INTERNET OF THINGS (IOT)

Report on: Industry-Specific Intelligent Fire Management System

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BONAFIDE CERTIFICATE

Certified that this report titled 'INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM' is the bonafide work of MOHAMED ANAS A (961419104035), JOSE JENITO J (961419104029), AJITH P (961419104008) and AALJIN DANIEL R P (961419104001) who were carried out the project work study under my supervision. Certified further that to the best of my knowledge the work reported here in does not from part of any other report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Industry specific intelligent fire management system aims to prevent fire accidents in industries and take appropriate measures to avoid any catastrophe. The main objective of the industry specific intelligent fire management system is to prevent fire accidents caused due to flammable gas, smoke and rise in temperature. The system incorporates sensors that detects any changes in the environment. Based on the sensor readings, if any discrepancy is encountered, appropriate actions will be taken in order to prevent any misfortune. The model incorporates MQ2 gas sensor for detecting propane and methane gases, IR Flame sensor module to detect flame and LM35 Temperature sensor to measure the temperature of the environment. The sensor readings are monitored continuously via ThingSpeak 10T Platform. In case of any undesirable variations the authorities and fire station will be alerted via Twilio software. The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment. Based on the temperature readings and if any Gases are present the exhaust fans are powered ON. If any flame is detected the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and Fire station.

CONTENT

CHAPTER 1

INTRODUCTION

This chapter gives an overview of Industry Specific Intelligent Fire Management System, presents the need and objective of the project.

1.1 OVERVIEW OF INDUSTRY SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM

Industry Specific Intelligent Fire Management System prevents fire accidents caused due to flammable gas, smoke and rise in temperature. The system incorporates sensors that detects any changes in the environment. Based on the sensor readings, if any discrepancy is encountered, appropriate actions will be taken in order to prevent any misfortune. The model incorporates MQ2 gas sensor for detecting propane and methane gases, IR Flame sensor module to detect flame and LM35 Temperature sensor to measure the temperature of the environment. The sensor readings are monitored continuously via IBM Watson 10T Platform and stored in Cloudant DB. In case of any undesirable variations the authorities and fire station will be alerted via Fast2SMS web service. The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment. Based on the temperature readings and if any Gases are present the exhaust fans are powered ON. If any flame is detected the sprinklers will be switched on automatically. Emergency alerts are notified to the authorities and Fire station.

1.2 NEED FOR THE PROJECT

Businesses in the industrial and energy sector work with unique processes, chemicals, and equipment. Because of this, the demanding working conditions in industrial, manufacturing, and energy facilities require specific fire protection systems to suppress the unique special hazards found within these settings. This can be a difficult task as industrial facilities contain various workplace fire risks. From combustible dust and flammable materials to electrical equipment that would be irreplaceably damaged if exposed to water, industrial and energy facility owners and managers need complete fire protection if they're going to continue operations in confidence.

1.3 OBJECTIVE

The main objective is to ensure occupational safety of industry workers and environmental safety, thereby helping the industrial facilities to continue their operations.

1.4 ORGANIZATION OF REPORT

Chapter 1: Gives an overview of Industry Specific Intelligent Fire Management System, states the need for the project and objective of the project.

Chapter 2: Discusses the literature review.

Chapter 3: Discusses the ideation and the proposed solution.

Chapter 4: Discusses the requirement analysis.

Chapter 5: Discusses about the project design and working.

Chapter 6: Discusses about the project planning and scheduling.

Chapter 7: Discusses about the coding and the features added in the project.

Chapter 8: Discusses about the advantages and the disadvantages.

Chapter 9: Discusses about the results.

Chapter 10: Discusses about the conclusion.

Chapter 11: Discusses about the future scope.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

This chapter gives an overview of research carried out related to the project work on "Industry Specific Intelligent Fire Management System".

2.2 EXISTING SOLUTION

The existing works have employed flame sensor, temperature sensor and gas sensor for monitoring the environment and Blynk Application, Thinkspeak tool have been used for alerting purpose. Some works have employed GSM and GPS modules for notifying the concerned authorities, by using image processing for monitoring.

2.3 PROBLEM STATEMENT

Industry Specific Intelligent Fire Management System aims to prevent fire accidents in industries and take appropriate measures to avoid any catastrophe.

2.4 SUMMARY

In this chapter, the research carried out related to the project work on "Industry Specific Intelligent Fire Management System" is discussed in detail with problem statement and existing solutions. From the existing works, it is inferred that the models have not employed any measures to control spread of fire. The existing works have not incorporated algorithms that take action based on the exact prevailing scenario. Real time actuators like sprinklers and exhaust fans are also not in place in the existing works.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 INTRODUCTION

This chapter describes the detailed description about the Ideation and the proposed solution of the "Industry Specific Intelligent Fire Management System".

3.2 EMPATHY MAP CANVAS

An empathy map is a collaborative visualization used to express clearly what one knows about a particular type of user. It externalizes knowledge about users in order to create a shared understanding of user needs, and aid in decision making.

