FINAL REPORT

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

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1.INTRODUCTION

1.1 Project Overview

The Internet of Things is an emerging topic of technical, social, and economic significance. Consumer products, durable goods, cars and trucks, industrial and utility components, sensors, and other everyday objects are being combined with Internet connectivity and powerful data analytic capabilities that promise to transform the way we work, live, and play. Projections for the impact of IOT on the Internet and economy are impressive, with some anticipating as many as 100 billion connected IoT devices and a global economic impact of more than $11 trillion by 2025.The Internet of Things (IoT) is an important topic in technology industry, policy, and engineering circles. This technology is embodied in a wide spectrum of networked products, systems, and sensors, which take advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities. The large-scale implementation of IoT devices promises to transform many aspects of the way we live. For consumers, new IoT products like Internet-enabled appliances, home automation components, and energy management devices are moving us toward a vision of the "smart home'', offering more security and energy efficiency. IoT systems like networked vehicles, intelligent traffic systems, and sensors embedded in roads and bridges move us closer to the idea of "smart cities'', which help minimize congestion and energy consumption. IoT technology offers the possibility to transform agriculture, industry, and energy production and distribution by increasing the availability of information along the value chain of production using networked sensors. Safety plays a major role in today's world and it is necessary that good safety systems are to be implemented in places of education and work. This work modifies the existing safety model installed in industries and this system also be used in homes and offices. The main objective of the work is designing microcontroller based toxic gas detecting and alerting system. The hazardous gases like LPG and propane were sensed and displayed and notify each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (Email) is sent to the authorized person through the INTERNET and used ARM development board. The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation.

1.2 Purpose

An overall conclusion IOT based toxic gas detector, or IOT technology has come a long way since it was conceptualized two decades ago. It has become more efficient, more applicable to today's applications and smarter. The work presented in this project was directed towards pushing IOT technology to the next level. The work has presented solutions to several problems and issues that have not been addressed in previous work. The principle of operation of Operation of IOT based gas leakage and monitoring system was shown by operating the Raspberry pi 3 model attached with embedded system with required input and output gas level with the help of gas sensors. This results in a more efficient in operation because it is connected to a common web page specially built to notify or email the responsible authority automatically so reduces the stress of constant monitoring. The choice of using a real time gas leakage monitoring and sensing the output levels of gas has been clearly observed by the help of this system.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEMS

It [1] proposes a system that uses an MQ-2 sensor which is capable of detecting gases such as H2, LPG, CH4, CO, Alcohol, Smoke and Propane. This system is not only capable of detecting the leakages and hence presence of excess amounts of harmful gases and alerting through audible alarms but also, with the help of IOT, alerting the concerned authority about the condition before any mishap takes place through a personal call and message using GSM module, an e-mail about the details of the area using an Ethernet Shield. The system cuts off the main power supply of the house or building when the concentration of gas is about to reach its Lower Explosion Limit (LEL) which is done with the help of relays. The Gas Leakage Detector System also sends the sensor reading to cloud so that analytics could be carried out on the readings for increasing the precision of the system. In this paper [2] the hazardous gases like LPG and propane were sensed and displayed and notify each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (Email) is sent to the authorized person through the INTERNET and used ARM development board. The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation. A Web page is built to show the status to the user monitoring it. The web page gives a notification via mail of the Gas leakage. The LCD screen shows the status. The system puts on the buzzer when the level of gas crosses the set limit. Thus this system helps to keep by informing about gas leakages by providing danger position of the gas leakage via a web page. It [3] describes that once gas is leaked from the surroundings, a physical alert in the form of a buzzer and a led is indicated to the user for preventive action before harm to surrounding. Also, a notification to the mobile/laptop from push bullet is sent to the user. This output is monitored in our computers/mobiles where the stored values are sent for analysis and storage in the database through the cloud. A lighter is used to release gas for the MQ5 gas sensor to detect the gas leaked and alert the user. The data is sent through the cloud for receiving notifications from the internet to our mobile phones/laptop using the application. This paper [4] purposed that the presence of hazardous LPG gas leakage in a domestic, work place, also, stored gases container gas which exhibits ideal characteristic is use. For that sake, an alarm unit is used to vibrate an alarm which is buzzer. Buzzer gives an audible sign of the presence of LPG volume. The sensors are widely used to detect essence of propane, iso-butane, LPG and even smoke. The sensor has an advantage to combine a sensitivity response time. If the LPG sensor senses gas leak from work place or

home, sensor output goes to active low (logic-0) condition. Arduino UNO is used in the project; low signals are overlooked by the Arduino and gas leakage is been noticed by the Arduino. The Arduino UNO turns on the LCD and buzzer. It even turns on the GSM modem after that, it continues to send messages SMS to mobile number specifically mentioned in the program of the source code for alerting danger to the people. The LPG leakage detection and alert system presented in this paper [5] is battery operated and hence portable. It is designed in such a way that it can also be operated with ac power supply. To support the latter case, it has a bridge rectifier with a capacitor filter. This is followed by a regulator designed with IC7805 which provides +5V regulated power supply. To detect the LPG, MQ-6 gas sensor is employed. The sensitivity of this sensor is very high and it has quick response time. It can detect the LPG concentration in the range of 200-10000ppm. The output of the gas sensor is given to LM358 dual operational amplifier where it is compared with the threshold value for gas density which is set using preset potentiometers and amplified. If the sensed voltage is greater than the preset threshold voltage, the operational amplifier output fires the driver circuit for LED and Buzzer. As a result, the LED will glow and the buzzer starts to produce alarm sound.

