



PROJECT REPORT

PROJECT NAME: GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

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1.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 cut off 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 peruser 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.

2.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.

3.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.

4.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.

5.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:

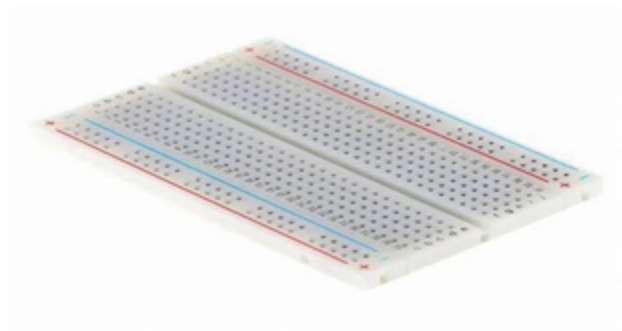


The ATmega328P-based Arduino Uno is a microcontroller board (datasheet). It has 14 digital input/output pins, 6 analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header, and a reset button. It comes with everything you need to support the microcontroller; simply connect it to a computer via USB or power it via an ACtoDC adapter or 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

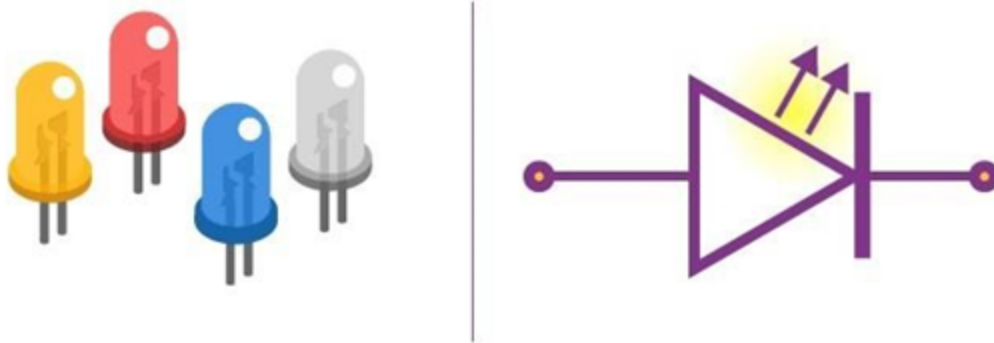
3rd as well as most recent modification of the Arduino Uno. Arduino board and IDE software are the reference versions of Arduino and currently progressed to new releases. The Uno-board is the primary in a sequence of USB-Arduino Board, & the reference model designed for the Arduino platform.

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.

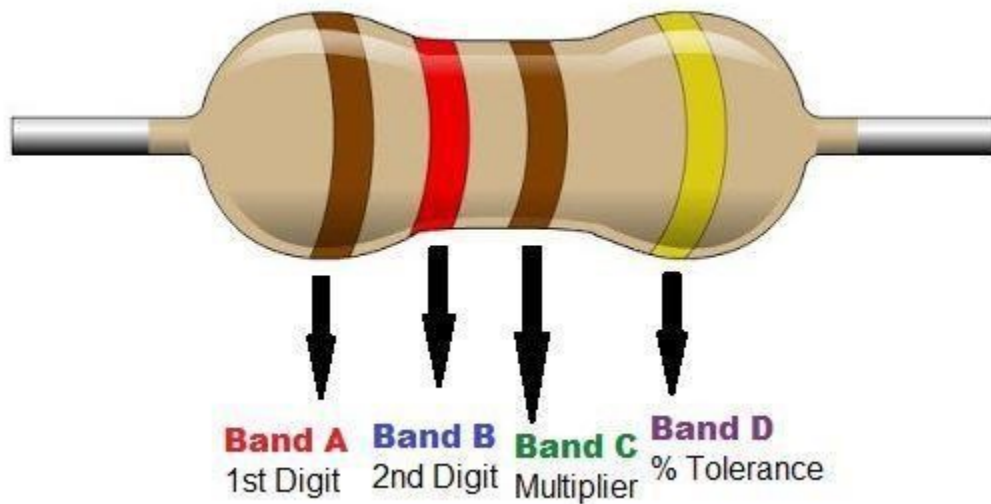
LED:



LED (Light Emitting Diode) is an optoelectronic device which works on the principle of electro-luminance. Electro-luminance 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.

