other works or by relaxing them.</p>
5.	Business Model (Revenue Model)	<p>The main target of our solution is Industries so we have planned to visit industries and explain them about the benefits of our products. So that they can aware of the importance of this solution and use it.</p>
6.	Scalability of the Solution	<p>Our solution can be integrated for further future use because the solution we have provided will be lay on the basic or initial stage of any upgraded version.</p>

● Proposed Solution Fit :

Project Title: Gas Leakage monitoring & Alerting system for Industries

Project Design Phase-I - Solution Fit

Define CS, fit into CC	<div>1. CUSTOMER SEGMENT(S)</div> <div>CS</div> <div>Who is your customer?</div> <div>Most of Industry workers who are engaged with gas related productions.</div>	<div>6. CUSTOMER</div> <div>CC</div> <div>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.</div> <div> <div>✓ It measures toxic gases in very low concentrations.</div> <div>✓ It has ability to detect wide range of gases.</div> <div>✓ It is difficult to know failure</div> </div>	<div>5. AVAILABLE SOLUTIONS</div> <div>AS</div> <div>Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital monitoring.</div> <div>Testbenches, Quick connectors (They enable a fast and tight "Connection" also on non-round and cast surfaces), Leak tester are some of the available solutions.</div>	Explore AS, differentiate
	<div>2. JOBS-TO-BE-DONE / PROBLEMS</div> <div>J&P</div> <div>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.</div> <div>Flammable gas leakage may lead to secondary accidents such as fire and explosion, while toxic gas dispersion mainly leads to poisoning casualties lead to death.</div>	<div>9. PROBLEM ROOT CAUSE</div> <div>RC</div> <div>What is the root reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the chance in regulations.</div> <div>Behind this gas leakage problem there could be many reasons like atomic reactions between gas molecules, material's quality... etc. Even though customers have to do this job then only we can get our end products or needful chemical solutions.</div>	<div>7. BEHAVIOUR</div> <div>BE</div> <div>What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits, indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)</div> <div>Have a check of where it has the sense of Harmful gases such as H2S, Methane, and CO.</div> <div>Will also check for temperature sensor that helps to detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts.</div>	
Identify strong TR & EM	<div>3. TRIGGERS</div> <div>TR</div> <div>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</div> <div>Constitution should bring gas leakage indicating system as a mandatory precaution in every factory and industries like fire extinguisher.</div>	<div>10. YOUR SOLUTION</div> <div>SL</div> <div>If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</div> <div>We are planning to fit a sensor nearby the gas plants which will detect if there is any leak of gas. If there is a gas leak then we will send a message to admin department and also alarm will be set on so that the workers can know about the leak and run into a safe place</div>	<div>8. CHANNELS of BEHAVIOUR</div> <div>CH</div> <div>ONLINE: What kind of actions do customers take online? Extract online channels from #7.</div> <div> <div>✓ In online, user can monitor the each sensor and its rates, sensor like temperature, gas, humidity, oxygen level.</div> <div>✓ Also have the statistical report.</div> <div>✓ Precautions can be altered and users take care of the</div> </div> <div>OFFLINE: What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.</div> <div> <div>✓ The have to manually check the leakage of gases when the statistics changes.</div> <div>✓ Handling the critical situation should be taken care of the safety officers.</div> </div>	Extract online & offline CH of BE
	<div>4. EMOTIONS: BEFORE / AFTER</div> <div>EM</div> <div>How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure > confident, in control - use it in your communication strategy & design.</div> <div>While facing the problem people may get fatigue, dizziness, severe headache, loss of concentration, loss of consciousness. Afterwards people feel insecurity because of the health issues it's hard for them to lead a normal life.</div>			

● Solution Architecture :

The system can be taken as a small attempt in connecting the existing primary gas detection methods to a mobile platform integrated with IoT platforms. The gases are sensed in an area of 1m radius of the rover and the sensor output datas are continuously transferred to the localserver. The accuracy of MQ sensors are not upto the mark thus stray gasesare also detected which creates an amount of error in the outputs of the sensors, especially in case of methane. Further the availability and storageof toxic gases like hydrogen sulphide also creates problems for testing theassembled hardware. As the system operates outside the pipeline, the complication of system maintenance and material selection of the system

in case of corrosive gases is reduced. Thus the system at this stage can only be used as a primary indicator of leakage inside a plant.

