

Gas Leakage Monitoring and Alerting system for Industries

A PROJECT REPORT Submitted by

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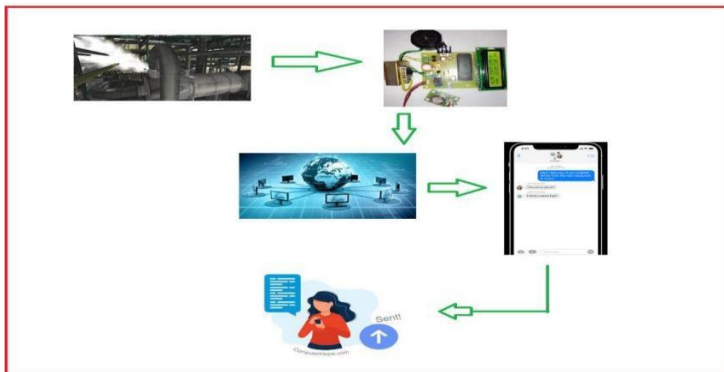
ABSTRACT

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

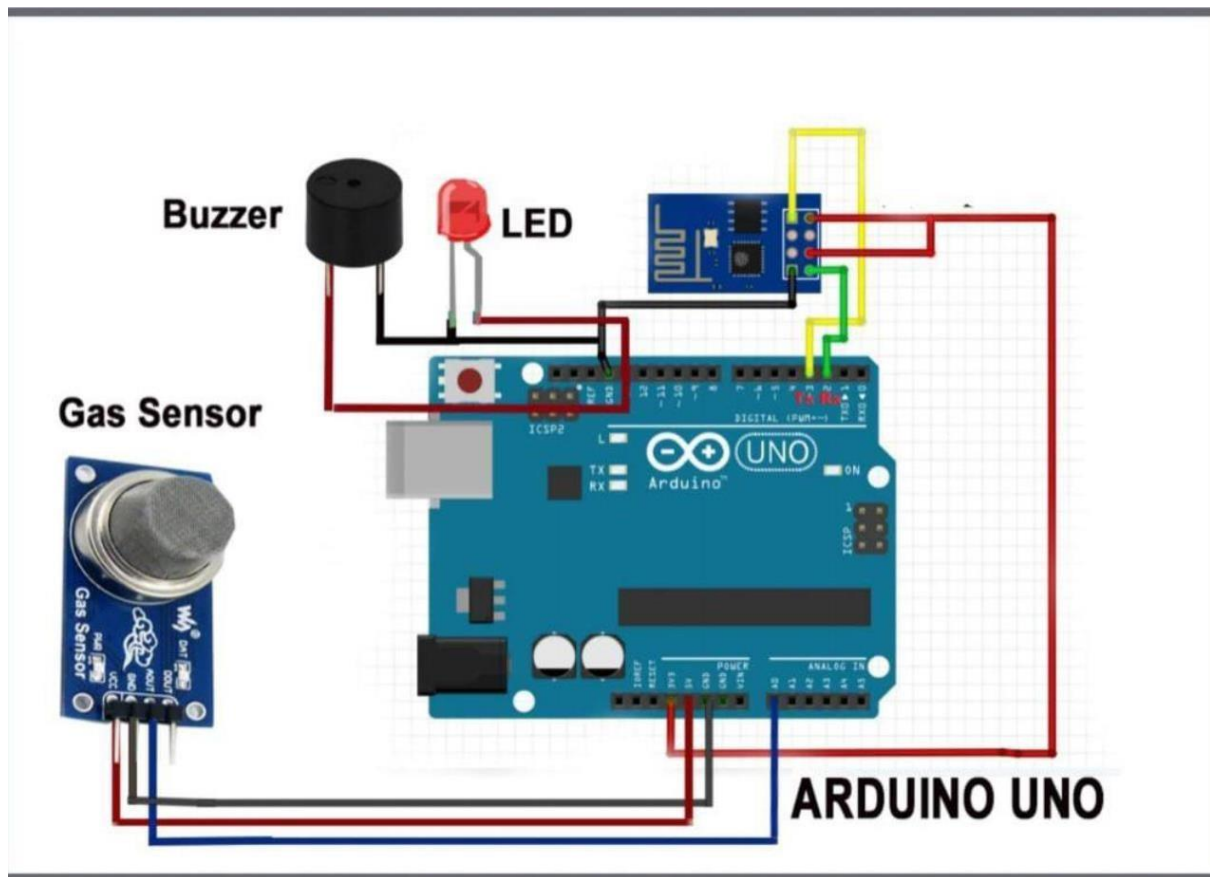
CHAPTER -1

1.1 INTRODUCTION TO IOT

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.

1.2 SCOPE:

- The future scope is regarding to minimize the problem of Gas leakage Accidents and for reducing overall cost of other commercial Gas sensor products.
- Also, in order find the amount of temperature and humidity is sensed by the sensor and control action to take automatically to turn off the gas generated.

1.3. Project Overview:

The main aim of smart gas management system includes a Gas sensor, humidity sensor and temperature sensors to detect any changes in the environment. Based on the temperature readings and if any Gases are present the warning will be sent and the exact location in which the gas leakage has been occurred.

1.4. Purpose:

The primary purpose of a Gas management system is to design, manage, plan and co-ordinate appropriate Gas safety procedures to reduce the risks of Gas and to ensure the safety of building occupants. A complete gas management system ensures legal compliance and protection of lives and assets.

CHAPTER-2 LITERATURE SURVEY

Gas Leakage Detection and Smart Alerting and Prediction Using IoT:

IoT is an expanding network of physical devices that are linked with different types of sensors and with the help of connectivity to the internet; they are able to exchange data. Through IoT, internet has now extended its roots to almost every possible thing present around us and is no more limited to our personal computers and mobile phones. 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 having Smart Alerting techniques involving calling, sending text message and an e-mail to the concerned authority and an ability to predict hazardous situation so that people could be made aware in advance by performing data analytics on sensor readings.

Internet of Things is being used everywhere in order to ease our daily tasks and improve the quality of life. There are innumerable modules that could be thought of for smart homes and cities and one of them are discussed below:

A. Gas Detection Systems:

This is the system which has been discussed in this paper.