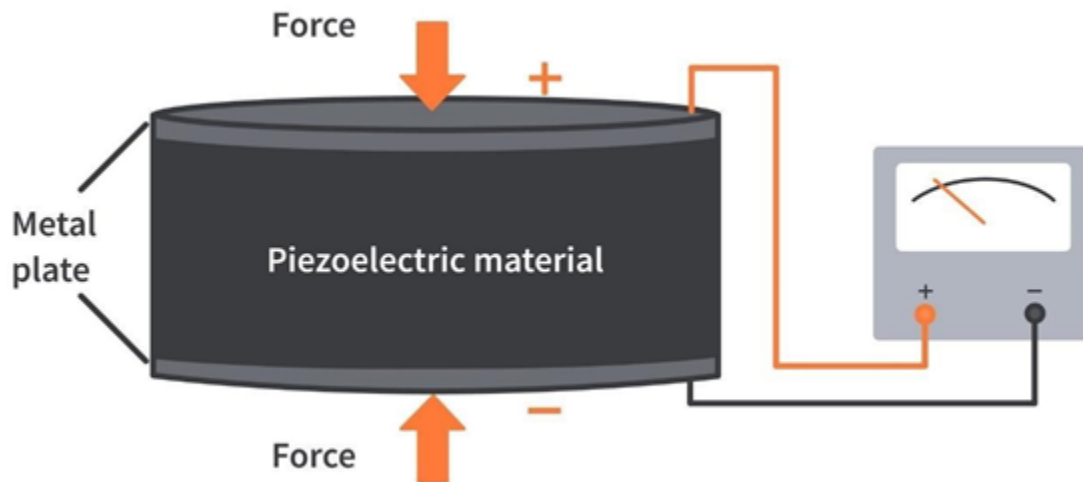
When an electric current flows through a light-emitting diode (LED), the device emits light. When current flows through an LED, electrons recombine with holes, resulting in the emission of light. LEDs allow current to flow in one direction but prevent it from flowing in the opposite direction. Light-emitting diodes are p-n junctions that have been heavily doped. When forward biased, an LED will emit coloured light at a specific spectral wavelength depending on the semiconductor material used and the amount of doping. An LED is encapsulated with a transparent cover, as shown in the figure, so that the emitted light can be seen.

Resistors:



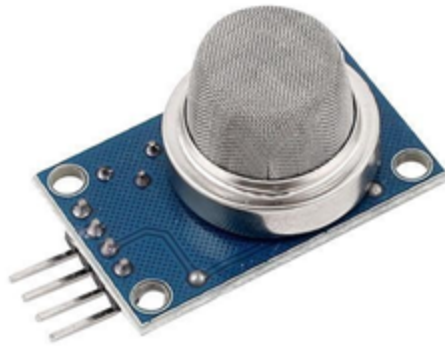
A resistor is a passive electrical component that creates resistance in the flow of current. They can be found in almost all electrical networks and electronic circuits. The resistance is expressed in ohms (Ω). An ohm is the resistance that occurs when a current of one ampere (A) flows through a resistor with a voltage drop of one volt (V) across its terminals. The voltage across the terminal ends determines the current. Ohm's law represents this ratio. Resistors serve a variety of functions. Limiting electric current, voltage division, heat generation, matching and loading circuits, gain control, and setting time constants are a few examples. They are commercially available with resistance values ranging from less than one order of magnitude to more than nine orders of magnitude. They can be used as electric brakes to dissipate kinetic energy from trains, or be smaller than a square millimeter for electronics.

Piezo:



A piezo is a device that generates a voltage when force is applied or becomes deformed when voltage is supplied. In 1880, two French scientists, Jacques and Pierre Curie, discovered piezoelectricity. They discovered piezoelectricity after discovering that applying pressure to quartz or even certain crystals generates an electrical charge in that material. The strange and scientific phenomenon was later dubbed the piezoelectric effect. The inverse piezoelectric effect was quickly discovered by the Curie brothers. They discovered that when an electric field was applied to crystal leads, it caused malformation or disorder, which is now known as the inverse piezoelectric effect. Piezoelectricity is derived from the Greek word piezo, which means to squeeze or press. Interestingly, the word "electric" in Greek means "amber."