2.2 REFERENCES

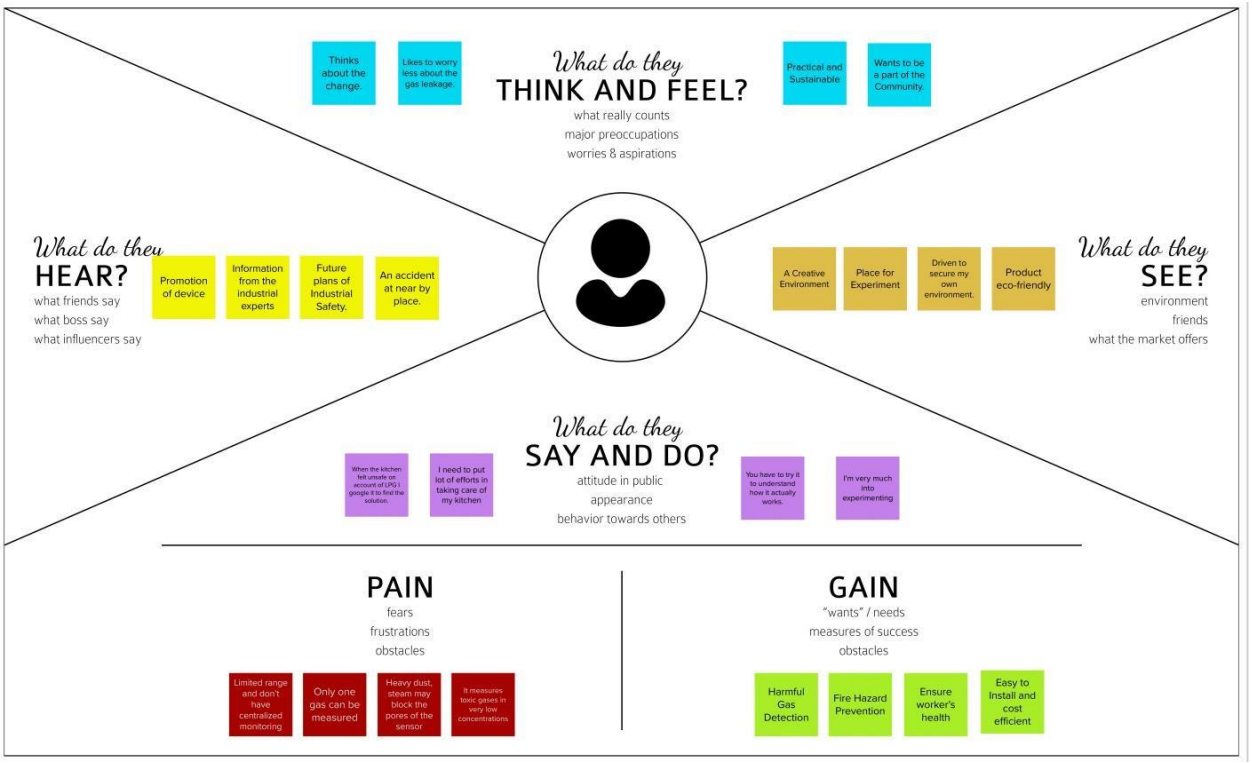
[1] Varma, A., Prabhakar, S., & Jayavel, K. (2017, February). Gas leakage detection and smart alerting and prediction using IoT. In 2017 2nd International Conference on Computing and Communications Technologies (ICCCT) (pp. 327- 333). IEEE. [2] Pandey, R. C., Verma, M., Sahu, L. K., & Deshmukh, S. (2017). Internet of things (IOT) based gas leakage monitoring and alerting system with MQ-2 sensor. International Journal of Engineering Development and Research, 5(2), 2135-2137. [3] Subramanian, M. A., Selvam, N., Rajkumar, S., Mahalakshmi, R., & Ramprabhakar, J. (2020, January). Gas Leakage Detection System using IoT with integrated notifications using Pushbullet-A Review. In 2020 Fourth International Conference on Inventive Systems and Control (ICISC) (pp. 359-362). IEEE. [4] Shahewaz, S. B., & Prasad, C. R. (2020). Gas leakage detection and alerting system using Arduino Uno. Global Journal of Engineering and Technology Advances, 5(3), 029-035. [5] Leavline, E. J., Singh, D. A. A. G., Abinaya, B., & Deepika, H. (2017). LPG gas leakage detection and alert system. International Journal of Electronics Engineering Research, 9(7), 1095-1097.