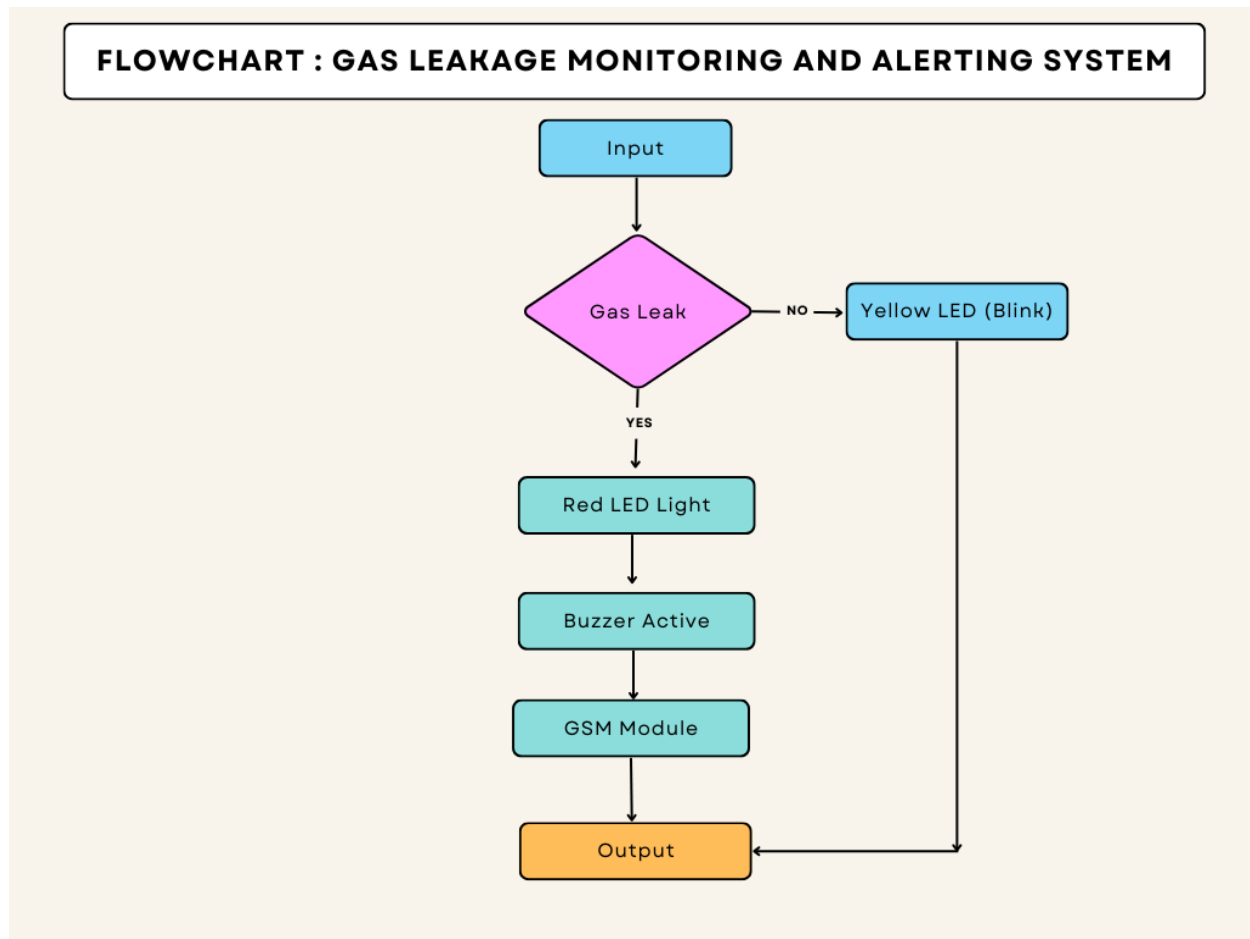
Project Design Phase II :