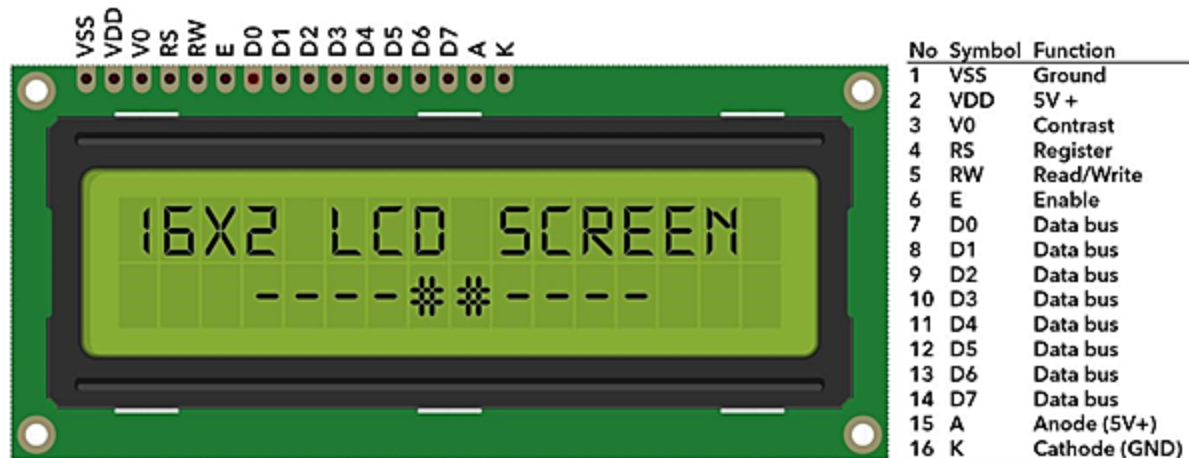
Gas Sensor:



Gas sensors (also called gas detectors) are electronic devices that detect and identify various types of gases. They are commonly used to detect and measure the concentration of toxic or explosive gases. Gas sensors are used in factories and manufacturing facilities to detect gas leaks, as well as in homes to detect smoke and carbon monoxide. The size (portable and fixed), range, and sensing ability of gas sensors vary greatly. They are typically connected to an audible alarm or interface and are often part of a larger embedded system, such as hazmat and security systems. Because gas sensors are constantly in contact with air and other gases, they require more frequent calibration than many other types of sensors.

The physical makeup and sensing process of sensors can differ significantly depending on their intended environments and functions. The metal oxide-based gas sensor is one of the most commonly used gas sensors for toxic identification and smoke detection. A chemiresistor comes into contact with and reacts with target gases in this type of sensor. When metal oxide gas sensors come into contact with gases such as carbon monoxide, hydrogen, methane, and butane, their electrical resistance increases. The majority of home-based smoke detection systems use oxide-based sensors.

LCD 16*2 :



LCD is an abbreviation for liquid crystal display. It is a type of electronic display module that is used in a wide range of applications such as various circuits and devices such as mobile phones, calculators, computers, TV sets, and so on. These displays are mostly used for light-emitting diodes with multiple segments and seven segments. The main advantages of using this module are that it is inexpensive, easily programmable, has no limitations for displaying custom characters, special and even animations, and so on.

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.

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.

6.Project Design & Planning :-

a)Ideation Phase :-

i) 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

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.