2.3 PROBLEM STATEMENT DEFINITION

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. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



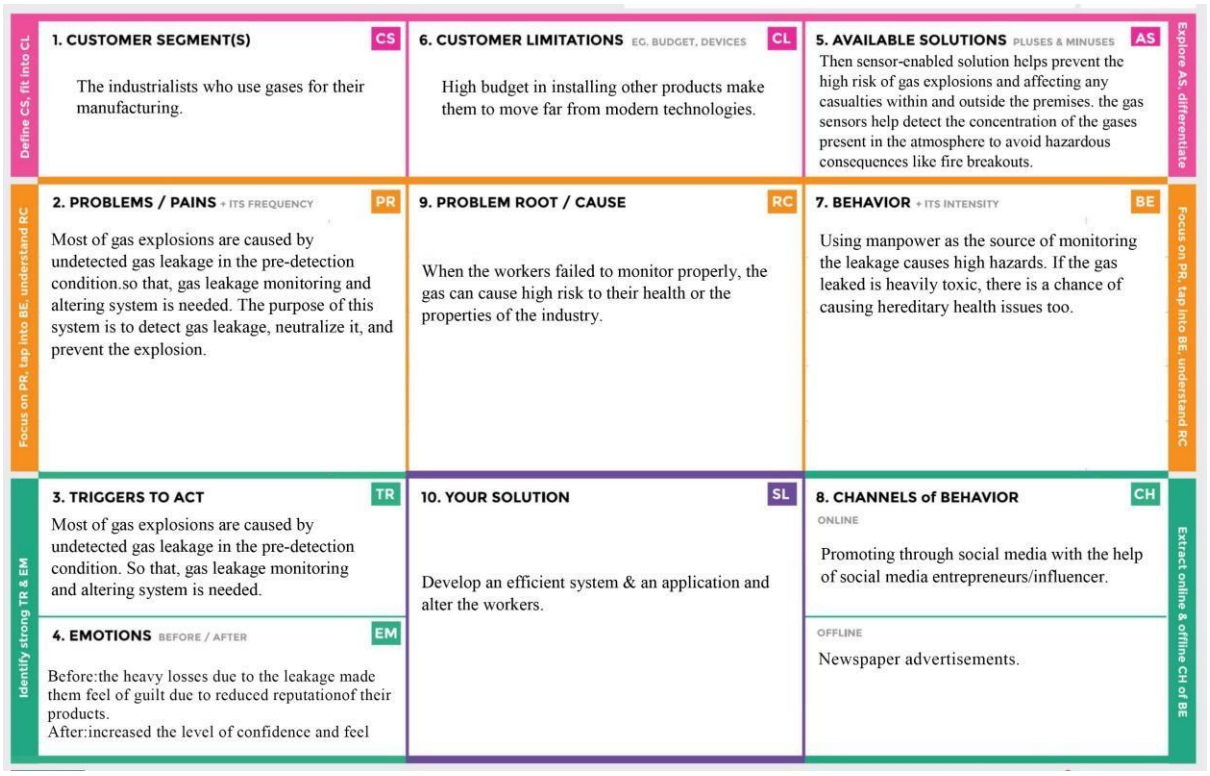
3.2 IDEATION AND BRAINSTORMING

3.3 PROPOSED SOLUTION

We are planned to fit a sensor in the gas plants to monitor it. If there is any slight leak of gas then we will notify the admin department and fire fighters about the leakage and also alert the workers through an alarm sound to move out of the place where the gas pipe / plant are leaking. As a future scope we planned to lay additional layer of pipe (material which carries/contains the gas) in case of leak occurrence to

cover the leakage place which will help the workers to fix the problem and work without any worries.

3.4 PROBLEM SOLUTION FIT



4. REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Business 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.

User Requirements:

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.

Product Requirements:

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 fulfil.

4.2 Non-functional Requirements:

Usability

The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises.

Security

The device is intended for use in Industry and also in household safety where appliances and heaters that use natural gas and liquid petroleum gas (LPG) maybe a source of risk.

Reliability

Gas Leakage Detection system(GLDS) can detect leakage at homes, commercial premises or factories. GLDS detects the leakage soon after it happened and sends users an immediate alarm on the incident.

Performance

The gas leakage detector is a wall mounted device fitted close to the floor level with an alarm setting at 20% of lower explosive limit. Whenever there is a leak, the built -in sensor detects and alerts the user in less than 5 minutes, much before it can cause any accidents.

