Faculty of Electrical Engineering and Technology

DEVELOPMENT OF AUTOMATIC PERSONAL INDUSTRIAL WARNING WITH INTERNET OF THINGS SYSTEM FOR PETROCHEMICAL INDUSTRIES.

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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MOHAMAD AKMAL SYAFIQ BIN ZULKIFLI

A project report submitted
in partial fulfillment of the requirements for the degree of
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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

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DEDICATION

I would like to express my deepest gratitude towards individuals that had helped me through the process of wiring this paper. My supervisor Mr. Arman Hadi Bin Azahar and Co supervisor Dr. Nor Hafizah Binti Hussin for guidance for the structural development of the project, and all other lecturer and friends that might have involved directly or indirectly during the thesis development. Special thanks to my family and friends for their morale and support. Lastly but not least, to all other party that might involve in making this paper thank you with idea and encouragement.

ABSTRACT

Malaysia is one of the countries that strongly promotes industrial development, especially in petrochemical processing, which involves many types of chemicals, gases and dangerous liquids to will be make a good commercial stock. With the advancement of petrochemical industries, the country has experienced several major accident hazards, thus sacrificing many lives, causing assets and environmental destruction. According to the Department of Safety and Health's investigation, the accident in the petrochemical industries resulted from the high purity of chemical density, unsafe workplace's, human error and unsafe tools use during works. In additional, the limitation of monitoring and information about the site can be dangerous to workers, facilities, and workplaces. Workplaces with poor safety standards put employees in greater danger. Hence, this study about how to minimize risk and hazard and how to make sure all site places in petrochemical industries are safe and secure all the time without sacrificing many lives, causing assets and environmental destruction.

ABSTRAK

Malaysia adalah sebuah negara yang pesat membangun dalam bidang perindustrian teruatama di dalam petrokimia dalam pemprosesan pelbagai jenis bahan kimia, gas dan cecari berbahaya untuk menjadikan seseuatu barangan di pasaran.. Dalam kepesatan perindusrian tersebut, negara telah mengalami beberapa kejadian yang melibatkan kemalangan besar yang melibatkan kerosakan harta benda, kemusnahan alam sekitar dan kemalangan jiwa yang disebabkan oleh bahan kimia. Berdasarkan penyiasatan Jabatan kesihatan dan Keselamatan Perkerja, kemalangan industri petro-kimia disebabkan oleh kadar kepekatan kimia yang tinggi, keadaan tempat kerja yang tidak selamat, kecuaian manusia dan alatan kerja yang tidak selamat ketika kerja. Selain itu juga, kekangan sistem dan maklumat terkini tentang keadaan tempat kerja juga akan membahayakan perkerja, kelengkapan dan tempat kerja. Oleh sedemikian, kajian ini dijalankan adalah untuk memastikan keadaan tempat kerja di petro-kimia sentiasa dalam keadaan selamat agar daripada kemalangan, kerosakan harta benda, pencemaran alam sekitar dan kematian.

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LIST OF SYMBOLS

C	-	Charge
%RH	-	% Relative Humidity
v	-	Voltage
MHz	-	MegaHertz
ppm	-	Part per Minutes
CO	-	Carbon Monoxide
H2S	-	Hydrogen Sulfide
Kb	-	Kilo bits
C	-	Celsius

LIST OF ABBREVIATIONS

DOSH	-	Department of Occupation Safety and Healty
OSHA	-	Occupation Safety and Healthy Administration
IoT	-	Internet of Things
DCS	-	Distribution Control System
AIBN	-	Azobisiobutyronitrile
LPO	-	Low Pressure Oxidation
LOTO	-	Lock Out and Track Out
RFID	-	Radio Frequency Identification
IR 4.0	-	Industrial Revolsion 4.0
GSM	-	Group Safety Management
UWB	-	Ultra-WideBand
CCTV	-	Closed Circuit Television
CPU	-	Central Processing Unit
AVR	-	Automatic Voltage Regulation
ARM	-	Arteriouenous Malfunction
SoC	-	System on Chips
VOC	-	Volatile Organic Compound
LED	-	Light-emitting diode
PCB	-	Printed Circuit Board
PWM	-	Pulse width modulation
DHT	-	Digital Temperature and Humidity

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

The petrochemical industry will process many types of chemicals into material for people, material and chemicals for chemical use. Accidents such as explosions, collision and burning of petrochemical industries cause very high pollution levels to humanity, the environment and worldwide. To clarify the characteristics of the accident and the risk root contained in the enterprise's production process, avoid the risk reasonably and improve the petrochemical industry's overall safety level, the worst chemical industry accident risks caused by this integration are complex and diverse (Figure 1.1).

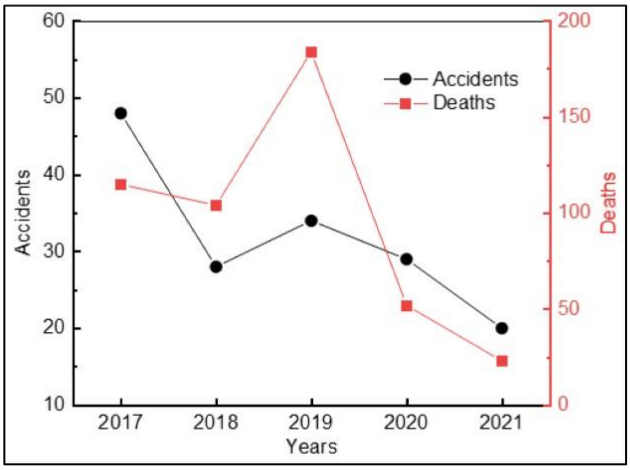
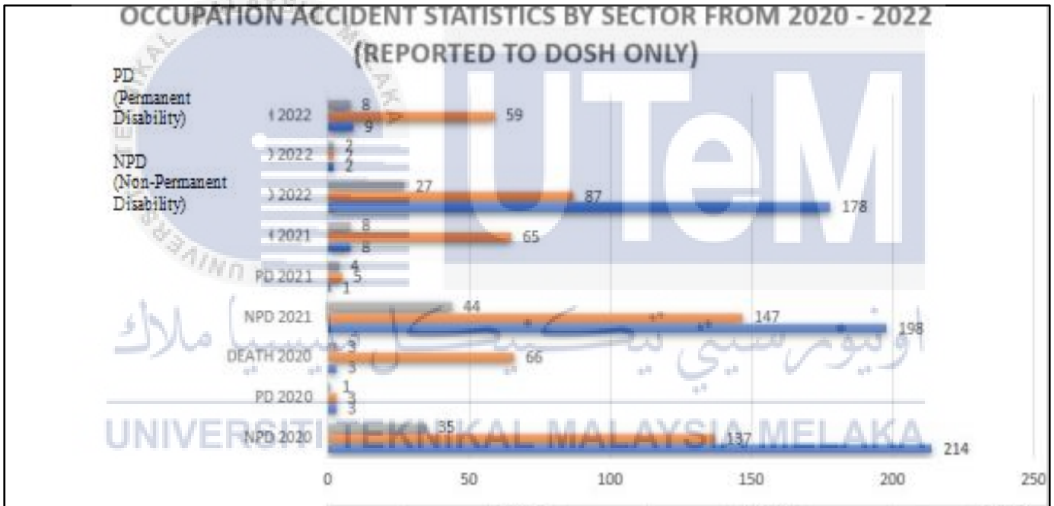


Figure 1.1 Overall characteristics of accidents in Petrochemical Industries [24 September 2022, Lidong Pan, Min Wang]

From the Department of Occupation Safety and Healthy *DOSH* Malaysia’s data and analysis for accidents from 2020 until 2022 (Figure 1.2), the major industries with the most accidents reported are utilities (Electricity, Gas, Water and Sanitary Service). The total reported base on this sector in the time lapse are 220 cases in 2020, 207cases in 2021 and 187 cases in 2022. The construction sector reported 206 cases in 2020, 217 cases in 2021 and 148 cases in 2022. The mining and quarrying sector reported 39 cases in 2020, 56 cases in 2021 and 37 cases in 2022.



	NPD 2020	PD 2020	DEATH 2020	NPD 2021	PD 2021	DEATH 2021	NPD 2022	PD 2022	DEATH 2022
Mining And Quarrying	35	1	3	44	4	8	27	2	8
Construction	137	3	66	147	5	65	87	2	59
Utilities (Electrical, Gas, Water and Sanitary Service)	214	3	3	198	1	8	178	2	9

Figure 1.2 Occupation Accidents Statistics Reported to Malaysia DOSH 2020-2022.

1.2 Concern About Petrochemical Health Risk Before and After to worker how a exposed with chemical production and low attention about safety requirements.

We usually hear and see about petrochemical accident in the news, this accident revealed the worker's heavy injuries, death, and environmental pollution. The worker exposed the chemical for long terms may suffer heavy injuries, physiology, mental health problems and even death over long period of time. Every risk associated with human error will occur prior to entering the site, there are some requirement and rule workers must follow as well, including wearing good personal protection equipment (PPE), checking the level of environmental gas by using a gas detector, installing a fire blanket to avoid a fire spark and following the site instruction. Additionally, some of the causes of this accident come from weather and environment, the increasing temperature of site environment, heavy weather and lightning. With information and monitoring on environmental gas type and level, excessive heat and the weather, we can avoid the risk of accident in petrochemical industries for the safety of workers, facilities and equipment at all times.

1.3 Problem Statement

The Petrochemical Industries espically oil and gas industry aims to improve safety performance by analyzing industry safety data and identifying areas for improvement. Althought there has been a reduction in fastalities and injuries based on the latest report, there is still a need to continosly strive for zero accidents and ensure sustained safety improvements in face of potential major incidents.

1.4 Project Objective

The main aim of this project is to propose a systematic and effective methodology systems to monitoring and supervisory areas to avoid workplace exposure to dangerous gases, flammable atmosphere.

a) To design a safety monitoring system for the petrochemical industry, the site includes confined spaces areas.

b) To develop safety equipment to avoid a accidents in site area of petrochemical industries.

c) To analyze the trend of risk of accidents in petrochemical industry for workers, facilities and the environment in the site area.

1.5 Scope of Project

The scope of this project are as follows:

a) To make sure the workplace has a stable air flow from hazardous gas chemicals.

b) To control the temperature surrounding the area and avoid anything can spark a fire and explosion

c) To proactive performance monitoring involves monitoring data that indicates performance before a hazard expresses itself.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The importance of incorporating Internet of Things technologies into industrial safety is revealed by the literature analysis on the creation of an automatic personal industrial warning system with an Internet of Things (IoT) system for Petrochemical Industries, Early warning systems are crucial for reducing possible risks and guaranteeing worker safety in the Petrochemical Industries, according to earlier studies. Exploring existing IoT implementations in industrial contexts, their advantages and disadvantages are highlighted. Additionally, the evaluation identifies research gaps in the areas of personal industry warning systems and the requirement of the petrochemical industry. Overall, the body of research backs up the case for creating an automatic personal industrial warning system that uses IoT to improve safety protocols in the Petrochemical Industries.

2.2 Thermal hazard analysis applications for process safety evaluations.

Reactive materials are often used as catalysts, hardeners or cross-linking agents in the radical polymerization process using unsaturated monomers in various chemical industrial applications. A runaway reaction, a thermal reaction, a thermal explosion, fire, and the release of dangerous poisonous compounds owing to the intense heat and gas products from thermal decomposition are all unexpected process elements that can't be eliminated. To characterize the inherent hazard behaviors if compounds and organic peroxides in the process and differential technology of thermal analysis [1].

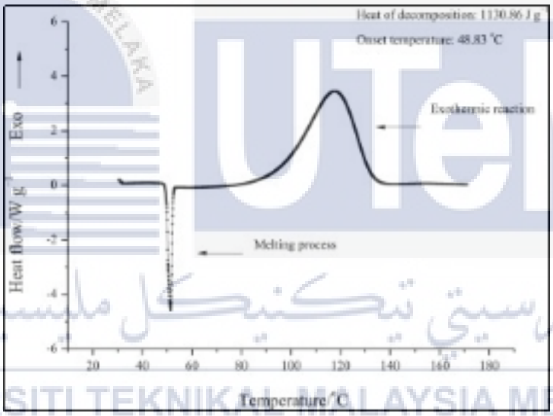


Figure 2.1 Thermal graphs

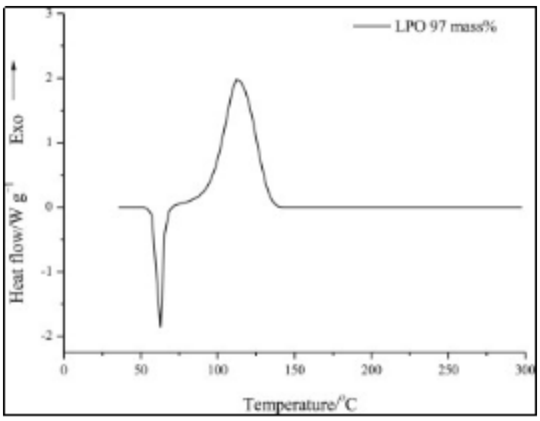


Figure 2.2 The DCS curve for AIBN

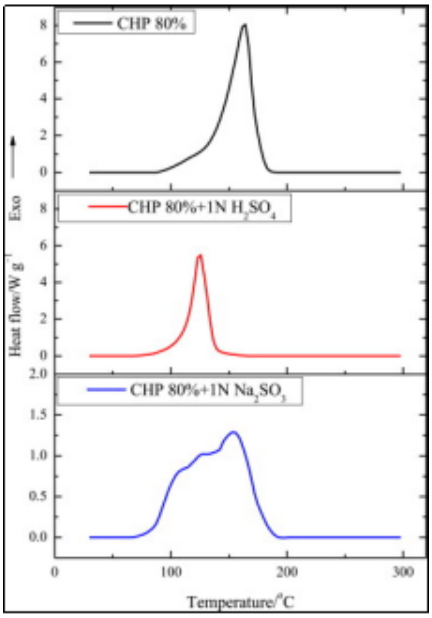


Figure 2.3 The DCS Curve for LPO

Figure 2.4 The structure of Thermometric

From the study of the past technology monitoring of Thermal measuring and monitoring, the data of temperature and thermal in Petrochemical Industries instead of equipment, process, and type of chemical. For this project, the measurement and monitoring of the temperature sustainable an important to make sure the a in safe work for implementation.

2.3 Oil Refineries and Petrochemical Plant Protection.

By implementing new technology, automating production, stepping up industrial safety standards, and strengthening labor protection laws, oil processing and petrochemical companies' demon started scientific and technical development. However, this sector of the economy continues to include highly sophisticated and technically challenging fire and explosion – risky machinery with detrimental impacts on the environment and first and foremost, on employees. The main, auxiliary, and providing production of the demanding special receptions in the analysis and prevention of their harm and danger not only to worker but also the population, oil processing and petrochemistry represent various conglomerates among the object of sanitary inspection in any region of the enterprise [2].

Since tank storage is the primary method used for raw materials and finished goods storage in the petroleum and petrochemical sectors, the operation, maintenance, and anti-corrosion of storage tanks are crucial to the overall industry's industrial safety. The development of tank anti-corrosion technology in the petrochemical industry is summarised in this paper. It also discusses the mechanisms of inside and outside corrosion of tanks and different anti-corrosion measures, emphasises the significance of tank anti-corrosion protection, and looks ahead to the continued advancement of tank anti-corrosion technology. Modern industry runs on petroleum, which also supports the security of the country's energy supply [3].

The supply storage of Petrochemical products is instead about the type of chemical substance and the design of the plant. For the project, only the measurement and monitoring of type gases and pressure of the gas in the storage are important to protect workers and plants from incidents and destruction.

2.4 Utilizing Ultra-Wideband UWB sensor, Intelligent manufacturing monitoring.

Petrochemical industrial workers may suffocate to death or go unconscious as a result of chemical asphyxiation. Without displaying any warning signs that increase the risk of an oxygen shortage, certain substances vaporize and combine with air. To provide safe and comfortable working conditions in industries, Industry 4.0 places a greater emphasis on human-centricity than technology-driven initiatives. Recently, unwavering research on plant safety management reliant on Internet of Things (IoT) sensors has been carried out. In this study, an ultra-wideband (UWB) sensor is used to track employees' mobility and breathing patterns in virtual smart factories [4].

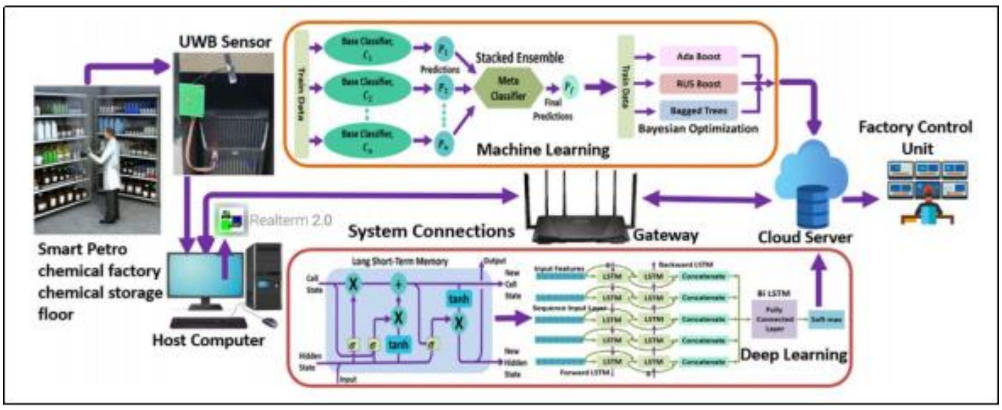


Figure 2.5 System model for breathing rate detection in smart Petrochemical factory scenario.

From the figure above, the air flow and air quality in this industries a very important insert type of gases and percentage of the oxygen to the worker. In this project a confusing to air quality in this industry especially in the confined space.

2.5 Lock Out and Tack Out (LOTO) System.

Lock Out – Tag Out is a vital safety measure used in the Petrochemical Sector to shield personnel from dangerous energy sources, while doing maintenance, repair, or service tasks. It includes isolating and managing energy systems using locks and tags to avoid unintentional or unauthorized activation. LOTO strives to avoid or reduce the danger of sudden equipment activation or release of stored energy, protecting personnel form potential harm or death. This thorough process guarantees that energy sources are successfully segregated, tagged, and confirmed, ensuring a safe working environment, and fostering the well-being of personnel in the Petrochemical Sector [5].

LOTO related fatalities continue to happen despite the laws and infractions in the sector were second in will breaches in 2016 and ranked fifth overall. Numerous factors, including personal traits, the state of energy control and the nature of the activity, might contribute to LOTO related deaths. LOTO programmers have a number of flaws, such as a incomplete programmers, missing step in general procedures and user who fail to read placards, a propensity to use alternative methods without conducting adequate risk assessments, a lack of audit tools and lack of results documentation [6].

A common definition of situation awareness is the perception of environmental factors over a volume of time and space, the interpretation of those factor's meanings and the projection of those factor's future states. With respect to informational signals perceived at level1, many bits of information are integrated at level 2 and their applicability to objective is assessed at level 3, future circumstances, events, and dynamic are predicted. The creation of operator interfaces, automatic ideas, and training curricula in a wide range of areas across many safety-critical sectors have all made use of situation awareness principles [7].

To improve the Lock Out and Tack Out system during operation and maintenance, by using Radio Frequency Identification (RFID), the data will present and save the background of workers with accuracy of time in-out during implementation. Additionally, RFID will be present worker card identity, follow the development of Industries Revolutions 4.0 (IR 4.0) interface and control the data by using Internet of Things.

