

Gas Leakage monitoring & Alerting system for Industries

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ABSTRACT

A gas leakage refers to a leakage of natural gas or another gaseous product from a pipeline or other containment into any area where the gas should not be present. Gas leaks can be hazardous to health as well as the environment. The explosion due to gas leakage has become a serious problem in our country's daily activities. Now the world is evolving with technology, so it is necessary to use technology if possible in every case. To resolve the accident occurred we can prevent it through technology. The system is based on a microcontroller, which uses gas sensors as well as GSM, display and buzzer. It is designed for Gas Leakage Monitoring and Alert System using Arduino Mega with MQ Series Gas Sensor. This circuit contains MQ Series gas sensor, microcontroller, buzzer, display and GSM. The sensor will detect the gas leakage and transmit the information to the microcontroller. On the basis of those information, the microcontroller makes a decision and then displays a warning message on the display and the message will be sent to the user via GSM. The uses of the Arduino microcontroller with Arduino, provide a suitable platform for implementing an embedded control system and it is possible to modify it to meet our future requirements easily and quickly.

1. INTRODUCTION

1.1 PROJECT OVERVIEW:

In today's world, safety is of the utmost importance, and certain measures must be taken at both work and home to ensure it. Working or living in a dangerous environment necessitates specific safety measures, whether the subject is electricity or oil and gas. A type of natural gas known as "Liquified Petroleum Gas" (LPG) is compressed under high pressure and stored in a metal cylinder. LPG is extremely vulnerable to fire and can result in catastrophic damage if left unprotected near any fire source. LPG is primarily utilized for cooking and is more readily available than any other natural gas. Sadly, its widespread use makes gas leakage or even a blast a common occurrence. As a result, a system for detecting and monitoring gas leaks is required. Through a flame sensor, the system will keep an eye on fire and flame. The buzzer begins to ring when a fire is detected. Tests have shown that the system can keep track of the wastage of gas and leaks and notify the user. The performance that was produced showed that it was successful in reducing the amount of domestic gas that was wasted.

1.2 PURPOSE:

Nowadays the home safety detection system plays an important role in the security of people. Since all the people from the home goes to work on a daily bases, it makes it impossible to check on the appliances available at home especially LPG gas cylinder, wired circuits, Etc. In the last three years, there is a tremendous hike in the demand for 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 a large scale in industry, as heating, home appliances, and motor fuel. To monitor this gas leak, the system includes an MQ6

gas detector. This sensor detects the amount of leaking gas present in the surrounding atmosphere. In this way, the consequences of an explosion or gas leak can be avoided.

2.LITERATURE SURVEY

2.1 EXISTING PROBLEM:

A). "Monitoring and Detection of Combustible Gas Leakage by Using Infrared Imaging", Binglu Liu;Haocheng Ma;Xiaoping Zheng;Lihui Peng;Anshan Xiao, 2018

In this paper, an infrared thermal imaging system is developed for combustible gas leakage monitoring and detection. The related imaging processing and gas leakage detection algorithms are presented. The gas leakage monitoring and detection experiments regarding three different scenes, including two indoor scenes and one outdoor scene, are carried out. The preliminary results show that the proposed imaging system and the algorithms are of detecting the leakage of 1% isobutane at 0.2L/min.

B). "LPG Monitoring and Leakage Detection System", Shruthi Unnikrishnan; Mohammed Razil; JoshuaBenny; Shelvin Varghese; C. V. Hari, 2017

In this paper, we have proposed a Liquefied Petroleum Gas (LPG) monitoring and leakage detection system. With the large demand and use of LPG, this system would be helpful to monitor the usage of LPG on a regular basis and to alert about any hazards that may occur due to LPG leakage. We have designed a system that alerts the user of the amount of LPG left so that appropriate measures can be taken. Since LPG is a highly hazardous and inflammable gas, we have also designed a system to alert the user with an alarm when there is a leakage of LPG so that measures are taken to avoid an explosion.

C). "Wireless Gas Leak Detection and Localization", F. Chraim, Y. Erol & K. Pister, April 2016

Thousands of industrial gas leaks occur every year, with many leading to injuries, deaths, equipment damage, and a disastrous environmental effect. There have been many attempts at solving this problem, but with limited success. This paper proposes a wireless gas leak detection and localization solution. With a monitoring network of 20 wireless devices covering 200 m², 60 propane releases are performed. The detection and localization algorithms proposed here are applied to the collected concentration data, and the methodology is evaluated. A detection rate of 91% is achieved, with seven false alarms recorded over 3 days, and an average detection delay of 108 s. The localization results show an accuracy of 5 m. Recommendations for future explosive gas sensor design are then presented.

