Gas Leakage Monitoring and Alerting System

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Abstract:

Internet of Things aim towards making life simpler by automating every small task around us. As much is IoT helping in automating tasks, the benefits of IoT can also be extended for enhancing the existing safety standards. Safety, the elementary concern of any project, has not been left untouched by IoT. Gas Leakages in open or closed areas can prove to be dangerous and lethal. The traditional Gas Leakage Detector Systems though have great precision, fail to acknowledge a few factors in the field of alerting the people about the leakage. Therefore we have used the IoT technology to make a Gas Leakage Detector for society which having Smart Alerting techniques involving sending text message to the concerned authority and an ability performing data analytics on sensor readings. Our main aim is to proposing the gas leakage system for society where each flat have gas leakage detector hardware. This will detect the harmful gases in environment and alerting to the society member through alarm and sending notification.

Introduction:

Internet of Things aim towards making life simpler by automating every small task around us. As much is IoT helping in automating tasks, the benefits of IoT can also be extended for enhancing the existing safety standards. Safety has always been an important criterion while designing home, buildings, industries as well as cities. The increased concentration of certain gases in the atmosphere can prove to be extremely dangerous. These gases might be flammable at certain temperature and humidity conditions, toxic after exceeding the specified concentrations limits or even a contributing factor in the air pollution of an area leading to problems such as smog and reduced visibility which can in turn cause severe accidents and also have adverse effect on the health of people. Most of the societies have fire safety mechanism. But it can use after the fire exists. In order to have a control over such conditions we proposed system that uses sensors which is capable of detecting the gases such as LPG, CO2, CO and CH4. This system will not only able to detect the leakage of gas but also alerting through audible alarms. Presence of excess amounts of harmful gases in environment then this system can notify the user. System can notify to society admin about the condition before mishap takes place through a message.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