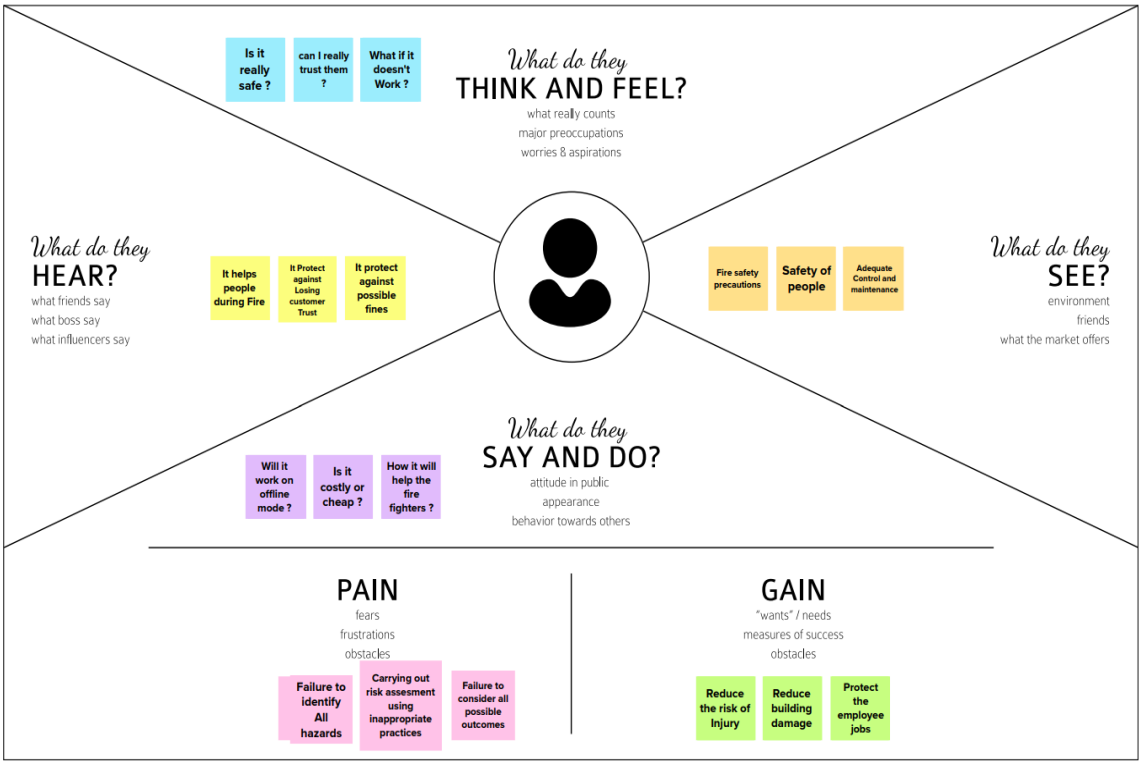

Fig 3.1 Empathy map

The empathy map for Industry Specific Intelligent Fire Management System is shown in Fig 3.1. Empathy maps are split into 4 quadrants (Says, Thinks, Does, and Feels), with the user in the middle. Empathy maps provide a glance into who a user is as a whole. The Says quadrant contains what the user says or what he needs. The Thinks quadrant captures what the user is thinking throughout the experience. The Does quadrant encloses the actions the user takes. The Feels quadrant is the user's emotional state.

3.3 IDEATION AND BRAINSTORMING

Ideation is often closely related to the practice of brainstorming, a specific technique that is utilized to generate new ideas. Brainstorming is usually conducted by getting a group of people together to come up with either general new ideas or ideas for solving a specific problem or dealing with a specific situation. A principal difference between ideation and brainstorming is that ideation is commonly more thought of as being an individual pursuit, while brainstorming is almost always a group activity. The Ideation chart for Industry Specific Intelligent Fire Management System is shown in Figure 3.2.

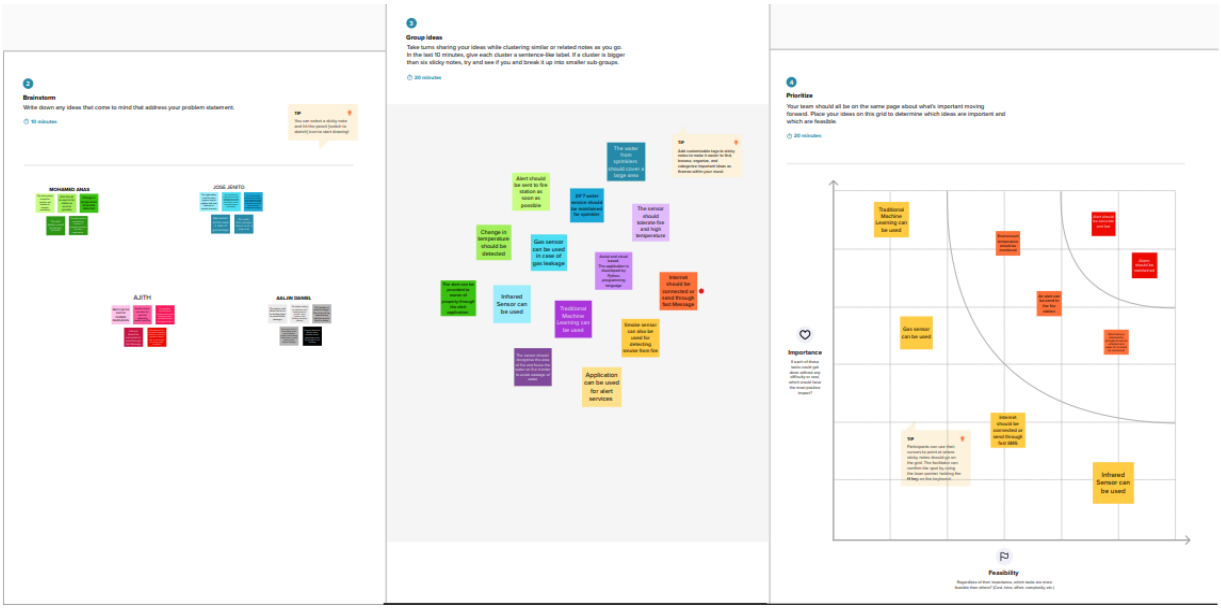

Fig 3.2 Ideation and Brainstorming

Both brainstorming and ideation are processes invented to create new valuable ideas, perspectives, concepts and insights, and both are methods for envisioning new frameworks and systemic problem solving.

3.4 PROPOSED SOLUTION

The proposed solution for Industry Specific Intelligent Fire Management System is shown in Table 3.1.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Suggest a creative strategy for efficient fire management in industry to avoid fire accidents and take the necessary precautions.
2.	Idea / Solution description	To use temperature, gas, and flame sensors and to look for environmental changes. According to the current situation, suitable actions are done based on sensor data.
3.	Novelty / Uniqueness	The exhaust fans are turned ON if there are any gases. The sprinklers will be turned on automatically if any flame is found. Authorities and the Fire Station are informed of emergency alerts via FAST2SMS.
4.	Social Impact / Customer Satisfaction	Reduces fire incidents, assures factory workers' occupational safety, and stops environmental deterioration.
5.	Business Model (Revenue Model)	The proposed model is intended for thermal industries and industries involving flammable substances. It can also be used in small scale industries because the project is cost effective.
6.	Scalability of the Solution	The model is flexible in terms of its ability to incorporate changes into its design.

Table 3.1 Proposed Solution

3.5 PROBLEM SOLUTION FIT

The Problem-Solution Fit simply means that one has found a problem with the customer and that the solution one has realized for it actually solves the customer's problem. The Problem-Solution Fit is an important step towards the Product-Market Fit. The structure of Problem Solution Fit is given below:

- **Customer State fit:** To make sure one understands the target group, their limitations and their currently available solutions, against which one is going to compete.
- **Problem-Behavior fit:** To help one to identify the most urgent and frequent problems, understand the real reasons behind them and see which behavior supports it.

- **Communication-Channel fit:** To help one to sharpen the communication with strong triggers, emotional messaging and reaching customers via the right channels.
- **Solution guess:** Translates all the validated data one has gathered into a solution that fits the customer state and his/her limitations, solves a real problem and taps into the common behavior of the target group.

The problem solution fit for Industry Specific Intelligent Fire Management System is shown in Fig 3.3.