Availability

The circuit for an LPG leakage detector is readily available in the market, but it is extremely expensive. Presented here is a low cost circuit for a Gas leakage Detection that you can build easily

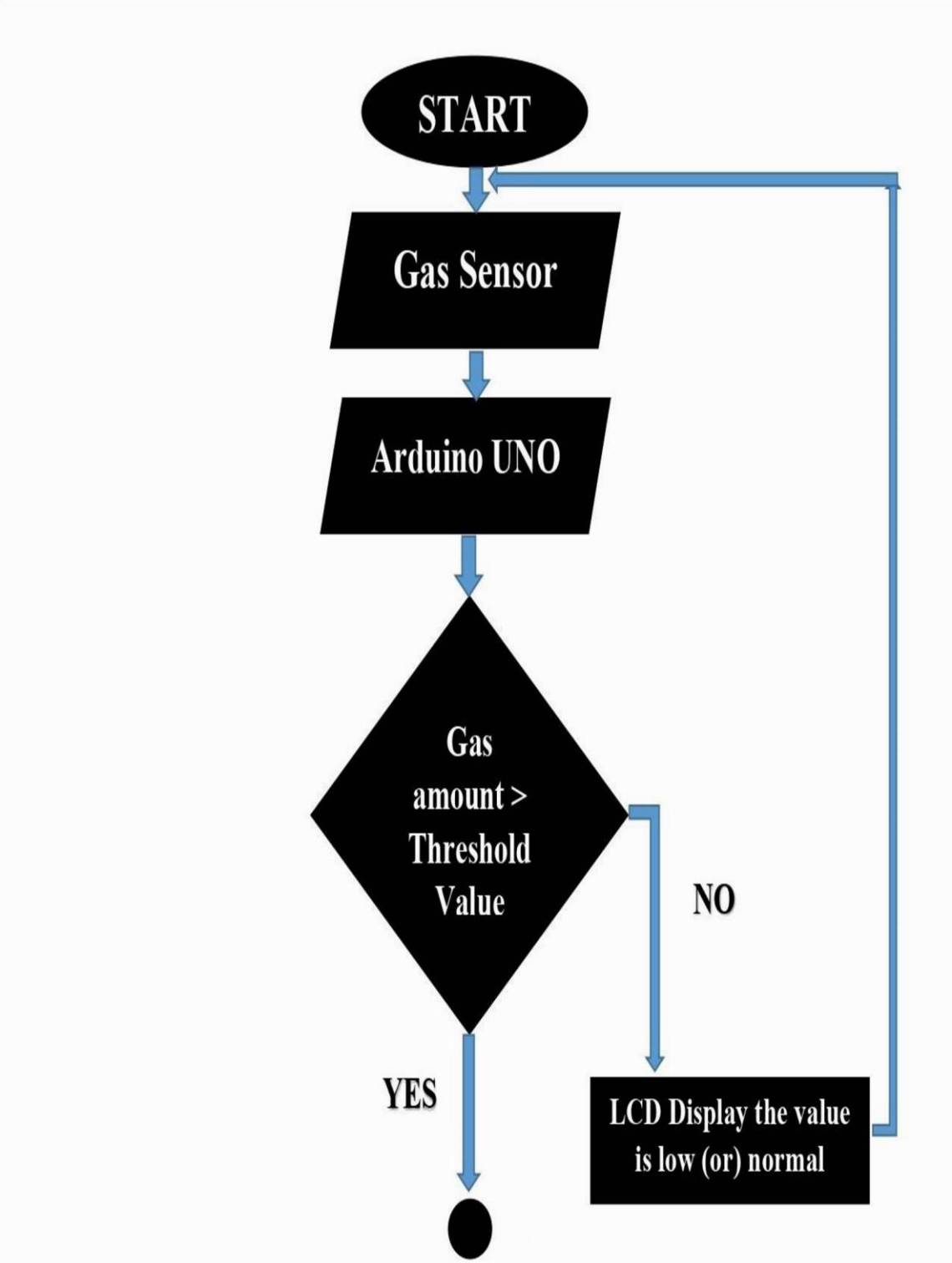
Scalability

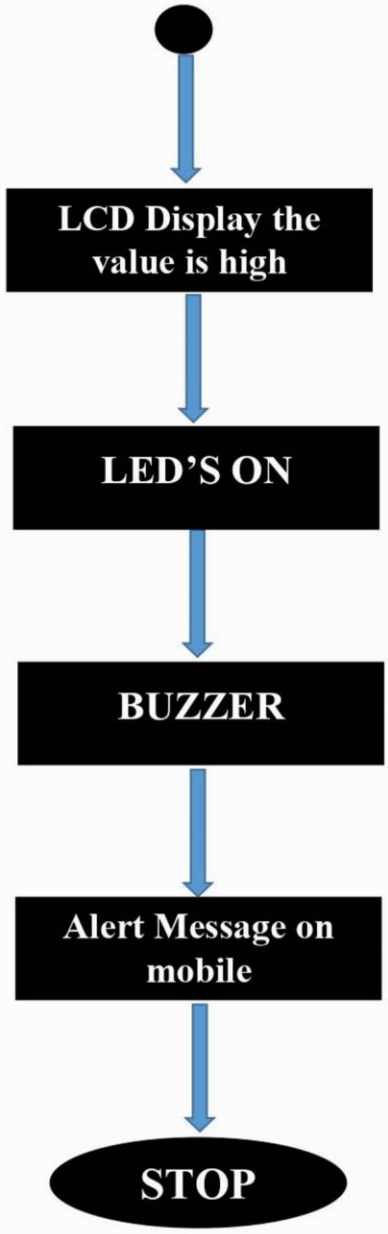
The system proves the need for gas detection alarm systems to be 100% reliable. A backup power supply can be included in the system design to augment for power failure condition. Also, calibration of the gas sensor can be done in other for a specific gas to be sensed instead of the LPG numerous gases.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