The versatile nature of this system comes because of the fact that the same system with a change in the type and number of sensors can be used in different places. They can be used at homes, buildings, industries for detecting LPG, Propane, Methane or any other harmful gas leakages (discussed in this paper) and with some changes could be used in cities for detecting air pollution and performing analytics on the sensor readings to predict and prevent dangerous situations.

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SENSORS USED:

When it comes it to security of the kit as well as gas container we have an MQ-2(gas sensor), LM 35(temperature sensor), which will detect the surrounding environment for any chance of error. Whenever any change is subjected in any of the sensors (load cell, LM35, Mq-2) a siren (60db) is triggered.

A. LM 35 (temp. sensor):

For the sensors, if any fire is to be happened then the temperature sensor will sense an high change(positive change) in temperature and will send an pulse to microcontroller which intern will send an update to the internet through IoT, and as well it will trigger an siren alarm in the RF Rx kit(sub board).

B. MQ-2 (Gas Sensor):

MQ 2 sensor is basically an LPG (liquefied petroleum gas) which is composed of propane & butane, so when a gas leakage is sensed by the sensor it will send an high pulse to the MQ-2 which will update it in the IoT, and even an buzzer is heard in the RF Rx kit. And the problem can be sorted & solved. Thus the overall components & sensors play role in the paper as explained above.

Applications and Benefits of Using Gas Sensors:

Gas detection sensors are most commonly used to develop an IoT-powered system and identify the variation of toxic gases around an industrial facility. It helps benefit the factories and refineries by keeping them safe against any unexpected threats like explosions.

APPLICATIONS:

Harmful Gas Detection:

The sensing of toxic gases such as H₂S, Methane, and CO is of great importance in any industry to avoid unwanted leakage and consequences like poisoning or explosions. The presence of these gases can be easily detected in the industrial facilities and commercial buildings with the help of IoT-powered gas monitoring solution. Moreover, a gas detector or sensor device is a crucial part to carry out safe industrial operations. The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises.