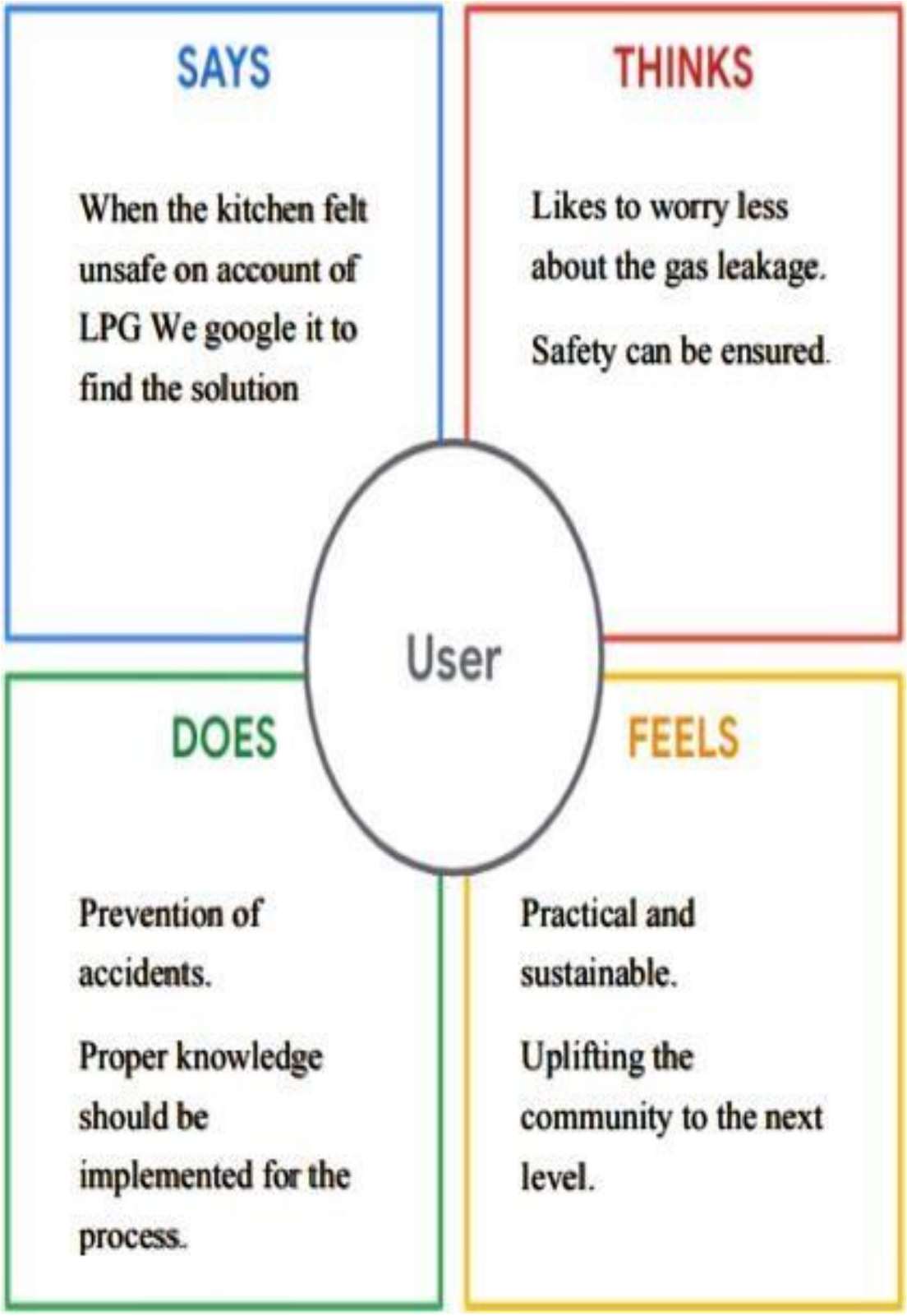
such as user name, mobile number, per user flat sensor details information. Society admin can configure the threshold value of each sensor. System hardware can be deployed on each flat. Sensors can sense the value per time. System can send the values to cloud server. Server can Check that the sensor 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. In this paper we use IOT technology for enhancing the existing safety standards. While making this prototype has been to bring a revolution in the field of safety against the leakage of harmful and toxic gases in environment and hence nullify any major or minor hazard being caused due to them. We have used the IOT technology to make a Gas Leakage Detector for society which having Smart Alerting techniques involving sending text message to the concerned authority and an ability performing data analytics on sensor. This system will be able to detect the gas in environment using the gas sensors. This will prevent form the major harmful problem.

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. 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 Phase & Proposed Solution:

Empathy Map:



Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs away 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 monitoringor leakage of gas, this will indeed reduce the manpower of that industry.
2.	Idea/ Solution description	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs away 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 monitoringor 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 . 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 . Our solution will prevent great disasters like Bhopal Gas Tragedy so that so many lives can be saved. Through this project the workersmental 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 for buildings and Industries so wehave planned to visit 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.

Proposed Solution Fit:

Project Design Phase-I - Solution Fit

Project Title: Gas Leakage monitoring & Alerting system for Industries

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) — CS

Who is your customer?

Most of Industry workers who are engaged with gas related productions.

6. CUSTOMER — CC

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.

- ✓ It measures toxic gases in very low concentrations.
- ✓ It has ability to detect wide range of gases.
- ✓ It is difficult to know failure

5. AVAILABLE SOLUTIONS — AS

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 dothese solutions have? i.e. pen and paper is an alternative to digital notetaking

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.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS — J&P

Which jobs-to-be-done (or problems) do you address for your customers?There could be more than one; explore different sides.

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.

9. PROBLEM ROOT CAUSE — RC

What is the real 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 chanee in reeulations.

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.

7. BEHAVIOUR — BE

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)

Have a check of where it has the sense of Harmful gases such as H2S, Methane, and CO.

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.

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS — TR

What triggers customers to act? i.e. seeing their neighbour installingsolar panels, reading about a more efficient solution in the news.

Constitution should bring gas leakage indicating system as a mandatory precaution in every factory and industries like fire extinguisher.