<table>
<tr>
<td>1.CUSTOMER SEGMENTS:
• Thermal industries
• All types of Small-Scale Industries
• Industries that is associated with flammable substances</td>
<td>6.CUSTOMER LIMITATIONS:
• Requires analytical expertise for analysing the Sensor data.
• Requires manpower with strong technical expertise for handling the associated software.
• Industry level MIME sensors for accurate sensing is required</td>
<td>5. AVAILABLE SOLUTIONS:
• Various sensors are employed for monitoring the environment.
• Blynk Application and ThingSpeak tool have been used for alerting purpose.
• Some works have employed GSM and GPS modules for notifying the concerned authorities, by using image processing for monitoring.</td>
</tr>
<tr>
<td>2.PROBLEMS/PAINS:
• The fire accident if not controlled at the right time can lead to heavy financial and human loss.
• Prompt appropriate action for the particular situation needs to be taken at the right time.</td>
<td>9. PROBLEM ROOT/CAUSE:
• In industries employing chemicals there are high chances of building up of harmful flammable gases.
• There are chances of manual errors while operating the machineries.</td>
<td>7. BEHAVIOUR:
• Gain knowledge on the existing solutions and try to learn more on the products available in this domain.
• Visit the industries to gain knowledge about the working and operation of the machineries.</td>
</tr>
<tr>
<td>a3. TRIGGERS TO ACT:
• Real time water sprinklers for controlling the fire
• Exhaust fans for providing ventilation if the concentration of the gases goes high</td>
<td rowspan="2">10. YOUR SOLUTIONS:
• The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment.
• Based on the temperature readings and if any Gases are present the exhaust fans are powered ON. If any flame is detected the sprinklers will be switched on automatically.
• Emergency alerts are notified to the authorities and Fire station</td>
<td>8. CHANNELS OF BEHAVIOUR:
Online:
Gather information from websites and journals about the existing models</td>
</tr>
<tr>
<td>4.EMOTIONS: BEFORE/ AFTER:
Before: Tragic, Unprepared, Helpless
After: Stress free, Fearless, Tranquil</td>
<td>Offline:
Visit industries to acquire adequate knowledge about the operation and working principle of the machineries.</td>
</tr>
</table>

Fig 3.3 Problem Solution Fit

3.6 SUMMARY

In this chapter the ideation and proposed solution of the Industry-Specific Intelligent Fire Management System is presented with Empathy Map Canvas, Ideation & Brainstorming, Proposed Solution and Problem Solution fit in detail.

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 INTRODUCTION

This chapter presents the requirement analysis in detail with the aid of Functional requirements and Non-Functional requirements of the proposed model.

4.2 FUNCTIONAL REQUIREMENTS

A Functional Requirement (FR) is a description of the service that the software must offer. It describes a software system or its component. A function is nothing but inputs to the software system, its behavior, and outputs. It can be a calculation, data manipulation, business process, user interaction, or any other specific functionality which defines what function a system is likely to perform. The functional requirements of the proposed solution are listed in table 4.1.

FR No.	**Functional Requirement (Epic)**	**Sub Requirement (Story / Sub-Task)**
FR-I	Assemble the model	Place the sensors in appropriate locations
FR-2	Test the Hardware	Test for the proper working of the sensors
FR-3	User Registration	Create user accounts for the required software incorporated in the model
FR-4	Test the Software	Check for the proper delivery of alerts and SMS
FR-5	Test the data storage	Check for the proper storage of sensor data in the database

Table 4.1 Functional Requirement

4.3 NON-FUNCTIONAL REQUIREMENTS

Nonfunctional Requirements (NFRs) define system attributes such as security, reliability, performance, maintainability, scalability, and usability.

They serve as constraints or restrictions on the design of the system across the different backlogs. They ensure the usability and effectiveness of the entire system. Failing to meet any one of them can result in systems that fail to satisfy internal business, user, or market needs. The non-functional requirements of the proposed solution are listed in table 4.2.

FR No.	Non-Functional Requirement	Description
NFR- 1	Usability	The model is used in small scale industries involving flammable chemical substances
NFR-2	Security	The model ensures security for the workmen in the industry by taking necessary actions in case of any misfortune.
NFR-3	Reliability	The model is highly reliable as it consumes less power
NFR-4	Performance	The model provides ample performance in delivering alerts and SMSs to the concerned authority
NFR-5	Availability	The model gives instant response to the user
NFR-6	Scalability	The model is scalable for implementing it in large scale industries

Table 4.2. Non-Functional Requirements

4.6 SUMMARY

In this chapter, the requirement analysis is presented in detail with the aid of Functional requirements and Non-Functional requirements of the proposed model.

CHAPTER 5

PROJECT DESIGN

5.1 INTRODUCTION

This chapter presents the project design of the Industry Specific Intelligent Fire Management System and discusses on the solution and technical architecture models.

5.2 DATA FLOW DIAGRAMS

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Data flowcharts can range from simple, even hand-drawn process overviews, to in-depth, multi-level DFDs that dig progressively deeper into how the data is handled. They can be used to analyze an existing system or model a new one.

Data Flow Diagrams provide a straightforward, efficient way for organizations to understand, perfect, and implement new processes or systems. They're visual representations of your process or system, so they make it easy to understand and prune.

There are two types of DFDs — logical and physical. Logical diagrams display the theoretical process of moving information through a system, like where the data comes from, where it goes, how it changes, and where it ends up. Physical diagrams show you the practical process of moving information through a system, like how your system's specific software, hardware, files, employees, and customers influences its flow of information. The data flow diagram for Industry Specific Intelligent Fire Management System is shown in the figure 5.1.