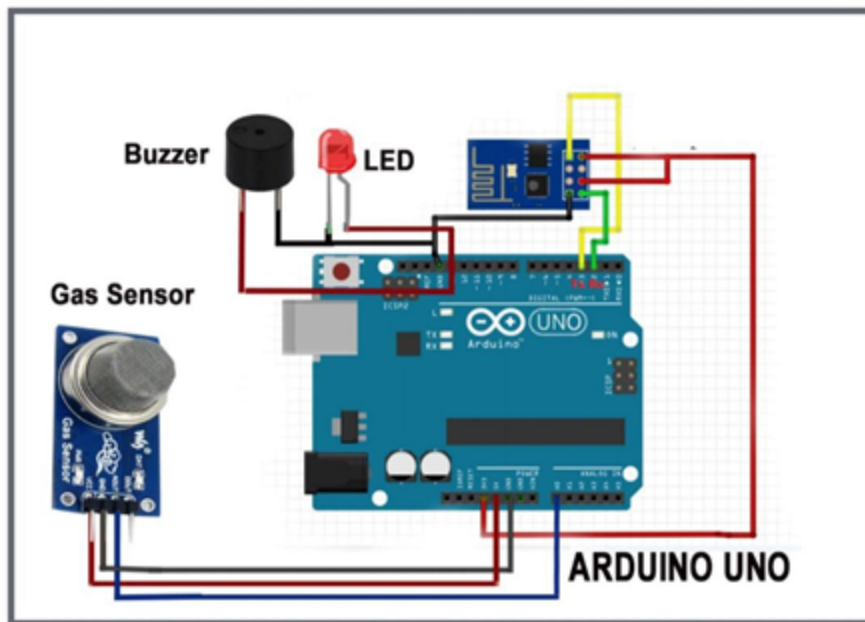
On the other hand, ultrasonic sensors are free from the above disadvantages for the measurement of gas concentration with fast response time and the device is compact and inexpensive too.

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.