D). "IoT and ML based Smart System for Efficient Garbage Monitoring: Real Time AQI monitoring and Fire Detection for dump yards and Garbage Management System", Dev V. Savla;Amogh N. Parab;Kaustubh Y. Kekre;Jay P. Gala;Meera Narvekar, 2020

There is always a significant amount of challenges associated with waste and its disposal, which can be essentially mitigated by the use of technology. As the urban population increases, the amount of waste disposal is also increasing at an unprecedented rate. The inappropriate disposal of this waste will lead to many hazards including the risk of fires in the dump yards that leverages poisonous smoke in the atmosphere by adversely affecting the safety of nearby residential areas. Monitoring the occurrence of fire in huge dumping grounds manually is a tough task and thus developing an automatic fire extinguishing system is highly required. The advanced technologies can be leveraged to ensure the protection and safety of people by eliminating such hazardous risks. The air quality index (AQI) is an indicator of daily air quality report that shows how air quality affects a person's life in a very short time. AQI plays a key role in ensuring the safety of

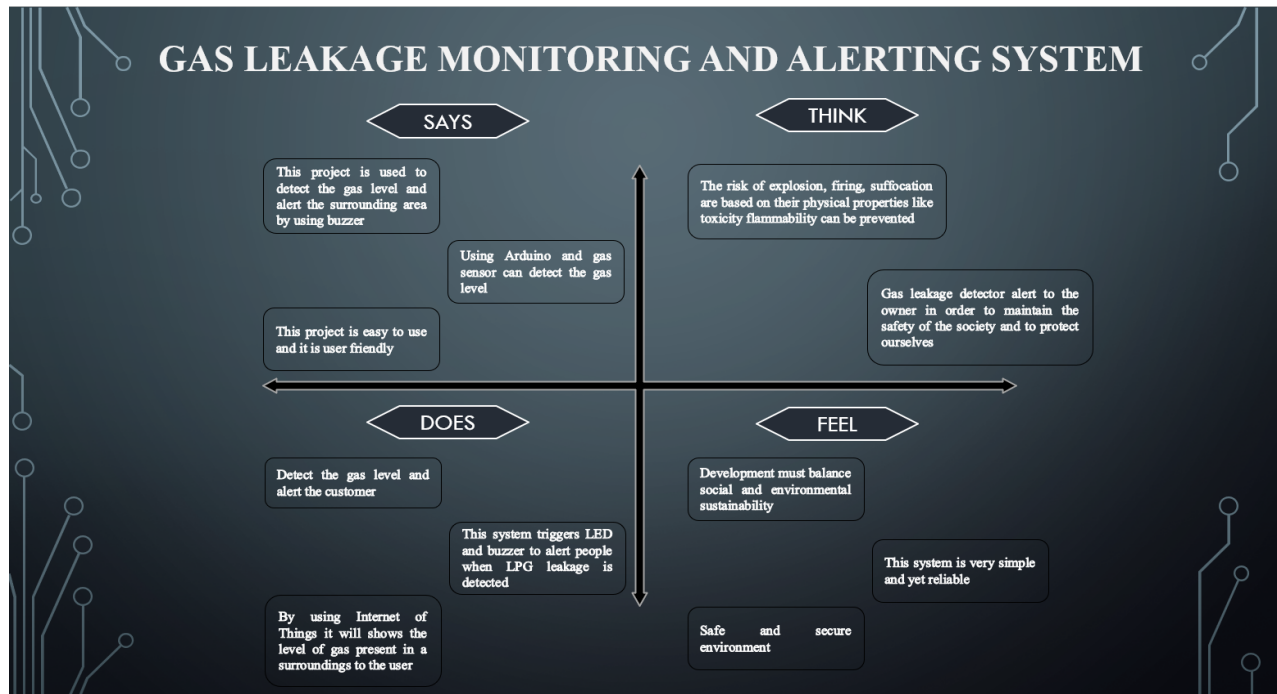
residential areas. The proposed system aims to aid the possible hazardous risks associated with the dump yard and waste management.

E). "A Smart Natural Gas Leakage Detection and Control System for Gas Distribution Companies of Bangladesh using IoT", Hilton Paul; Mohammad Khalid Saifullah; Md. Monirul Kabir, 2021

This paper proposes a smart mobile based model of gas leakage detection and control for gas distribution system of Bangladesh using IoT, called as smart natural gas leakage detection and control system (SNLDCS). The proposed SNLDCS has been implemented in both software and hardware modules. The existing researches are about Liquefied Petroleum Gas (LPG) leakage detection that are used for cylinder gas. Therefore, these models are not suitable for gas distributions companies of Bangladesh where natural gas leakage is being controlled from remote places. The experimental results confirm that, implementation of SNLDCS model in gas distribution system in Bangladesh can provide the quickest detection and rapid resolve of gas leakage. As a result, it will increase safety, decreases system loss and reduces Greenhouse Gas (GHG) emission in the air.