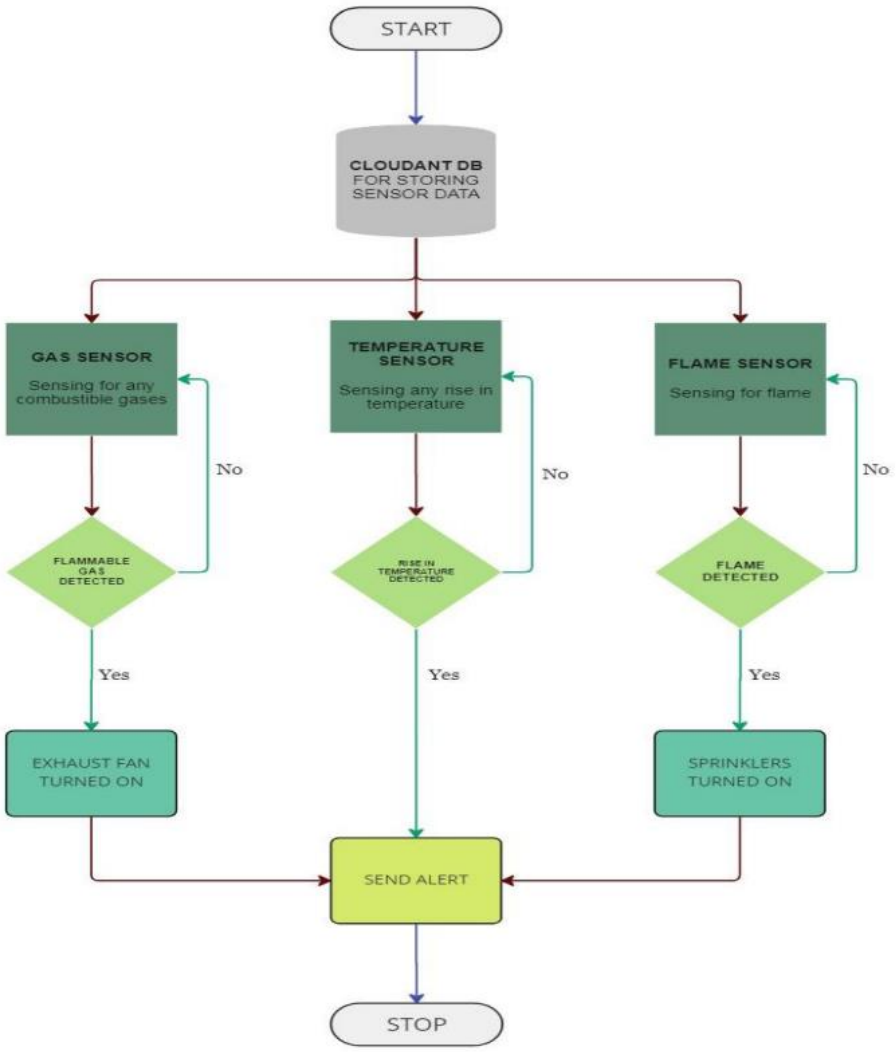

Fig 5.1 Data Flow Diagram

5.3 SOLUTION AND TECHNICAL ARCHITECTURE

Solution architecture is the process of developing solutions based on predefined processes, guidelines and best practices with the objective that the developed solution fits within the enterprise architecture in terms of information architecture, system portfolios, integration requirements and many more.

Technical architecture involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system-relevant requirements are met.

The solution and technical architecture for Industry Specific Intelligent Fire Management System is shown in the figure 5.2.

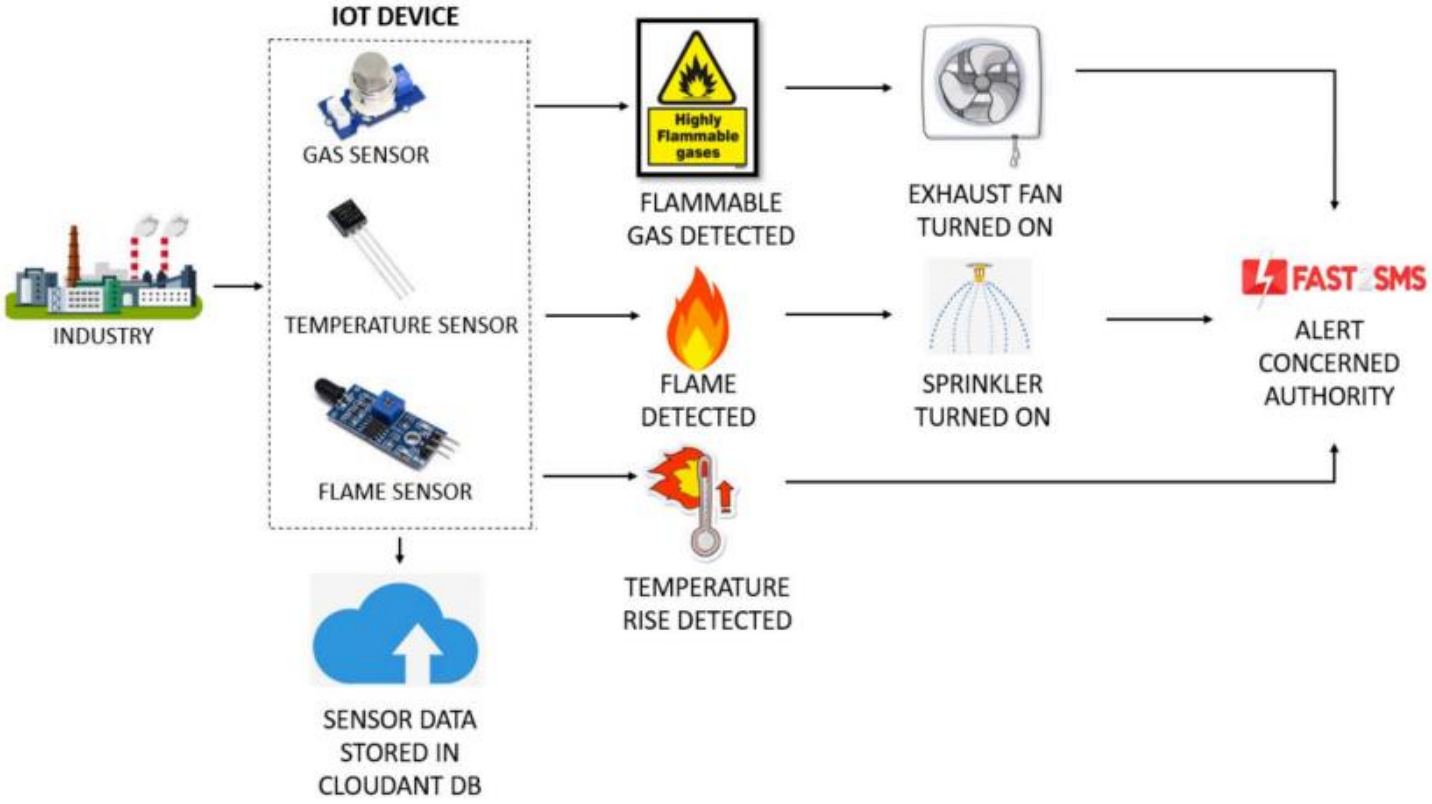

Fig 5.2 Solution and Technical Architecture

5.4 USER STORIES

In software development and product management, a user story is an informal, natural language description of features of a software system. They are written from the perspective of an end user or user of a system, and may be recorded on index cards, Post-it notes, or digitally in project management software.

User stories reduce the time spent on writing exhaustive documentation by emphasizing customer-centric conversations. Consequently, user stories allow teams to deliver quality software more quickly, which is what customers prefer.

Thus, a user story is a lightweight method for quickly capturing the "who", "what" and "why" of a product requirement. In simple terms, user stories are stated ideas of requirements that express what users need. User stories are brief, with each element often containing fewer than 10 or 15 words each. User stories are "to-do" lists that help you determine the steps along the project's path. They help ensure that your process, as well as the resulting product, will meet your requirements. Table 5.1 shows the Components and technologies and Table 5.2 shows application characteristics.