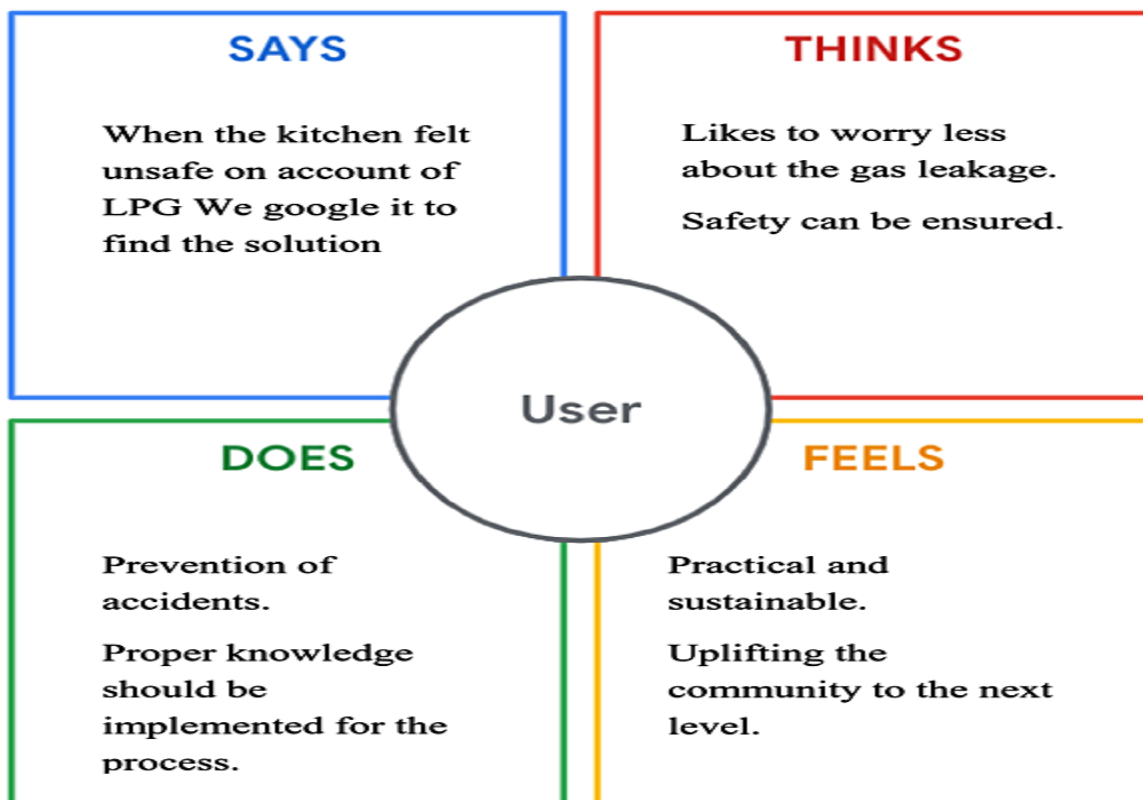
ii) Ideation :-

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



iii)Empathy Map :-



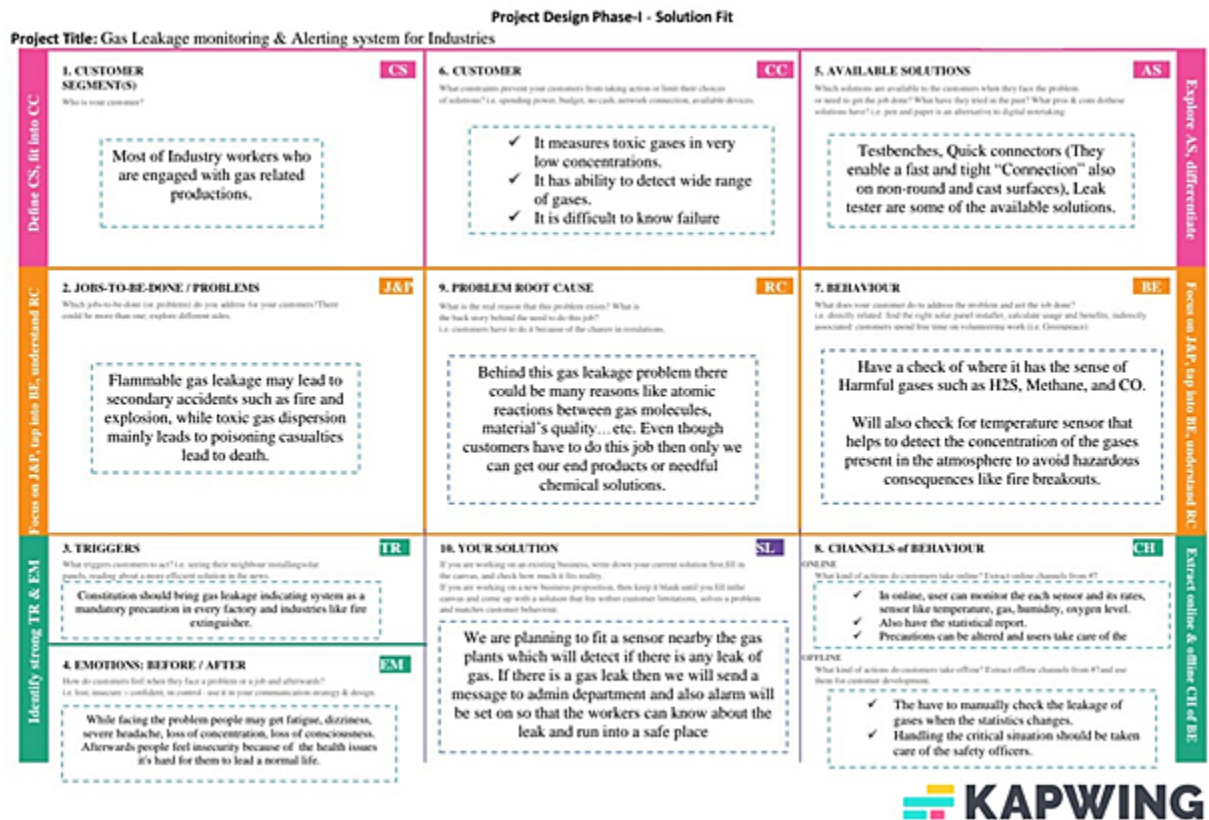
b)Project Design Phase I :-

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 failed to alert the main department and other solutions are with some delays. 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.
4	Social Impact / Customer Satisfaction	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.
5	Business Model (Revenue Model)	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.
6	Scalability of the Solution	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.

ii)Proposed Solution Fit :-



iii)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 local server. The accuracy of MQ 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.