FLOWCHART

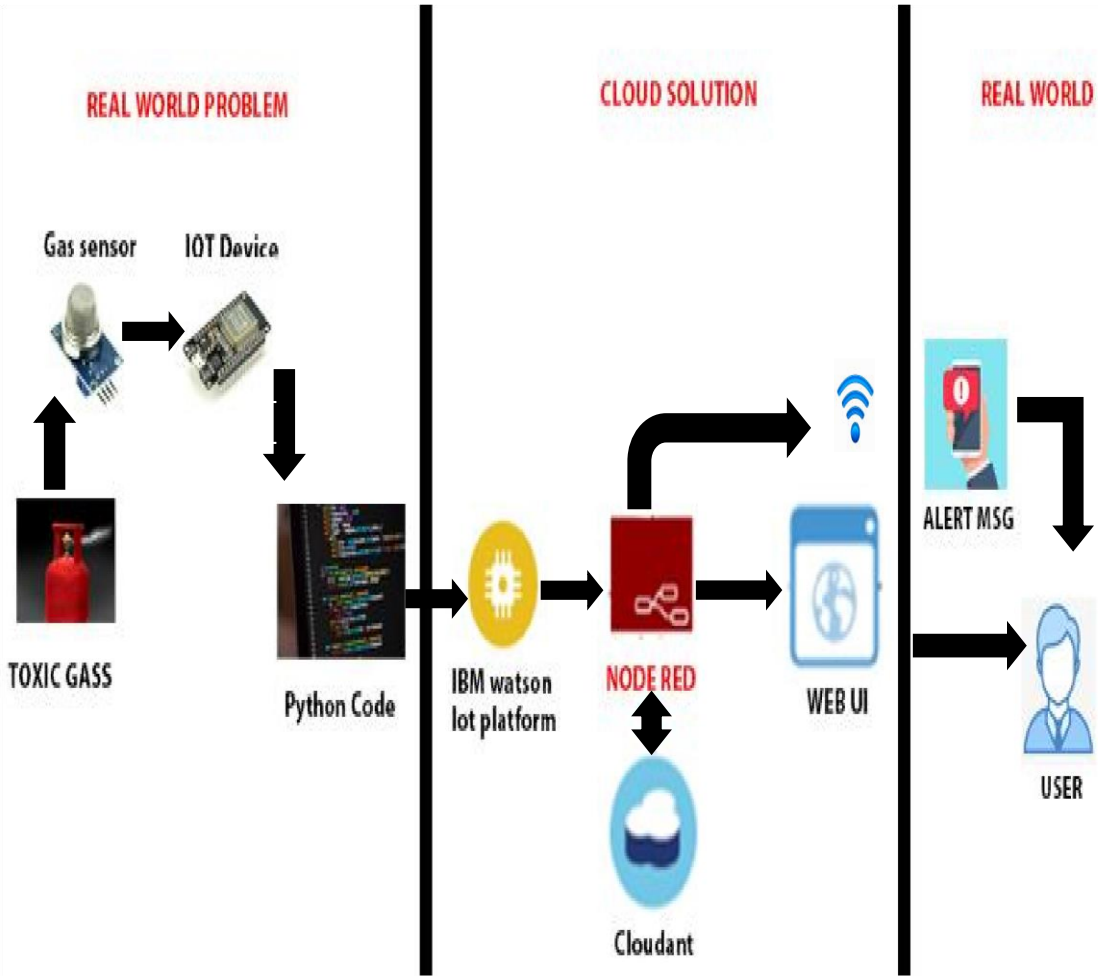



LCD Display the value is high
LED'S ON
BUZZER
Alert Message on mobile
STOP

5.2 SOLUTION AND TECHNICAL ARCHITECTURE

Components & Technologies:

INDUSTRIES

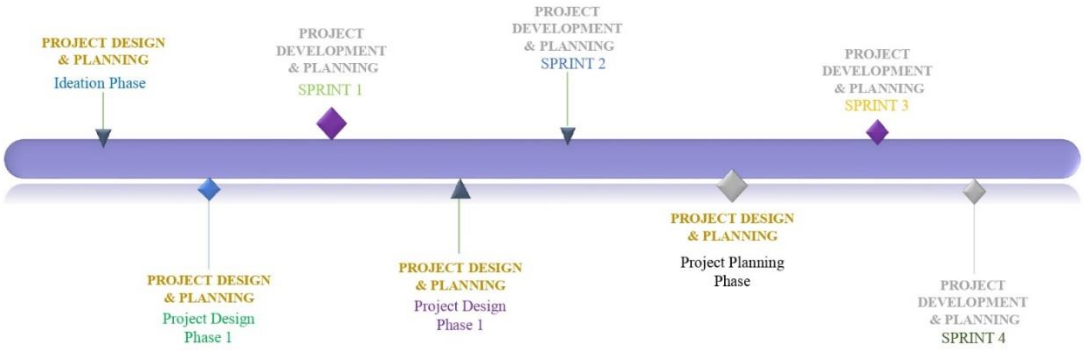


Name	Quantity		Component
Arduino uno		1	Arduino Uno R3
U1		1	LCD 16 x 2
GAS1		1	Gas Sensor
M1, M2, M3, M4		4	DC Motor
R1, R2		2	1 kΩ Resistor
Rpot1		1	250 kΩ Potentiometer
PIEZO1		1	Piezo
D1		1	Red LED
D2		1	Green LED