3.IDEATION & PROPOSED SYSTEM

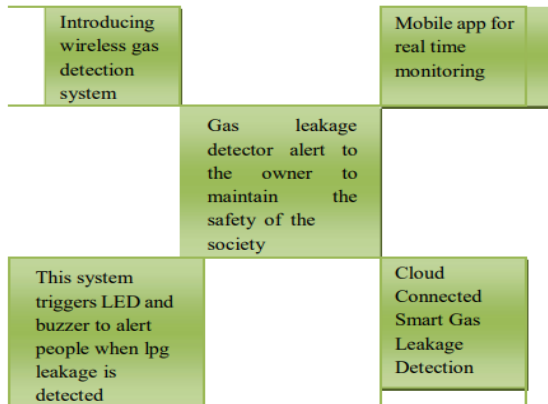
3.1 EMPATHY MAP CANVAS:



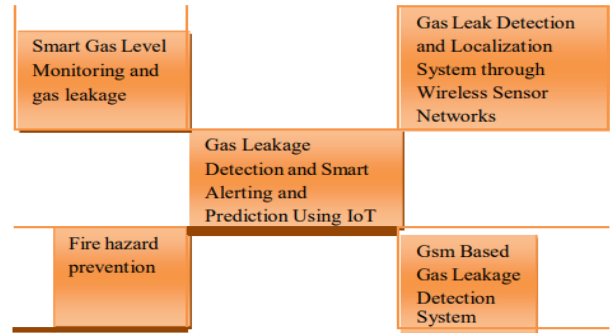
3.2 IDEATION & BRAINSTORMING:

Brain storming

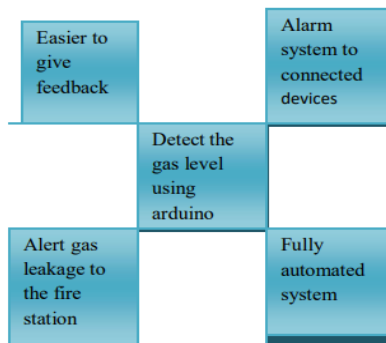
TAMILMANI



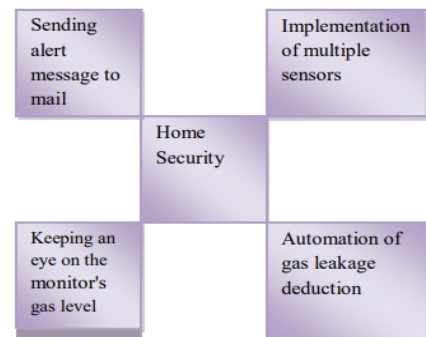
KARTHIKA



ROHITH SANKAR

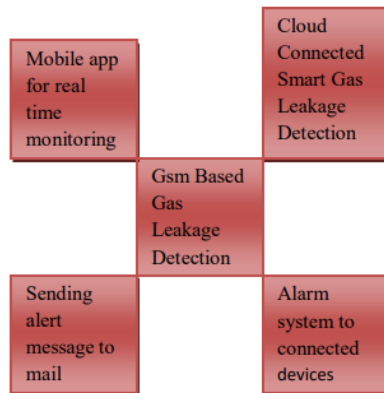


NINSHIYA MARY

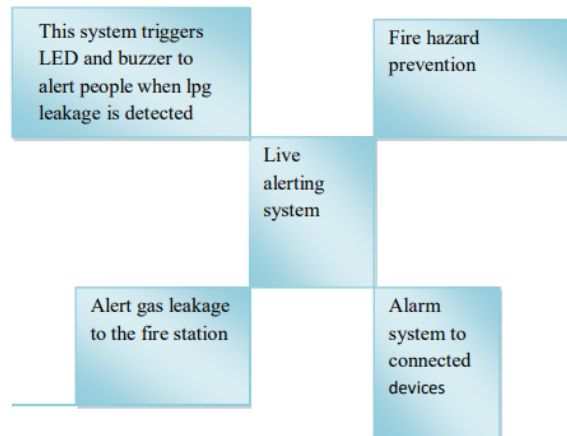


Group ideas

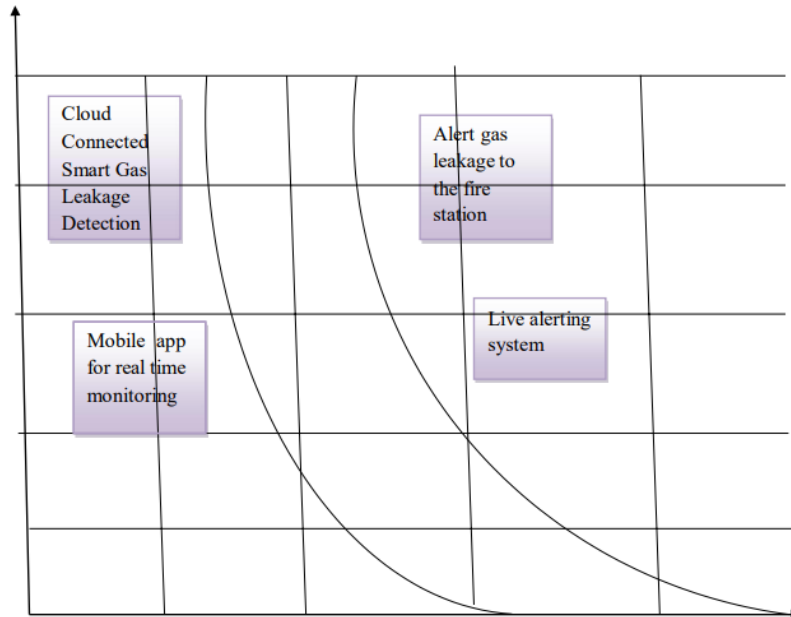
Network based



Alerting systems



Prioritize



3.3 PROPOSED SOLUTION:

S.No	Parameter	Description
1.	Problem Statement	This project helps industries monitor the emission of harmful gases. In several areas, the gas sensors will be integrated to monitor the gas leakage. The leakage of gases only can be detected by human nearby and if there are no human nearby, it cannot be detected by human that has a low sense of smell. Thus, this system will help to detect the presence of gas leakage
2.	Idea/Solution description	The proposed system that uses the sensor which is capable of detecting hazardous gases like LPG and propane were sensed and displayed 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 (SMS) is sent to the authorized person through the GSM.
3.	Novelty/Uniqueness	<ul style="list-style-type: none">• Ability to predict the hazardous gases like lpg and propane• User friendly• Live alert to the workers
4.	Social Impact / Customer Satisfaction	<ul style="list-style-type: none">• Low cost• Compact size• Easy to use without fear
5.	Business Model(Revenue Model)	<ul style="list-style-type: none">• The product is advertised all over the platforms, because it is economical and easy to use• As the product usage can be understood by everyone it is easy for them to use it properly without fear
6.	Scalability of the Solution	Includes some safety measurements

3.4 PROBLEM SOLUTION FIT:

1. CUSTOMER SEGMENTS <ul style="list-style-type: none"> Large industries where heavy equipments are used in which gas leakage is possible these industries admins are our major customer Sometimes it is hard to identify the area where the leakage occurs 	6. CUSTOMER CONSTRAINTS <ul style="list-style-type: none"> Proper maintenance should be taken at least once in a month and this prevents the customers from taking actions in gas leakage problem. 	5. AVAILABLE SOLUTIONS <ul style="list-style-type: none"> Usage of sensors to sense gas Leakage. Buzzer to indicate the leakage. GSM module helps us to get notification when there is a gas leakage.
2. JOBS-TO-BE-DONE / PROBLEMS <ul style="list-style-type: none"> Most of GAS explosions are caused by undetected gas leakage in the pre detection condition So that the gas leakage monitoring and alerting system is needed The purpose of the system is to detect the gas leakage neutralize it and prevent explosion 	9. PROBLEM ROOT CAUSE <ul style="list-style-type: none"> Some of the faults in the machines, leakage by the machines, people carelessness in workplace and life security 	7. BEHAVIOUR <ul style="list-style-type: none"> Network issue is very common as most of the industries are located at the country side. Here contact both the developers and the service providers. To determine the gas characteristics and solve the issue, they will locate the leak and identify the warning.
3. TRIGGERS <ul style="list-style-type: none"> The trigger varies from the incorrect installation to the use of defective gas cylinders. Employee and organization safety triggers this installation 4. EMOTIONS: Before/After <ul style="list-style-type: none"> Before the action is taken the user feels deceived and cheated. After the problem is resolved user feels the sincerity of the developer 	10. YOUR SOLUTION <ul style="list-style-type: none"> Low cost IOT based device that can be easily accessed and fixed by people. Network strength must be boosted in the device. Device can be manufactured in multiple standards based on the environment. 	8. CHANNELS OF BEHAVIOUR <p>ONLINE</p> <ul style="list-style-type: none"> Sending messages via gsm <p>OFFLINE</p> <ul style="list-style-type: none"> Prevent physical damage to sensor. Provide proper network and power supply to sensors. Complaint letters. Alarm generates high noise which provides warning

4.REQUIREMENT ANALYSIS:

4.1 FUNCTIONAL REQUIREMENT:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Gas Leakage detection	Gas leakage detection through gas sensors
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Hardware Requirement	Optical, Soil, Ultra flow meter
FR-4	Precaution Steps	Automatically turn off the gas knob.
FR-5	Easy to implement	IOT application with Arduino
FR-6	User welfare	Reliable in all environmental conditions.

4.2 NON - FUNCTIONAL REQUIREMENT:

Following are the non-functional requirements of the proposed solution.