Fire Hazard Prevention:

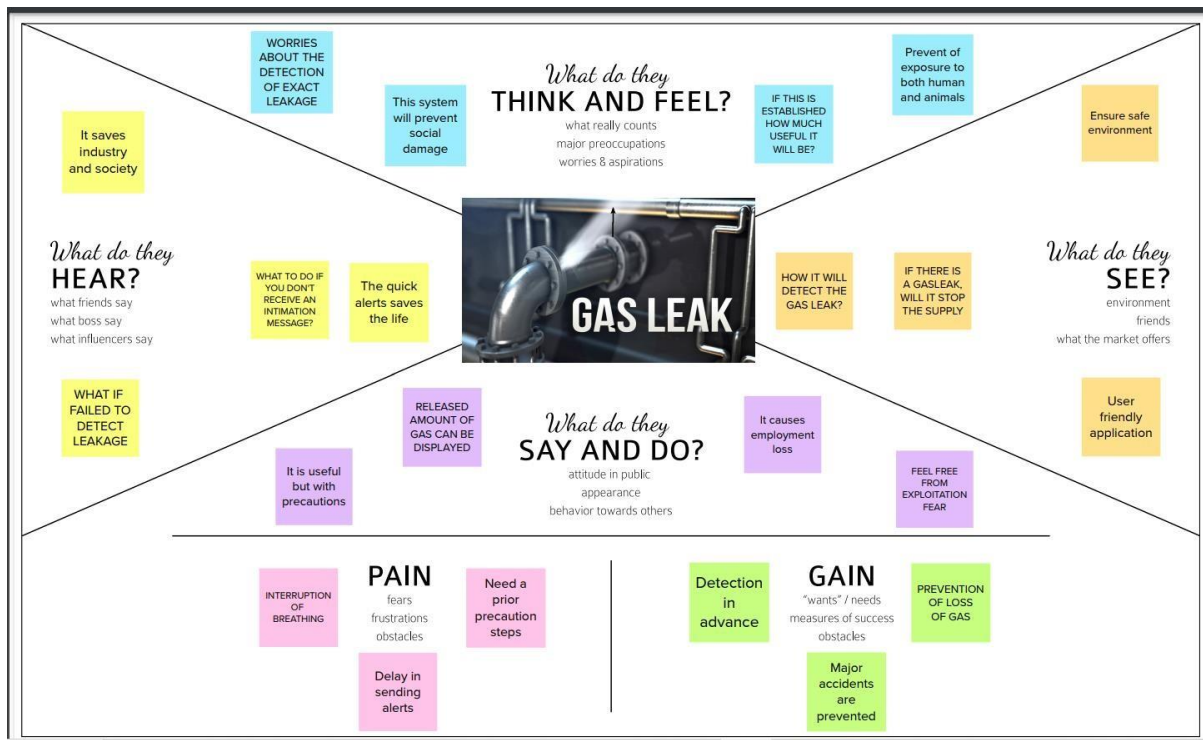
The gas sensors help detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts. Also, it is an imperative solution to keep the plant workers and equipment safe from fire hazards. It effectively detects the presence of hazardous gases like propane and methane and alerts the plant authorities, preventing the premises from unexpected ignition. Moreover, a gas monitoring solution uses gas analysers to generate alerts regarding the temperature increase. This allows the management to take immediate actions to curb harmful fire explosions.

Oxygen Level Measurement:

Sensing the presence of gases is a necessity to conduct industrial operations as several pitmen had lost their lives due to lack of oxygen in the process of mining explorations. A sudden decrease in the oxygen levels can result in dizziness, brain damage, or even death among the workers working in mines or close-packed industrial premises. A gas monitoring system significantly benefits the industries by maintaining proper oxygen levels that reflect

the optimal performance of your workers. This system also creates alerts in real-time about the decreasing oxygen levels, which gives enough time to take necessary measures to evacuate the facilities much before the health gets affected.