S. No	Component	Description	Technology
1.	User Interface	How user interacts with application (Web UI)	HTML, CSS, JavaScript
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson IOT Platform
4.	Database	Data Type, Configurations etc.	MySQL
5.	Cloud Database	Database Service on Cloud	IBM Cloudant
6.	File Storage	File storage requirements	IBM Block Storage
7.	External API-1	Purpose of External API used in the application	REST API
8.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud	Local, Cloud Foundry.

Table 5.1 Components and Technologies

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Node.js, Web UI
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	Encryption, IAM Controls
3.	Scalable Architecture	Justify the scalability of architecture	Three tiers (data, Application and Presentation)

Table 5.2 Application Characteristics

5.5 SUMMARY

In this chapter the project design of the Industry Specific Intelligent Fire Management System is presented and the solution and technical architecture models are discussed.

CHAPTER 6

PROJECT PLANNING AND SCHEDULING

6.1 INTRODUCTION

This chapter describes the project planning and scheduling of Industry-Specific Intelligent Fire Management System.

6.2 SPRINT PLANNING AND ESTIMATION

The sprint is a set period of time where all the work is done. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. The objective (or goal) of the sprint and what backlog items contribute to that goal have to be described. The scrum team decides what can be done in the coming sprint and what they will do during the sprint to make that happen.

The team plans the work necessary to deliver the sprint goal. One needs to understand how they can or cannot deliver that goal. A great starting point for the sprint plan is the product backlog as it provides a list of 'stuff' that could potentially be part of the current sprint. The team should also look at the existing work done in the increment and have a view to capacity.

The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team.

6.3 SPRINT DELIVERY SCHEDULE

Table 6.1 shows the Sprint Planning and Estimation of Industry-Specific Intelligent Fire Management System.

SPRINT 1	The code for the required sensors which include flame sensor, gas sensor and temperature sensor is developed and all the necessary libraries are installed in Arduino IDE.
SPRINT 2	The code for the actuators is interfaced and the threshold conditions for the sensors are specified.
SPRINT 3	Application Program Interfaces such as Thingspeak, Blynk and Twilio are interfaced.
SPRINT 4	The real time sensor data are stored and analysed in Cloud.

Table 6.1 Sprint Planning & Estimation

6.4 REPORTS FROM JIRA

Jira is a software application used for issue tracking and project management. Product management is one of the common use cases for Jira Software. By integrating the tool with its product roadmap, a product team can also sync the status of its day-to-day tasks with its big-picture strategy. The software application can automatically sync updates of tasks in Jira with its roadmap.

Agile scrum methodology is a sprint-based project management system with the goal of delivering the highest value to stakeholders. Agile lets teams develop projects in small increments called "sprints" and allows for more effective collaborations among teams working on complex projects.

Scrum is a type of agile technology that consists of meetings, roles, and tools to help teams working on complex projects collaborate and better structure and manage their workload. Scrum is a framework for project management with an initial emphasis on software development, although it has been used in other fields including research, sales, marketing and advanced technologies. Scrum has three roles: product owner, scrum master and the development team members.

Figure 6.1 shows the project tracker of Industry Specific Intelligent Fire Management System.

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	28 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	03 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

Table 6.2 Project Tracker

The team's average velocity (AV) per iteration unit (story points per day) from project tracker is calculated and shown below.

$$AV = \frac{Velocity}{Sprint\ Duration} = \frac{20}{6} = 3.33$$

Figure 6.1 shows the Burndown Chart of Industry Specific Intelligent Fire Management System.

Fig 6.1 Burndown Chart

6.5 SUMMARY

This chapter described the project planning and scheduling of Industry-Specific Intelligent Fire Management System.

CHAPTER 7

CODING AND SOLUTIONING

7.1 INTRODUCTION:

This chapter presents the methodology involved in the design of Industry Specific Intelligent Fire Management System and the solution incorporated.

7.2 SENSORS AND ACTUATORS

The proposed system incorporates sensors that detects any changes in the environment. Based on the sensor readings, if any discrepancy is encountered, appropriate actions will be taken in order to prevent any misfortune. The model incorporates MQ2 gas sensor for detecting propane and methane gases, IR Flame sensor module to detect flame and LM35 Temperature sensor to measure the temperature of the environment. In case of any undesirable variations the authorities and fire station will be alerted. The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment. Based on the temperature readings and if any Gases are present the exhaust fans are powered ON. If any flame is detected the sprinklers will be switched on automatically.

7.2.1 ESP32 DEVKIT VI

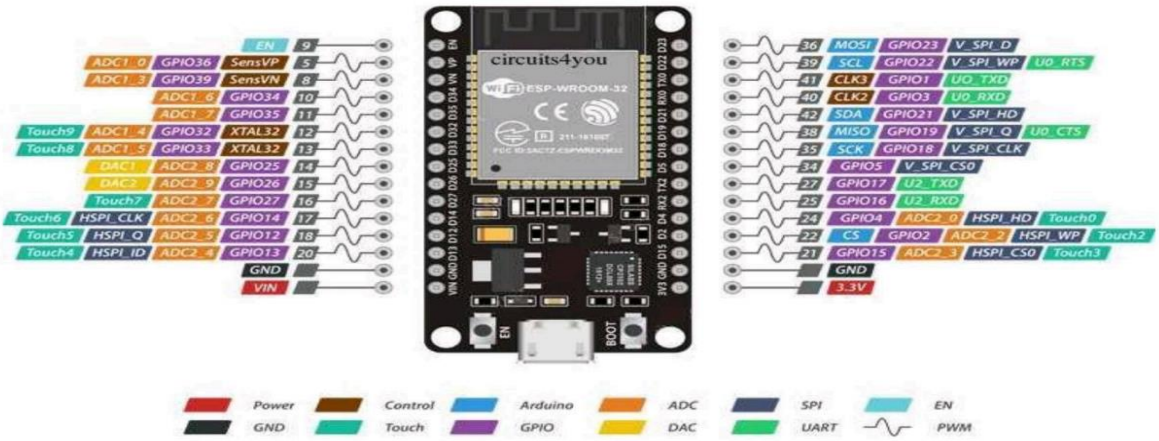

Fig 7.1 ESP32 DEVKIT VI

Fig 7.1 shows ESP32 DEVKIT VI which is a feature-rich microcontroller unit which offers Wi-Fi and Bluetooth connectivity for wide range of applications. ESP32 is designed in a way such that it removes any external circuit imperfections and adapt to the changes in external conditions.

ESP32 achieves ultra-low power consumption with a combination of several types of proprietary software hence it is used in mobile devices, wearable electronics and 10T applications. ESP32 also includes features, such as various power modes, fine-grained clock gating and dynamic power scaling.