2.6 Gas-Leakage, Fire and Temperature Detection System by using IoT.

Gas leaks and fire events frequently result in unfortunate accidents. Installing a gas leak and fire incident detection device at suitable locations is one technique to reduce mishaps with gas leakage and fire incident detection. Yes, the temperature might naturally rise when there is a gas leak or a fire. In the case of a gas or smoke leak, our suggested straightforward system of inexpensive gadgets is set up to call the user through GSM [8].

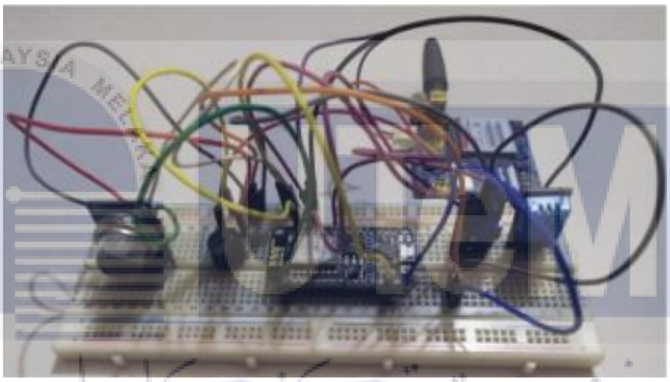


Figure 2.6 Gas-Leakage, Fire and Temperature Detection System by using IoT.

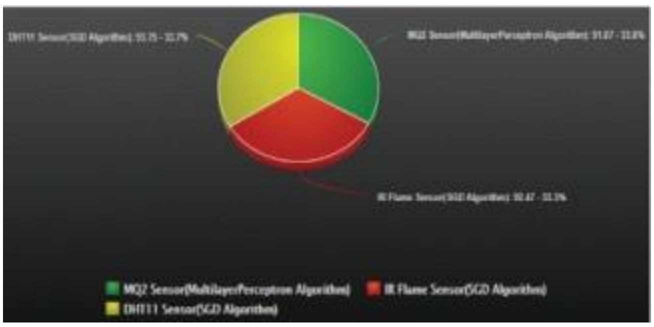


Figure 2.7 Performance from past Gas-Leakage, Fire and Temperature Performance.

From the past project of Gas-Leakage, Fire and Temperature detection system by using IoT it has some weakness application of communication data and the low of safety requirements to improve the efficiency of safety to avoid causes the incident.

2.7 Factors affecting Major Incidents in Petrochemical Sector.

Large-scale accidents using petrochemicals have become common in recent years. In addition, the petrochemical industry has surpassed the coal industry to take the top spot for significant incident frequency. These events not only resulted in numerous fatalities and significant financial losses but also seriously harmed the ecosystem. The underlying cause is that chemical accidents' primary mechanism is not well understood [9].

In the last 15 years, explosions, poisoning, suffocation, and fire have been determined to be the most significant form of the Petrochemical Sector. The “Production Safety Incident Reporting, Investigation and handling Regulations” classifies occurrences into four categories, very serious incidents, destruction incidents, large incidents, and general incidents. The majority of which included explosions [9].

Table 2.1Incident Category Statistic

Incident Type	Cases	Death Toll
Explosion	92	544
Poisoning & Suffocation	39	126
Falling	6	16
Leakage	10	26
Collapse	91	34
Traffic	6	31
Fire	11	11
Other	61	13

Primary and secondary causes may be used to categorise each occurrence. For example, in the 2006 gas explosion incident, the primary reason was sparks brought on by the breakdown of the power cable two-way junction box, and the secondary cause was a gas explosion. The reason for this is that a large disaster will not necessarily occur if there is not enough destructive energy, but rather because it will be a trigger for the release of energy from a high energy source. The reason may be referred to as a crucial incident, depending on how the event is defined and how it contributed to the occurrence of the incident [9] .

2.8 Effect of Temperature and Humidity on the amount of electric charge in static-resistant clothing used in Petrochemical Sectors.

By measuring the electric charge (qe) of various clothing samples, the effect of temperature and relative humidity on the electric charge (qe) of static protection clothing is investigated. The outcome demonstrates that temperature and relative humidity both have a small but significant impact on the quality of static protection gear, with relative humidity having a larger impact than temperature. The link between qe and relative humidity and temperature was analyzed in light of the experimental findings, and a discussion of the safety limit for the amount of electric charge followed [10].

Static electricity-related fire mishaps are highly common in the petrochemical sector due to the large number of combustible and explosive locations there. A very universal phenomenon, static electricity has a very high voltage. During movement, a person's body would create a significant number of electrostatic charges. Static protective clothing is essential for people working in combustible and explosive environments because it reduces electrostatic charges on the body and lowers the risk of fire accidents. However, the electrostatic charges that the clothing generates are crucial to the performance of the clothing in terms of safety [10].

Testing items	Technical demands	
	Class A	Class B
Quantity of electric charge (μC / piece of clothes)	<0.2	0.2~0.6

Figure 2.8 Technical demands for the quantity of electric charge.

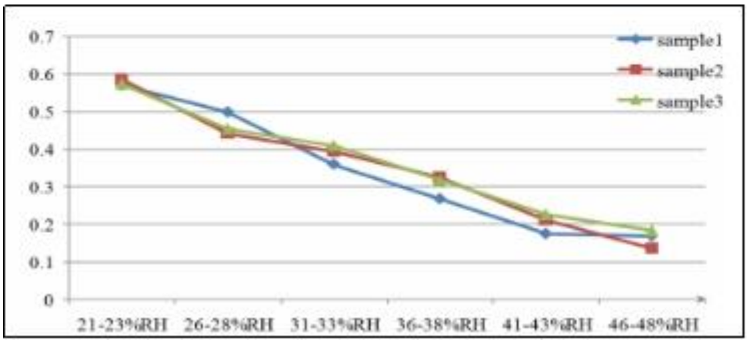


Figure 2.9 Quantity of electric charge under different relative humidity range.

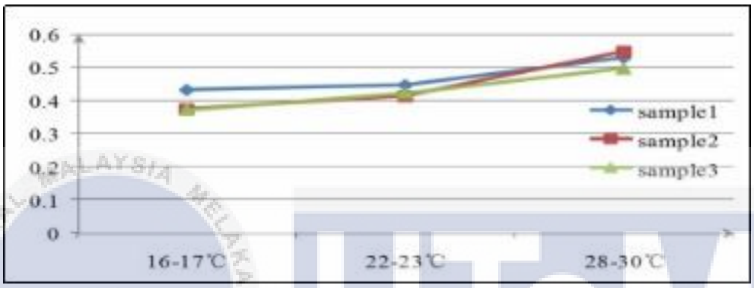


Figure 2.10 Quantity of electric charge under different temperature range. (Relative humidity : 23- 25%)

The amount of electric charge tends to rise as the temperature rises gradually while the relative humidity remains constant. Furthermore, relative humidity has a greater impact on the amount of electric charge in static-proactive clothing than does temperature. Additionally, when the humidity high the probability of electric charge high and the temperature a low. Its situation not sustainable to worker during implementation.

2.9 Petrochemical Pipelines detection system.

The significance of pipeline detects in petrochemical production to guarantee production safety. The existing approach manual detection using CCTV takes a lot of time and is prone to missing and false detections. The system employs a robust flaw detection model based on enhanced and transformers attention mechanisms, increases sample size and class balance and preprocesses pipeline videos to build a cohesive dataset. The Petrochemical pipeline using the CCTV to detects of defect pipeline by manually by using manpower to trace that's pipeline [11].

By using CCTV, it is not effective to detect the default pipeline because the leakage of gases can't be traced by using eyes and it not suitable to act immediately to stop those defaults.

2.10 Design to minimize hazards during in Confined Space.

Confined space are very important in the Petrochemical Industry, such as valves and tank for supply, operation and processing the chemical material. The worker will be exposed to dangerous chemical gases and poor air quality. It will be risk to the worker with the small area, bad air quality and hot temperature in the confined space. Confined space safety with small people entering, there will be small air ventilation and gas detection equipment alarms to indicate the air quality in the confined space. In small space, you can regulate the temperature and air quality with installation an alert to warn when the ventilation isn't working and installing the right fixed-gas detection quipment with an alarm to check air quality if a confined space is dependant on ventilation for human occupancy [12].

To upgrade the safety of confined space, the installtion of an air quality sensor and a flame sensor to indicate the quality of air and temperature of site areas. Additional, the alarm system can be improve with an interface system to inform the worker about the site situation and safety precautions to avoid the inccident and death.

2.11 Pass Database and Analysis of Industrial Accident Chemical Industry Sector.

Lack of communication, lack of availability of personnel and the escalation of accidents are all factors that contribute to frequent workplace accidents. For this reason, additional layers of safety should be installed. This, along with safety measures in organizations, can prevent accidents from occurring more frequently. Additionally, system flaws like holes in organizational controls system also contribute to accidents. However, science and technology are employed in the workplaces can be analyzing accident data and the information we obtain from previous accidents can be utilized to uncover the underlying causes and assisting in the prevention in the future. Performing experiments to predict an accident is a difficult undertaking, unlike other fields of science and technology where experimental and analysis data are used. The information we gather from past catastrophes can be used to pinpoint the underlying issues, which would aid in preventing similar mishaps in the future [13].

The communication of the system was asynchronous with the worker during the incident, the data only analyzed past events that happened but did not avoid the incident immediately. It posed a high risk for workers in the site area during the installation, operation, and maintenance.

2.12 Case Studies of Fire Triangle Incidents.

The several incident cases reported by the Department of Safety and Health Malaysia in volved the factory processing the chemicals such as material, liquid and the condition of site areas in the the case studies of Fire Triangle. This fire and explosion of this incident become part of fire triangle concept such as fuel, ignition, dispersion, oxygen and confinement [14].

The first incident in this cases involved hot work activites in a confined space, this incident involved a workers welding in a confined space area of a flour factory. The spark of the welding triggers the fire and the conditions of site area of confined space with many type of chemical gases can be a factor the explosion in the confined space. The incident happens at a factory that makes flour, welding in the corn starch-filled restricted space area set off the incident because it was a hot labour activity [14].

The seconds incident in this case was triggered by a dust explosion from the polishing activity in making rim. The transportation system of the aluminium dust to the tower duct collector destroyed because of a fire started by an explosion. The result of the explosion was the spark and fire polishing during making rim activities [14]

A few methods can avoid the hazard and risks of this incident, such as improving reliability, reducing risk and improving financial performance. This method will be highlighted to avoid the incident become in the future by companies and safety authorities. The organization's company and goverment authority such as Safety Deparment have a few method to improve the site safety to avoid the same incident in the future [14].

From the data analysis and past incidents, the companies and authorities just improved reliability, reduce risk and improve financial performance in the report of companies audit but did not take action in safety site situation. They just monitored years cases and cost of the incident but did not know about device and implementation to avoid the incidents base on the site situation espically the fire triangle.

2.13 Features based fault detection.

There is a big demand for efficient monitoring techniques to identify and treat process problems in real time as well as enable predictive maintenance to prevent large production interruptions in future. Although periodic operations have been extensively employed in the chemical and petrochemical sectors, non-periodic continuous or batch processes have gained more attention when it comes to processing monitoring. One explanation might be that monitoring periodic processes is far more difficult than monitoring systems that function at a steady state [15].

There is a sizeable need for effective monitoring systems that allow for the immediate detection and remediation of process issues as well as the facilitation of predictive maintenance to avoid furthers production failure. While periodic operations have been extensively employed in the chemical and petrochemical industries, monitoring non-periodic continuous or batch process is receiving more attention.

2.14 Design of an Internet of Things based monitoring system for The Chemical Industry.

The Internet of Things functional module for the chemical industry's production allows for continuous function completion assurance and future production technical assistance. The monitoring system eventually develops into a potent management tool and the new technology that came along with the explosive growth of information also modifies the conventional production model for the chemical sector. At the same time, industrial pollution is a significant contributor to environmental influence. Due to the unique characteristics of the sector, especially in the manufacturing of chemicals [16].

The suggested flat mesh network layout facilities the spread and dispersed processing of the field data gathering locations. To achieve effective control and administration of the communication hardware and communication flow of the Internet of Things, the function entity of the aggregation layer is introduced to the network structure. Additionally, the network's deployment plan makes use of cable and wireless dual channel heterogeneous networking technologies to increase the system's failure tolerance [17].

Based on the Internet of Things, build a remote monitoring system and briefly describe the system's general architecture as well as the software and hardware designs. Sensing devices are used by the system to gather data on the industry, including temperature and humidity. Establishing a though information management platform for the implementation of the Internet of Things in the Chemical Industry. The network is used to send the data that is automatically collected by sensors [18].

Using Internet of Things technology, a monitoring, warning, and emergency response system for chemical manufacturing. A few Internets of Things (IoT) services, including equipment state monitoring, data connectivity, automatic analysis, accident quick warning and emergency intelligent decision-making are set up in the chemical industry. The new system leverages the IoT technology to raise the organization's degree of automated management, transforming the whole chemical industry into a thorough network management system that incorporates security, production, monitoring, and early warning [19].

The device's Internet of Things (IoT) has many advantages for the next level of Chemical Industry, but the system Internet of Things has a limitation to combine all the system and give an immediate response time worker during the site's work. The IoT system's only limitation is to collect data analysis about the environmental site, type of pressure and temperature, and type of chemical gases for the management to avoid the cause of incident for the future. However, with the Internet of Things we can advise not only to monitoring and collection data environment sites but also on raising awareness among worker to avoid the risk of evacuation if the environment site a not in good conditions.

2.15 Summary.

Since the Petrochemical sector has remark emphasizes the significance of integrating Internet of Things (IoT) technology into industry site. The claim makes use of a literature review that focuses on the creation of an IoT-based autonomous personal industrial warning system. According to earlier research, it indicates how important early warning systems are for reducing hazards and guaranteeing worker safety in the Petrochemical Industry. In addition, researcher gaps on individual industry warning system and the particular needs of the Petrochemical sector were found during the evaluation of these implementations

CHAPTER 3

METHODOLOGY

3.1 Introduction.

In general, accuracy and effectiveness are considered the two conflicting requirements of worker safety in the Petrochemical Industry. Here, accuracy in the measurement and monitoring of surrounding of site area a very importance to avoid the risks and hazards from the high temperature, dangerous gas chemical and quality of air. The effectiveness of sensor to measure and monitor the site area a depends on type of sensor and device used. In addition, the difference in type of sensor and device for measurement and monitoring will give different site results. Based on the researcher's review, there are some idea that can be used to conduct this project. Tinker CAD will simulate the sensors are function as well, which will be simulated in Proteus for the Internet of Things from the device to the interface for the warning alert if have a risk and hazards in site areas.

3.2 Methodology.

This thesis presents the Development of Automatic Personal Industrial Warning with Internet of Things for Petrochemical Industries. Overall project flowchart in Figure 3.1 and project system setup in 3.2 shows the overall flow from the planning down to the actual product testing of this study.

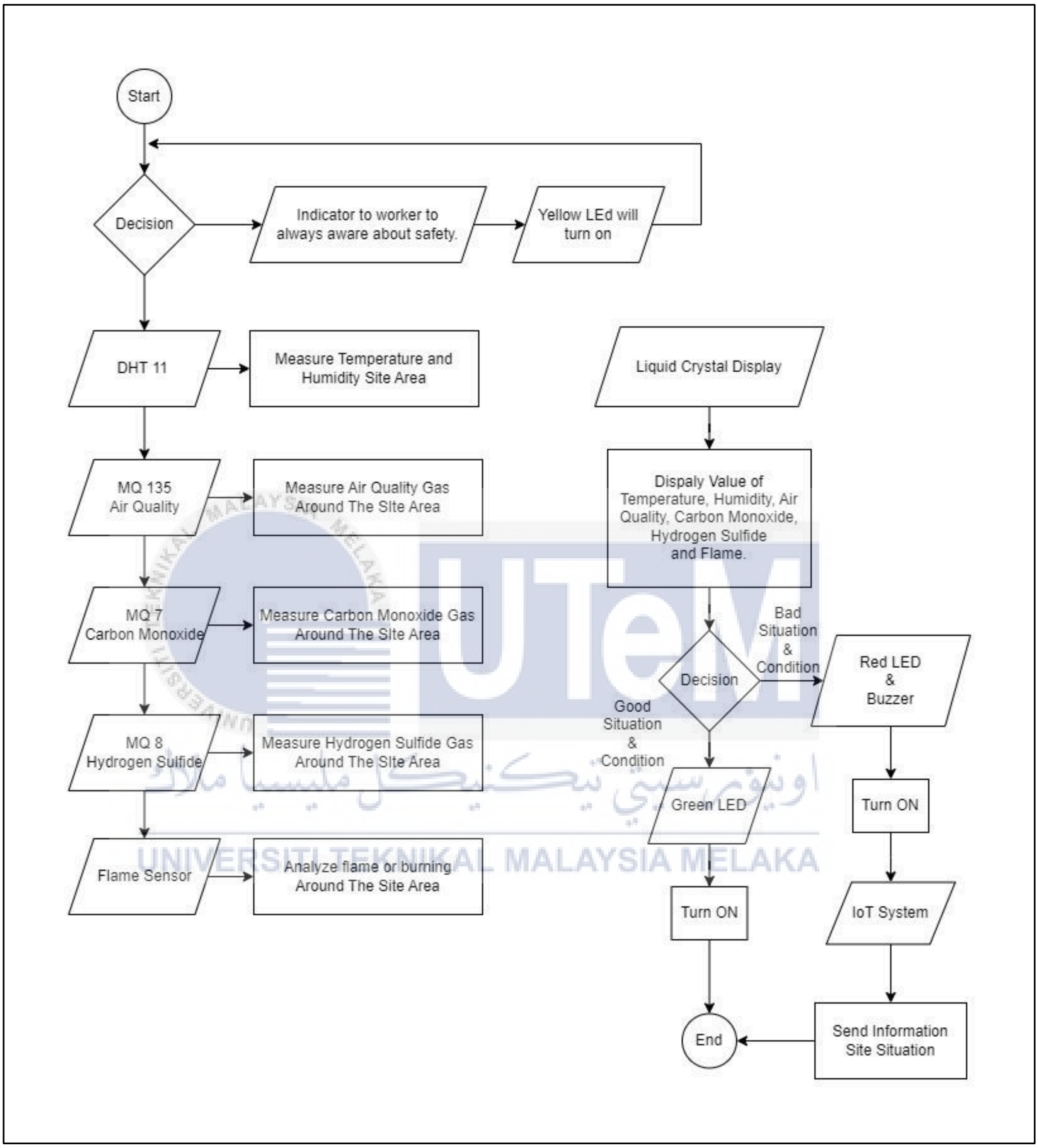


Figure 3.1 Overall Flowchart.