CHAPTER – 3 IDEATION & PROPOSED SOLUTION



Proposed Solution Template:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To ensure the safety of workers in the industries, we develop an efficient system & an application to monitor the gas pipelines continuously and detect early if there is any gas leakage in the surroundings. Generally, in industries there are some places that are too noisy. So in those areas workers can't hear the siren sound when the gas leakage alerting system alerts.
2.	Idea / Solution description	By using Arduino UNO with MQ Gas sensors it detects the Gas leakage and alerts the admin.

3.	Novelty / Uniqueness	We use location tagging and alert service so that the admin and fire department team will be notified the exact location as soon as the leakage is detected.
4.	Social Impact / Customer Satisfaction	Saves labour life and resources from fire accident.
5.	Business Model (Revenue Model)	By using : Safe from fire accidents, strong financial By without using :Fire accident, loss of lives, loss of resources.
6.	Scalability of the Solution	Alerting system over this methods offers quick response time and sends alert to people in short period of time. So that people can evacuate as fast as they can and also the workers in the industries can fix before the explosion as fast as they can. Even when the gas leakage is more, the product sense the accurate values and alerts the workers effectively

CHAPTER – 4

REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENT (Functional & non-functional)

FR No.	Functional Requirements (Epic)	Sub Requirements (Story/ Sub-Task)
FR-1	User Entry	Scan the QR code
FR-2	User Access	Real time monitoring of gas leakage systems through web portals for authorised users.
FR-3	User Alert	User receives an alert through the website.
FR-4	Review and Feedback	Suggestion boards that allow customers to submit Feedback.
FR-5	Gas Sensor	Gas sensors are used to detect and identify different types of gas leaked.
FR-6	Temperature Sensor	Temperature sensor is used to measure the temperature of its environment and converts the input data into electronic data
FR-7	Open CV	OpenCV technology accesses a camera to detect the fire (may occur due to external entities like rise of temperature) and interface with an arduino to control the water sprinkler.

FR-8	Relay	Relays whose control is taken by arduino to switch ON or OFF the water sprinkler motor.
FR-9	Water Pump Motor	Water sprinkler system that discharges water when the fire has been detected, such as when a predetermined temperature has been exceeded.
FR-10	Arduino	Open-source electronic prototyping platform interfaces with sensors, OpenCV and delivers desired alerts, data , monitoring of unsafe places and takes control measures.

Non-Functional Requirements:

NFR No.	Non Functional Requirements	Description
NFR-1	Usability	Usage of UI template of Node - Red could make well understandable representation of data like usage of gauge representation, Graphical representation, Sliders etc
NFR-2	Security	Only authorised persons have access to the system and also data transmission and handling through secured protocols
NFR-3	Reliability	Gas Sensor has an anti-explosion network which ensures the heating element does not cause explosion on interfacing with flammable gases.

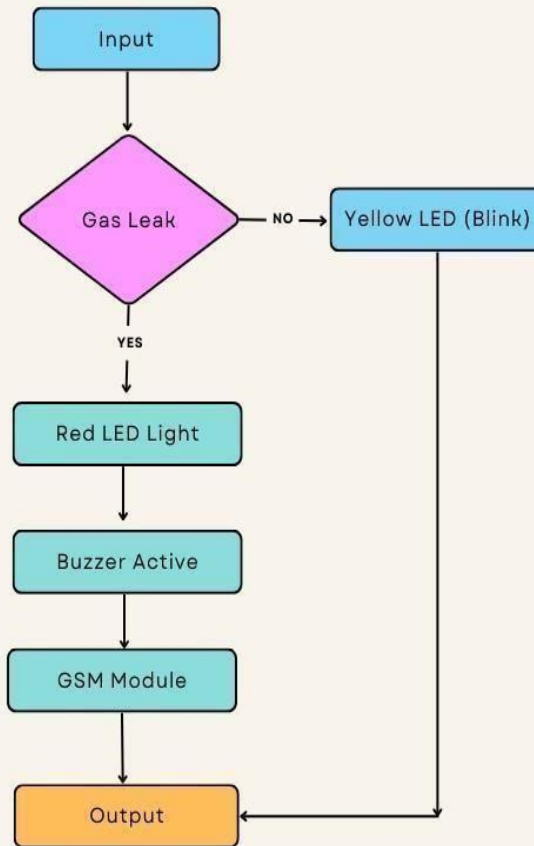
NFR-4	Performance	Faster response and high accuracy of gas leakage detection in localised areas
NFR-5	Availability	Real time monitoring system and also the user can access the website 24/7
NFR-6	Scalability	The system is scalable even in case of many gas sensors or in case of many supervisors.