● Customer Journey Map :

Customer Journey Map

	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5
OBJECTIVES	Write a goal or activity	Gas leakage detection systems protect personnel and the environment from potentially hazardous exposure to gases.	The system comprises of sensors for detecting gas leak interfaced to microcontroller that will give an alert to user whenever there is a gas leakage, display warning information by using Liquid.	Gas Leak Detection System Gas leak detection is the process of identifying potentially hazardous gas leaks by sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected.	An alarm management system represents the series of actions a system performs in an event of gas leakage.
NEEDS	Write a need you want to meet	Fire hazard prevention	Harmful gas detection	Oxygen level measurement	Prompt gas leak alerts
FEELINGS	Write an emotion you expect the customer to have	Happy about this solution	Embrassed on the solution and promoted the good wordes towards this project	Happy	Encouraging, towards this project and giving good feedbacks.
BARRIERS	Write a potential challenge to your objective	Higher Officials	commercial companies	The gasses are toxic in nature, resulting in human unconsciousness and even death if consumed in larger quantities.	Moreover, gaseous blasts are another disaster that everyone - working in a factory or at home - would want to avoid at all costs!

- **Data Flow Diagram :**

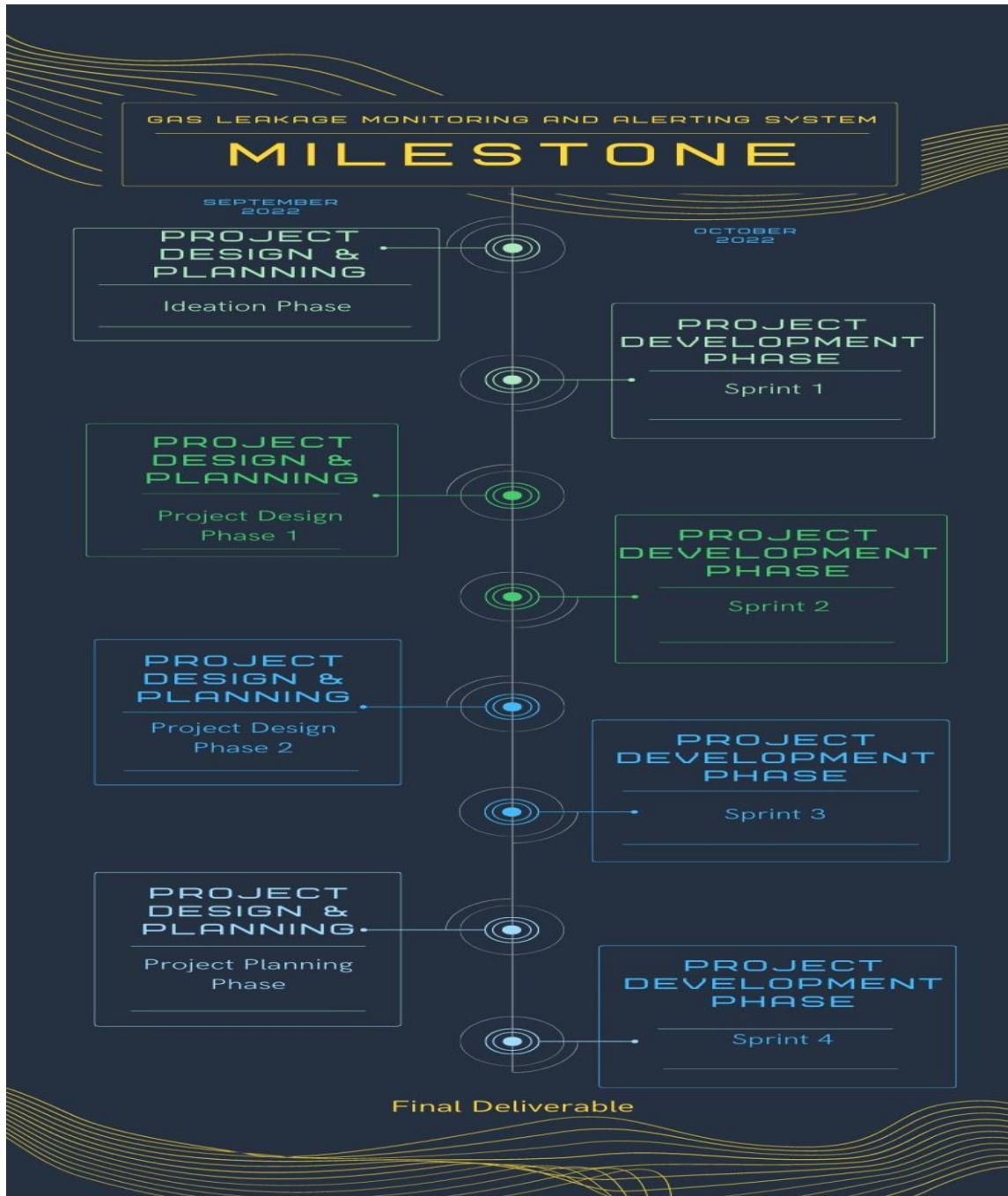


● Functional Requirements :

Business Requirements	User Requirements	Product Requirements
The said system can be deployed in homes, hotels, factory units, LPG cylinder storage areas, and so on. The main advantage of this IoT and Arduino-based application is that it can determine the leakage and send the data over to a site. It can be monitored, and preventive measures can be taken to avoid any disaster.	The gas leakage detection system can be optimized for detecting toxic gasses along with upgrading them with smoke and fire detectors to identify the presence of smoke and fire. Ensuring worker safety is important but making using of the right technology is even more vit	Detecting gasses is necessary regardless of your business role or individual purpose. Certain technologies at play make such IoT devices what they are, and if you want to indulge in IoT application development, you must know what they are and what purpose they can fulfill

Project Planning :

- Milestone and Activity List :