5.3 USER STORIES

GAS LEAKAGE MONITORING AND ALERTING SYSTEM

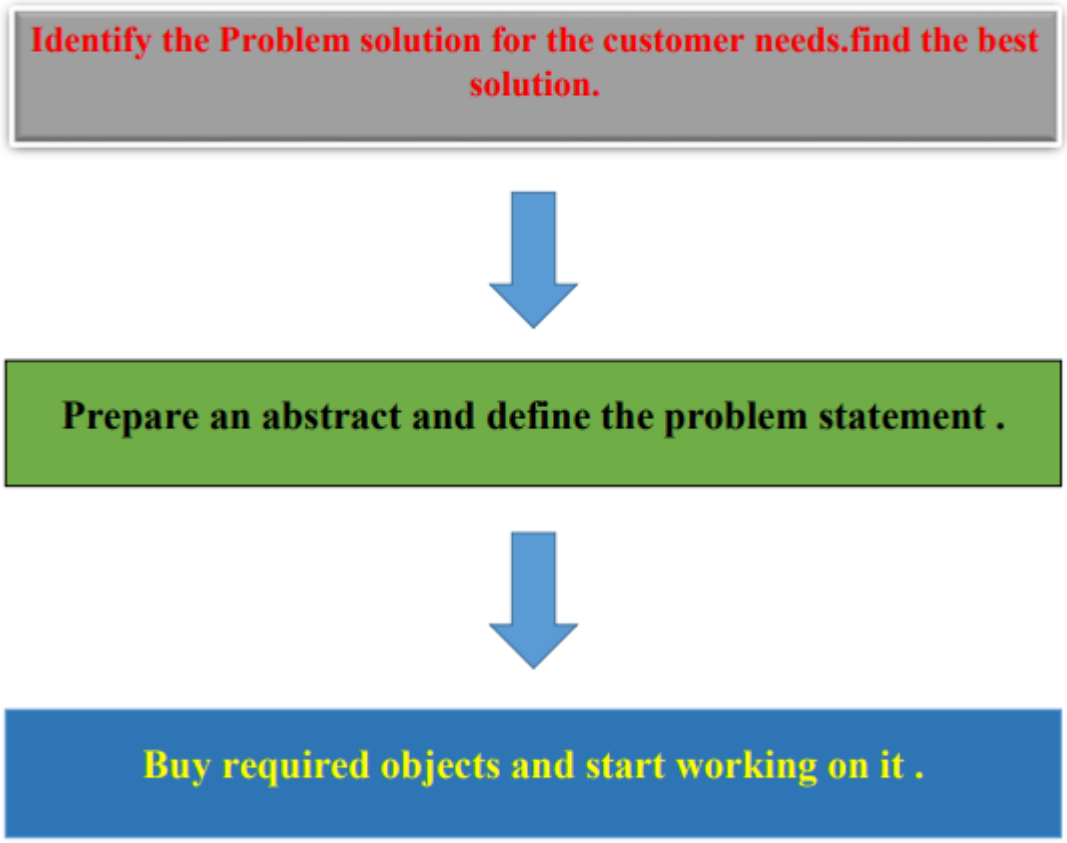
MILESTONE

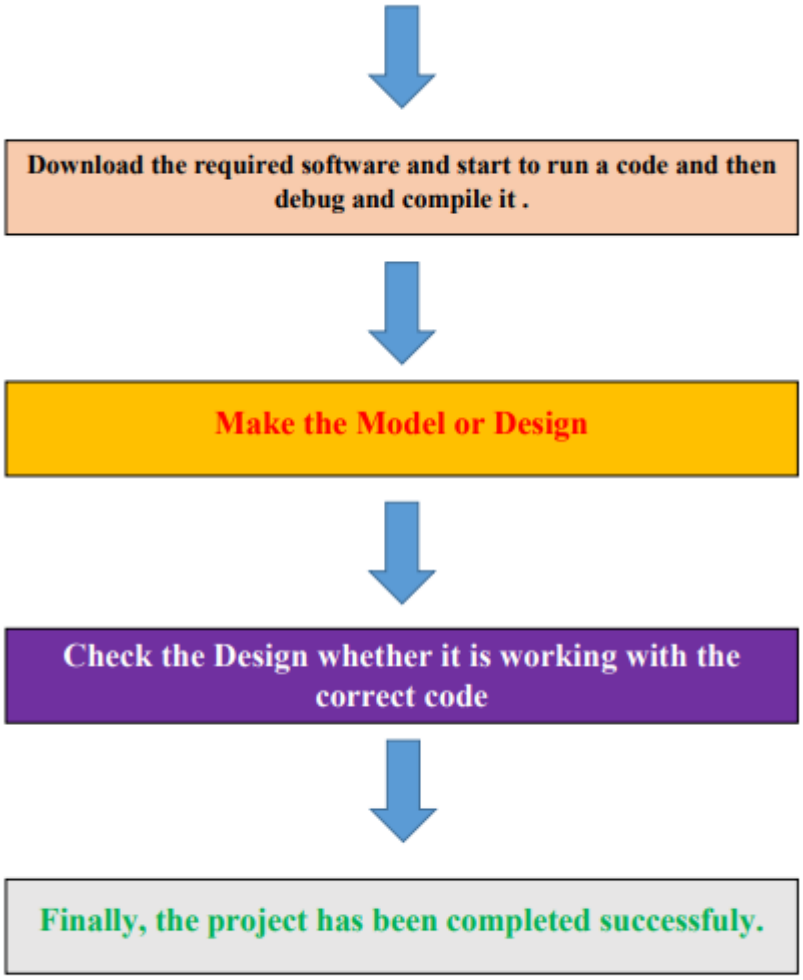


Date:13-11-2022 Team ID: **PNT2022TMID51764**

6 PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND EXECUTION





7.3 REPORTS FROM JIRA

8 CODING & SOLUTIONING

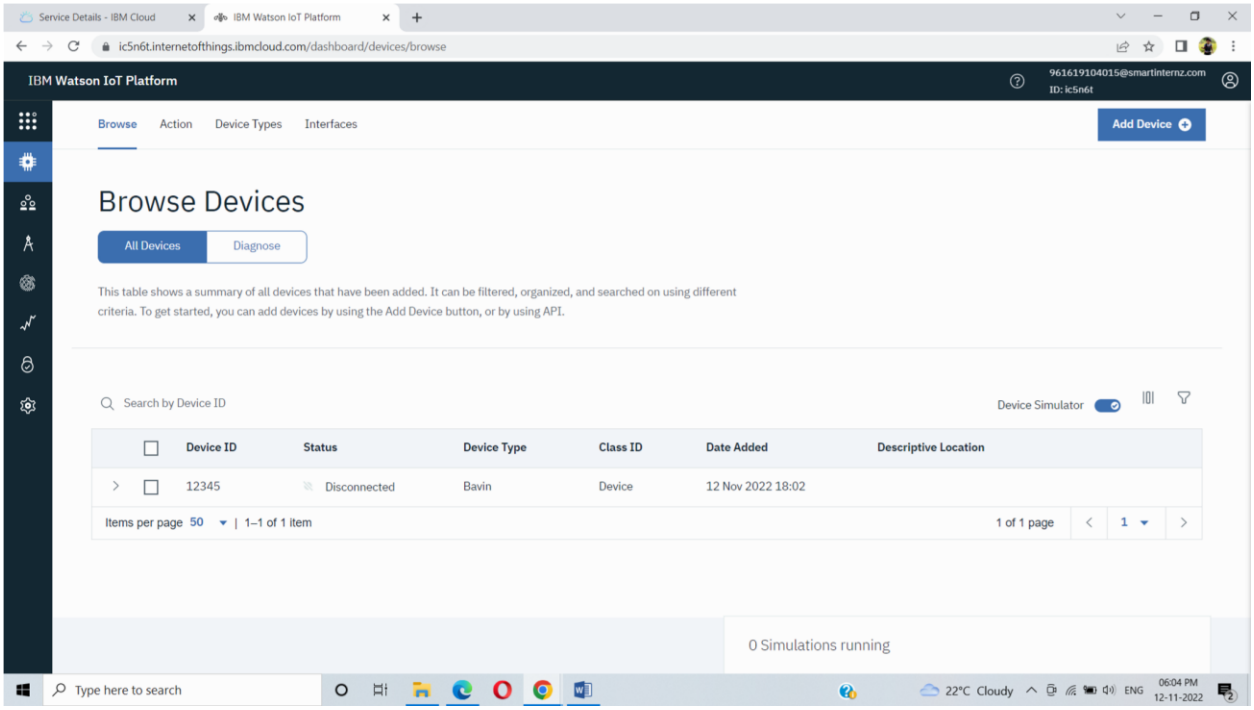
8.1 FEATURE 1

Our environment contains different gases which could be hazardous beyond certain limits. It is essential to monitor gas levels for the safety of human beings, animals and plants. There are various gas sensor technologies for detection of these different gases. We have developed a web application, which allows a user to monitor the value of temperature, humidity and gas values remotely with the help of sensors. User can monitor the values in any location and any device. We have created a cloud account which collects a real time data of sensors .In addition to that ,we had use node red open source service it will shows a graphical representation of temperature, humidity, gas values.

8.2 FEATURE 2

We have created a Android application which indicate The user about gas leakage via, SMS. The importance of Android application in our everyday life and activities is undeniably unending. This is so because there is ongoing tremendous transformation in that mobile phones are no longer the ordinary communication device it used to be. To use this application user need to login using Gmail. Application will collects data from cloud. Also it shows an exact numerical value of temperature, humidity and gas.