c)Project Design Phase II :-

i)Customer Journey Map :-

Customer Journey Map

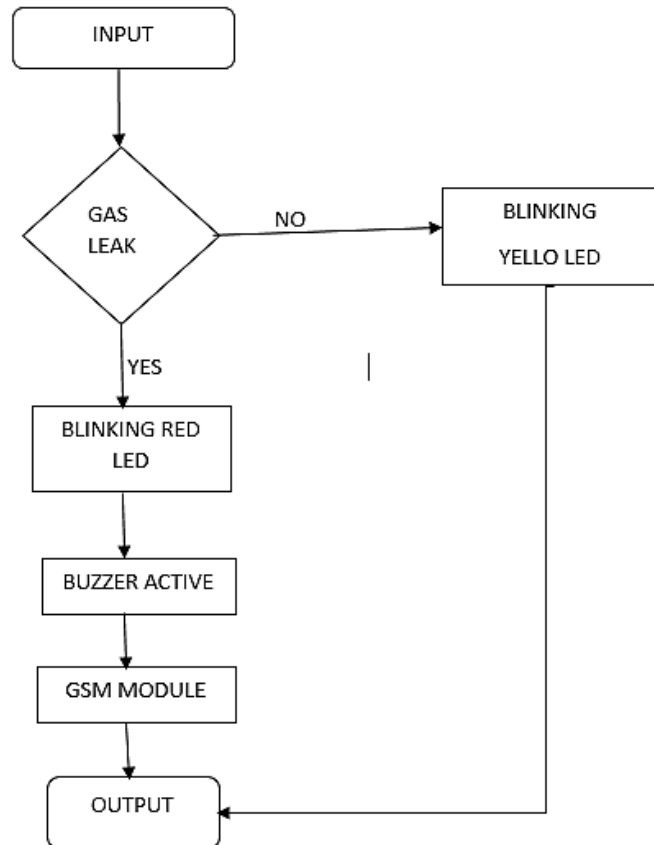
	STAGE 1	STAGE 2	STAGE 3	STAGE 4	STAGE 5
OBJECTIVES	Write a goal or activity	Gas leakage detection systems protect personnel and the environment from potentially hazardous exposure to gases.	The system comprises of sensors for detecting gas leak interfaced to microcontroller that will give an alert to 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	Embraced 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!

ii)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	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	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

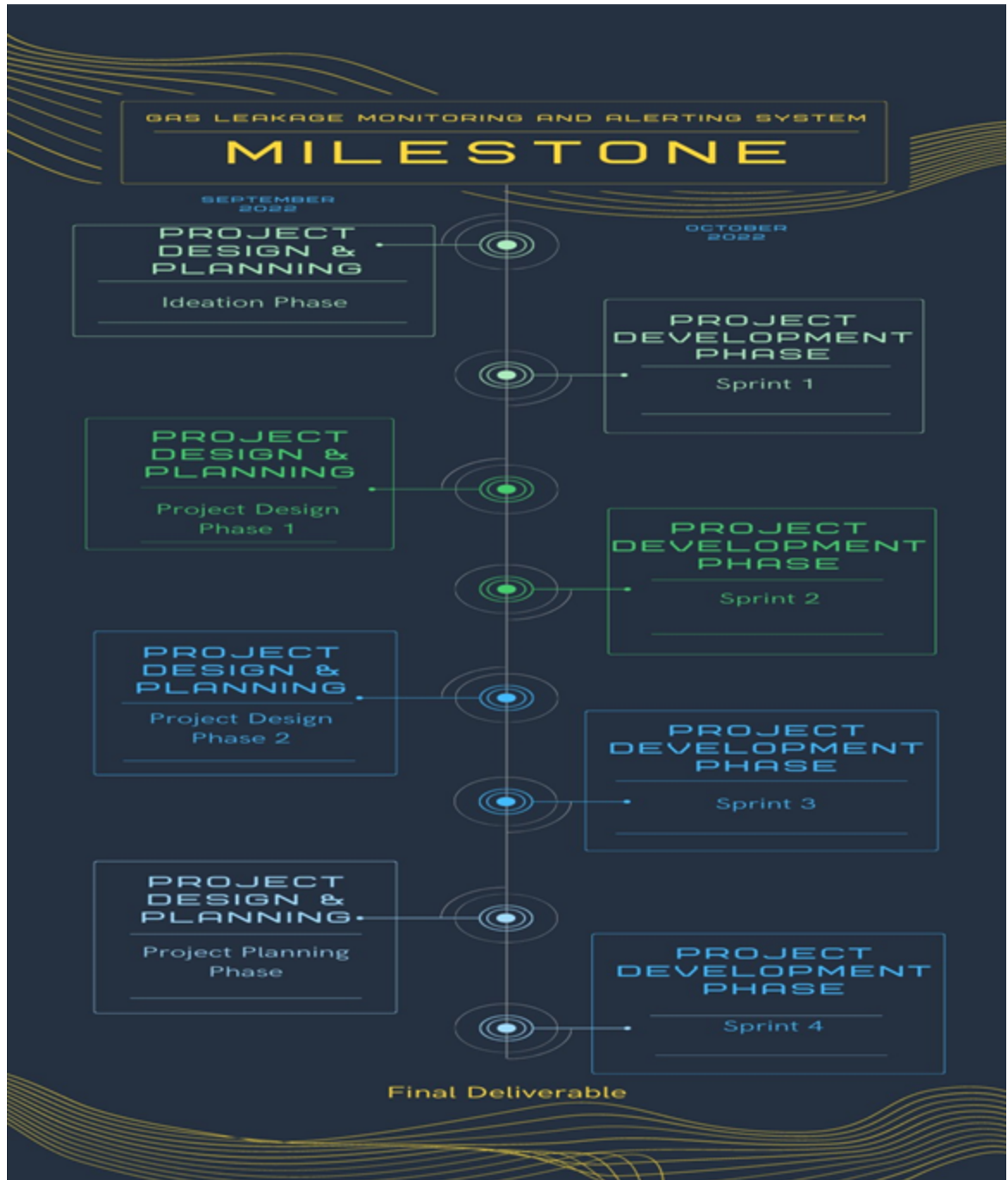
preventive measures can be taken to avoid any disaster.	vit	what purpose they can fulfill
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iii)Data Flow Diagram :-