ESP32 is the board incorporated in the model as it provides with a wide variety of features and can be used for several applications. Its inbuilt WIFI makes it unique among the available boards.

7.2.2 LM35 TEMPERATURE SENSOR

LM35 is a temperature sensor which gives analog output, whose electrical output is proportional to Degree Centigrade. LM35 Sensor does not require any external estimation or pruning to provide typical accuracies. The LM35 provides low output impedance, linear output, and precise inherent estimation make interfacing to readout or control circuitry easy. As said LM35 is linear i.e., 10mv/0 C which means for every degree rise in temperature the output of LM35 will rise by 10mv. So, if room temperature is 27^{0} C, then the output of LM35 will be 270mv i.e., 0.27V.

Fig 7.2 LM35 Temperature Sensor

The LM35 Temperature Sensor is shown in Fig 7.2. LM35 sensor is used for monitoring the temperature of the machineries present in the industry and alerts in case the temperature exceeds the threshold level. i.e., 600C.

7.2.3 MQ2 GAS SENSOR

MQ2 Gas Sensor Module is a preferable Gas sensor for detecting LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations in the air. MQ2 is one of the most commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor. The detection is based upon change in the resistance value of the sensing material

when the gas comes in contact with the material and hence it is known as Chemiresistors. The sensing element is made up of Aluminum Oxide and has a coating of Tin Dioxide. The analog output voltage produced by the sensor changes in proportional to the concentration of smoke or gas.

Fig 7.3 MQ2 Gas Sensor

As shown in fig 7.3, the MQ2 Gas Sensor possess 4 pins and they are AO, DO, Vcc and Gnd. The MQ2 sensor is used for monitoring the level of flammable gas in the surroundings and sends alert via SMS and turns on the exhaust fan.

7.2.4 FLAME SENSOR

A sensor which is most sensitive to a normal light is known as a flame sensor. That's why this sensor module is used in flame alarms. This sensor detects flame otherwise wavelength within the range of 760 nm — 1100 nm from the light source. This sensor can be easily damaged to high temperature. So, this sensor can be placed at a certain distance from the flame. The flame detection can be done from a 100cm distance and the detection angle will be 600. The output of this sensor is an analog signal or digital signal.

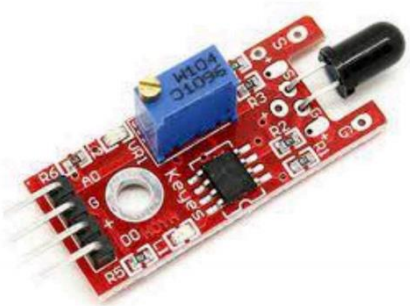

Fig 7.4 Flame Sensor

Fig 7.4 displays a flame sensor. The flame sensor is used to detect the presence of flame in the industrial environment and turns on the water sprinklers to extinguish the fire and control its spread.

7.3 MONITORING AND ALERTING

Sensors are interfaced and their values are monitored using various software tools like blynk, Twilio and ThingSpeak. ThingSpeak is a time-series database stored in cloud and an open-source framework. It displays the graphical chart of various sensors. It helps to analyze the values of sensors at different times. Blynk is a Third-party API which is used to alert the authority. It sends mail to the authority when the level of any sensor reaches beyond the threshold value. Twilio is also a third-party API which is used to alert the emergency service by sending the SMS when the values of sensor go beyond the threshold value.

7.3.1 BLYNK

Blynk was designed for the Internet of Things. Blynk is a new platform that allows to build interfaces quickly for controlling and monitoring hardware projects from iOS and Android device. A new project dashboard can be created and buttons can be arranged, sliders, graphs, and other widgets onto the screen. Using the widgets, the pins can be turned on and off or display data from sensors.

Fig 7.5 Logo of Blynk Application

The logo of Blynk application is as shown in fig 7.5. It comprises of three major components which are Blynk App - that allows one to create interfaces for a project using widgets which are available inbuilt, Blynk Server - that is built for communicating between the mobile and hardware and the Blynk Libraries - that enables communication with the server. Blynk is implemented for the real time monitoring of sensor data using gauges and other widgets.

7.3.2 THINGSPEAK

Fig 7.6 ThingSpeak Logo

ThingSpeak logo is shown in Fig 7.6. It is an open-source software which allows communication between users with the internet-enabled devices. It is an 10T analytics platform service that allows to aggregate, analyze and visualize live data streams in the cloud by providing an API (Application Program Interface) to the devices at both ends. Live data streams can be visualized using social network websites. ThingSpeak provides instant visualizations of analyzed data posted by the devices to ThingSpeak. ThingSpeak is used for storing real time data in the cloud and visualizing the sensor data using gauges and graphs to observe the change in the sensor values.

7.3.3 TWILIO

Twilio is an American company which provides programmable communication tools for making and receiving phone calls, sending and receiving text messages, and performing other communication functions using its web service APIs.

Fig 7.7 Twilio Logo

The logo of Twilio is shown in fig 7.7. Twilio is a platform for businesses and developers to build unique, personalized experiences for their customers. The alert messages are sent to the concerned authority using Twilio application.

7.4 SUMMARY

In this chapter the methodology and technologies involved in the design of the Industry Specific Intelligent Fire Management System is presented and the solution is discussed.

CHAPTER 8

ADVANTAGES & DISADVANTAGES

8.1 ADVANTAGES

- The project aids in ensuring the occupational safety of workers employed in chemical industries.
- Immediate responses are taken with respect to the prevailing environment situation in industry.
- Alerts are given on time to corresponding authorities and emergency service when needed
- The data is stored in a cloud database for future analyses.
- Buzzer is used to alert the working employees in the industry, if there is any fire around the environment.

8.2 DISADVANTAGES

Frequent check on actuators has to be done in order to verify whether they are in working condition or not. Else the proper actions will not be taken based on the conditions set in the program.

CHAPTER 9

RESULTS

9.1 INTRODUCTION

This chapter presents the results of the Industry Based Intelligent Fire Management System and discusses on the simulation of the model on ThingSpeak, Blynk and Twilio.

9.2 TEMPERATURE AND GAS SENSOR

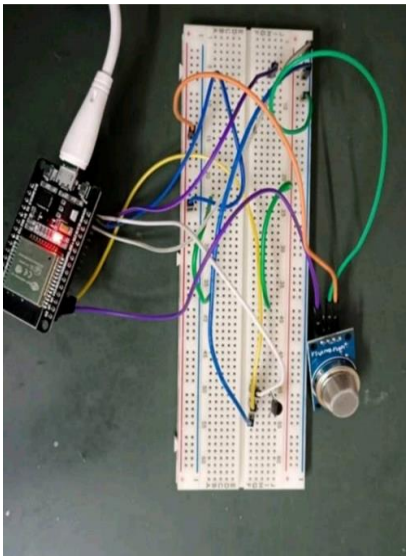

Fig 9.1 Hardware Setup of the Proposed model

Fig 9.1 shows the hardware setup of the model.