8.3 DATABASE SCHEMA



9 RESULTS

9.1 PERFORMANCE METRICS

The Nalaiya Thiran has introduced us into a new field associated with the help of IBM. Through this project we have learned about the various features of IBM application. Finally we have created a mobile application and web application which displays the gas pipeline location area and the measurement of the humidity and temperature which is measured by the gas sensor placed at the particular place. Using Node Red application we have integrated the sensor with our web and mobile application. Our application will displays the measured humidity and temperature value of the gas pipelines placed in the industry and remote areas. Through this project we can able to prevent from huge disaster and also save the lives of many industry workers and surrounding people.

10. ADVANTAGES & DISADVANTAGES

This project has application in our home we can also use this project in Industries, offices and Colleges

It gives the remote indication to the user about the gas leakage with the help of message.

To enhance this project we can add a GPS Modem to this system

Also we can add other sensor like smoke, alcohol sensor along with the detector circuit.

Even we can add light sensor depends on the application we need.

Through this project we can save the life of many people and also save the industry

This system enables monitoring of gas leakages in remote locations and there by leads to a faster response time in the event of a leakage condition.

The main disadvantage is that it doesn't identify very small leakages.

Accuracy of location is also need to be verified carefully is also a disadvantage

It's sensitivity depends on the humidity and the temperature is also considered as an disadvantage.

It increases the cost of digital system.

Installation of this project will be simpler.

11. CONCLUSION

In this paper we have proposed a simple solution for the monitoring of gas pipes and alert the Industry people and disaster management team if any gas leak occurs. We have achieved the alert through a mobile application and web application with the help of IBM MIT App Inverter. Early detection of toxic gases such as H2S, methane, and CO is important for avoiding dangerous, unwanted leakages leading to poisoning or explosions. Through this project we could save the life of many industry workers and the peaceful minds of their families.

12 FUTURE SCOPE

In the future we are planning for dual structure for every gas plants presented in the industry. Repeated Inspection of the industry could also reduce the impact of gas leakage. We have done the measurement of temperature, humidity and gas level. For the next upgraded release we are planned to build a map of industry in the application which will be easier for the fire fighters and disaster management department to control the situation. Also we can integrate the mobile application with household. Because the household too face the difficulties of gas explosion through the cooking cylinder (LPG), if we alert them during the LPG leak it will save the life of a home.

13. APPENDIX

Source Code

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(6, 7, 8, 9, 10, 11);
float gasPin = A0;
float gasLevel;
int ledPin = 2;
int buttonPin = 3;
int buzzPin = 4;
int buttonState;
int fan = 5;

void setup(){
  pinMode(ledPin, OUTPUT);
  pinMode(buttonPin, INPUT);
  pinMode(gasPin,INPUT);
  pinMode(fan,OUTPUT);
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.setCursor(0,0);
```

```
  lcd.print(" Welcome");
  lcd.setCursor(0,2);
  lcd.print("GAS LEAKAGE SYSTEM");
  delay(500);
  lcd.clear();

}

void loop(){
  // Read the value from gas sensor and button
  gasLevel = analogRead(gasPin);
  buttonState = digitalRead(buttonPin);
  // call the function for gas detection and button work
  gasDetected(gasLevel);
  buzzer(gasLevel);
  exhaustFanOn(buttonState);

}

// Gas Leakage Detection & Automatic Alarm and Fan ON
void gasDetected(float gasLevel){
  if(gasLevel >= 300){
   digitalWrite(buzzPin,HIGH);
    digitalWrite(ledPin,HIGH);
    digitalWrite(fan,HIGH);
    lcd.setCursor(0,0);
   lcd.print("GAS:");
```

```
    lcd.print(gasLevel);
   lcd.setCursor(0,2);
   lcd.print("ALERT!! PLEASE EVACUATE");
   delay(1000);
  }else{
   digitalWrite(ledPin,LOW);
    digitalWrite(buzzPin,LOW);
    digitalWrite(fan,LOW);
    lcd.setCursor(0,0);
   lcd.print("GAS:");
    lcd.print(gasLevel);
   lcd.setCursor(0,2);
   lcd.print("NORMAL");
   delay(1000);
   lcd.clear();
  }
}

//BUZZER
void buzzer(float gasLevel){
if(gasLevel>=300)
  {
  for(int i=0; i<=30; i=i+10)
  {
  tone(4,i);
  delay(1400);
  noTone(4);
```

```
  delay(400);
  }
  }
}

// Manually Exhaust FAN ON
void exhaustFanOn(int buttonState){
  if(buttonState == HIGH){
    digitalWrite(fan,HIGH);
    lcd.setCursor(0,0);
   lcd.print("Button State:");
    lcd.print(buttonState);
    lcd.setCursor(0,2);
    lcd.print("ALERT!! PLEASE EVACUATE");
    delay(10000);
  }
}
```

14.GitHub & Project Demo Link:

https://github.com/IBM-EPBL/IBM-Project-5514-1658770963.git

https://app.flonnect.com/view/video/jobb33ann/6378a668e746641a4b9a5d90