- **Sprint Delivery Plan :**

SPRINT PLAN

Identify the Problem

1

Prepare a Abstract, Problem Statement

2

List a required object needed

3

Create a Code and Run it

4

Make a Prototype

5

Test with the created code and check the designed prototype is

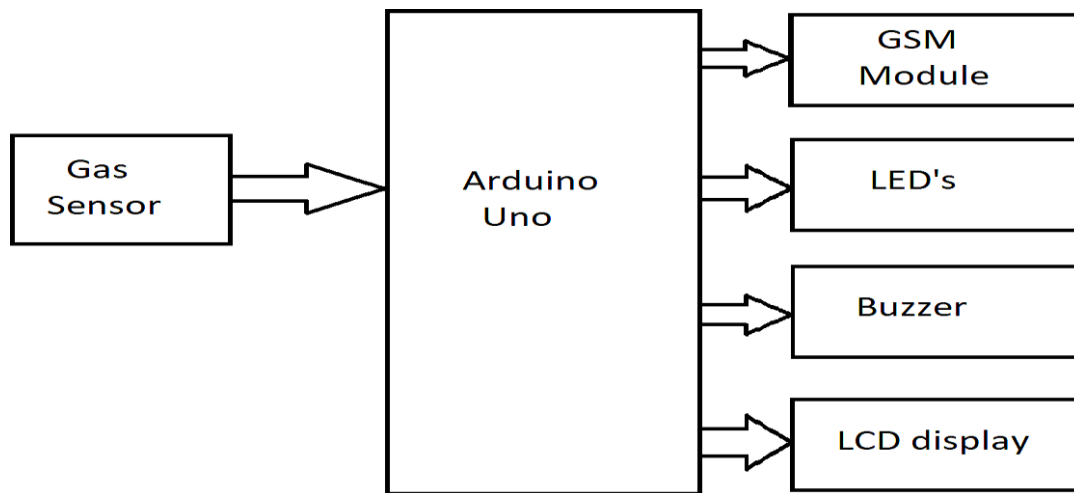
6

Solution for the Problem is Found!!

7

Proposed method :

Arduino UNO (Atmega-328) is the main unit of the system which performs the following tasks. A signal conditioning of the Arduino UNO is done by output signal of the sensor, provided input to Arduino. The detection results displayed on LCD. Indicates the people of danger in work place, factory, home. Buzzer activity with beep(siren) sound is made. Also send alert SMS to the in charge of the plant whose number is saved in SIM card by using GSM modem. The SMS received depends upon the leak of gas in the detection area of the sensor.