d)Project Planning :-

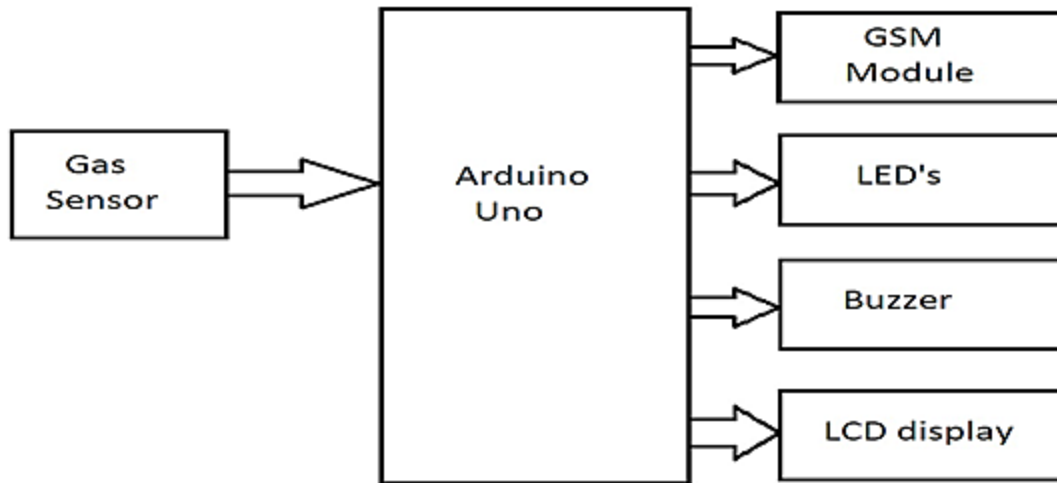
i)Milestone and Activity List :-



ii)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

7.Proposed method :-



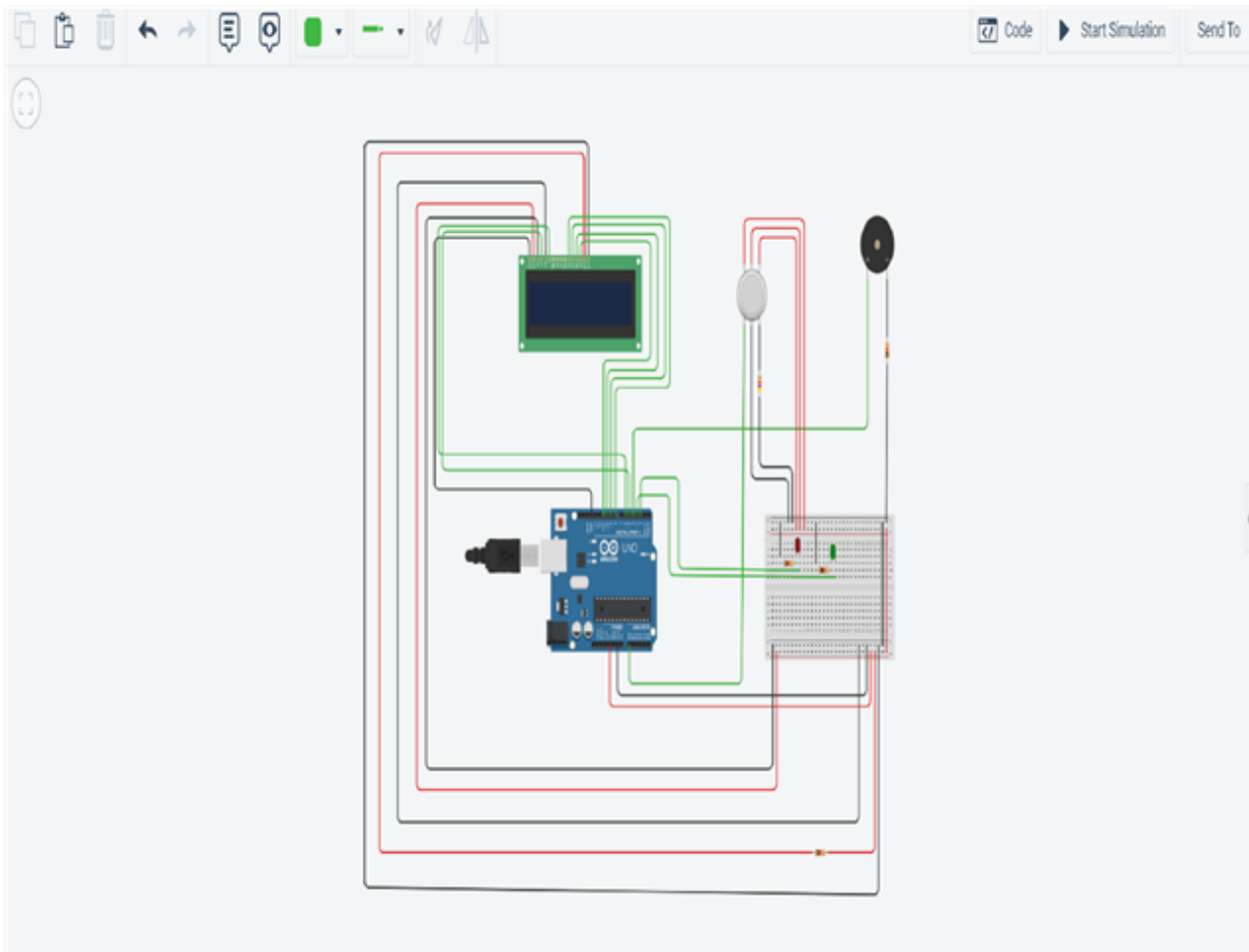
Arduino UNO (Atmega-328) is the main unit of the system which performs the following tasks. A signal conditioning of the Arduino UNO is done by output signal of the sensor, provided input to Arduino. The detection results displayed on LCD. Indicates the people of danger in work place, factory, home. 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.

8.Solution Statement :-

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

9.Circuit Diagram :-



10.Project Development Phase :-

a)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);
}
}

```

11)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.

GitHub link: <https://github.com/IBM-EPBL/IBM-Project-10006-1659088593>

demolink: https://drive.google.com/file/d/1Rzbzp2tEerVxWVEH2CZ8AwZDAxw9uqh_/view?usp=drivesdk