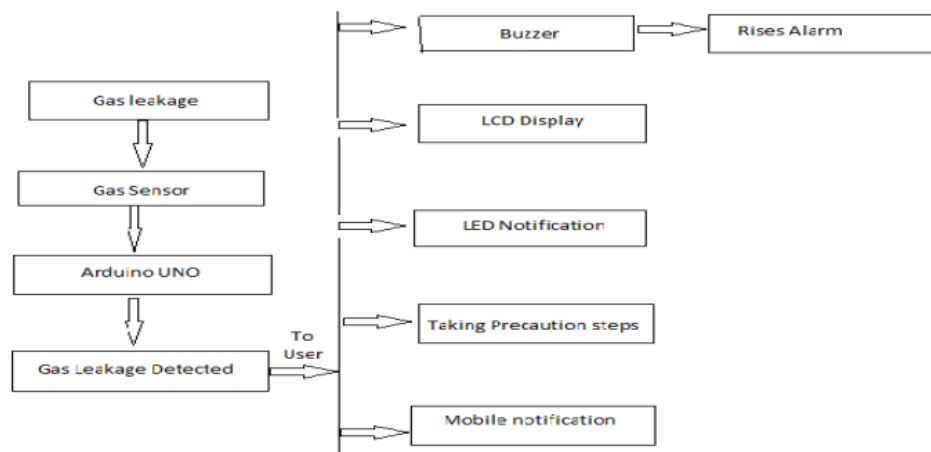
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The sensor enabled solution helps in preventing the high risk of gas explosions and rises an alarm to detect the release of gases and sends the notification to the user.
NFR-2	Security	The devices is intended for use in household appliances and to ensure safety to people.
NFR-3	Reliability	Detects the gas accurately and sends the alerting message to user soon after the incident happened.
NFR-4	Performance	Whenever there is a leak , automatically detects the release of gas and alerts the user within 5 minutes to prevent from causing any accidents.
NFR-5	Availability	Can be used anywhere ,presented here for low cost circuit that can build easily.
NFR-6	Scalability	The system proves the gas of detection alarm system is 100% reliable and detects different types of gases

5.PROJECT DESIGN:

5.1 DATA FLOW DIAGRAM:

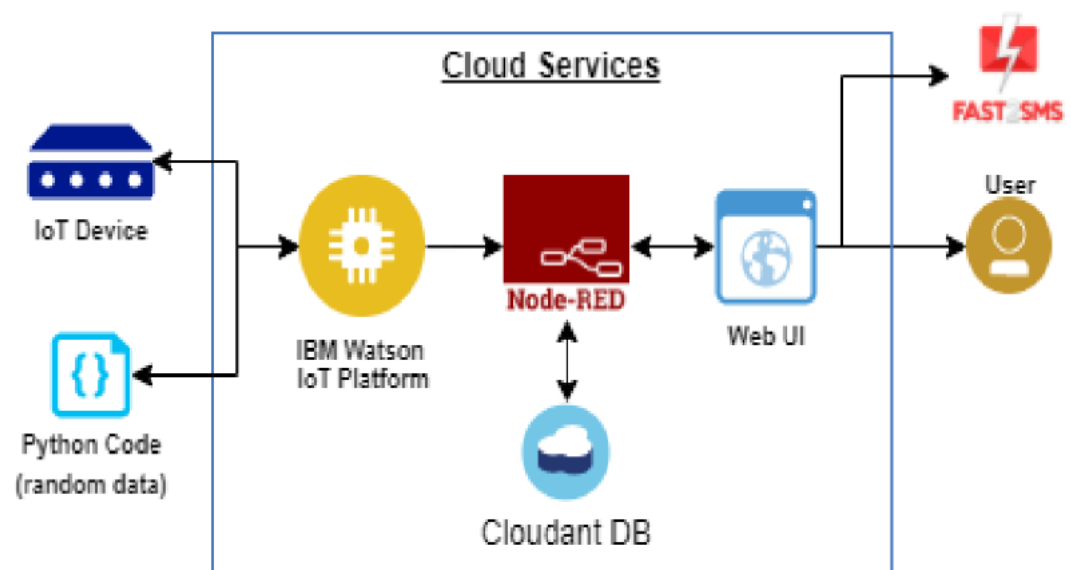
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Data Flow Diagram for – GAS LEAKAGE MONITORING AND ALERTING SYSTEM:



5.2 SOLUTION AND TECHNOLOGY ARCHITECTURE:

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2



6.PROJECT PLANNING AND SCHEDULING:

6.1 SPRINT PLANNING AND ESTIMATION:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my Gmail, email then you can receive the OTP or Verification Code.	2	High	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY
Sprint-1		USN-2	As a user, I will receive confirmation Gmail or email once I have registered for the application.	1	High	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY
Sprint-2		USN-3	As a user, I can register for the application through Gmail and phone number.	2	Low	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY
	Dashboard	USN-6	Once confirmation message received after login the system and Check Credentials After checking credentials, go to Manage modules.	2	High	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY
		USN-7	In this manage modules described the below functions like Manage System Admins Manage Roles of User Manage User permission and etc..	2	Medium	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY
	Logout	USN-8	Then check Temperature, humidity and moisture after then logout or exist the application.	1	Medium	TAMILMANI KARTHIKA ROHITH SANKAR NINSHIYA MARY