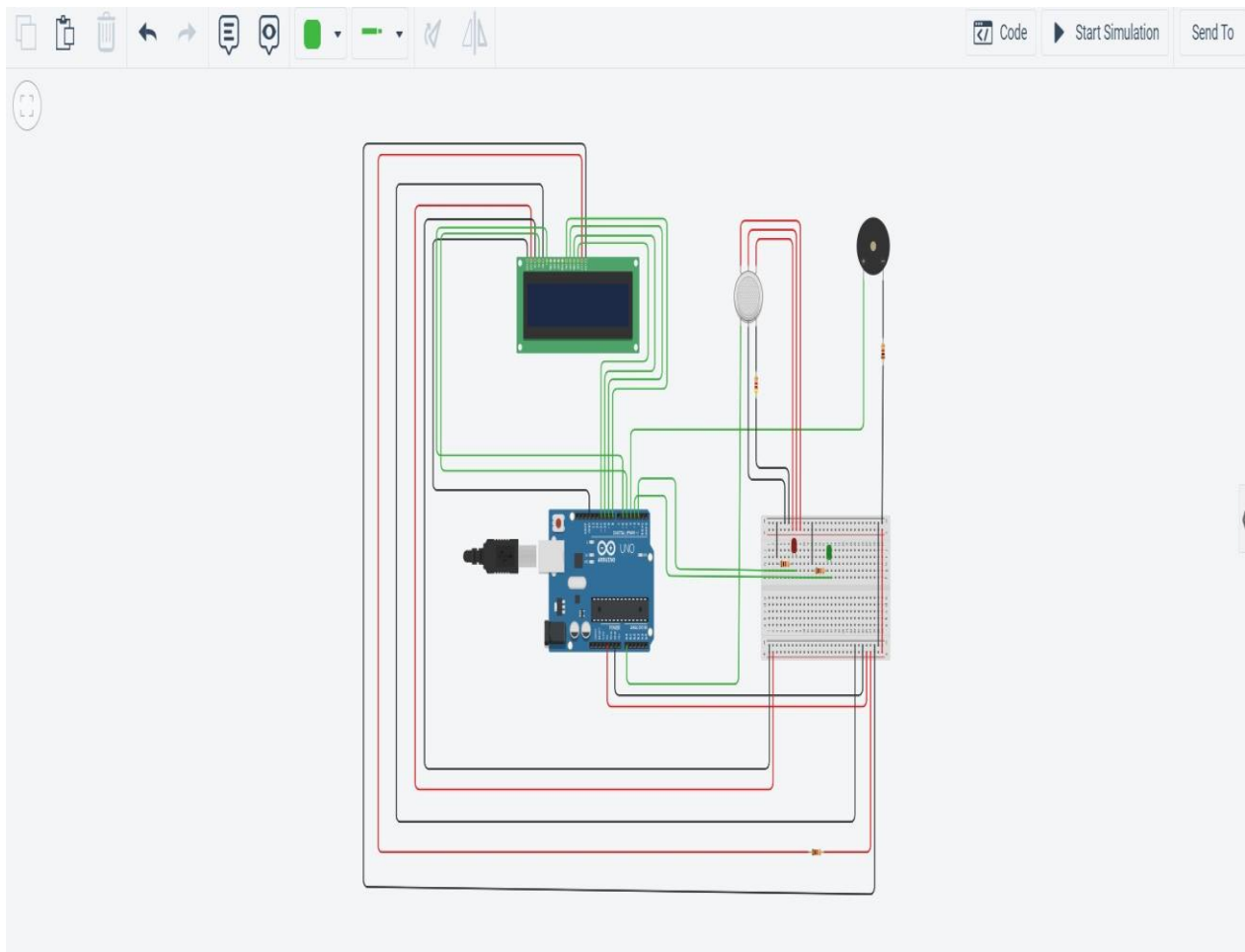


Solution Statement :

The system can be taken as a small attempt in connecting the existing primary gas detection methods to a mobile platform integrated with IoT platforms. The gases are sensed in an area of 1m radius of the rover and the sensor output datas are continuously transferred to the local

server. The accuracy of sensors are not upto the mark thus stray gases are also detected which creates an amount of error in the outputs of the sensors, especially in case of methane. Further the availability and storage of toxic gases like hydrogen sulphide also creates problems for testing the assembled hardware. As the system operates outside the pipeline, the complication of system maintenance and material selection of the system in case of corrosive gases is reduced. Thus the system at this stage can only be used as a primary indicator of leakage inside a plant.

Circuit Diagram :



Project Development Phase :

● Sprint :

```
#include <LiquidCrystal.h>
```

```
LiquidCrystal lcd(5,6,8,9,10,11);
```

```
int redled = 2; int
```

```
greenled = 3;int
```

```
buzzer = 4; int
```

```
sensor = A0;
```

```
int sensorThresh = 400;
```

```
void setup()
```

```
{
```

```
pinMode(redled, OUTPUT);
```

```
pinMode(greenled,OUTPUT);
```

```
pinMode(buzzer,OUTPUT);
```

```
pinMode(sensor,INPUT);
```

```
Serial.begin(9600);
```

```
lcd.begin(16,2);
```

```
}