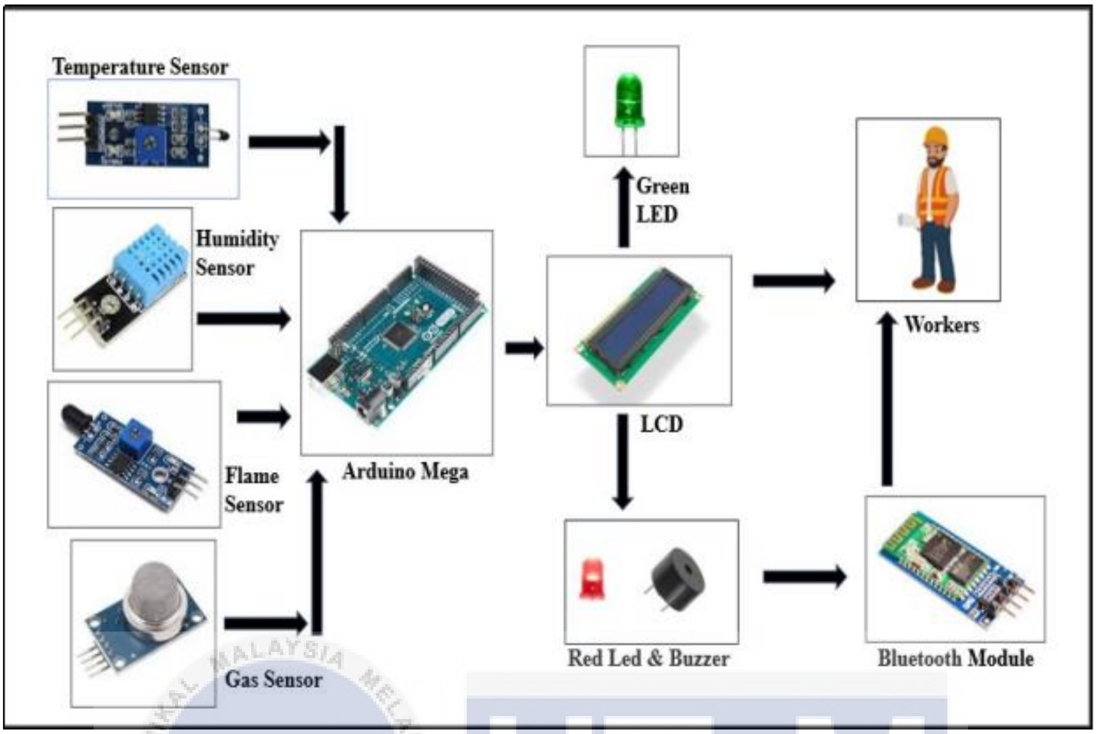


Figure 3.2 Project System Setup.

Firstly, the sensor will measure and monitor the site area for such things as temperature, humidity, air quality and flame. The data from the sensor will be processed by the Mega Arduino of the Central Processing Unit (CPU), which will present the measurement and monitoring on Liquid Crystal Display (LCD), worker will get info the site environment and surroundings before and during the work. If the site situation in bad, the Bluetooth module will be Internet of Things to informing the worker about the type of risk and hazard such as high temperature, low humidity, dangerous gases or low air quality and flame from the site surroundings (Figure 3.2). This device can avoid prevent the incident, injuries and death of workers. In addition, this device of project makes sure the worker is in health and safe before, during and after work.

3.3 Apparatus and Equipment.

There are apparatus and equipment that need to be used for this project. The choice and estimation cost for the items was shown (appendix d). Below is the apparatus used for the overall study: -

Table 3.1 Item Lists

No	Apparatus and Equipment	Quantity
1.	Arduino Mega	1
2.	Bluetooth Module	1
3.	Temperature Sensor	1
4.	Humidity Sensor	2
5.	Gas Sensor (MQ 7 – Carbon Monoxide)	1
6.	Gas Sensor (MQ 135 –Air Quality)	1
7.	Flame Sensor	1
8.	Liquid Crystal Display (LCD)	2
9.	LCD Adapter	2
10.	LED (Green)	1
11.	LED (RED)	5
12.	LED (YELLOW)	2
13.	Buzzer	1
14.	Battery 9 V	1
15.	Bread Board	1

3.3.1 CPU Project.

The Central Processing Unit (CPU) Arduino is a microcontroller board that uses a CPU to manage and carry out instructions of a variety of functions. A programmable interface is offered by the open-source electronics platform Arduino, which enables the development of interactive electronic creations. It has a microcontroller that serves as the board's input and output controller and is commonly based on the Atmel AVR and ARM architecture. The malfunctions of Arduino board to build variety of projects, communications, automatically and sensor-based systems. The Arduino will be present to many types and configuration dependencies on type of microprocessor, input-output port, data memory and size.

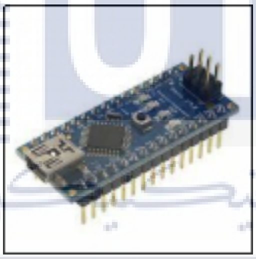


Figure 3.3 Arduino Nano.

The Arduino Nano is the smallest Arduino design (Figure 3.3) and offers similar functionality in a more compact form factor and friendly user interface. This design includes 8 analogue pin inputs and 14 digital pin inputs that will be connected to input-output for device, sensor or equipment and will be process by a simple microcontroller ATMega32u4, CPU speed of 16MHz, a flash processor 32 Kb and Micro USB to data transfer that can carry a 5V or 7-12V voltage supply.

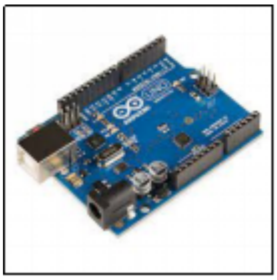


Figure 3.4 Arduino Uno R3

The Arduino Uno R3 (Figure 3.4) is a regular and mostly user-friendly Arduino. This design includes 6 analog pin input and 14 digital pins inputs that will be connected to input-output for device, sensor or equipment and will be processed by a simple microcontroller ATMega328, with a CPU speed of 16MHz, a flash processor of 32 Kb and regular USB to data transfer that can carry a 3.3V or 7-12V voltage supply.

Figure 3.5 Arduino Mega

The Arduino Mega (Figure 3.5) is the bigger design with includes 16 analogue pin input and 54 digital inputs will be connected to input-output for device, sensor or equipment and will be processed by a simple microcontroller ATMega2560, with a CPU speed of 16MHz, a flash processor 256 Kb and regular USB for data transfer that can carry a 5V or 7-12V voltage supply.

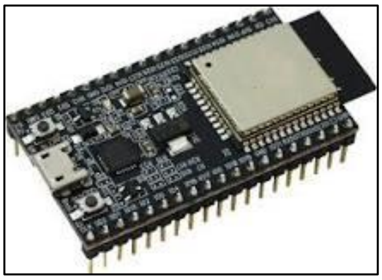


Figure 3.6 ESP 32

The ESP 32 is a low-cost system on chip (SoC) series. With its small size and relatively low power consumption, the ESP 32 is well-suited to a number of different IoT applications. ESP 32 is single 2.4GHz Wi-FI and Bluetooth combo chip designed with tTSMClow-power 40nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility and reliability in a wide variety of application and power scenarios.

For this project, Arduino will use the best-chosen Arduino, an Arduino Mega(Figure3.5). This Arduino Mega has many analogue pins that will be connected to many types of sensors, a bigger memory processor and fast CPU speed controller for processing this project. Additionally, the supply can carry a 5V or 7-12V suitable voltage supply and included Wi-Fi interface such as Bluetooth and Wi-Fi.

3.3.2 Sensor Component.

To maintain worker safety, sensor components in this project Development of Automatic Personal Industrial Warning with Internet of Things system for Petrochemical Industries a to continuously monitor a range of environmental variables. They can identify fire, smoke, gas leaks, unusual temperatures, pressure fluctuations, unauthorize entry and providing early warning. Prompt action and preventative measures to lessen possible threats.

3.3.2.1 Flame Sensor.

Figure 3.7 Flame Sensor

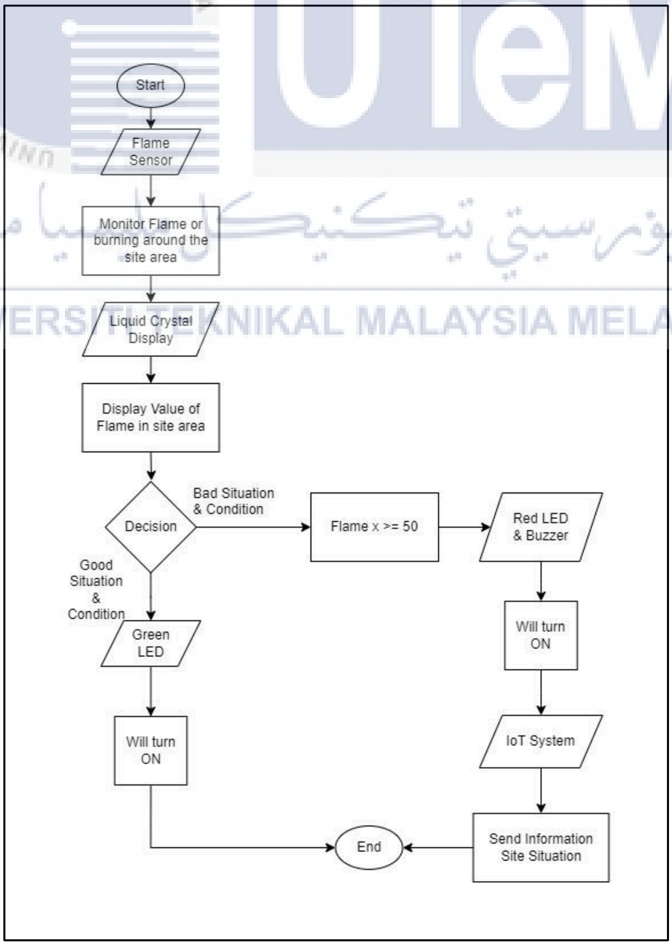


Figure 3.8 Flame Sensor Flowchart

A flame sensor is able to recognise and react to the presence of a flame (Figure 3.7).Instead of smoking smoke, which can start an open fire, these detectors can track the temperature. On a gas heating system, a flame sensor is an essential safety component. The gas in gas furnace is actually ignited during the ignition cycle by a spark or a hot surface ignitor. The flame sensor generates an electrical current as the gas is ignited.

3.3.2.2 Humidity Sensor.

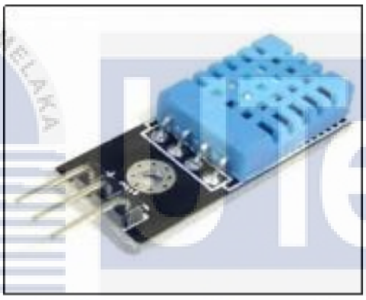


Figure 3.9 Humidity Sensor

The Humidity sensor measure the air's moisture content (Figure 3.10). The more water vapour. There is in the air, the higher the humidity and the wetter it seems outside. The aspirated psychrometer measeures humidity by determining the difference in temperature between the dry and wet bulbs. The psychrometer measeures is made up of two identical thermometer that hang side by side suspended side by side in the air.

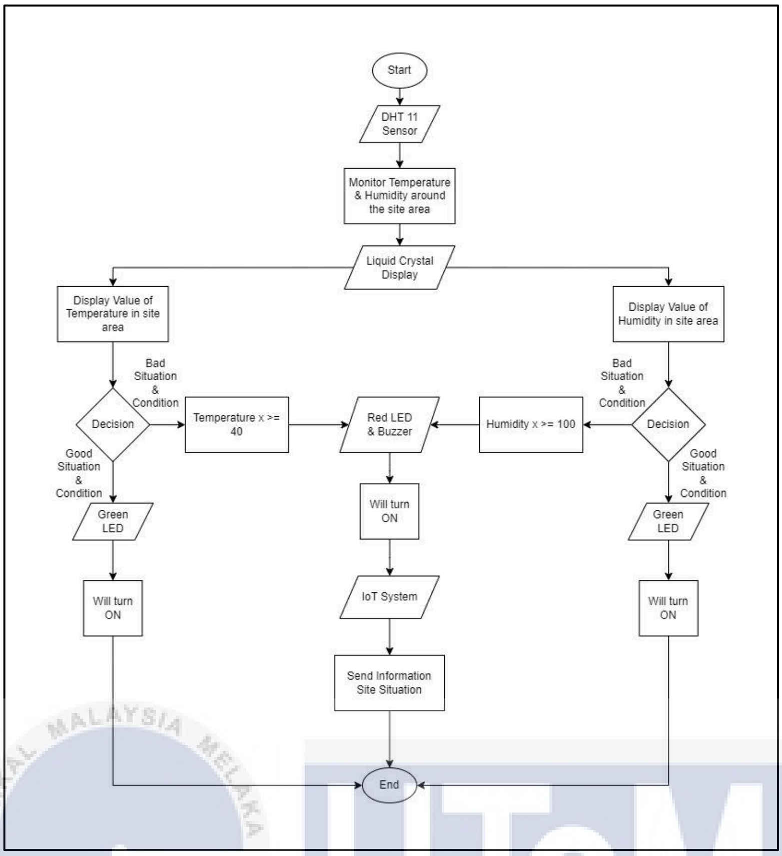


Figure 3.10 Humidity Sensor Flowchart

3.3.2.3 Gas Detector Sensor.

Gas sensors are devices that can identify the concentration and presence of several dangerous gases and vapours, including vapours, volatile organic compound (VOC), humidity and odors. Gas sensors are used in industries and manufacturing facilities to locate gas leaks and detect smoke and carbon monoxide, depending on their size, ditection range and sensing capaability. The use of gas sensors help prevent dangerous consequences like fire breakouts by detecting the concentration of gases that are present in the atmosphere. Sensitivity, selectivity, stability, operating temperature, response and recovery times, detection limit and resolution are key performance metrics for gas sensors.

Figure 3.11 Family Gas Sensor

Table 3.2Type of Gas Sensor and functioning

No	Model	Nominal Test Target Gas
1.	MQ 8	Hydrogen, Coal and Gas
2.	MQ 9B	Carbon Monoxide
3.	MQ 2	Flammable Gas, Smoke
4.	MQ 5	Liquefied Petroleum Gas, Methane, Coal, Gas
5.	MQ 135	Ammonia, Sulfida
6.	MQ 3B	Alcohol
7.	MQ 7B	Carbon Monoxide
8.	MQ 4	Natural Gas, Methane
9.	MQ 2	Flammable Gas, Smoke
10.	MQ 6	Liquefied Petroleum Gas, Isobutane, Propane
11.	MQ 7	Carbon Monoxide
12.	MQ 8	Hydrogen Sulfide

3.3.2.4 MQ 7 Gas Sensor.

The MQ 7 Gas Sensor is very sensitive to Carbon Monoxide. The sensor is inexpensive, adaptable, and capable of detecting a variety of gases, including Carbon Monoxide. This is an easy to use Carbon Monoxide sensor that may be used to measure airbone CO concentrations. CO gas concentrations range from 10 to 500 ppm, which the MQ 7 can detect responds quickly and has a high sensitivity.

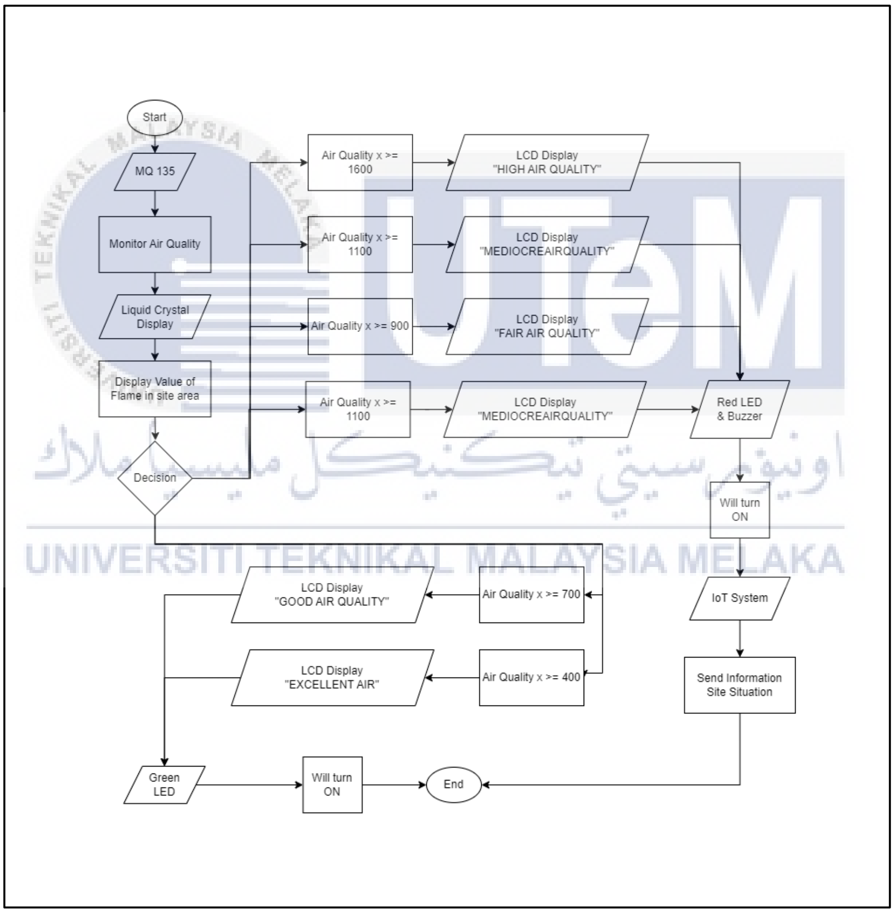


Figure 3.12 Carbon Monoxide Gasses FlowChar

3.3.2.5 MQ 8 HydroSulfide Gas Sensor.

The MQ 8 Gas Sensor is a hydrogen gas sensor that may use to measure the amount of hydrogen in the atmosphere. Between 100 to 100000ppm of hydrogen gas may be detected using the MQ 8 Gas Sensor. This sensor responds quickly and with excellent sensitivity. The MQ 8 Gas Sensor's sensitivity component of SnO2, which has reduced conductivity in the clean air. The conductivity of the sensor increases along with the gas concentrations when hydrogen gas is present.

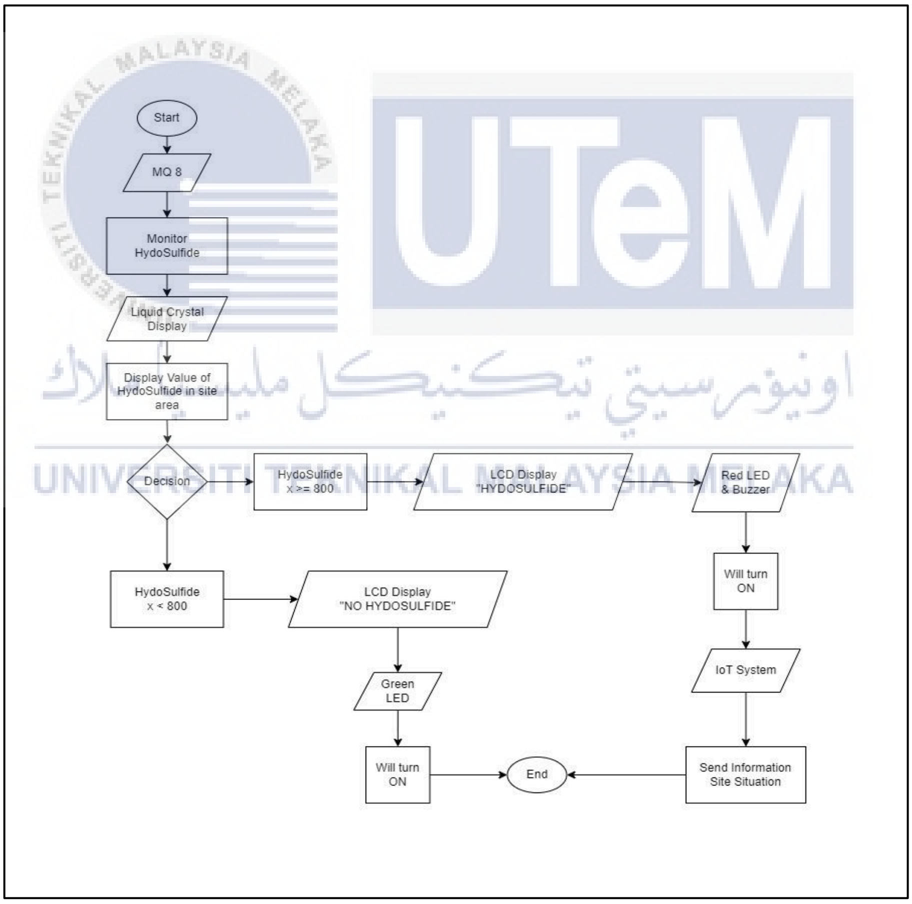


Figure 3.13 HydroSulfide Gasses FlowChart

3.3.2.6 MQ 135 Air Quality Sensor.

The MQ 135 Gas Sensor may be used to identify dangerous gases such as smoke, benzene, vapors and chemical gases. It can detect a variety of dangerous gases and may be used for noxious gas detection, portable air pollution detection, residential air pollution detection and industrial pollution detection. The MQ 135 Gas Sensor is also sensitive to methane, alcohol, and LPG. It can relocate harmful LPG leaks in the surroundings of a service station, storage tank and site environment with a range detection of 10-1000ppm.

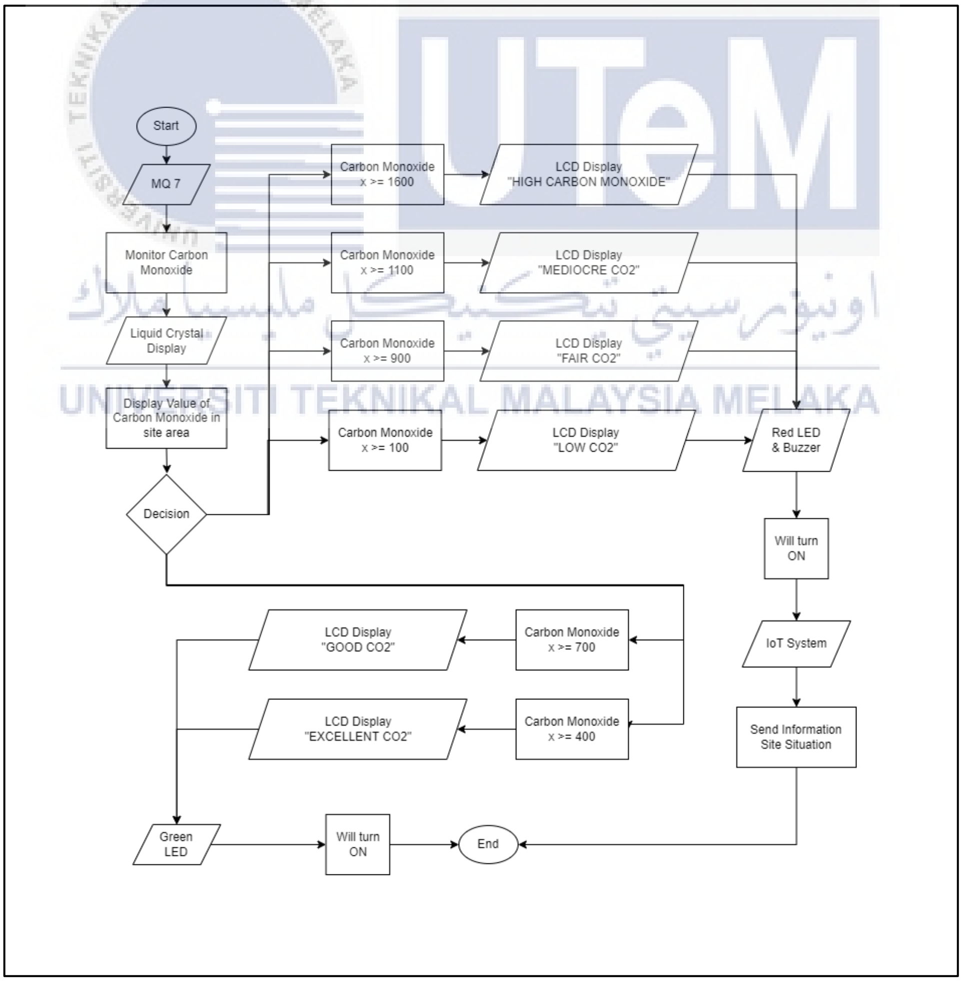


Figure 3.14 Air Quality Gasses FlowChart.

For this project, the gas sensor will be use are MQ 135 for Air Quality to measure Air Quality, MQ 7 for measure Carbon Monoxide from burning or leakage gases for this type and MQ 8 for Hydrogen Sulfide for measure VOC Organic Compound release in the confined space area and around the site area. This to ensure the site area a secure from the dangerous gases before, during and after operation and maintenance around the worker's, equipment, facilities and the site areas.

3.3.2.7 Liquid Crsytal Display (LCD).

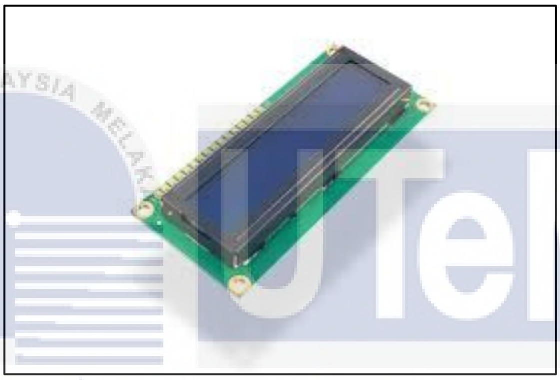


Figure 3.15   Liquid Crsytal Dispaly (LCD)

The Liquid Crystal Display (LCD) panel is designed to project on screen Information of a microcomputer onto a larger screen with the aid of a standard overheasd projector., so that large audiences may view on screen information without having to crowd to know the know the information from the sensor. The main advantages of LCD is, it is low cost and energy effiecient and has very little power consumption, lighter, thinner and flexible. Additionally, LCD provides excellent resolution, brightness and contrast so the picture quality is crystal clear.

3.3.2.8 Bluetooth Module HC-06.

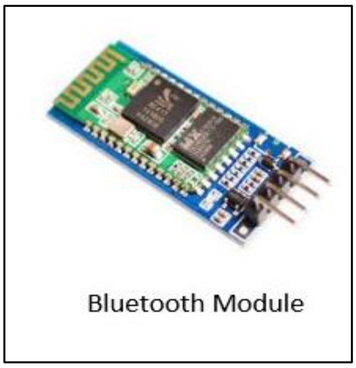


Figure 3.16 Bluetooth Module HC06

The Petrochemical Industry's safety may be improved by using Bluetooth Arduino as an Internet of Things solution. Multiple sensors and monitoring equipment may be wirelessly connected to the Arduino by incorporating Bluetooth technology, allowing for the collection of data on important factors such as temperature, humidity, air quality and more. For monitoring and analysis, this real-time data can be sent to module application or a central control system. Personnel may access the data remotely via Bluetooth connectivity, which gives them the ability to see possible dangers, monitor the state of their equipment and act quickly in case of crises or anomalies. With this Internet of Things solution, the Petrochemical Sector can improve safety, avoid accidents, and reduce risks in an effective and dependable manner.

3.4 Summary

This chapter presents the proposed methodology in order to develop a new accuaracy and effective way to measure, monitoring and respond to the workers, analyse the data and avoid a causes incident in the future for Petrochemical Industry. This method of using Internet of Things to control, measure and monitoring data follows the development of Industries Revolution 4.0 (IR 4.0). Sensor will measure the site enviroment and the data of the site enviroment will be analyse, this will help worker, company and the industries to avoid the causes of incidents quickly and improve the safe of the Petrochemical Induries in the future.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The results of this project are presented in this chapter. As a result, all of the objectives of this project have been achieved. Firstly, the device's instant temperature sensor, humidity sensor, flame sensor, and type of gas sensor will measure and monitor the environment of the site area, especially the place exposed to dangerous conditions such as high temperature, low humidity, low air quality, and any type of material that can spark a flame in the Petrochemical Industries. This sensor's data will be analyzed by an Arduino Mega's central processing unit (CPU). The data measurement and monitoring will be displayed on the LCD, and the indicator LED will turn on and off based on the flow of the sensor. When the site is insecure, safe, and in good condition, the green LED will turn on, but the buzzer will not turn ON. If the site condition is bad, the red LED will turn on based on the type of sensor, and the buzzer will turn ON. The CPU will then notify the workers via Bluetooth device based on the type of risk and danger of the site situation. This component will help workers evacuate the site area immediately, save their lives, and avoid incidents.

4.2 Experimental and Testing Sensor.

This project presents the Development of Automatic Personal Industrial Warning with Internet of Things for Petrochemical Industries using Mega Arduino as a Central Processor Unit. The purpose of experimental and testing for measure and monitoring the sensor in the simulation to make sure the coding useful very well. The testing be presented by the sensor will be use with difference codings.

4.2.1 Temperature Sensor.

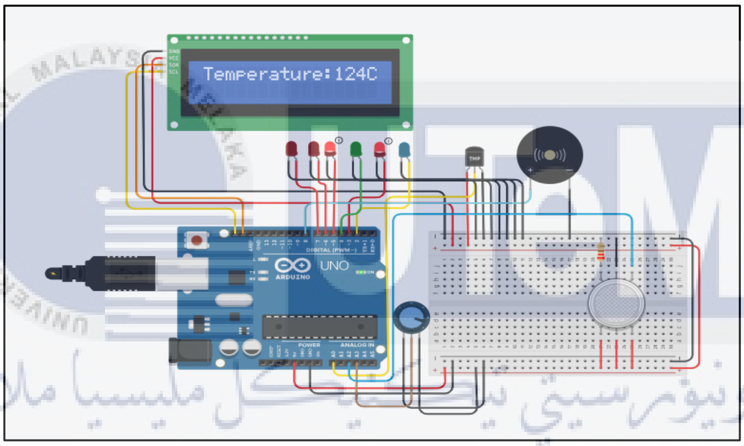


Figure 4.1 Temperature Sensor (TinkerCAD)

4.2.2 Gas Sensor MQ 135

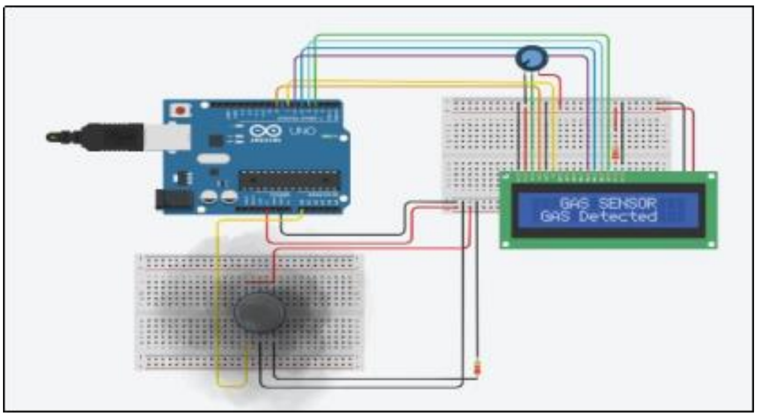


Figure 4.2 Gas Sensor (TinkerCAD)

The experiments and testing of type of the type of main sensor and component in this project, are to make sure the coding and components are functioning well before they are combined and compiled. This to avoid a fault and error of simulation, it was necessary to go through a complete circuit and codes.

4.3 Type of Simulation and Applications.

Simulation and application of this the Development of Automatic Personal Industrial Warning with Internet of Things for Petrochemical Industries will be simulated by using TinkerCAD for testing type of sensors and components before combining them into a complete circuit. This simulation and test in TinkerCAD are to make sure the coding of sensor a functioning by type of sensor. After that this, project will be simulated in Proteus to run all sensors and components in a complete circuit. Proteus Software can manage type of sensor and component will be use in this project such as, Gas detector MQ 135 air quality sensor, tempertaure sensor, humidity sensor, flame sensor and bluetooth module.

4.3.1 Proteus

Proteus 8.0 is a powerful software programme made for the design and simulation of electrical circuits. Proteus 8.0 offers a complete collection of components and modules for building complicated systems, enabling the development and modelling of analogue and digital circuits through its user-friendly interface. It is a vital tool for circuit design, PCB layout and firmware development and allows real-time debugging, virtual tetsing and interactive simulation, eventually assisting in the acceleration of the electronics design process. Additional, the components and sensor can be download and install into the library, this configuration help user to use the component and sensor. Besides that, this configuration do’t have in other simulation software.

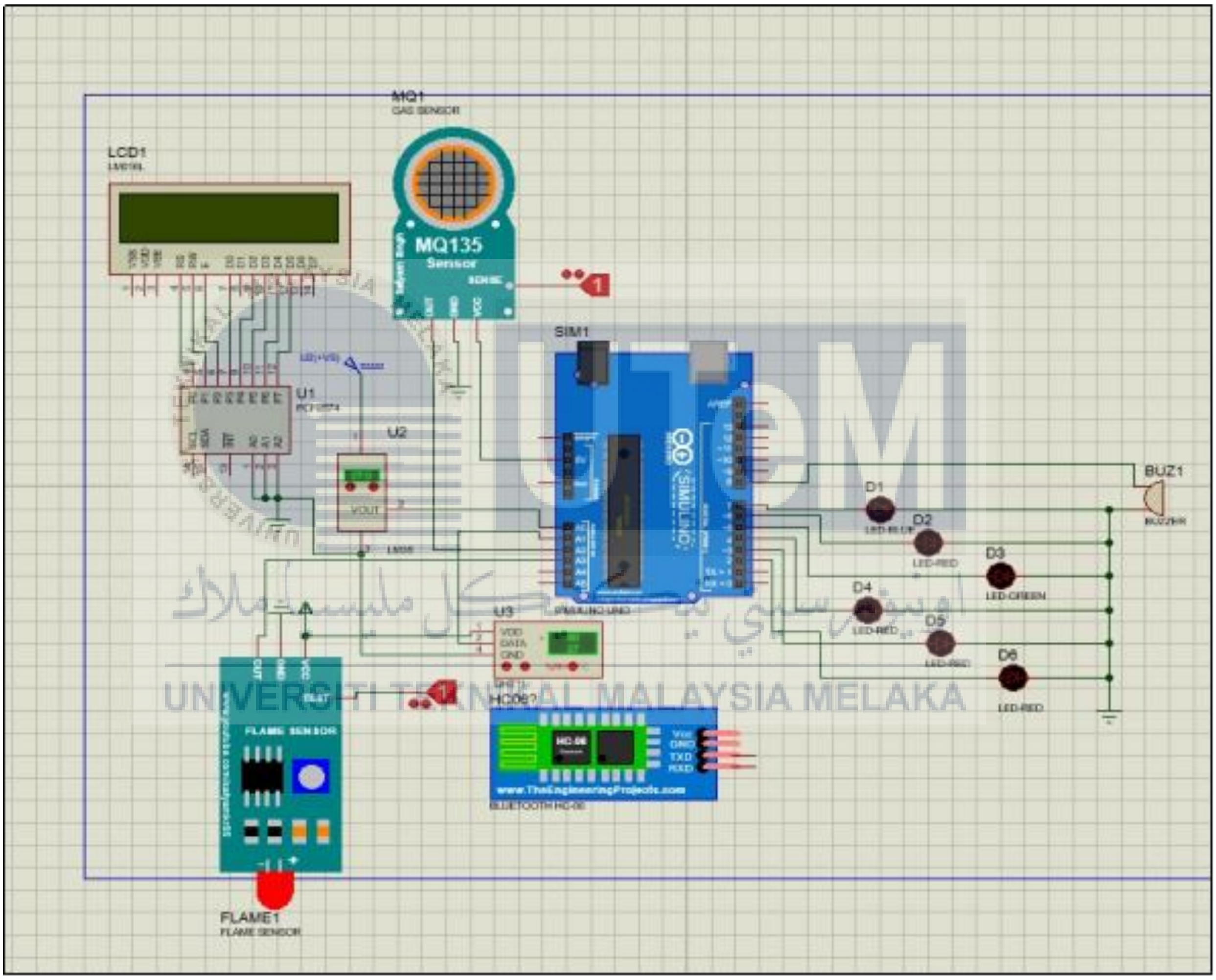


Figure 4.3 Proteus Circuit.

4.3.2 TinkerCAD

TinkerCAD is an easy to use web based platform for 3D design, electronics and scripting. It lets users quickly develop and modify 3D models, circuit designs and even programme their inventions. TinkerCAD enables both novices and professionals to relise ideas without the need for complicated software or in-depth technical expertise to its user-friendly interface. TinkerCAD is a perfect tool offer a varienty of tools and features that enables users to prototype, explore and invent in the areas of 3D printing, electronics and design.

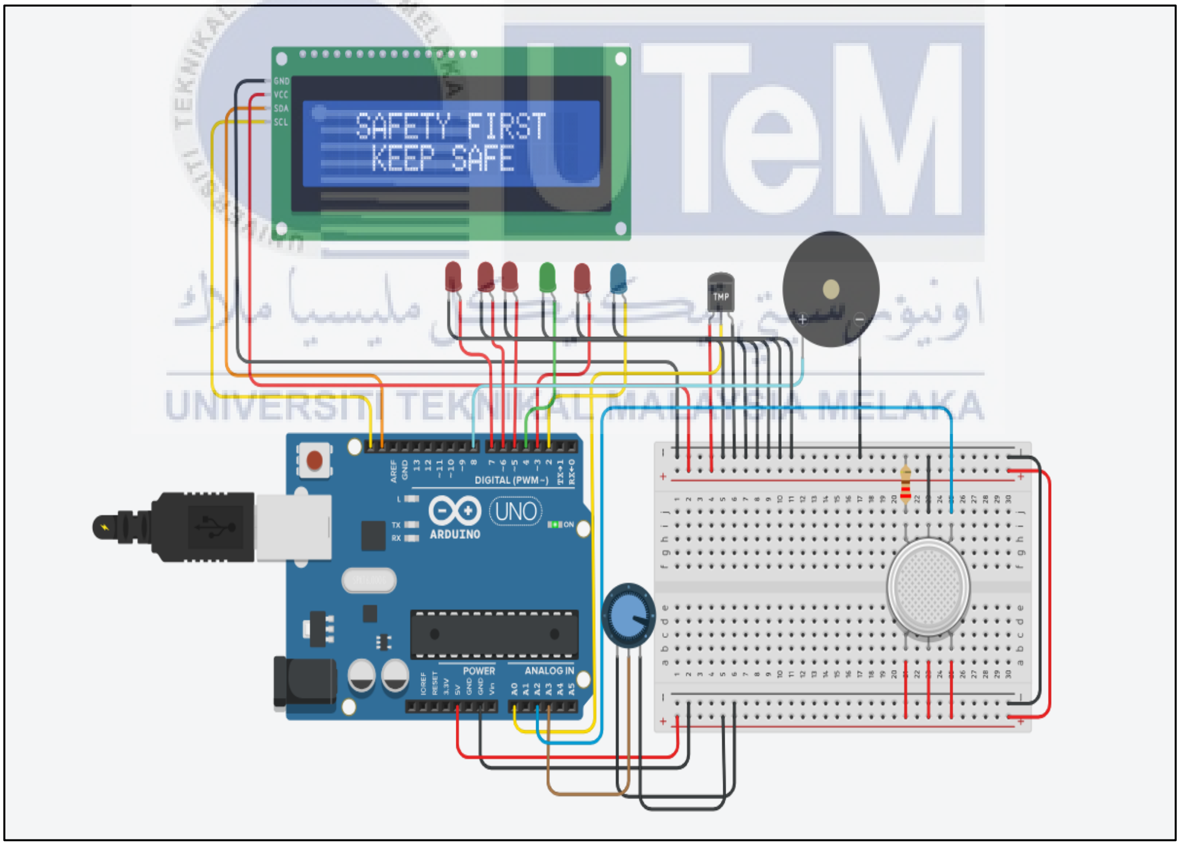


Figure 4.4 Circuit in TinkerCAD.

4.4 Project Circuit

This project circuit sketch and development is to connect the sensor and component in right port place of input-output (Figure 3.15), the sensors of this project usually in analog sensening to sensoring the sensor situation and condition of temperature, humidity, air quality and flame. In this project circuit, the sensor components will connected to analogue input port and the indicator will be connected to the PWM or digital port. Additionally, this connection of inpuit sensor and output component will make the measurement and monitoring of the condition and site situation more effective. It is critical to avoid the causes of risk and hazard of incidents in the Petrochemical Industrial.

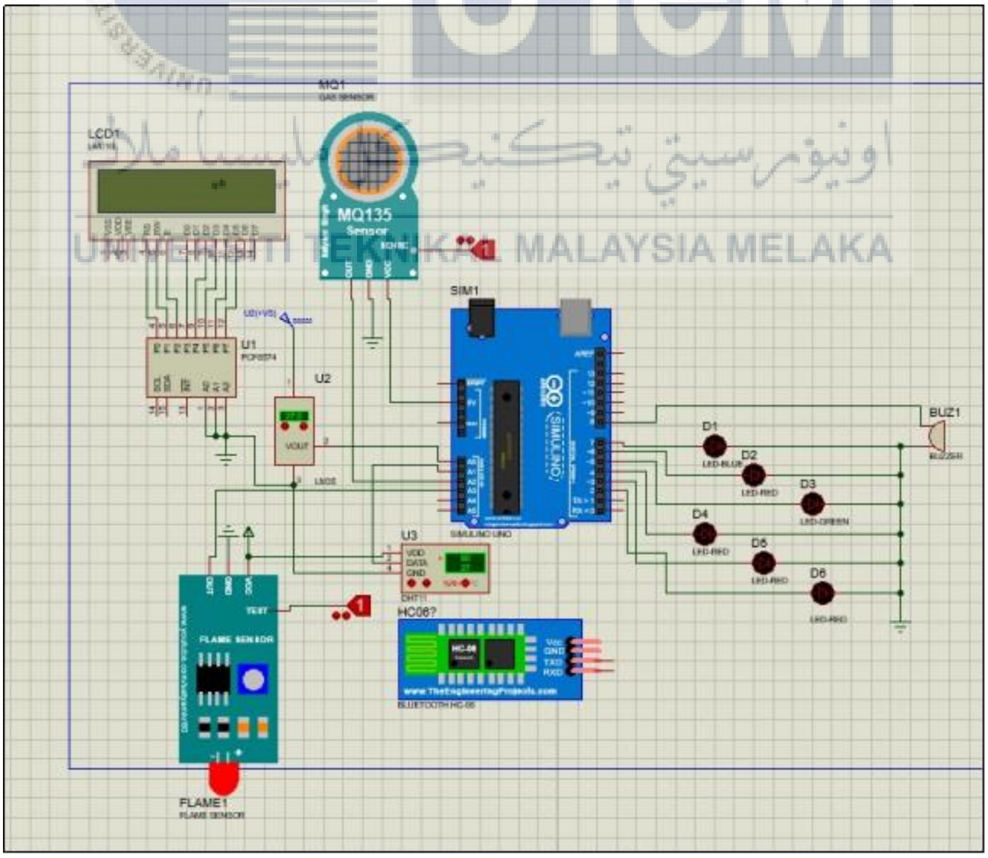


Figure 4.5 Complete circuit in Proteus 8.

4.5 Result and Analysis

The testing and the results are based on regulation of Occupation Safety and Health Administration (OSHA) Malaysia. The temperature and humidity are tested based on standard values of OSHA. Addition, the gas type that have level of air condition from Good, Moderated, and unhealth air. These results and analysis were collected by different type of sensors.

4.5.1 Temperature and Humidity (DHT 11)

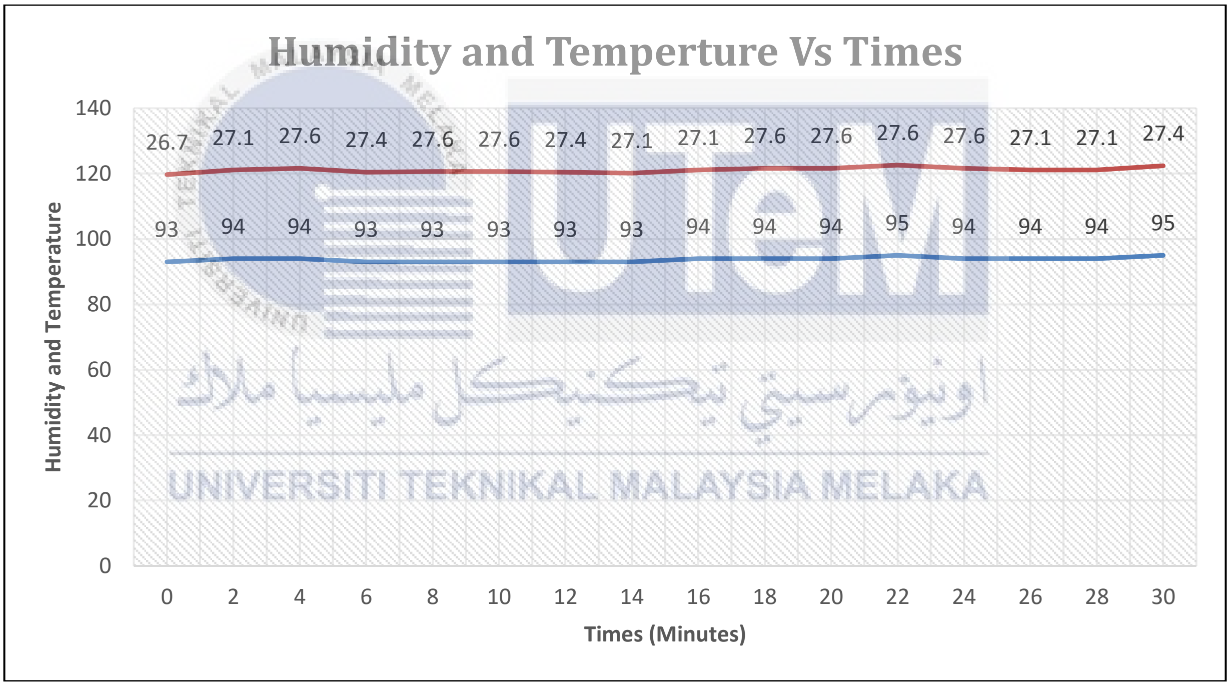


Figure 4.6 Humidity and Temperature (DHT 11) versus Times

Based on the results (Table 4.1), we can conclude that the increased temperature will decrease the value of humidity in the surrounding area. This sensor is in opposition to another. This data was recorded every 2 minutes, and we can observe that the high humidity can contribute to the surrounding temperature. In this case, the high value of temperature and humidity is not conducive to worker implementation of operations and maintenance in the Petrochemical Industries.

Table 4.1Humidity and Temperature versus Times (DHT 11)

Times (Minutes)	Humidity %RH	Temperature (Celcius)
0	93	26.7
2	94	27.1
4	94	27.6
6	93	27.4
8	93	27.6
10	93	27.6
12	93	27.4
14	93	27.1
16	94	27.1
18	94	27.6
20	94	27.6
22	95	27.6
24	94	27.6
26	94	27.1
28	94	27.1
30	95	27.4

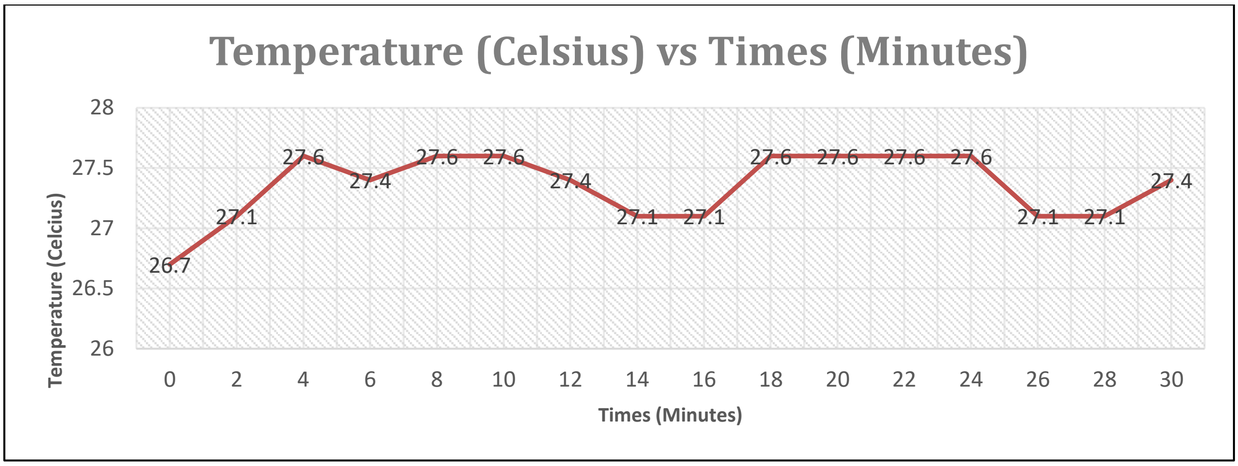


Figure 4.7 Temperature Celsius versus Times

Table 4.2Temperature Celsius versus Times

Times (Minutes)	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
Celsius	26.7	27.1	27.6	27.4	27.6	27.6	27.4	27.1	27.6	27.6	27.6	27.6	27.6	27.1	27.1	27.4

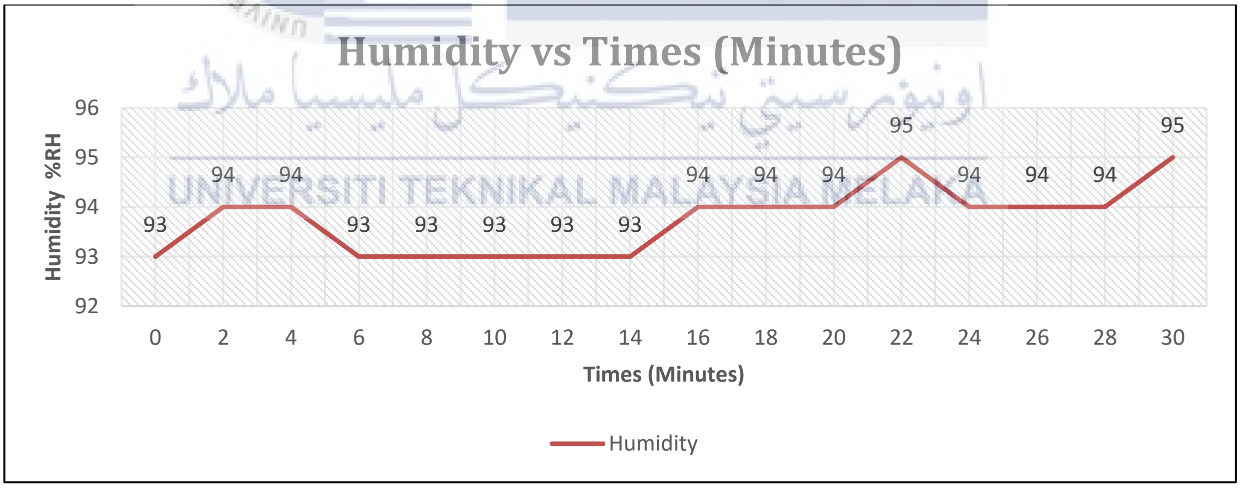


Figure 4.8 Humidity RH vs Times Minutes

Table 4.3 Humidity RH vs Times Minutes

Times (Minutes)	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
Humidity	93	94	94	93	93	93	93	93	94	94	94	95	94	94	94	95

4.5.2 Gas Sensor

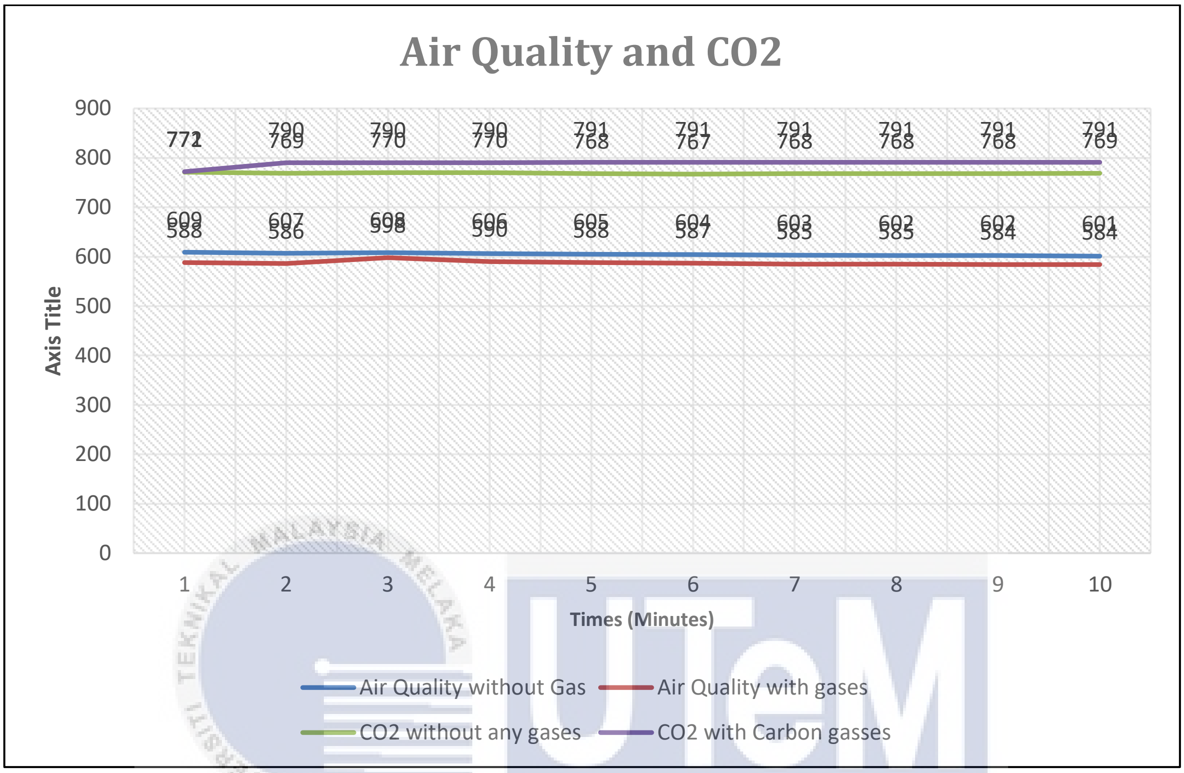


Figure 4.9 Air Quality and Carbon Monoxide (0 cm)

Table 4.4 Air Quality (0 cm)

Times (Minutes)	1	2	3	4	5	6	7	8	9	10
0cm No Gas	609	607	608	606	605	604	603	602	602	601
0cm Gas	588	586	598	590	588	587	585	585	584	584

Table 4.5 Carbon Monoxide (0 cm)

Times (Minutes)	1	2	3	4	5	6	7	8	9	10
0cm No Gas	771	769	770	770	768	767	768	768	768	769
0cm Gas	772	790	790	790	791	791	791	791	791	791

Carbon monoxide and air quality (Figure 4.9) are taken at a distance of 0 cm from the source, they are probably going to be much higher than typical. This is a result of the sensors immediately capturing a larger concentration of air pollutants released by the source at such close distances. Increased readings for air quality assessment might point to a nearby, immediate source of pollution, while a spike in readings for carbon monoxide detection would point to a possible safety risk because of the carbon monoxide-emitting combustion source's close vicinity. Because of the unique properties of the sensors, the makeup of the surrounding environment, and the possible effects on health and safety, it is imperative to interpret these findings with caution.

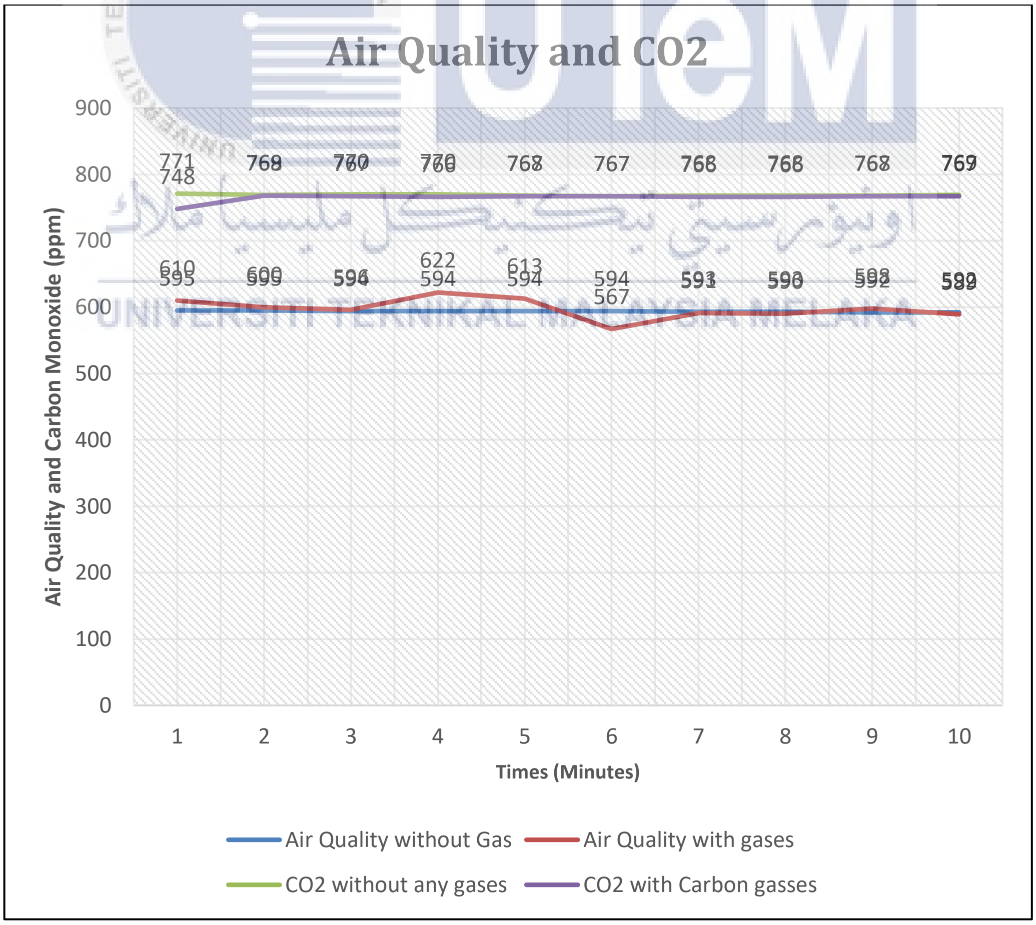


Figure 4.10 Air Quality and Carbon Monoxide (30 cm)

The evaluating environmental safety are the air quality and carbon monoxide levels as reported by sensors at a distance of 30 cm (Figure 4.10). With greater values signifying elevated levels of contaminants. Elevated amounts of carbon monoxide or air pollution may be indicated by a persistent trend in the sensor readings. But the precise interpretation of these readings necessitates calibration according to the properties of the sensors and the surrounding environment. In general, larger sensor readings at the same distance might indicate higher quantities of carbon monoxide and worse air quality. It is crucial to remember that in order to accurately assess the environmental factors and potential health concerns at the designated distance, these data should be analysed in combination with recognised air quality regulations and recommendations.

Table 4.6 Air Quality (30 cm)

Times (Minutes)	1	2	3	4	5	6	7	8	9	10
30cm No Gas	595	595	594	594	594	594	593	593	592	592
30cm Gas	610	600	596	622	613	567	591	590	598	589

Table 4.7 Carbon Monoxide (30 cm)

Times (Minutes)	1	2	3	4	5	6	7	8	9	10
30cm No Gas	771	769	770	770	768	767	768	768	768	769
30cm Gas	748	768	767	766	767	767	766	766	767	767

4.5.3 Flame Sensor

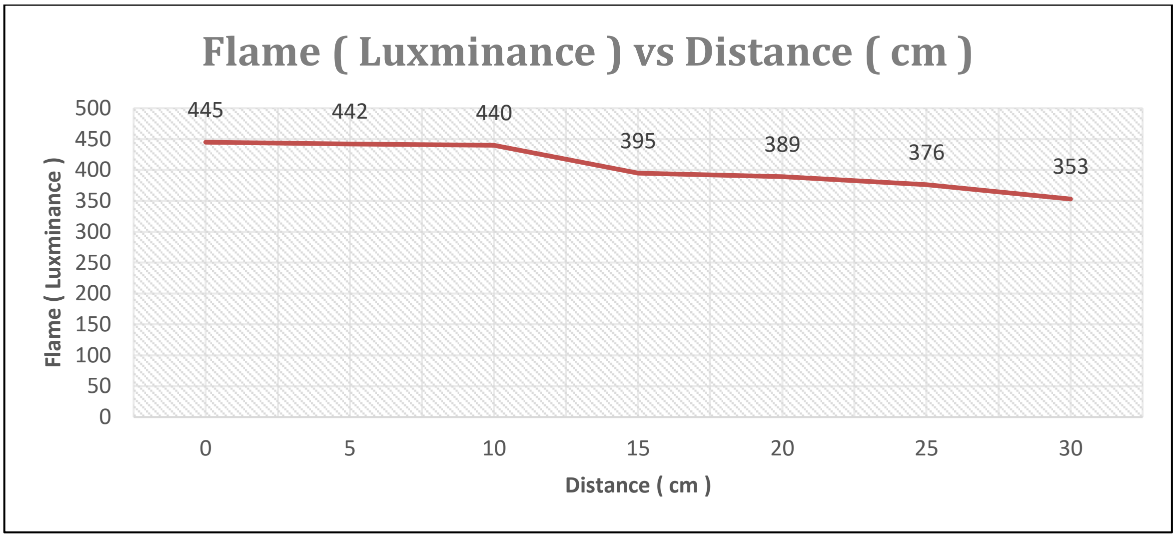


Figure 4.11 Flame Luminance versus Distance

Table 4.8 Flame Luminance versus Distance

Distance (cm)	0	5	10	15	20	25	30
Luminance's	334	320	315	314	314	310	309
	331	317	314	313	313	309	303
	330	316	315	313	313	310	305
	328	314	315	317	314	311	304
	320	314	314	314	313	312	305
Total Luminance	1643	1581	1573	1571	1567	1552	1526
Average of Luminance	328.6	316.2	314.6	314.2	313.4	310.4	305.2

Based on the results (Table 4.8), the position and distance of the light source from the flame sensor are important to increase the efficiency of the flame sensor. Additional, the value of the luminance of light will also contribute to the value measured by the flame sensor. If the sensor is close to a light source, the value of luminance will increase, and a high value of luminance is not stable for workers, especially for our eyes.

4.5.4 Hardware System

The overall hardware (Figure 4.10) that was used in this final project. The hardware was successfully develop, this hardware has 2 type of LCD, first LCD remind the worker about the safety and the second LCD to display the value type of sensor. On the top of hardware, thats have type of sensor such as Air Quality sensor, Carbon Monoixde sensor, and Hydrosulfide sensor. Additional, flame sensor to detect any flame or fire around the site areas. Side of the hardware DHT 11 will measure temperature and humidity a surronding area. Lastly, 2 LEDs will blink between the changes in the sensor value display. The communication is done by connecting it to the Arduino Mega 2560 microcontroller module, the receiver will be done by the ESP32.

Figure 4.12 Overall Hardware

4.5.5 Recorded Results.

This recorded result was all sensor during testing our development; this result was recorded for four condition and condition (Figure 4.13). This test was divided into four point and positions in one area's. Based on the results, we can conclude that the position of the device near water resources will increase, the value of %RH will increase, and the temperature will decrease. The type of gas sensor will analyse the gases surrounding the area to make sure the area has good air quality, a good percentage of oxygen, and doesn't have any unknown gases around the area, such as hydrogen sulphide for the Votalite Organic Compound. However, the value of luminance is different from that of the flame sensor and light sources.

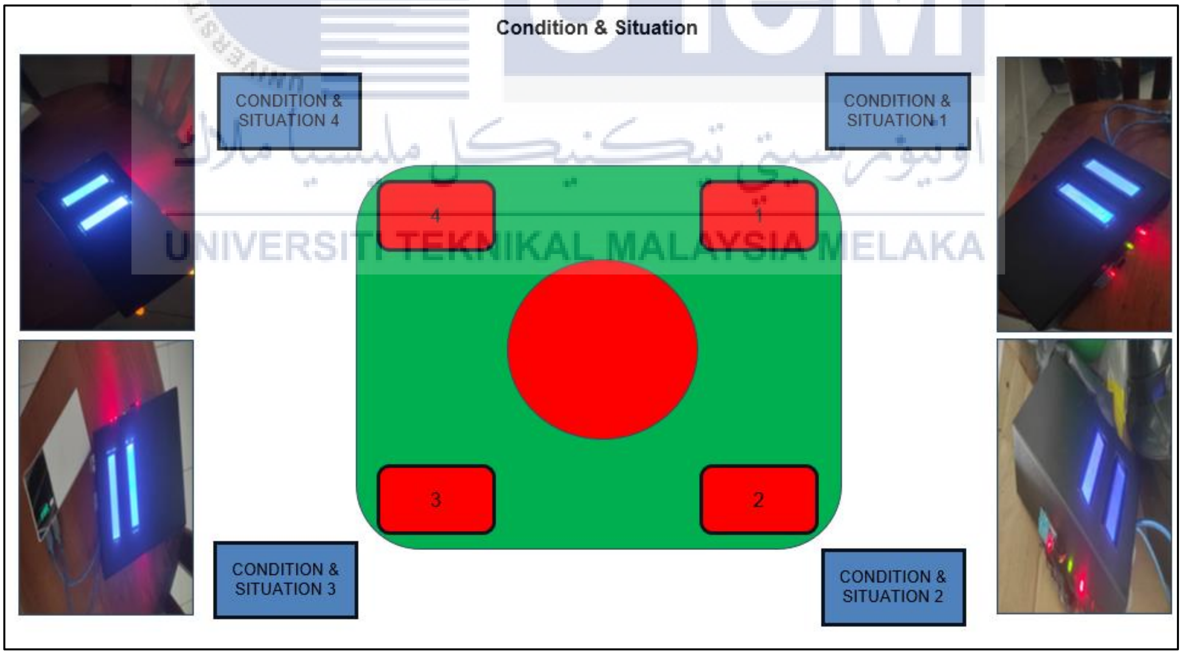


Figure 4.13 Condition & Situation

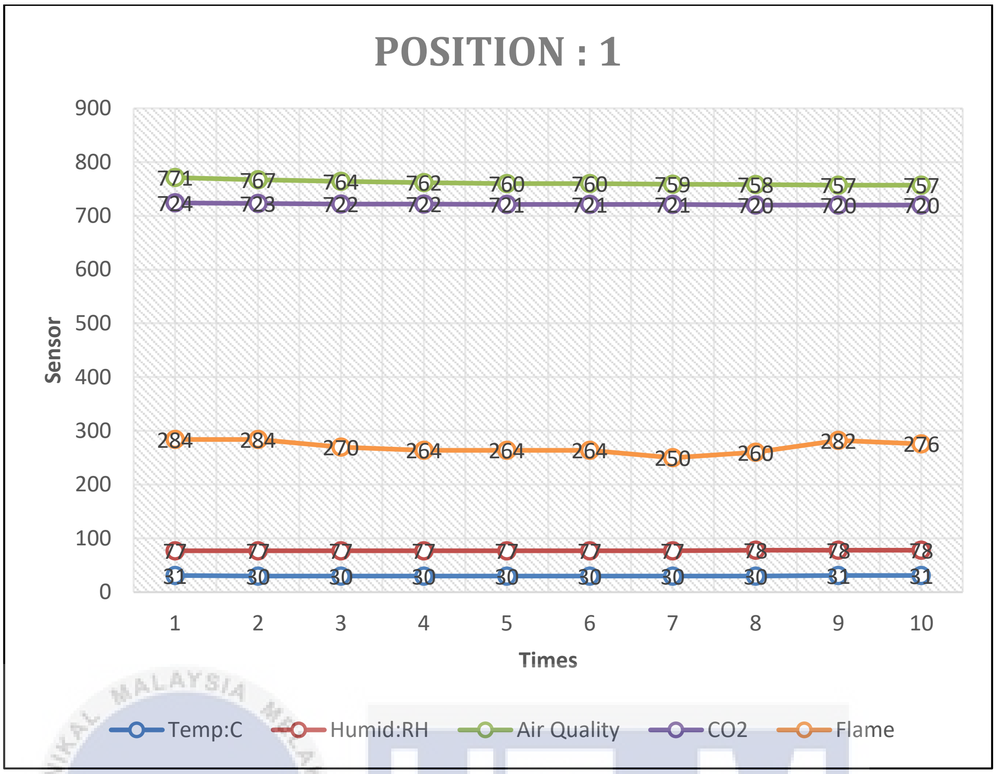


Figure 4.14 Position 1

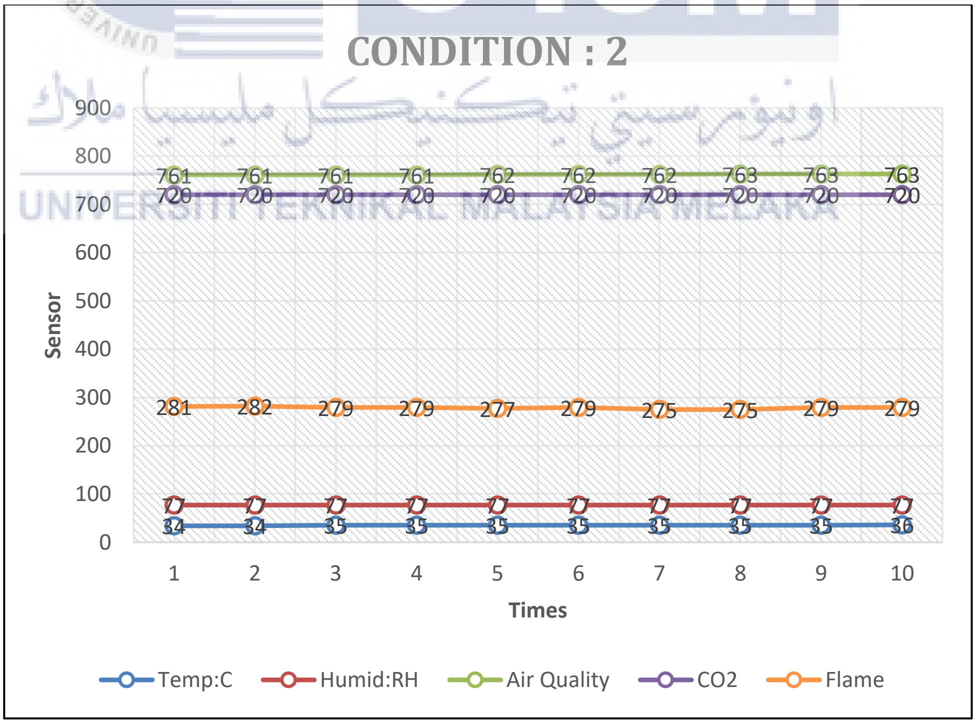


Figure 4.15 Position 2

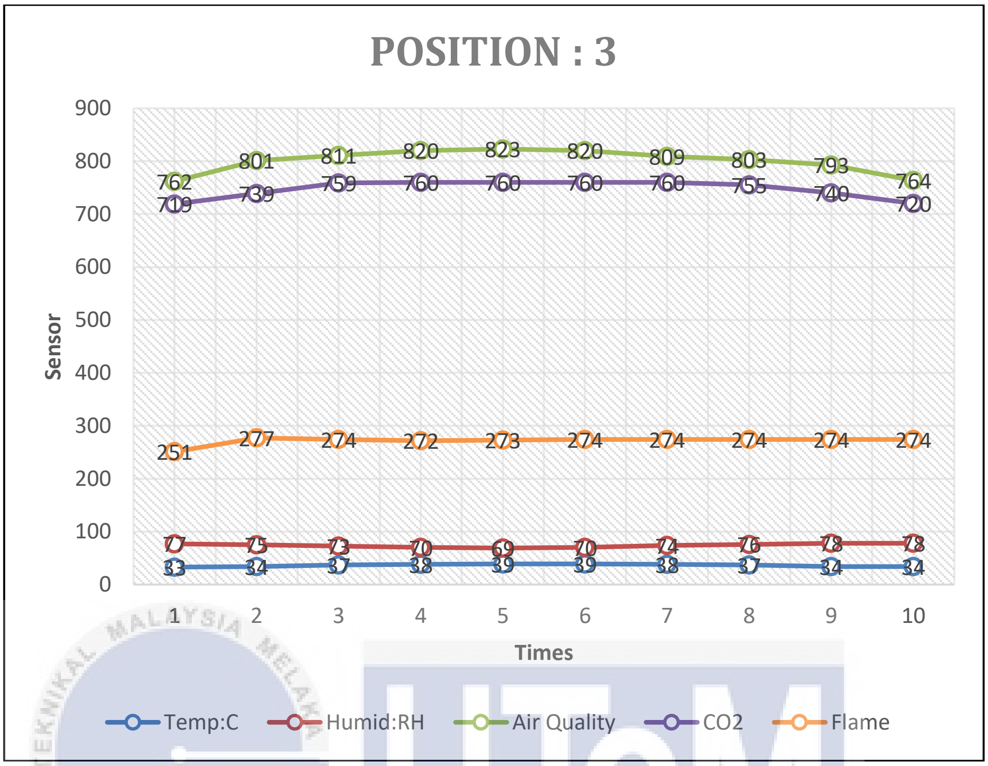


Figure 4.16 Position 3

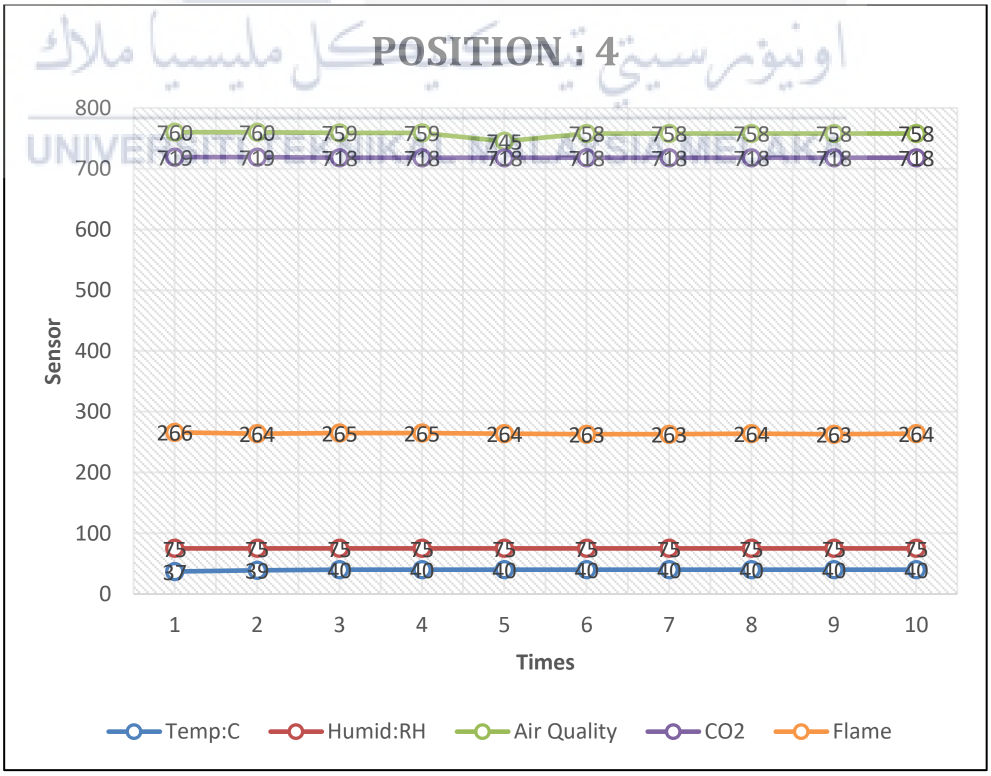


Figure 4.17 Position 4

In position 2 (Figure 4.15), the flame sensor has a higher value than the other position in this test. This is because the position and distance of the flame sensor are close the light sensor. Additional, the humidity is at a high value, and as we know, the humidity is in the opposite direction of temperature. When the humidity is high, the temperature is low value. This is because the position of devices is close to water resources or these is high humidity in these areas.

In position 1 (Figure 4.14), the type of gas sensor have a higher value than the other position in this test. This is because the position of the devices is a source of gases or close chemical storage. Just as we know, the chemicals in storage under pressure and chemical vapor leaks surrounding this devices testing.

For position 3 and 4 (Figure 4.16 & 4.17), all sensor values are smaller than those for position 1 and position 2 because this position isn't close to the source of water resource, chemical material, humidity and light. For these results and analyses, we can conclude that positions 1 and 2 are the best places for the devices to measure and monitor the surrounding area more efficiently and accurately.

4.6 Summary

In summary, After extensive experimentation and observation, it has been determined that the error-prone and inaccurate sensors used for measurement and monitoring purposes will be replaced in accordance with safety regulations, site conditions, incident types, and industrial requirements. Additionally, gas sensors will be incorporated based on prevalent incidents of gas leakage and pollution, as documented by the OSHA. These sensors will undergo filtration and categorization according to predefined safety standards, with specific thresholds dictating whether a work area is recommended or not based on gas concentrations.

Furthermore, environmental conditions such as temperature and humidity are considered critical factors affecting worker safety. Working in areas where temperature exceeds 40°C and humidity exceeds 80% RH is discouraged due to the discomfort and potential health risks associated with such conditions. Flame sensors are also deployed to detect any presence of flames or high luminance, providing crucial information to workers regarding the safety of their working environment.

To disseminate real-time information to workers and enhance safety protocols, data collected from sensors will be displayed on LCD screens and transmitted via the ESP32 platform. This technological advancement aims to proactively inform workers about their surroundings, thereby mitigating the risk of incidents, reducing fatalities, preventing facility damage, and minimizing environmental pollution.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion.

In conclusion, based on the results and discussion, the results and analysis of all sensors in the safety requirement for Petrochemical Industries and their involvement in Industry Revolution 4.0. All three objectives of this project have been achieved, firstly, the intelligent monitoring system to measure, analyse, and immediately respond to inform and raise awareness among workers about the environmental conditions of Petrochemical Industries areas. This device will be placed in a dangerous area with a high potential for incidents and confines space. This area has the potential for low air quality, low oxygen quality, and dangerous gases such as carbon monoxide and volatile organic compounds. The low pressure and air flow can be factors in incidents in the petrochemical industry. The data analyses will be connected to the Internet of Things quickly to inform the workers about the condition and situation before, during, and after the site. Lastly, with the deployment of these devices, this sector can avoid, reduce, and minimise incidents and fatalities and make the environment safe for work.

5.2 Potential for Commercialization.

The development of an automatic personal industrial warning system for the petrochemical industry, utilising Internet of Things (IoT) technology and a combination of sensors such as DHT11, MQ135, MQ7, MQ8, and a flame sensor, holds significant potential for commercialization. This innovative system aims to enhance safety measures in petrochemical environments by continuously monitoring key parameters such as temperature, humidity, gas levels (specifically methane, carbon dioxide, and other hazardous gases), and flame presence. The integration of these sensors with an IoT framework enables real-time data collection and analysis, providing quick and accurate alerts in case of abnormal conditions.

Because accidents in the petrochemical sector can have serious implications, the project's capacity to solve important safety problems is essential to its financial sustainability. The warning system's automatic features minimise the need for manual monitoring, lowering the possibility of human error and guaranteeing an early reaction to possible threats. The solution's scalability further enables customisation in accordance with the unique requirements of diverse petrochemical plants, rendering it versatile for a range of industrial environments. The sale of hardware parts, software licencing, and the provision of maintenance and support services are examples of potential revenue sources.

The rising emphasis on worker safety and regulatory compliance by various businesses has led to a surge in the market for industrial safety solutions, especially those that include IoT technology. Because of the project's ability to effectively handle these issues, it is in a good position to draw funding and form alliances with petrochemical businesses that want to improve their safety procedures. Overall, this autonomous personal industrial warning system has a promising future for commercialization since it may make workplaces safer and follow industry trends towards smart, connected solutions.

5.3 Future Works.

Improving safety and operational efficiency might be greatly enhanced by future work on an autonomous personal industrial warning system for the petrochemical industries that makes use of the Internet of Things (IoT) and other sensors like flame sensors, DHT11, MQ135, MQ7, and MQ8. To protect workers' health and safety in an industrial context, this integrated system seeks to continuously monitor surrounding circumstances and identify any threats.

Accurate temperature and humidity measurements are essential for evaluating environmental factors that might affect worker safety, and the DHT11 sensor delivers these data. Offering an extra line of defence against exposure to dangerous materials, the MQ135 sensor is skilled at detecting a wide range of gases, including dangerous ones like benzene and ammonia. While the MQ8 sensor is more concerned with detecting hydrogen concentrations and combustible gas concentrations, the MQ7 sensor is made to detect carbon monoxide. Together, these sensors provide thorough environmental monitoring.

By quickly detecting the existence of flames, a flame sensor gives the system an extra layer of complexity and enables a quick reaction to possible fire threats. Centralised monitoring and control are made possible by the smooth data flow and connectivity that the Internet of Things framework provides amongst sensors. Future improvements can include enhancing the system's scalability to meet changing industry demands, integrating machine learning for predictive analysis, and optimising algorithms for more accurate danger identification. In addition to putting worker safety first, this all-encompassing approach to personal industrial warning also helps the petrochemical industries remain resilient and sustainable in the face of new threats.

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APPENDICES

Appendix A

Project Planning PSM 1

PROJECT PLANNING PSM 1														
	2023													
PROJECT ACTIVITY FYP	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Proposal Project	B													
Decide Project Title	D													
Write a synopsis of our title	P													
Research for the paper related to the title														
CHAPTER 1 DRAFT	B													
Write a objective, problem statement, and scope of the project.	R													
Meet the Supervisor and discuss Chapter 1.	I													
Complete Chapter 1.	E													
CHAPTER 2 DRAFT	F													
Research Article and Journal about the Project.	I													
Write a draft of Chapter 2.	N													
Meet the Supervisor and discuss Chapter 2.	G													
Complete Chapter 2.														
CHAPTER 3 DRAFT	P													
Research for hardware and software	S													
Search for the software and component used.	M													
Sketch the circuit and prototype.	1													
Simulation Project.														
Meet the Supervisor and discuss Chapter 3.	2													
Complete Chapter 3.	2													
SLIDE PRESENTATION	/													
Complete a full report for PSM 1.	2													
Complete Slide Presentation.	3													

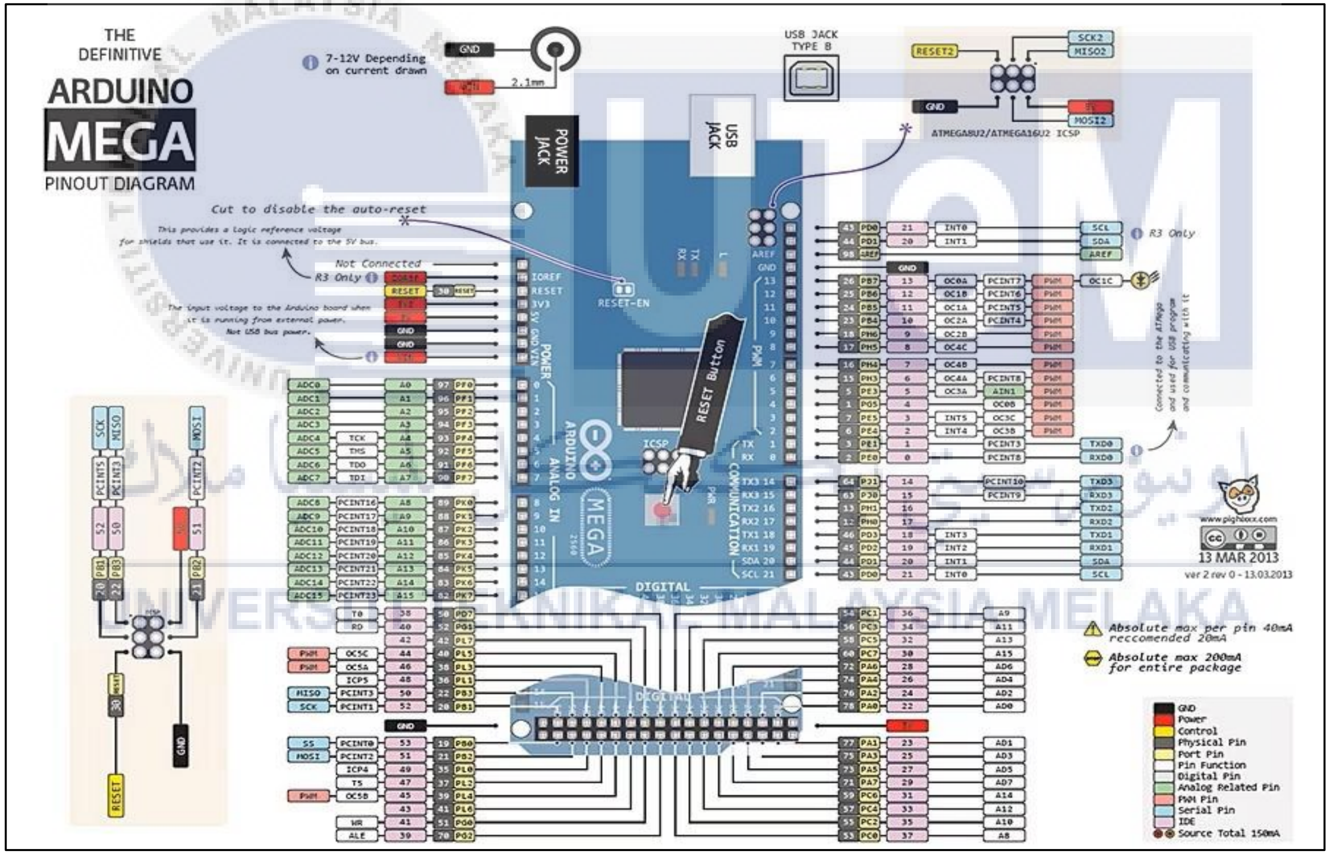
Appendix B

Project Planning PSM 2

PROJECT PLANNING PSM 2														
	2023													
PROJECT ACTIVITY FYP	01	02	03	04	05	06	07	08	09	10	11	12	13	14
CHAPTER 4 DRAFT	B													
Circuit Design.	D													
Buy Item.	P													
Software Analysis.														
Bluetooth Analysis.	B													
Project Design.	R													
Sensor Analysis.	I													
Troubleshoot.	E													
Data collection 1.	F													
Data Anlysis 1.	I													
Builds Hardware and Camber .	N													
IoT Replacement.	G													
Data collection 2.														
Data Analysis 2.	P													
Hardware Testing	S													
Complete Chapter 4	M													
CHAPTER 5 DRAFT	2													
Draft Chapter 5.														
Poster.	2													
Complete Chapter 5	3													
SLIDE PRESENTATION	/													
Complete a full report for PSM 2.	2													
Complete Slide Presentation.	4													

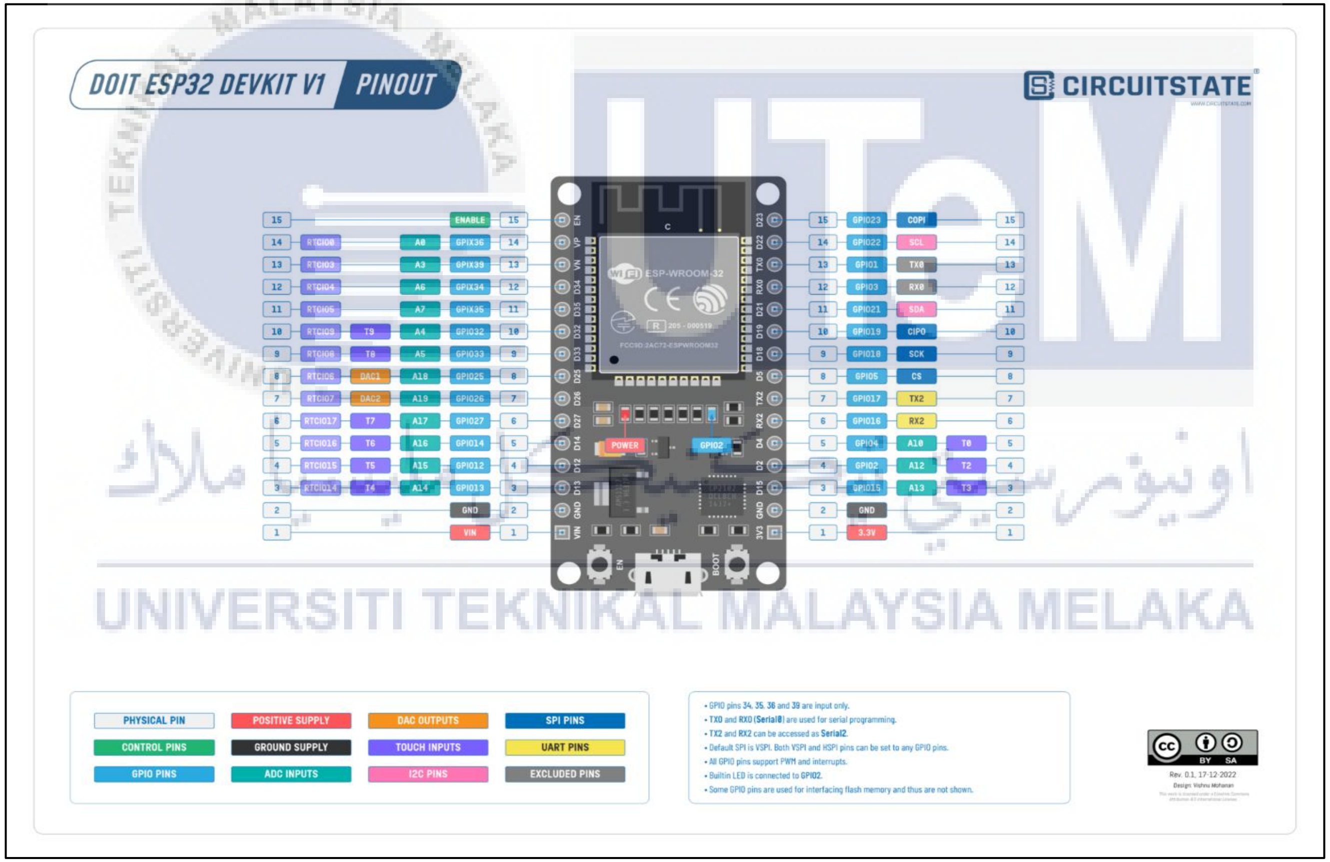
Appendix C

ARDUINO MEGA



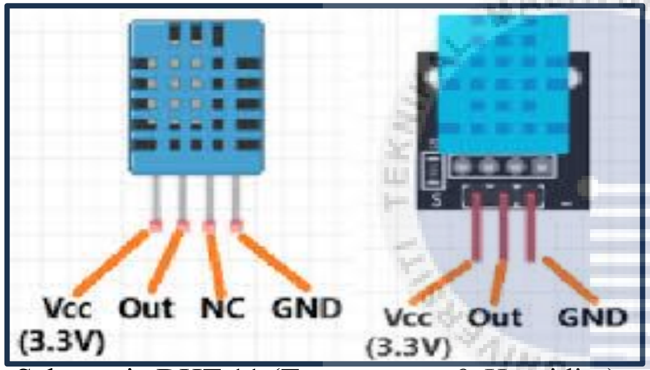
Appendix D

ESP 32

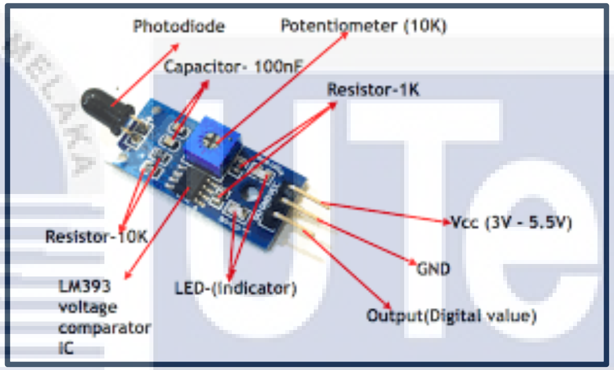


Appendix E

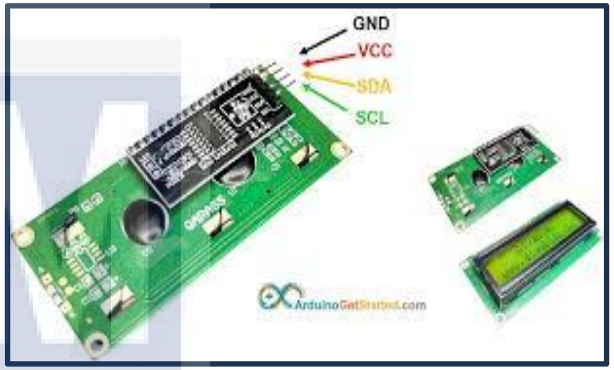
Sensor Schematic



Schematic DHT 11 (Temperature & Humidity)

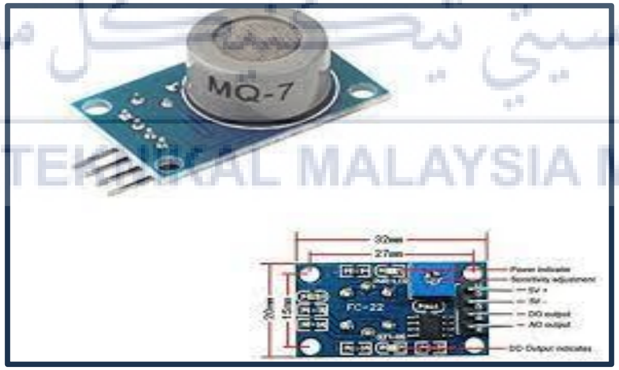


Schematic Flame Sensor



Schematic LCD 16x2 I2C

Schematic MQ135 (Air Quality Sensor)



Schematic MQ 7 (Carbon Monixide Sensor)

Schematic MQ8(HydroSulfide Sensor)

Appendix F

Estimation Cost

BIL	DESKRIPSI	NO RESIT/INVOIS	HARGA		
			TANPA GST (RM)	GST (RM)	JUMLAH (RM)
1	Casing CSPC38	CS00045426	7.00	0	7.00
2	MQ7 Sensor Carbon Monoxide	CS00045426	15.00	0	15.00
3	Arduino Mega 2563	CS00045426	80.00	0	80.00
4	LCD 16x2	CS00045426	25.00	0	25.00
5	LCD1602+I2C Blue	231025TQ1W114M	6.50	0	6.50
6	LCD1602+I2C Green	231025TQ1W114M	6.50	0	6.50
7	Shipping Fee	231025TQ1W114M	4.90	0	4.90
8	MQ 135 Sensor Air Quality	2305208DV4W85R	6.90	0	6.90
9	Shipping Fee	2305208DV4W85R	4.90	0	4.90
10	DHT 11 Humidity Sensor	231108343T328J	4.90	0	4.90
11	Analog Temperature Sensor	231108343T328J	6.90	0	6.90
12	nRF24L01 2.4Ghz Wireless	231108343T328J	8.40	0	8.40
13	BT06 HC06 Wireless RF Data	231108343T328J	13.90	0	13.90
14	MQ 8 Sensor Hydrogen Gases	231108343T328J	6.90	0	6.90
15	Red Led 3mm (10 Pieces)	231108343T328J	1.20	0	1.20
16	D0 A0 Infrared IR Flame Fire Detect	231108343T328J	4.30	0	4.30
17					
18					
JUMLAH TUNTUTAN					203.20

Appendix G

Overall Hardawre Code

```
Full_Combinetion_Coding_Sensor_Latest
//FULL COMBINETION CODING PSM
//MAIN SENSOR, LCD_I2CX2, 7_SEGMENT, BLUETOOTH

#include <Wire.h>
#include <Adafruit_LiquidCrystal.h>
#include <LiquidCrystal_I2C.h>
#include <DHT.h>
#include <MQ135.h>
#include <SoftwareSerial.h>

#define DHTPIN 12
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

LiquidCrystal_I2C lcdSmall(0x26, 14, 2);
LiquidCrystal_I2C lcdBig(0x27, 14, 2);

int t;
int h;
float air   = 0;
float co2   = 0;
float h2s   = 0;
float flame = 0;

const int a = 46;
const int b = 48;
const int c = 50;
const int d = 52;
const int e = 47;
const int f = 49;
const int g = 51;


void setup()
{
  // initialize the lcd
  lcdSmall.init();
  lcdBig.init();
  lcdSmall.backlight();
  lcdBig.backlight();

  dht.begin();

  //Output Indicator
  pinMode(0, INPUT);                //RX Bluetooth
  pinMode(1, INPUT);                //TX Bluetooth
```

```
Full_Combinetion_Coding_Sensor_Latest
  pinMode(1, INPUT);            //TX Bluetooth
  pinMode(2, OUTPUT);           //Safety Warning      BLUE
  pinMode(4, OUTPUT);           //Good Good Situation GREEN
  pinMode(5, OUTPUT);           //High Temperature    RED
  pinMode(6, OUTPUT);           //Bad Humidity        RED
  pinMode(7, OUTPUT);           //Dangerous Gases     RED
  pinMode(8, OUTPUT);           //Oxygen Percentage   RED
  pinMode(9, OUTPUT);           //Hydrogen Gas Sensor RED
  pinMode(10, OUTPUT);          //Flame High          RED
  pinMode(11, OUTPUT);          //Buzzer Warning      SOUND


  //7 Segment
  pinMode(46, OUTPUT);          //7 Segment a
  pinMode(48, OUTPUT);          //7 Segment b
  pinMode(50, OUTPUT);          //7 Segment c
  pinMode(52, OUTPUT);          //7 Segment d
  pinMode(47, OUTPUT);          //7 Segment e
  pinMode(49, OUTPUT);          //7 Segment f
  pinMode(51, OUTPUT);          //7 Segment g


  //Input Sensor
  pinMode(A0, INPUT);           //Bluetooth
  pinMode(A1, INPUT);           //Temperature
  pinMode(A2, INPUT);           //Humidity
  pinMode(A3, INPUT);           //Air Quality
  pinMode(A4, INPUT);           //Carbon Monoxide
  pinMode(A5, INPUT);           //Hydrogen Gas Sensor H2S
  pinMode(A6, INPUT);           //Flame

}


void loop()
{
  digitalWrite (2,HIGH);
  delay (500);
  digitalWrite (2,LOW);
  delay (500);

  lcdSmall.setCursor(0,0);
  lcdSmall.print("  SAFETY FIRST   ");
  lcdSmall.setCursor(0,1);
  lcdSmall.print("   KEEP SAFE   ");
```

Full_Combinetion_Coding_Sensor_Latest

```
lcdBig.clear();

digitalWrite (2,HIGH);
delay (500);
digitalWrite (2,LOW);
delay (500);

t = dht.readTemperature();
h = dht.readHumidity();

lcdBig.setCursor(0, 0);
lcdBig.print("TEMP:      ");
lcdBig.print(t);
lcdBig.setCursor(15, 0);
lcdBig.print("C");

lcdBig.setCursor(0, 1);
lcdBig.print("HUMIDITY:   ");
lcdBig.setCursor(11, 1);
lcdBig.print(h);
lcdBig.setCursor(13, 1);
lcdBig.print("%RH");

delay (2000);

if (t > 40)
{
  lcdBig.setCursor(0, 0);
  lcdBig.print("HIGH TEMPERATURE");
  digitalWrite (3, HIGH);         //Bad Situation
  digitalWrite (4, LOW);          //Good Situation
  digitalWrite (5, HIGH);         //Flame
  digitalWrite (11, HIGH);        //Buzzer
}

else (t < 39);
{
  lcdBig.setCursor(0, 0);
  lcdBig.print(" LOW TEMPERATURE");
  digitalWrite (3, LOW);         //Bad Situation
  digitalWrite (4, HIGH);        //Good Situation
  digitalWrite (5, LOW);         //Flame
  digitalWrite (11, LOW);        //Buzzer
}
```

Full_Combinetion_Coding_Sensor_Latest

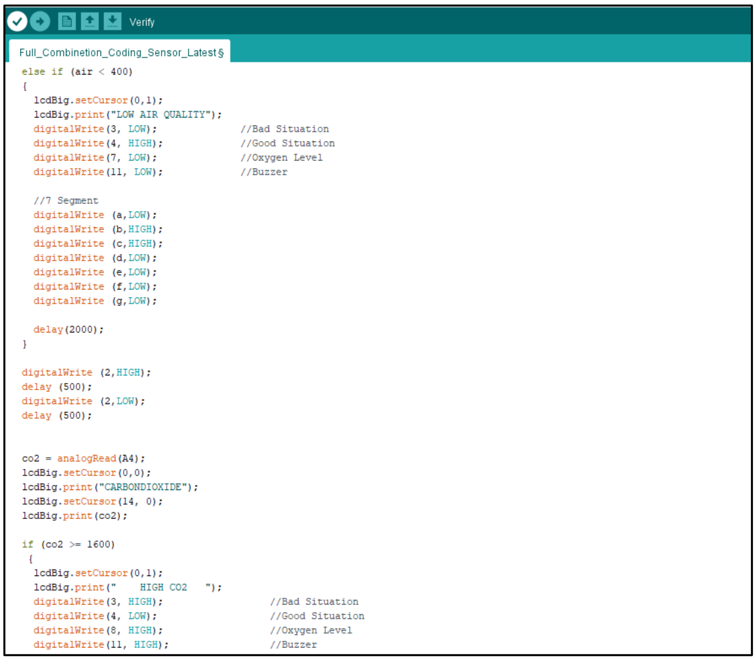
```
if (h < 89)
 {
  lcdBig.setCursor(0, 1);
  lcdBig.print("   GOOD HUMIDITY    ");

  digitalWrite(3, LOW);          //Bad Situation
  digitalWrite(4, HIGH);         //Good Situation
  digitalWrite(6, LOW);          //Humidity
  digitalWrite(11, LOW);         //Buzzer

  delay (2000);

 }
digitalWrite (2,HIGH);
delay (500);
digitalWrite (2,LOW);
delay (500);


air = analogRead(A3);
lcdBig.setCursor(0,0);
lcdBig.print("AIR QUALITY: ");
lcdBig.setCursor(13, 0);
lcdBig.print(air);

if (air >= 1600)
 {
  lcdBig.setCursor(0,1);
  lcdBig.print("   HIGH AIR QUALITY   ");
  digitalWrite(3, HIGH);          //Bad Situation
  digitalWrite(4, LOW);           //Good Situation
  digitalWrite(7, HIGH);          //Oxygen Level
  digitalWrite(11, HIGH);         //Buzzer

  //7 Segment
  digitalWrite (a,HIGH);
  digitalWrite (b,LOW);
  digitalWrite (c,HIGH);
  digitalWrite (d,HIGH);
  digitalWrite (e,HIGH);
  digitalWrite (f,HIGH);
  digitalWrite (g,HIGH);

  delay(2000);
 }
```

Full_Combinetion_Coding_Sensor_Latest

```
else if (air >= 1100)
{
  lcdBig.setCursor(0,1);
  lcdBig.print("MEDIOCREAIRQUALITY");
  digitalWrite(3, HIGH);           //Bad Situation
  digitalWrite(4, LOW);            //Good Situation
  digitalWrite(7, HIGH);           //Oxygen Level
  digitalWrite(11, HIGH);          //Buzzer

  //7 Segment
  digitalWrite (a,HIGH);
  digitalWrite (b,LOW);
  digitalWrite (c,HIGH);
  digitalWrite (d,HIGH);
  digitalWrite (e,LOW);
  digitalWrite (f,HIGH);
  digitalWrite (g,HIGH);

  delay(2000);
}

else if (air >=900)
{
  lcdBig.setCursor(0,1);
  lcdBig.print("FAIR AIR QUALITY");
  digitalWrite(3, HIGH);             //Bad Situation
  digitalWrite(4, LOW);              //Good Situation
  digitalWrite(7, HIGH);             //Oxygen Level
  digitalWrite(11, HIGH);            //Buzzer

  //7 Segment
  digitalWrite (a,LOW);
  digitalWrite (b,HIGH);
  digitalWrite (c,HIGH);
  digitalWrite (d,LOW);
  digitalWrite (e,LOW);
  digitalWrite (f,HIGH);
  digitalWrite (g,HIGH);

  delay(2000);
}
```

Full_Combinetion_Coding_Sensor_Latest

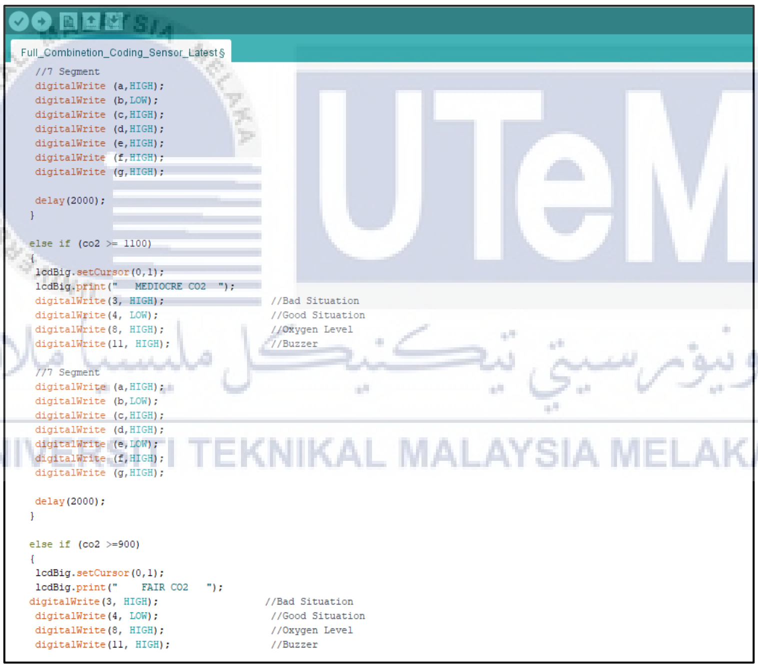
```
else if (air >=700)
{
  lcdBig.setCursor(0,1);
  lcdBig.print("GOOD AIR QUALITY");
  digitalWrite(3, LOW);              //Bad Situation
  digitalWrite(4, HIGH);             //Good Situation
  digitalWrite(7, LOW);              //Oxygen Level
  digitalWrite(11, LOW);             //Buzzer

  //7 Segment
  digitalWrite (a,HIGH);
  digitalWrite (b,HIGH);
  digitalWrite (c,HIGH);
  digitalWrite (d,HIGH);
  digitalWrite (e,LOW);
  digitalWrite (f,LOW);
  digitalWrite (g,HIGH);

  delay(2000);
}

else if (air >=400)
{
  lcdBig.setCursor(0,1);
  lcdBig.print("  EXCELLENT AIR  ");
  digitalWrite(3, LOW);              //Bad Situation
  digitalWrite(4, HIGH);             //Good Situation
  digitalWrite(7, LOW);              //Oxygen Level
  digitalWrite(11, LOW);             //Buzzer

  //7 Segment
  digitalWrite (a,HIGH);
  digitalWrite (b,HIGH);
  digitalWrite (c,LOW);
  digitalWrite (d,HIGH);
  digitalWrite (e,HIGH);
  digitalWrite (f,LOW);
  digitalWrite (g,HIGH);
;
  delay(2000);
}
```



Verify

Full_Combinetion_Coding_Sensor_Latest §

```
else if (air < 400)
{
  lcdBig.setCursor(0,1);
  lcdBig.print("LOW AIR QUALITY");
  digitalWrite(3, LOW);               //Bad Situation
  digitalWrite(4, HIGH);              //Good Situation
  digitalWrite(7, LOW);               //Oxygen Level
  digitalWrite(11, LOW);              //Buzzer

  //7 Segment
  digitalWrite (a,LOW);
  digitalWrite (b,HIGH);
  digitalWrite (c,HIGH);
  digitalWrite (d,LOW);
  digitalWrite (e,LOW);
  digitalWrite (f,LOW);
  digitalWrite (g,LOW);

  delay(2000);
}

digitalWrite (2,HIGH);
delay (500);
digitalWrite (2,LOW);
delay (500);


co2 = analogRead(A4);
lcdBig.setCursor(0,0);
lcdBig.print("CARBONDIOXIDE");
lcdBig.setCursor(14, 0);
lcdBig.print(co2);

if (co2 >= 1600)
 {
  lcdBig.setCursor(0,1);
  lcdBig.print("    HIGH CO2    ");
  digitalWrite(3, HIGH);                   //Bad Situation
  digitalWrite(4, LOW);                    //Good Situation
  digitalWrite(8, HIGH);                   //Oxygen Level
  digitalWrite(11, HIGH);                  //Buzzer
```



Full_Combinetion_Coding_Sensor_Latest §

```
  //7 Segment
  digitalWrite (a,HIGH);
  digitalWrite (b,LOW);
  digitalWrite (c,HIGH);
  digitalWrite (d,HIGH);
  digitalWrite (e,HIGH);
  digitalWrite (f,HIGH);
  digitalWrite (g,HIGH);

  delay(2000);
 }

 else if (co2 >= 1100)
 {
  lcdBig.setCursor(0,1);
  lcdBig.print("   MEDIOCRE CO2   ");
  digitalWrite(3, HIGH);                   //Bad Situation
  digitalWrite(4, LOW);                    //Good Situation
  digitalWrite(8, HIGH);                   //Oxygen Level
  digitalWrite(11, HIGH);                  //Buzzer

  //7 Segment
  digitalWrite (a,HIGH);
  digitalWrite (b,LOW);
  digitalWrite (c,HIGH);
  digitalWrite (d,HIGH);
  digitalWrite (e,LOW);
  digitalWrite (f,HIGH);
  digitalWrite (g,HIGH);

  delay(2000);
 }

 else if (co2 >=900)
 {
  lcdBig.setCursor(0,1);
  lcdBig.print("    FAIR CO2    ");
 digitalWrite(3, HIGH);                   //Bad Situation
  digitalWrite(4, LOW);                    //Good Situation
  digitalWrite(8, HIGH);                   //Oxygen Level
  digitalWrite(11, HIGH);                  //Buzzer
```

Full_Combinetion_Coding_Sensor_Latest §

```
  //7 Segment
  digitalWrite (a,LOW);
  digitalWrite (b,HIGH);
  digitalWrite (c,HIGH);
  digitalWrite (d,LOW);
  digitalWrite (e,LOW);
  digitalWrite (f,HIGH);
  digitalWrite (g,HIGH);

  delay(2000);
 }

 else if (co2 >=700)
 {
  lcdBig.setCursor(0,1);
  lcdBig.print("    GOOD CO2   ");
  digitalWrite(3, LOW);                //Bad Situation
  digitalWrite(4, HIGH);               //Good Situation
  digitalWrite(8, LOW);                //Oxygen Level
  digitalWrite(11, LOW);               //Buzzer

  //7 Segment
  digitalWrite (a,HIGH);
  digitalWrite (b,HIGH);
  digitalWrite (c,HIGH);
  digitalWrite (d,HIGH);
  digitalWrite (e,LOW);
  digitalWrite (f,LOW);
  digitalWrite (g,HIGH);

  delay(2000);
 }

 else if (co2 >=400)
 {
  lcdBig.setCursor(0,1);
  lcdBig.print(" EXCELLENT CO2 ");
  digitalWrite(3, LOW);                //Bad Situation
  digitalWrite(4, HIGH);               //Good Situation
  digitalWrite(8, LOW);                //Oxygen Level
  digitalWrite(11, LOW);               //Buzzer
```

Full_Combinetion_Coding_Sensor_Latest §

```
  //7 Segment
   digitalWrite (a,HIGH);
  digitalWrite (b,HIGH);
  digitalWrite (c,LOW);
  digitalWrite (d,HIGH);
  digitalWrite (e,HIGH);
  digitalWrite (f,LOW);
  digitalWrite (g,HIGH);

  delay(2000);
 }


 else if (co2 >=100)
 {
  lcdBig.setCursor(0,1);
  lcdBig.print("    LOW CO2     ");
  digitalWrite(3, LOW);                //Bad Situation
  digitalWrite(4, HIGH);               //Good Situation
  digitalWrite(8, LOW);                //Oxygen Level
  digitalWrite(11, LOW);               //Buzzer

  //7 Segment
  digitalWrite (a,LOW);
  digitalWrite (b,HIGH);
  digitalWrite (c,HIGH);
  digitalWrite (d,LOW);
  digitalWrite (e,LOW);
  digitalWrite (f,LOW);
  digitalWrite (g,LOW);

  delay(2000);
 }

digitalWrite (2,HIGH);
delay (500);
digitalWrite (2,LOW);
delay (500);


 h2s = analogRead(A5);
lcdBig.setCursor(0, 0);
lcdBig.print("HYDROSULFIDE:");
lcdBig.setCursor(14, 0);
lcdBig.print(h2s);
```

Full_Combinetion_Coding_Sensor_Latest§

```
 if (h2s < 800)
 {
  digitalWrite (3, LOW);                      //Bad Condition
  digitalWrite (4, HIGH);                     //Good COndition
  digitalWrite (9, LOW);                      //Hydrogen Gas
  digitalWrite (11, LOW);                     //Buzzer
  lcdBig.setCursor(1, 1);
  lcdBig.print("NO HYDROSULFIDE");

  delay (2000);
 }
 else
 {
  digitalWrite (3, HIGH);                     //Bad Situation
  digitalWrite (4, LOW);                      //Good Situation
  digitalWrite (9, HIGH);                     //Hydrogen Gas
  digitalWrite (11, HIGH);                    //Buzzer
  lcdBig.setCursor(1, 1);
  lcdBig.print("HYDROSULFIDE GAS");

  delay (2000);
 }

digitalWrite (2,HIGH);
delay (500);
digitalWrite (2,LOW);
delay (500);


flame = analogRead(A6);
lcdBig.setCursor(0, 0);
lcdBig.print("FLAME       :");
lcdBig.setCursor(13, 0);
lcdBig.print(flame);

 if (flame >= 500)
 {
  digitalWrite (3, HIGH);                     //Bad Situation
  digitalWrite (4, LOW);                      //Good Situation
  digitalWrite (10, HIGH);                    //Flame
  digitalWrite (11, HIGH);                    //Buzzer
  lcdBig.setCursor(1, 1);
  lcdBig.print("FLAME IS DETECTED  ");

  delay (2000);
```

```
 else
 {
  digitalWrite (3, LOW);                      //Bad Situation
  digitalWrite (4, HIGH);                     //Good Situation
  digitalWrite (10, LOW);                     //Flame
  digitalWrite (11, LOW);                     //Buzzer
  lcdBig.setCursor(1, 1);
  lcdBig.print("    NO FLAME    ");

  delay (2000);
 }

  digitalWrite (a,LOW);
  digitalWrite (b,LOW);
  digitalWrite (c,LOW);
  digitalWrite (d,LOW);
  digitalWrite (e,LOW);
  digitalWrite (f,LOW);
  digitalWrite (g,LOW);

 lcdBig.clear();
 delay(500);

}
```

Appendix H

Internet of Things Codes.

```
#define BLYNK_TEMPLATE_ID "TMPL6SmTctLgv"
#define BLYNK_TEMPLATE_NAME "PSM AKMAL"

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>
#include <MQ135.h>
#include <MQ7.h>
#include <MQUnifiedsensor.h>

#include <MQ8.h>
#include <Wire.h>

#define DHTPIN 14   // DHT data pin
#define DHTTYPE DHT11  // DHT sensor type

#define MQ135_PIN A0
#define MQ7_PIN A1
#define MQ8_PIN A2
#define flame_PIN 13
#define BLYNK_AUTH_TOKEN "b4DMl-KxO4k7ZW3HfqNEy38Ow_86tIlR"


char auth[] = ""; // You will receive this from the Blynk app

const char* ssid = "SAFETY DEVICES";
const char* password = "PSM";

DHT dht(DHTPIN, DHTTYPE); // Corrected the DHT constructor

bool manualControl = false;  // Variable to store manual control state

void setup() {
  Serial.begin(115200);
  Blynk.begin(auth, ssid, password);

  dht.begin();
  pinMode(MQ135, INPUT);
  pinMode(MQ7, INPUT);
  pinMode(MQ8, INPUT);
  pinMode(flame, INPUT);


}
```

```
BLYNK_WRITE(V9)
{  // Blynk function to handle button state
  manualControl = param.asInt();  // Update manual control state
}

void loop() {
  Blynk.run();

  // Read temperature and humidity
  float humidity = dht.readHumidity();
  float temperature = dht.readTemperature();
  if (!isnan(humidity) && !isnan(temperature))
  {
    Blynk.virtualWrite(V6, humidity);      // Use a Value Display widget in Blynk on V6
    Blynk.virtualWrite(V7, temperature);   // Use another Value Display widget in Blynk on V7
  }

  float MQ135 = MQ.135();
  float co2 = MQ7();
  float h2s = MQ8();
  float flame = flame();

  Blynk.virtualWrite(V5, MQ135);      // Use a Value Display widget in Blynk on V6
  Blynk.virtualWrite(V4, MQ7);   // Use another Value Display widget in Blynk on V7
  Blynk.virtualWrite(V3, MQ8);      // Use a Value Display widget in Blynk on V6
  Blynk.virtualWrite(V2, flame);   // Use another Value Display widget in Blynk on V7

  delay(20); // Update every 2 seconds (adjust as needed)

}
```

Bluetooth_Humidity

```
#include<SoftwareSerial.h>
#include"DHT.h"
SoftwareSerial B(0,1);

#define DHTPIN 2
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

void setup()
{
  B.begin(9600);
  dht.begin(9600);
}

void loop()
{
  delay (2000);

  float h = dht.readHumidity();
  float t = dht.readTemperature();
  float f = dht.readTemperature(true);

  B.print(h);
  B.print(" RH");
  B.print(",");
  B.print(t);
  B.print(" C");
  B.print(",");
  B.print(f);
  B.print(" F");
  B.print(";");

  delay(20);

}
```