CHAPTER – 5 PROJECT DESIGN

5.1: Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored. Using DFD, We created Gas Leakage Monitoring and Alerting System flow diagram.

FLOWCHART : GAS LEAKAGE MONITORING AND ALERTING SYSTEM



5.2 Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Watson IoT Platform, etc.
9.	External API-2	Purpose of External API used in the application	Fast SMS API, etc.
10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Cloudant DB, etc.

5.3 Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Python, Node RED Dashboard, MIT App Inventor, Fast SMS

2.	Security Implementation s	List all the security / access controls implemented, use of firewalls etc.	e.g. SHA- 256 , Encryptions, IAM Controls etc.
3.	Scalable Architecture	The user can also increase the range of the gas leakage monitoring system by increasing the number of sensors installed in the industry. Thus, making the system highly scalable.	
4.	Availability	It allows realtime monitoring of gas leakage system anywhere even in remote areas.	
5.	Performance	Fast SMS, Node RED provides realtime monitoring of sensor status.	

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5.	Performance	Fast SMS, Node RED provides realtime monitoring of sensor status.	e

5.4 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
Customer(higher authority)	confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
Customer (fire service 101)	Safety measure register	USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
Customer (mobile user)	Mobile application	USN-4	As a user, I can register for the application through Gmail	I can register & access the dashboard with Gmail Login	Medium	Sprint-1
Customer (credential)	Login	USN-5	As a user, I can log into the application by entering email & password	I can access my account / dashboard	High	Sprint-1
	Dashboard	USN-6	Uploading data	I can be able to upload my dataset	High	Sprint 2
Customer (Web user)	Notification	USN-7	As a user when there is a critical situation regarding a gas explosion the alert notification will be received through GSM module	The alert message is sent to the owner's mobile as an SMS.	High	Sprint 2
Customer Care Executive	Network Connectivity	USN-8	When there is a gas leakage is detected in the surrounding	The sensor detects the leakage and notifies the owner via message	High	Sprint 3
Administrator	Accessing	USN-9	When there is an issue in accessing the device	Admin/Device operator's advice should be undertaken	High	Sprint 3
		USN-10	Asking Help / feedback	I can be able to ask help if I can face any issues or problems while using the webpage	Medium	Sprint 4
		USN-11	Managing the database	I can assure that my data is in secure state	High	Sprint 4
		USN-12	Managing the over all process	I can assure that my data and process is going good	High	Sprint 4

CHAPTER – 6 PROJECT PLANNING & SCHEDULING

The definition of a sprint is a dedicated period of time in which a set amount of work will be completed on a project. It's part of the agile methodology, and an Agile project will be broken down into a number of sprints, each sprint taking the project closer to completion.