```

```
void loop()
```

```
{
```

```
int analogValue = analogRead(sensor);
```

```
Serial.print(analogValue); if(analogValue>sensorThresh)
```

```
{
```

```
digitalWrite(redled,HIGH);
```

```
digitalWrite(greenled,LOW);
```

```
        tone(buzzer,1000,10000);  
        lcd.clear(); lcd.setCursor(0,1);  
        lcd.print("ALERT");  
        delay(1000);  
        lcd.clear(); lcd.setCursor(0,1);  
        lcd.print("EVACUATE");  
        delay(1000);  
    }  
    else  
    {  
        digitalWrite(greenled,HIGH);  
        digitalWrite(redled,LOW);  
        noTone(buzzer);  
        lcd.clear();  
        lcd.setCursor(0,0);  
        lcd.print("SAFE");  
        delay(1000); lcd.clear();  
        lcd.setCursor(0,1);  
        lcd.print("ALL CLEAR");  
        delay(1000);  
    }  
  
}
```

Refer Link : [Circuit design Gas Leakage Monitoring and Alerting System | Tinkercad](#)

Conclusion :

After this project performance, can conclude that detection of the LPG gas leakage is incredible in the project system. Applicable usefully in the industrial and domestic purpose. In danger situations we are able to save the life by using this system. An alert is indicated by the GSM module. A sensor node senses gas like CO₂, oxygen, propane. The estimated range of transmission and consumption of power is obtained. The simple procedures and Arduino UNO Micro controller area used to build the sensor.