9.3 BLYNK OUTPUT

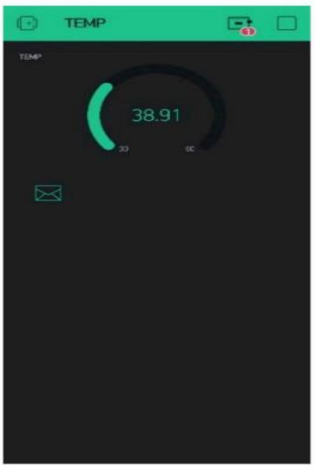

Fig 9.2 Temperature monitoring in Blynk mobile App

In Blynk mobile application, various virtual monitoring and controlling objects can be added like the gauge, a switch, etc. For instance, the temperature of the industrial environment is monitored using a virtual gauge present in the Blynk mobile application as shown in fig 9.2

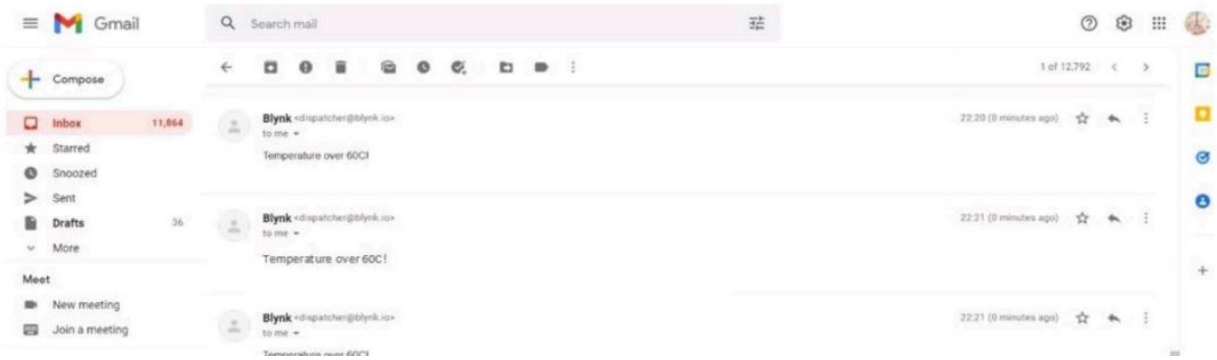

Fig 9.3 Mail alert given via Blynk App

An email alert will be sent to the mail of monitoring authority in Corporation in case of any undesirable variations inside the manhole as shown in fig 9.3. For instance, an email alert indicating that the Temperature is above the fixed threshold value (here, Threshold is fixed to be 60 degrees Celsius).

9.4 THINGSPEAK OUTPUT

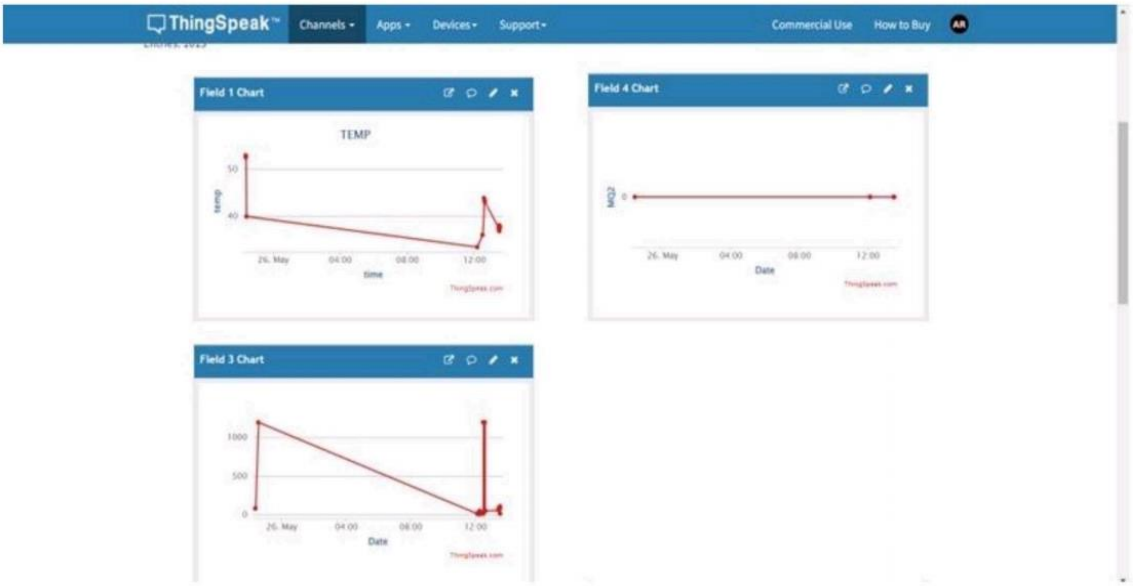

Fig 9.4 Graphs showing the variations of temperature, gas and flame

The variations of the data are shown in the form of graphs and gauges. The temperature variations from LM35 sensor, presence of flammable gas from MQ2 and presence of flame from Flame Sensor are shown in the fig 9.4.

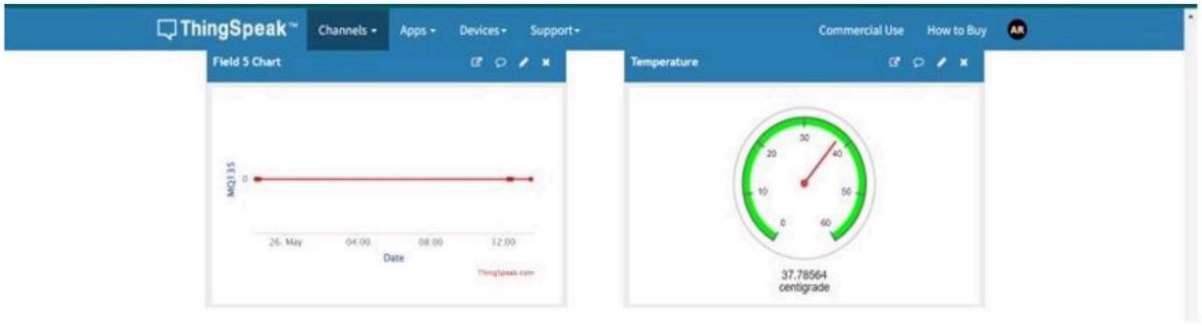

Fig 9.5 Graph and gauges showing the variations of gas and temperature

The temperature variations from LM35 sensor, presence of flammable gas from MQ2 and presence of flame from flame sensor are shown in the fig 9.5.