Project Tracker, Velocity & Burndown Chart: (4 Marks)

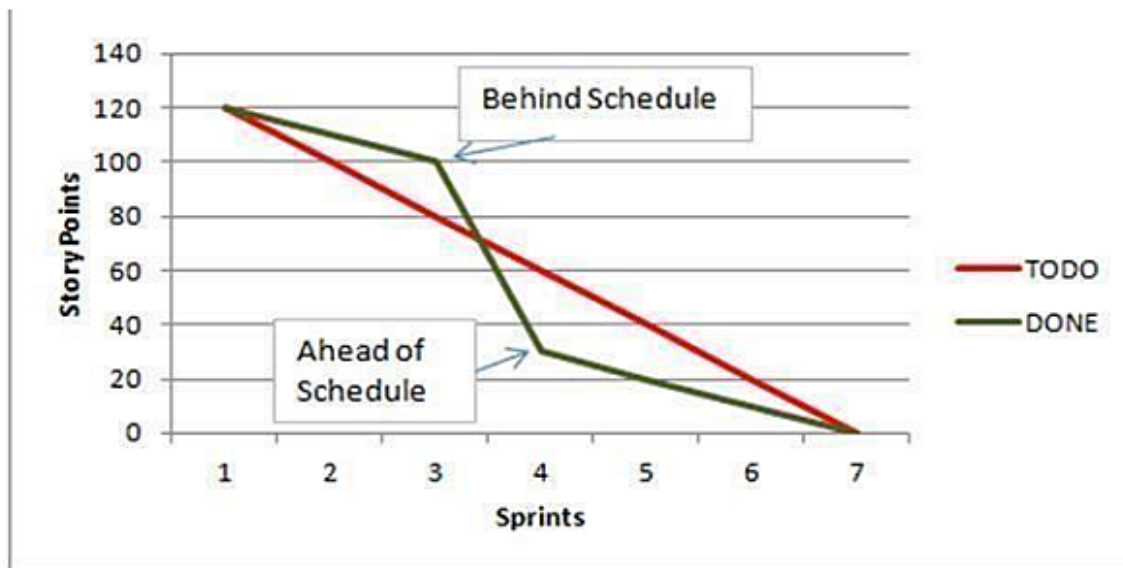
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date(Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	35	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	45	05 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	07 Nov 2022

Velocity:

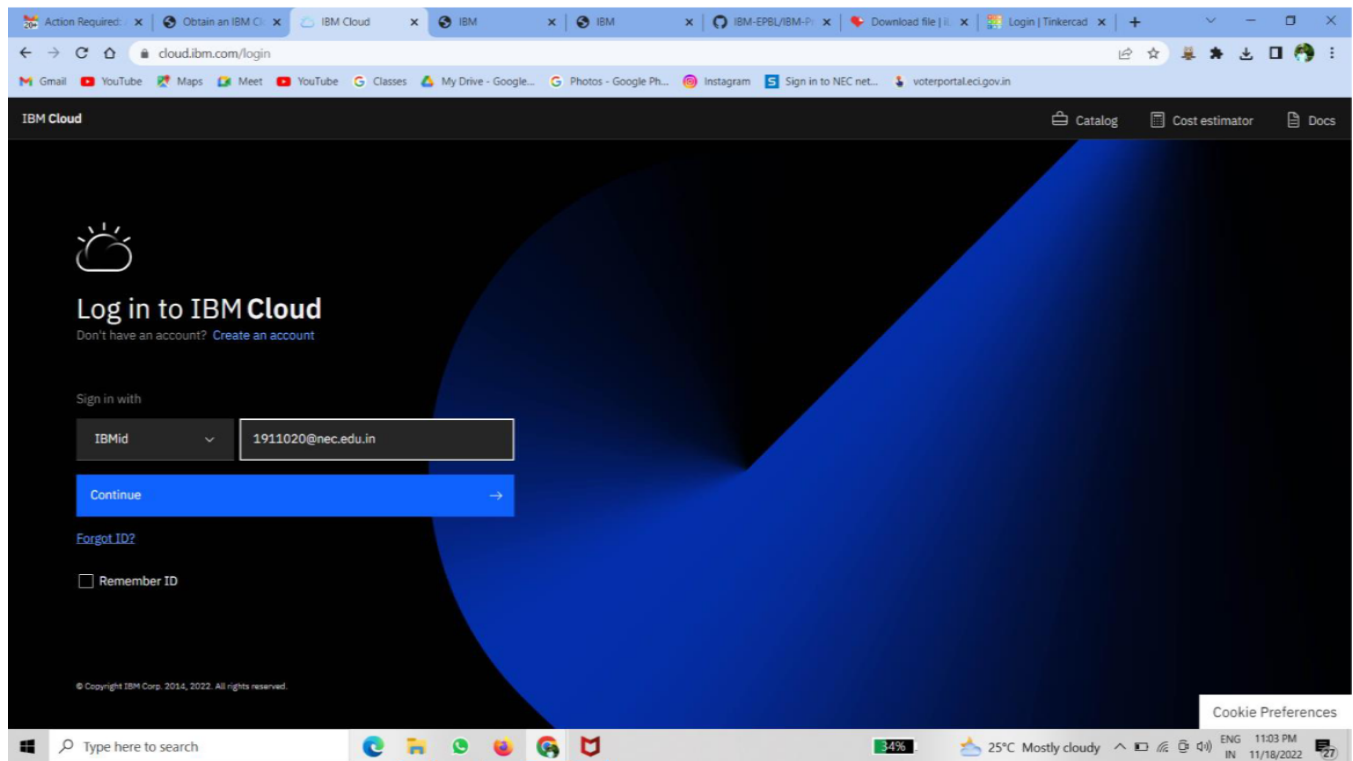
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