4. EMOTIONS: BEFORE / AFTER — EM

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.

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.

10. YOUR SOLUTION — SL

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 inthe canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

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

8. CHANNELS of BEHAVIOUR — CH

ONLINE

What kind of actions do customers take online? Extract online channels from #7.

- ✓ In online, user can monitor the each sensor and its rates, sensor like temperature, gas, humidity, oxygen level.
- ✓ Also have the statistical report.
- ✓ Precautions can be altered and users take care of the

OFFLINE

What kind of actions do customers take offline? Extract offline channels from #7and use them for customer development.

- ✓ The have to manually check the leakage of gases when the statistics changes.
- ✓ Handling the critical situation should be taken care of the safety officers.

Extract online & offline CH of BE

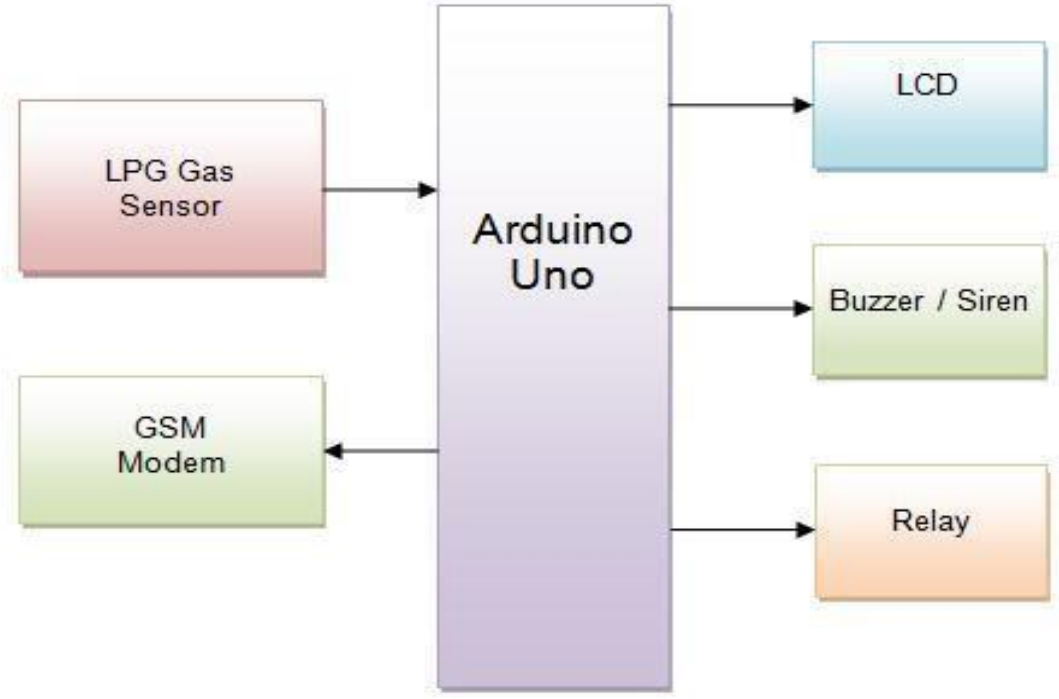
Requirement Analysis:

Functional Requirement:

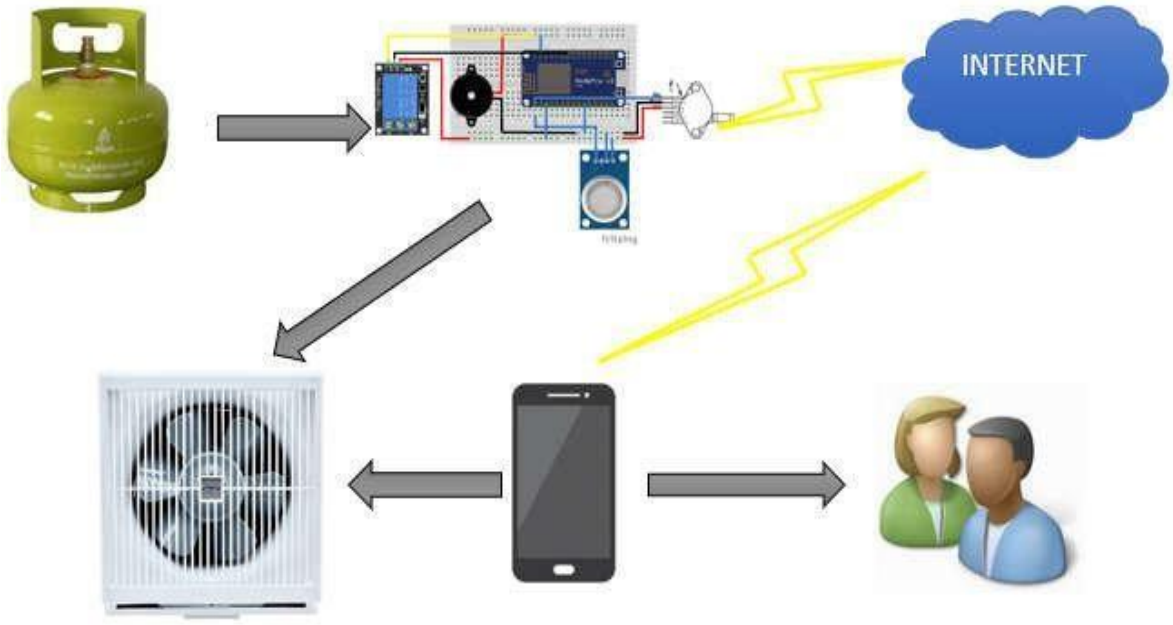
Business Requirements	User Requirements	Product Requirements
The said system can be deployed in homes, hotels, factory units, LPG cylinder storage areas,and soon. The main advantage of this IoT and Arduino-based application is that it can determine the leakage and send the data over to a site.It can 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 vital.	Detecting gasses is necessaryregardlessofyour business role or individual purpose. Certain technologies at play make such IoT devices what they are,andifyouwanttoindulge in IoT application development,youmustknow what they are and what purpose they canfulfill.

Project Design:

Data Flow Diagram:



Technology Architecture:



Customer Journey Map:

Gas Leakage

monitoring & Alerting system for Industries

Objective

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.

Feelings

Embrassed on the solution and promoted the good wordes towords this project

Needs

> Fire Hazard detection
> Harmful gas detection

Barriers

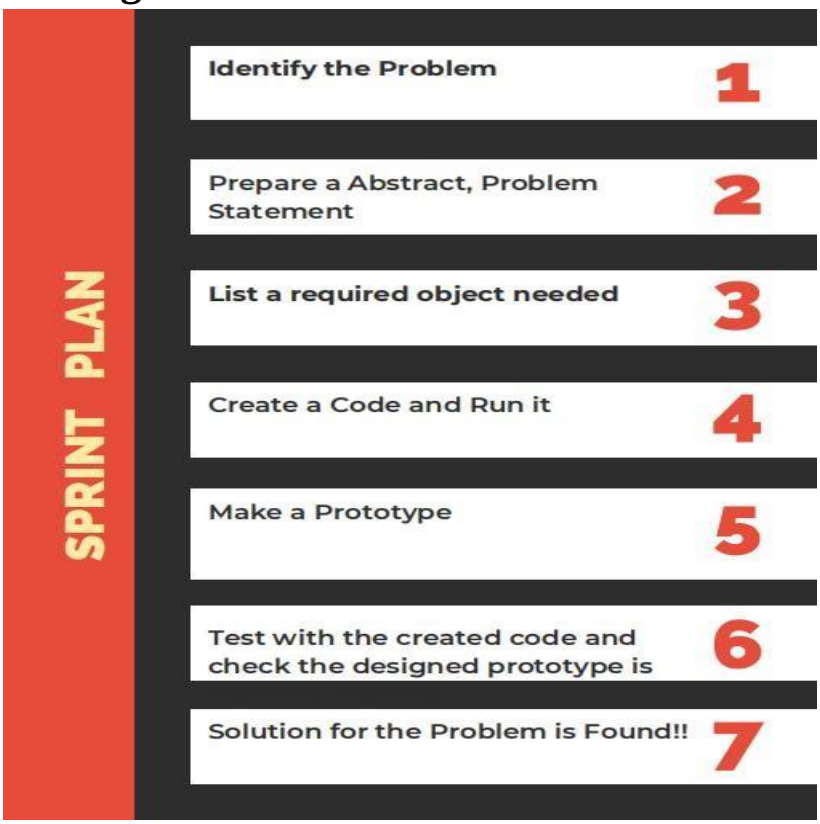
The gasses are toxic in nature, resulting in human unconsciousness and even death if consumed in larger quantities.