9.5 TWILIO OUTPUT

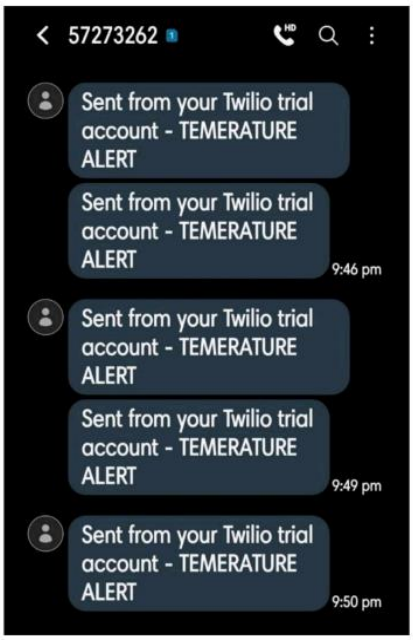

Fig 9.6 Alert message sent to Emergency Service as SMS

An alerting text message is sent to the emergency service if there is any undesirable variation in the manhole as shown in fig 9.6.

9.6 SERIAL MONITOR

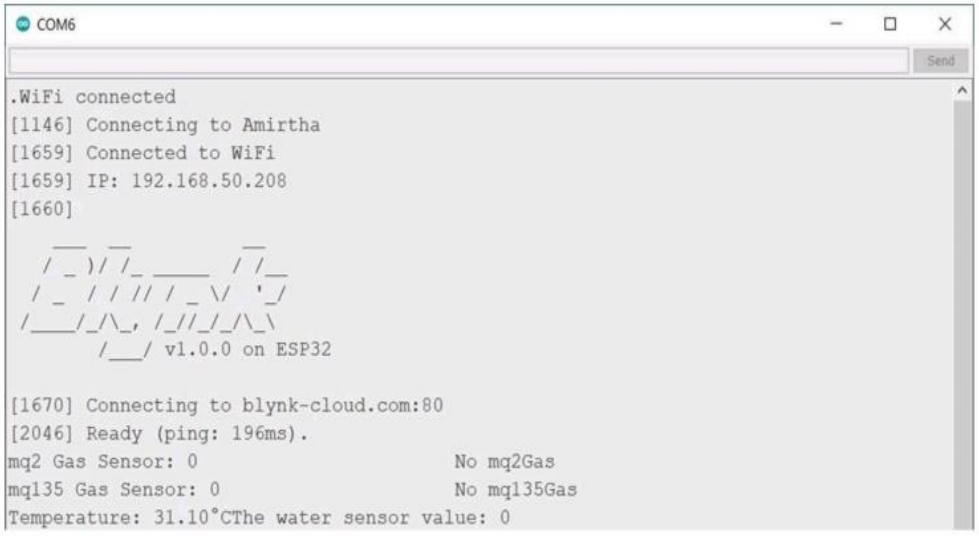

Fig 9.7 Sensor variations displayed in Serial monitor of Arduino IDE

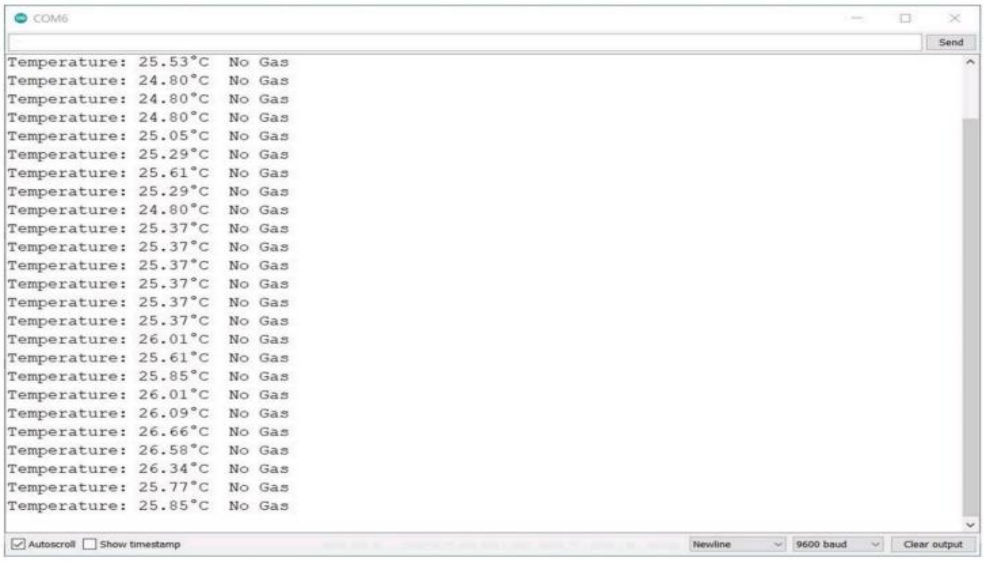

Fig 9.8 Variations of temperature and gas displayed in Serial monitor of Arduino IDE

The variations in the manhole can also be viewed in the serial monitor of the Arduino IDE as shown in fig 9.7,9.8.

9.7 SUMMARY:

Based on the results obtained from the simulation it has been observed that the industry can be monitored successfully through ThingSpeak software and Blynk mobile Application held by the concerned Authority. It can also be observed that an alerting message to the Emergency Service is sent via Twilio communication tool.

CHAPTER 10

CONCLUSION

The proposed system incorporates sensors that detects any changes in the environment. Based on the sensor readings, if any discrepancy is encountered, appropriate actions will be taken in order to prevent any misfortune. The model incorporates MQ2 gas sensor for detecting propane and methane gases, IR Flame sensor module to detect flame and LM35 Temperature sensor to measure the temperature of the environment. In case of any undesirable variations the authorities and fire station will be alerted. The smart fire management system includes a Gas sensor, Flame sensor and temperature sensors to detect any changes in the environment. Based on the temperature readings and if any Gases are present the exhaust fans are powered ON. If any flame is detected the sprinklers will be switched on automatically. Hence, all possible ways of providing occupational safety to the industry workers and the safety of the industry will be achieved by the "Industry-Specific Intelligent Fire Management System"

CHAPTER 11

FUTURE SCOPE

The proposed working model is a successful working prototype that aims to shut down the fire immediately to avoid catastrophic destruction. This system will help the users to monitor the temperature, gas levels and to notify the same.

This system assuredly assists the users to know about all the sensor values interfaced in the system. And also, the Industry Specific Intelligent Fire Management system implemented here brings a naval approach for prevention of fire accidents. This assures the early detection and prevention of incurring losses due to fire.

This model can be developed and implemented in future by driving the ESP32 using solar power. Solar panels can be installed for each industry and it can be set up in the way that the ESP32 uses the solar power.

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