Burndown Chart:



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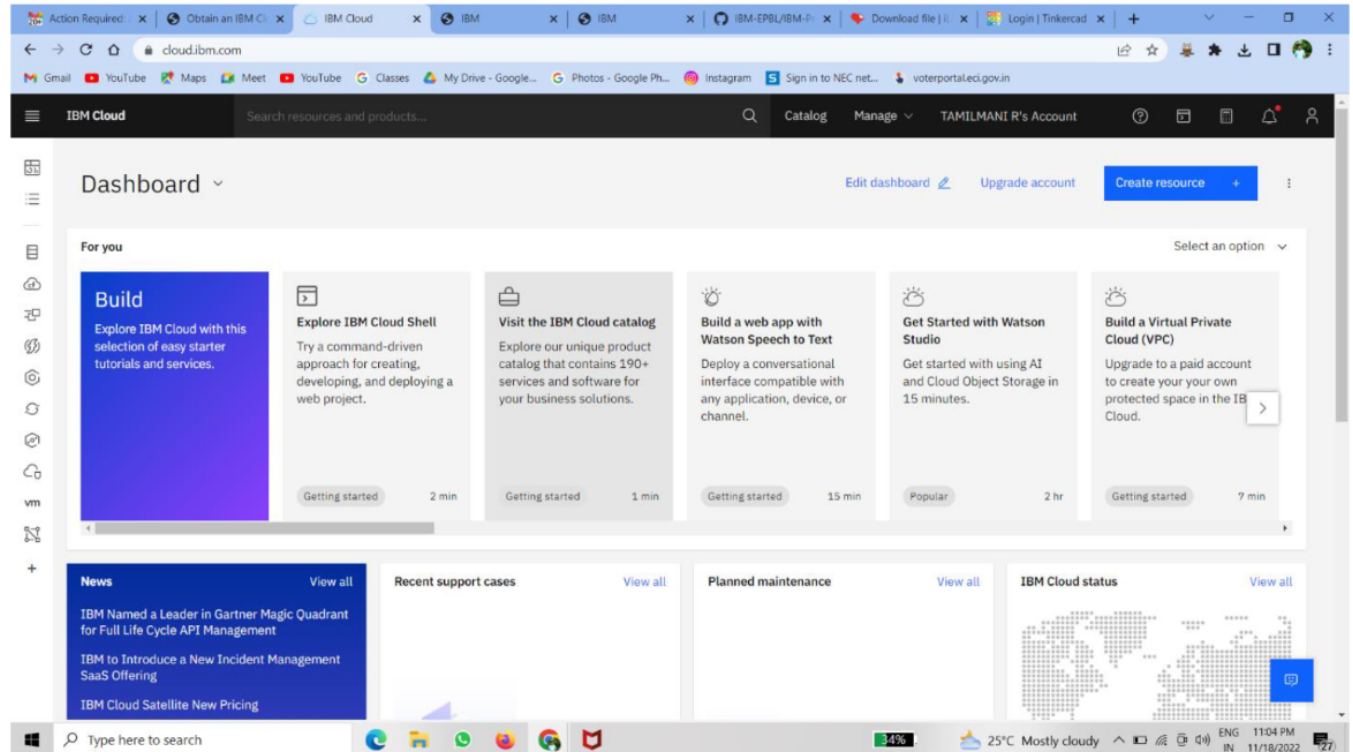
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Browse Action Device Types Interfaces

Identity Device Information Recent Events State Logs

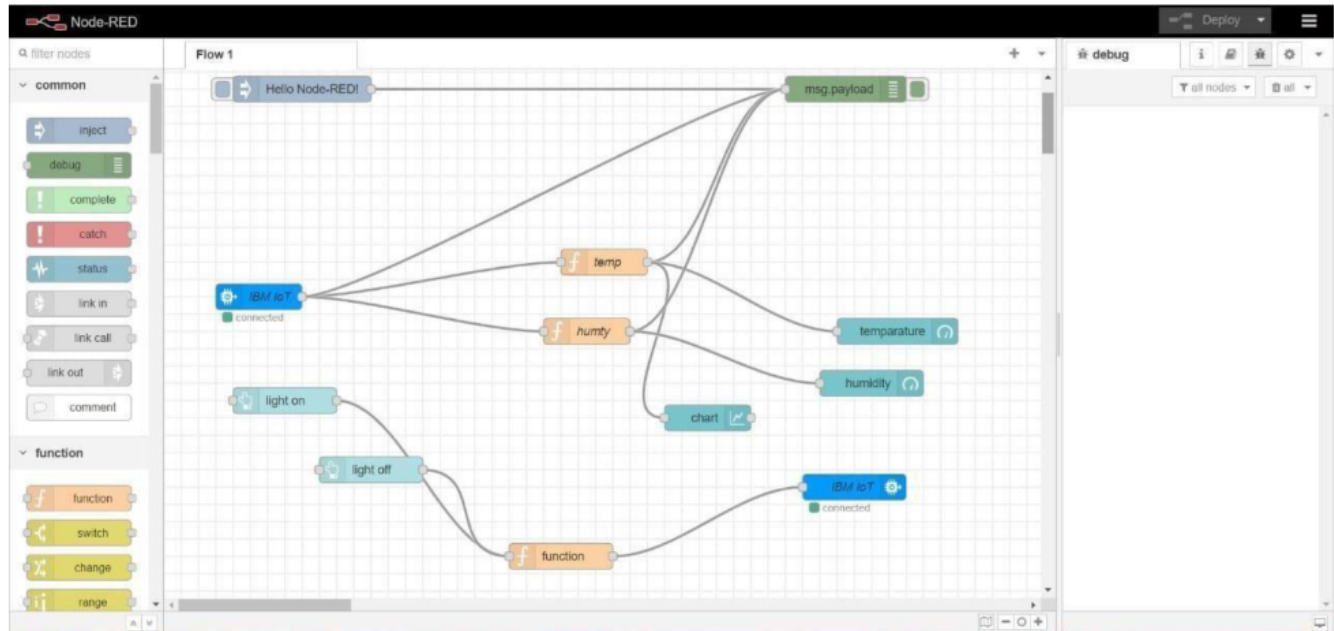
The recent events listed show the live stream of data that is coming and going from this device.

Event	Value	Format	Last Received
Data	{"Distance":95.94,"ALERT!":"Distance less than ...	json	a few seconds ago
Data	{"Distance":86.99,"ALERT!":"Distance less than ...	json	a few seconds ago
Data	{"Distance":86.96,"ALERT!":"Distance less than ...	json	a few seconds ago
Data	{"Distance":86.96,"ALERT!":"Distance less than ...	json	a few seconds ago
Data	{"Distance":87.01,"ALERT!":"Distance less than ...	json	a few seconds ago

Items per page 50 | 1-1 of 1 item

1 of 1 page

IMB NODE-RED SERVICE



Advantages:

- Detect the concentration of the gases
- The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises.
- Get real-time alerts about the gaseous presence in the atmosphere
- Prevent fire hazards and explosions
- Ensure worker's health
- Real-time updates about leakages
- Cost-effective installation
- Measure oxygen level accuracy
- Get immediate gas leak alerts

Disadvantage:

- Get immediate gas leak alerts
- When heavy dust, steam or fog blocks the laser beam, the system will not be able to take measurements

CONCLUSION:

Gas leakage leads to severe accidents resulting in material losses and human injuries. Gas leakage occurs due to poor maintenance of equipment and inadequate awareness of the people. Hence, gas leakage detection is essential to prevent accidents and to save human lives. This paper presented LPG leakage detection and alert system. This system triggers buzzer and notification to alert people when gas leakage is detected. This system is basic yet reliable.

FUTURE SCOPE:

Major cities of India are pushing Smart Home application, gas monitoring system is a part of SmartHome application. Enhancing Industrial Safety using IoT. This system can be implemented in Industries, Hotels and wherever the gas cylinders are used. This system can be used in industries involving applications such as Furnace, Boilers, Gas welding, Gas cutting, Steel Plants, Metallurgical industries, Food processing Industries, Glass Industries, Plastic industries maximum possible safety to patients, this system can be used to keep track of all the cylinders used in it. Some of the cylinders used are Oxygen cylinder, Carbon dioxide cylinder, Nitrous oxide cylinder. As many students are naive the risk of causing accidents is high. Hence, our system can also be used in schools, colleges. Many colleges have well established labs including chemistry lab and pharmaceutical labs where gas burners are used. Several medical equipment requires gas cylinders.