6.1 Project Planning Phase:

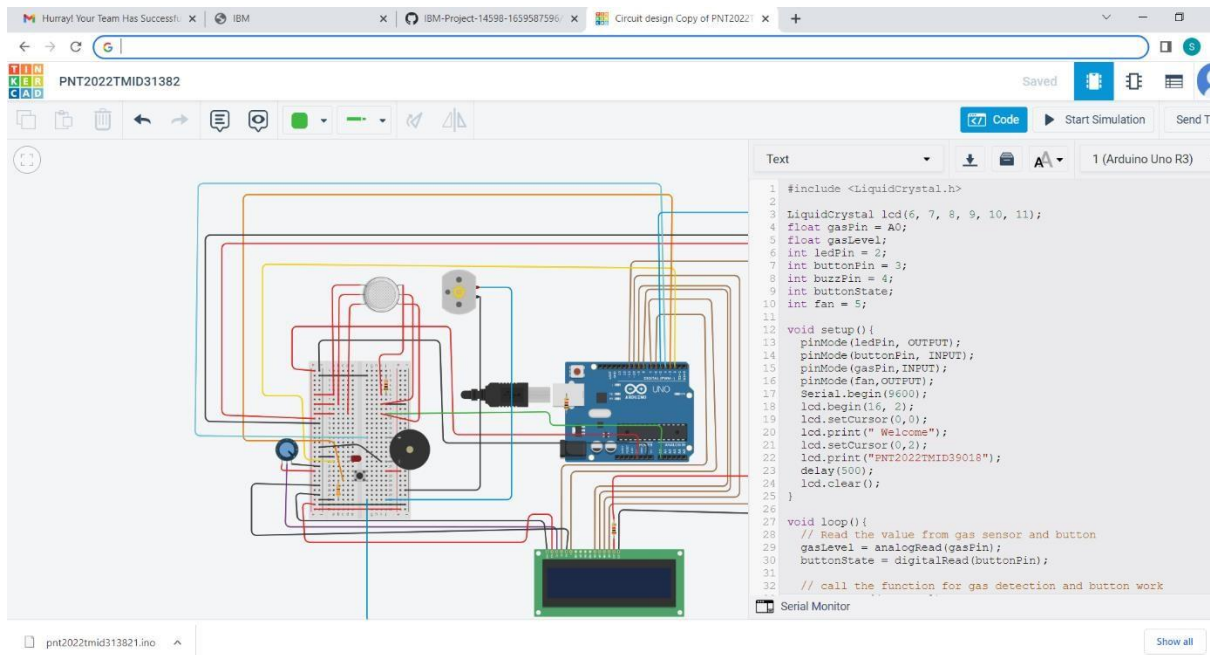
Gas Leakage alarm systems are only effective if they can generate reliable and fast fire alerts with exact location of leakage of gas. There is a direct correlation between the amount of damage caused by gas leakage and interventions time in various gas leakage alarm systems. As the time of intervention decreases, the damage also decreases. Hence the most important factor in a Gas leakage alarm system is the reaction or response time of gas leakage alarm system, that is, the time between gas detection and knowing the exact the location.

6.2 Sprint Delivery Schedule:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

CHAPTER – 7

CODING & SOLUTIONING



DEMO LINK:

<https://www.tinkercad.com/things/4KJhF8PIKtk-pnt2022tmd31382/edite1>

CHAPTER – 8 RESULTS

Measuring gas leakage is not easy and there are no simple answers to achieve this. The key to effective selection and measurement of gas leakage performance indicators is the quality of the performance standards and specifications that have been established. Performance indicators for reviewing overall performance can then be developed based on active and reactive measures that include: assessment of the degree of compliance with gas leakage detection system requirements identification of areas where the gas leakage detection system is absent or inadequate assessment of the achievement of specific objectives and plans within organizational policies and codes of practice gas and near miss data accompanied by analysis of immediate and underlying causes, trends and common features. In other words, the performance indicators should be answering questions in relation to where the organization stands in terms of aims and objectives and risk

control, along with the effectiveness, reliability, efficiency and proportionality of the management system. Indicators should also be able to indicate whether performance is getting better or worse and how well the organizational culture is supporting implementation.

CHAPTER – 9 CONCLUSION

Gas leakage detection and alarm systems are only effective if they can generate reliable and fast gas leakage alerts with exact location of fire. There is a direct correlation between the amount of damage caused by gas leakage and interventions time in various gas leakage detection and alarm systems. As the time of intervention decreases, the damage also decreases. Hence the most important factor in a gas leakage detection and alarm system is the reaction or response time of gas leakage detection and alarm system, that is, the time between fire detection and knowing the exact location.