Approach

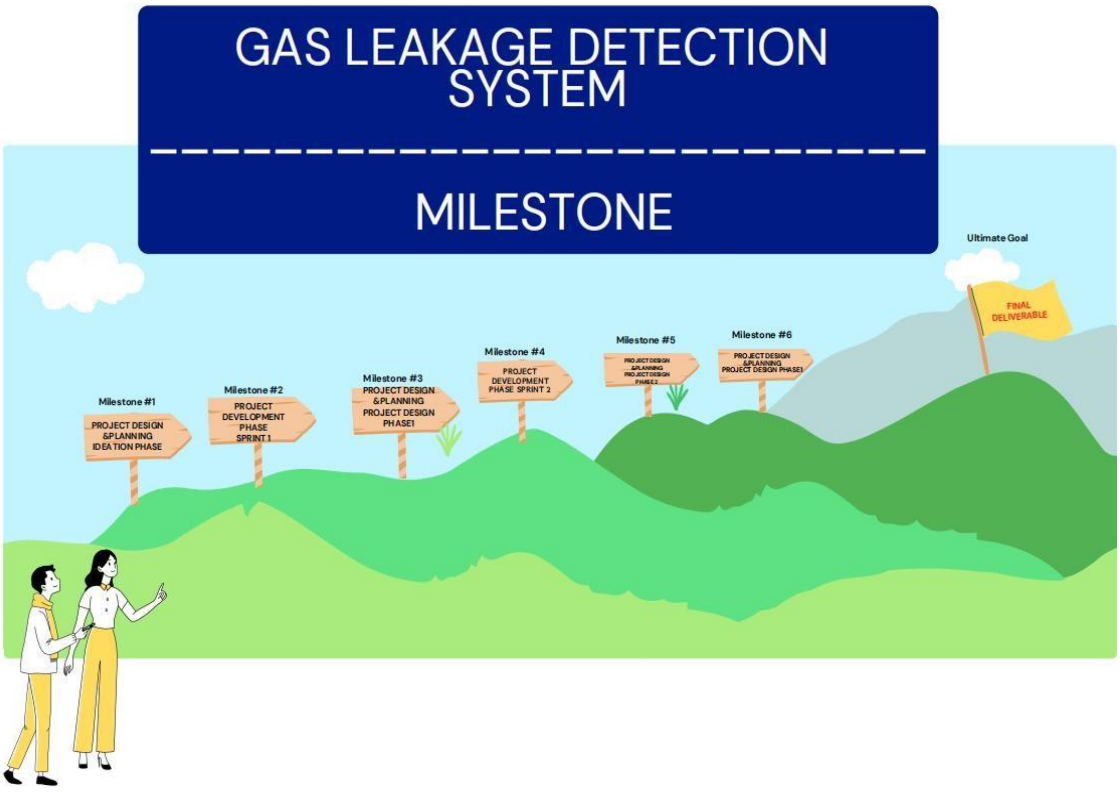
The system comprises of sensors for detecting gas leak interfaced to microcontroller that will give an alert to user whenever there is a gas leakage, display warning information by using Liquid.

Project Planning:

Sprint Planning:



Sprint Delivery:



Code & Solution:

```
#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);
  }
}
```

Output: