INTERNSHIP REPORT

LATIHAN INDUSTRI 2023/2024/3

Company Supervisor: Dr Aminnudin Saat

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OCTOBER 2024

ACKNOWLEDGEMENT

To begin with and in the first place, it is my honor and privilege to thank the ALL-Mighty ALL-Wise ALL-Knowing ALL-Hearing ALL-Seeing Allah for his innumerable bounties and continual guidance during the internship.

I wish to express my heartfelt gratitude to my supervisor, Dr. Aminnudin Saat for giving me immense assistance, direction, and for giving an opportunity to practice with a lot of practical experience during the internship. He has been a great mentor to me and has helped me in improving on the learning process.

I would also extend my heartfelt appreciation to my family and friends for their ever supporting me. My inspiration is my father whom I adore and my friends are more like brothers who encouraged me through this internship.

I would like to express my deepest appreciation to the lab technician and the helpful PhD student Mr. Ibrahim who introduced them self to me and wanted to help me whenever they saw me in the lab.

ABSTRACT

The following report details a summary of a 12-week internship at Universiti Teknologi Malaysia (UTM) from late July to early October 2024, which mainly involved the investigation and monitoring of Corrosion Under Insulation (CUI) - and developing an adjustable rig for testing the test pieces.

Some tasks that were accomplished during the internship include calibration of instrumentation, data gathering, and studying the corrosion behavior under various conditions. However, several issues emerged mainly relating to the networking, logging and archiving of data from the test rig. This case highlights one of the technical problems through which the flow of information had to be coordinated and the issues of data collection and storage had to be addressed.

Aside form technical issues encountered in the process, other circumstances that been raised include inadequate or unavailable technician. Lack of availability of certain employees at some point was also a concern that led to set back and thus the changing of some dynamics of work. However, the accessibility of the materials required for constructing the rig was an issue that was in addition we faced because it took several weeks and sometimes even more time to gather the right materials for the construction of the rig.

However, all such difficulties were addressed in advance by improving relations with the colleagues, involving the colleagues for coming up with the remedies and making alterations in the time frame accordingly. Small group work and collaboration greatly helped address these challenges to make sure the project went on.

This report details both the technical skills gained through various skills such as system design of the rig, knowledge of test rig testing protocols, and equipment handling and data analysis, as well as soft skills - i.e. working collaboratively with others, communicating engineering issues, group discussions, dealing with ambiguity, being adaptable, etc.

This report will be structured as follows:

Chapter 1: Introduction

Chapter 2: Background of the Organization

Chapter 3: Project Details / Comprehensive Training on CUI Investigation

Chapter 4: Conclusions and Future Recommendations

Overall, an internship under the guidance and supervision of Dr. Aminnudin Saat, such a value opportunity to experience the real world is quite rare and invaluable in shaping technicality and professionalism.

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INTRODUCTION

1.1 Introduction to the Industrial Training

Universiti Teknologi Malaysia offers its students a three-month supervised work period, in which students must undergo work training in their respective fields. This allows a smoother integration into working companies for fresh graduates, furthermore, it allows the university to evaluate its students based on critical thinking and collaborative work within their company. This training period is a compulsory task undertaken by third and fourth-year students, immediately before the graduation year for the engineers. The overall purpose of the training is to not only expose students to real working conditions but to ensure that their academic knowledge and critical skill are transferable to their industry.

The main aim of internship is to familiarize students with the working environment they are likely to meet in their future practice, thus creating a certainty that the theoretical knowledge obtained during the University education as well as problem solving skills are easily transferable to the real working environment. It also enables UTM to assess the student’s teamwork and problem solving skills amongst professional groups which makes it a vital part of student learning.

However, the internship also has its technical and academic roots, as well as the opportunity for the student to build their interpersonal skills like communication, teamwork, leadership, and time management. These are important experiences in any professional environment; this training mode offers students the basis to develop these skills. Sixthly, the internship enables the students to establish working relations and learn or get ideas about their prefer career paths in the industry.

Thus, the student’s professionalism is at a high level and it increases during the internship due to the permanent punctuality, responsibility, and ability to perform within the required work processes. It moreover highlights the importance of effective communication in the preparation of detailed reports in the engineering profession.

In general, the internship can be viewed as the important stage of the students’ studying process as this stage means the transition from the theoretical knowledge obtaining to the practice applying. The activity is significant in that it aids the students in preparing them for their professional careers and enabling them to pursue their careers with higher degree of confidence and competence. Although this could seem like a small start to the career training process, the period acts as the building block towards becoming engineers or professional workers.

1.2 Objective of Industrial Training

The objectives for this industrial training are as follows:

- To allow students to adapt to the professional working environment.
- To gain real-life working experience in their respective field.
- To apply and successfully implement the academic knowledge gained throughout the course of study.
- To develop essential soft skills, such as communication, teamwork, and leadership, which are crucial for fresh graduates entering the workforce.
- To cultivate a sense of responsibility by working in a professional environment and to build industry connections that will benefit students in their future careers.
- To enhance the ability to extract relevant information from various sources and apply it effectively in problem-solving scenarios.
- To encourage the use of imagination and creativity in solving complex, real-world problems, fostering innovative thinking in professional practice.

1.3 Scope of Industrial Training

The scope of the industrial training is ultimately determined by the company's supervisor. It serves as a roadmap that structures the training process and outlines the technical complexity of tasks assigned to the student. Essentially, the scope can be described as the knowledge and skills acquired and retained throughout the training period.

For the training period under the CUI (Corrosion Under Insulation) project with Hiref, the scope of the internship can be defined as follows:

- To understand the objectives and overall goals of the project.
- To work on improving, monitoring, and building the system.
- To regularly inspect the system, test the data received through the cloud interface, and analyze the performance of the test rig.
- To gain insight into the user perspective on the product and provide constructive feedback.
- To source the necessary components for the project and report on their availability in the market.
- To develop a full understanding of both the electronic and mechanical aspects of the system.
- To actively participate in the design process and suggest potential variations in the system and user interface for improvement.

1.4 Summary of Industrial Training

All in all, the industrial training period is considered an affirmative crossroad for upcoming engineers to exercise pragmatic experience as a platform to climb up the ladder and improve their resume. It serves as a perfect starting point for students to begin their professional endeavours, build up confidence, enhance interpersonal skills, and develop leadership skills.

After going through this type of internship students come out as more equipped engineers with better understanding of their basic principles. Moreover, the duration of training enables students to come up with the specific areas of concern in the chosen field of study hence tuning into the areas of interest that would gladly work on in the future.

This knowledge and skills make it easier for the students to apply what they have learnt during the internship when handling final year projects, and this will make the students ready to step the industry with even more readiness and competence to deliver high end performance.

CHAPTER 2

BACKGROUND OF THE ORGANIZATION

2.1 Company Introduction

Figure 2.1 Universiti Teknologi Malaysia Logo

Universiti Teknologi Malaysia (UTM) is Malaysia's premier technological university, known for pioneering innovative solutions through intensive research. One notable research initiative, led by Dr. Aminuddin Bin Saat, is the CUI (Corrosion Under Insulation) project, conducted in collaboration with PETRONAS. The primary goal of this project is to introduce and implement a cost-effective, sustainable, and efficient approach to studying, monitoring, and predicting corrosion that occurs beneath insulation materials in industrial applications.

The current CUI system focuses on smart monitoring of water flowing through steel pipes insulated with materials like polyurethane (PU) combined with mineral wool, simulating real-world industrial conditions. The project employs an advanced IoT system to monitor and transfer data to an app, allowing real-time analysis. Additionally, cutting-edge technologies such as Fiber Bragg Gratings (FBG) are used for precise monitoring.

Figure 2.2 Petronas Logo

Overall, the CUI project aims to address the challenges faced by the industry regarding corrosion under insulation, offering valuable insights and potential solutions to improve system longevity and efficiency.

2.2 Company Information

Company Name : UTM (Universiti Teknologi Malaysia)

Address : HIRef, R Blok E06, Universiti Teknologi Malaysia, Lengkok Kuasa, 80990 Skudai, Johor

Contact : Supervisor +60 13-772 2812

Email : aminudin@utm.my

2.3 Organizational Structure

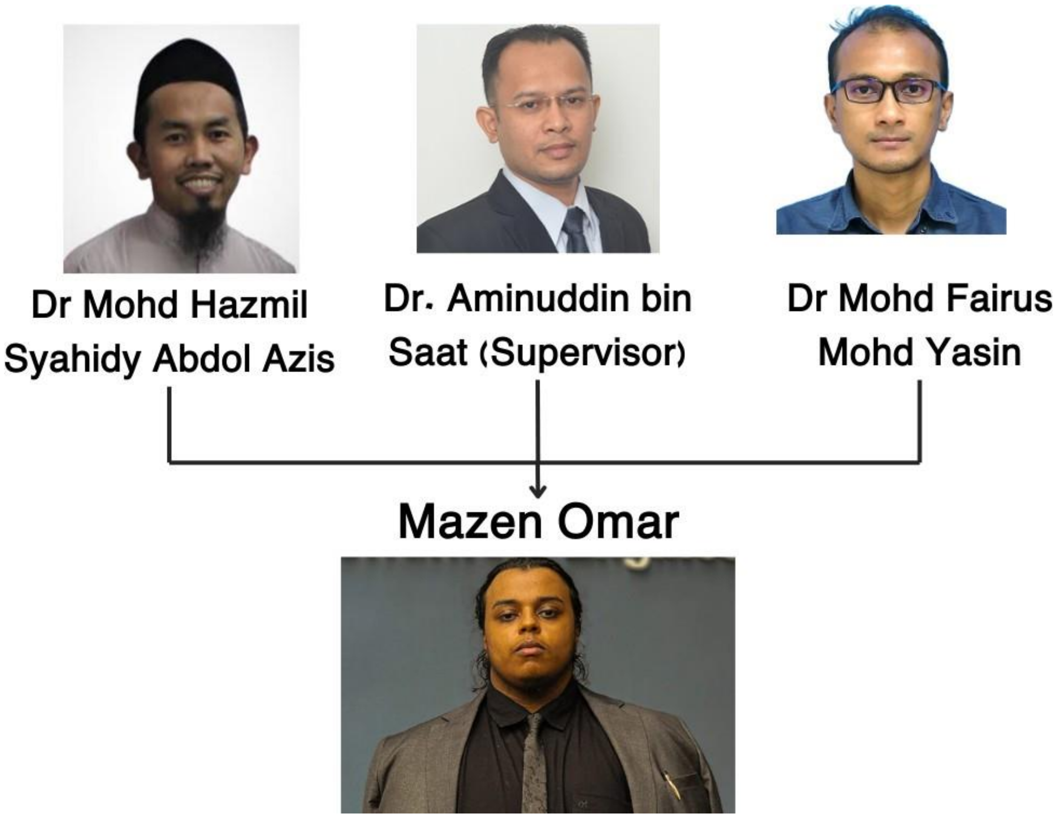

Figure 2.3 CUI Team Structure

2.4 Research Equipment

Sensors and Electrical Components:

- Arduino Uno Rev 4 WiFi a device that used for controlling many of the sensors and data acquisition and relay of the data wirelessly. Its wireless connectivity allowed easy connection with the IoT system for data reception and storage from a distance.
- Thermocouple Type K an accurate Temperature senser for measuring temperature variation over a large range of temperature. It was employed in modifications to measure changes in temperatures along the steel pipe and all

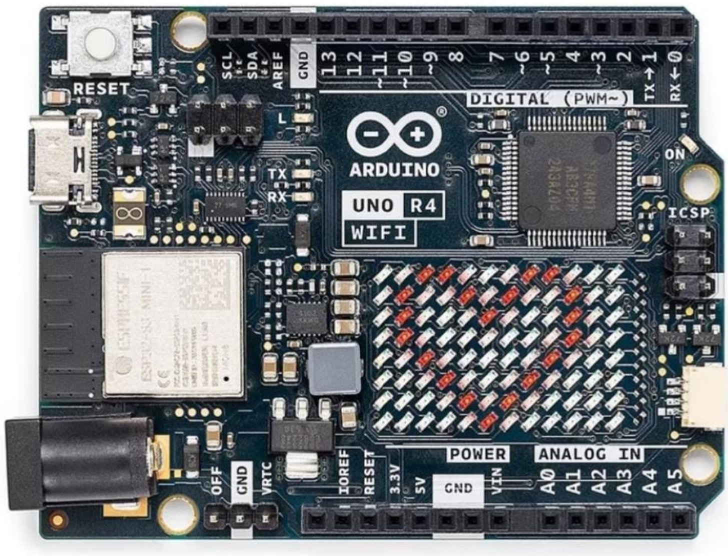

Figure 2.4 Arduino Rev 4 wifi

the insulation layers in order to get the right environment when testing was on progress.

- DHT11 a simple sensor for measuring humidity rudimentary yet stable and proven most fit for this job. It rendered real time humidity to understand the effects of moisture on the corrosion under insulation process.
- BME280 a multi-functional sensor that can for pressure, humidity, and temperature in the atmosphere. In this work, it was primarily used for supervising pressure situations within the rig in order to establish how exactly various parameters lead to corrosion.
- FBG (Fiber Bragg Grating) a pressure and humidity sensitive opto-electronic sensor of very high sensitivity. FBG sensors proved a good means of tracking small fluctuations in the environmental impact for corrosion which enabled high accuracy in measuring the system variations.
- Optical Fiber Coated with Polyetheramine Humidity sensing based on a unique type of an optical fiber. Coating the sensing part of the system was made of

Figure 2.5 Thermocouple Type K

Polyetheramine that made it more sensitive to moisture changes around the insulated pipes.

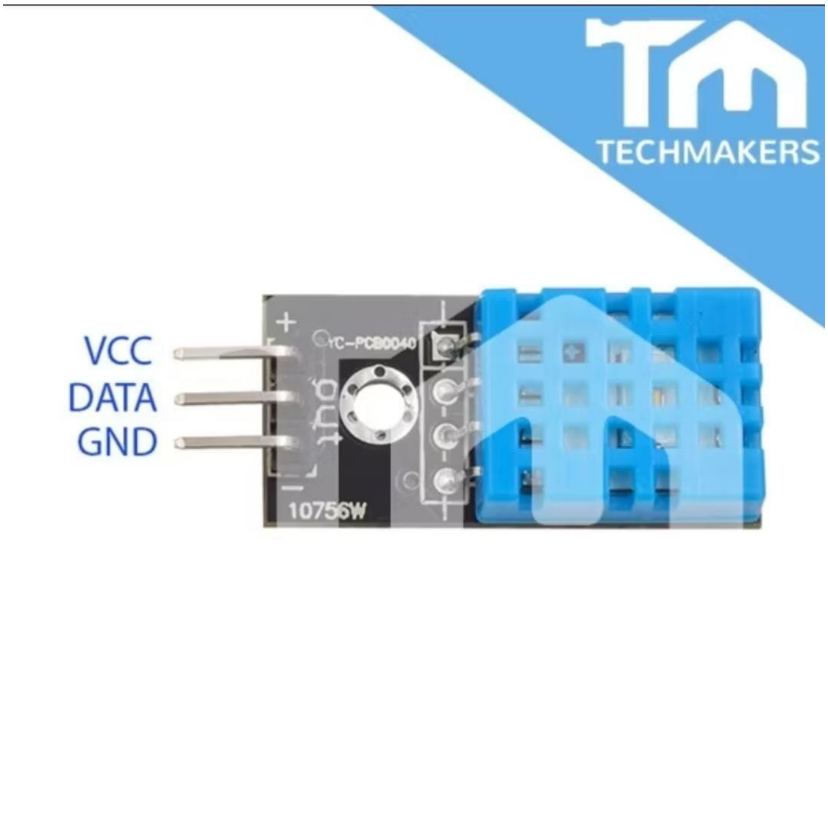

Figure 2.6 DHT11

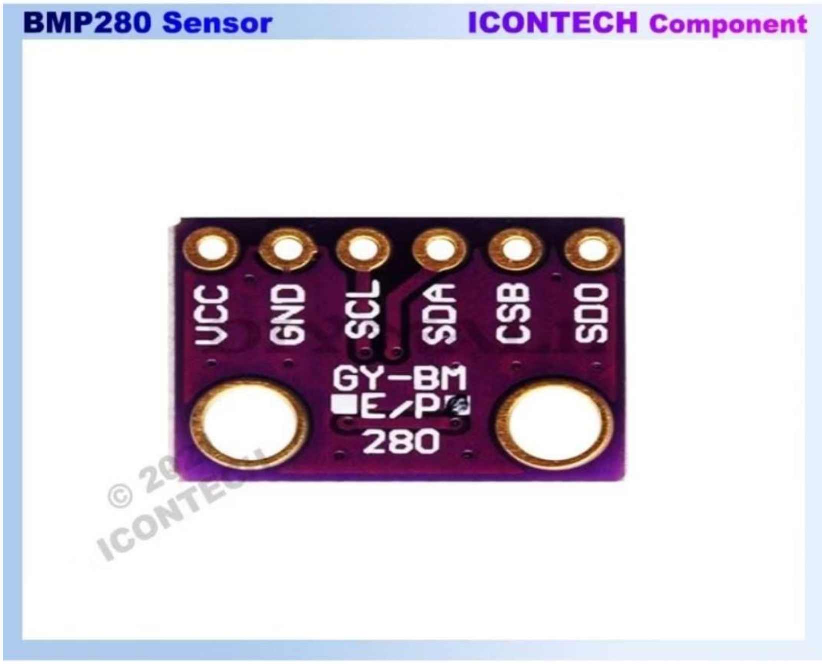

Figure 2.7 BME280

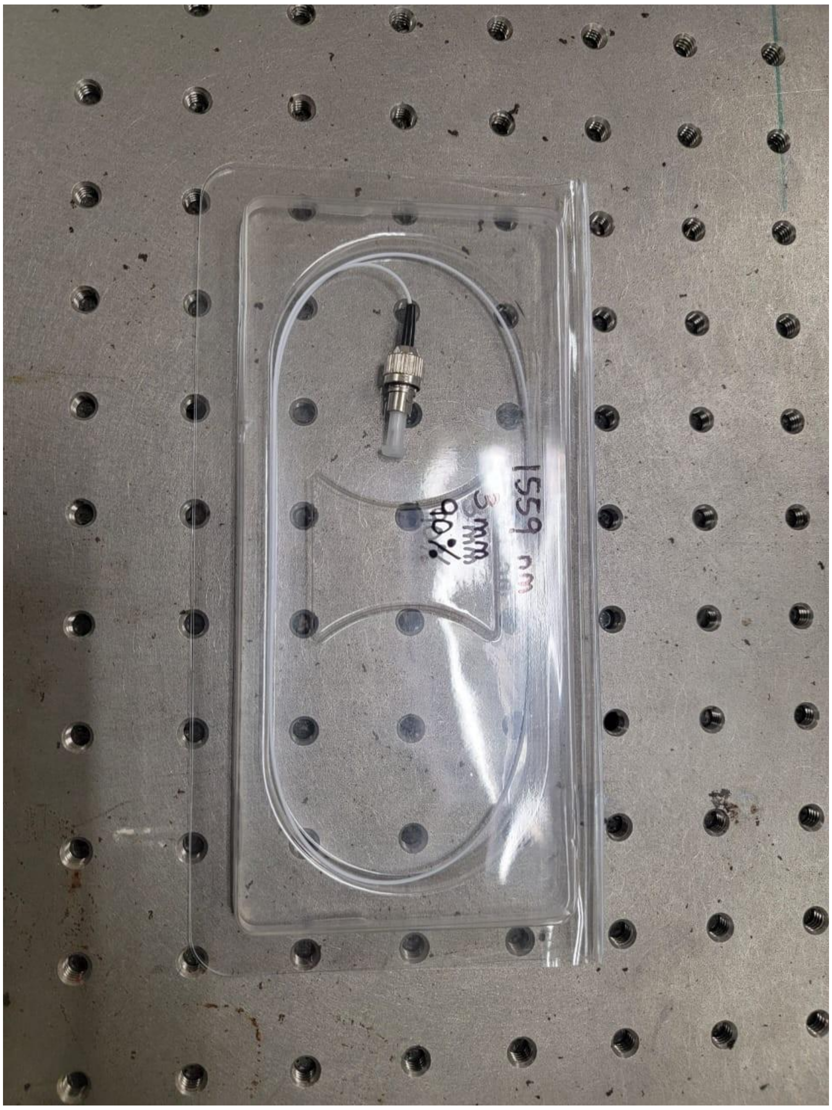

Figure 2.8 FBG (Fiber Bragg Grating)

CHAPTER 3

PROJECT INFORMATION/TRAINING

3.1 Introduction to the Project

Attending these twelve weeks of industrial training has enriched my array of techniques about programming, designing, operating heavy machinery equipment, communication skills, problem solving skills, welding, chemistry, presentation skills and creative thinking. However, given the small number of our team, I was blessed to have an excellent supervisor in the person of Dr. Aminuddin who made it possible for me to learn from different sources as I gained experience from the team.

My internship involved two primary aspects: , designing and monitoring with a fully functional prototype. Despite the fact that I was the only intern on the project, I was able to reap a lot from different department and labs as facilitated by my supervisor. This also enabled me to not only effectively proceed with coordinating the projects but to learn better through the ideas and resources of others as well.

3.2 Objectives of the Training

- Research and Prediction: Study insulation performance related to corrosion.
- Design a Rig: Develop a sustainable, adjustable, and modular testing rig.
- Data Collection: Integrate data into an IoT system.
- Code Development: Create a code for collecting and displaying data.

3.3 Implementation of Training

The first phase of any project, is dedicated to a lot of research to unravel the subject matter and possible solutions. In my first week the focus was on how can we predict corrosion before it happens and which parameters do we need to know in order to make these predictions. I also considered which type of sensor could be used to measure these parameters with time, and whether these sensors could be placed between the insulation material in our case. I also investigated the materials used in real-world applications to design the testing rig, ensuring it would simulate actual industrial conditions.

Through this research, we identified three critical parameters for corrosion prediction: Pressure, Humidity, and Temperature. I also explored and selected the sensors to measure these parameters both between the insulation and in the external environment to make comparisons that would help predict corrosion. The sensor chosen for use between the insulation is optical fibber, which operates by reflecting laser/light to calculate the parameters. This sensor is extremely thin and delicate, so it requires careful handling.

Dr. Aminuddin my supervisor guided me to where I can learn how to handle optical fibbers by spending a week training in the Laser Lab. I was also trained on how to use a device called the spectrum analyser, that receive the light signals throughout the fibber, and display the data. Mr. Nasir, one of the lab technicians was essential at teaching me more about optical fibbers, different kinds of optical fibbers, how to cut and handle them and put them into the spectrum analyser. There are different types of spectrum analyser, by having different number of channels and different levels of accuracy. The channels is about how many sensors it will read simultaneously and display at the same time, while accuracy refers to how well will the device interpret the reflected light. The higher the accuracy, the more precise the readings we can obtain, which is essential for reliable data collection in this project, and it effect the price of the spectrum which can be over 1 million RM.

Figure 3.1 LASER LAB in UTM

Figure 3.2 spectrum analyser

Once I was done with the training for optics fibbers, I proceeded with writing the code and building the app that would make data transfer using IoT system. I chose to use the Arduino Uno Rev 4 WiFi; it had built in WiFi capability, to allow me to connect to the cloud system, which facilitated the effortless transfer of the Arduino to the of the app I was building. I also worked on building the circuit which linked all the sensors to the Arduino for real time data collection as well as coding each sensor to be able to send the data with ease.

I was also asked to create a website for AsiaPlus by my supervisor. For the website I used HTML and CSS to design and write the code to make sure my website performed how I wanted it to look and function. The rig design phase followed. My

Figure 3.3 Website AsiaPlus

idea for a sustainable system was to have a water pump, water tank, and the testing rig all connected together. The idea was to have the water from the water tank to the water pump then go into the testing rig and then back to the water tank. This closed loop system would be sustainable as a result of re-usage of the same water, cutting waste. Another reason I wanted the system to be easy to assemble together and take apart was to make custom insulation something that could be done with ease to help boost research efficiency. I wanted to cut the insulation into half and then join together with the outer layer of the insulation, which could be clipped and overlapped. If the final layer was unclipped, we would be able to quickly exchange the insulation without having to remove the system. My supervisor liked this idea and gave me the go ahead.

Consequently, I researched to find a suitable materials that would best fit the design, and follow industrial standards. I discussed with my supervisor, and he arranged a meeting with the MRCG Lab, which is about material research. I met Mr. Ibrahim, a lab assistant and PhD student, to discuss material options, and availability, there. After an extensive discussion, we ended up using PU (polyurethane) combined with the mineral wool as the insulation material and for the other layers I chose PVC and Aluminium. After we had finalized the material, I got the material and Mr. Ibrahim taught me how to make the PU mixed with mineral wool because PU is in the liquid form. Having done that, I proceeded to make the insulation as well as getting the other

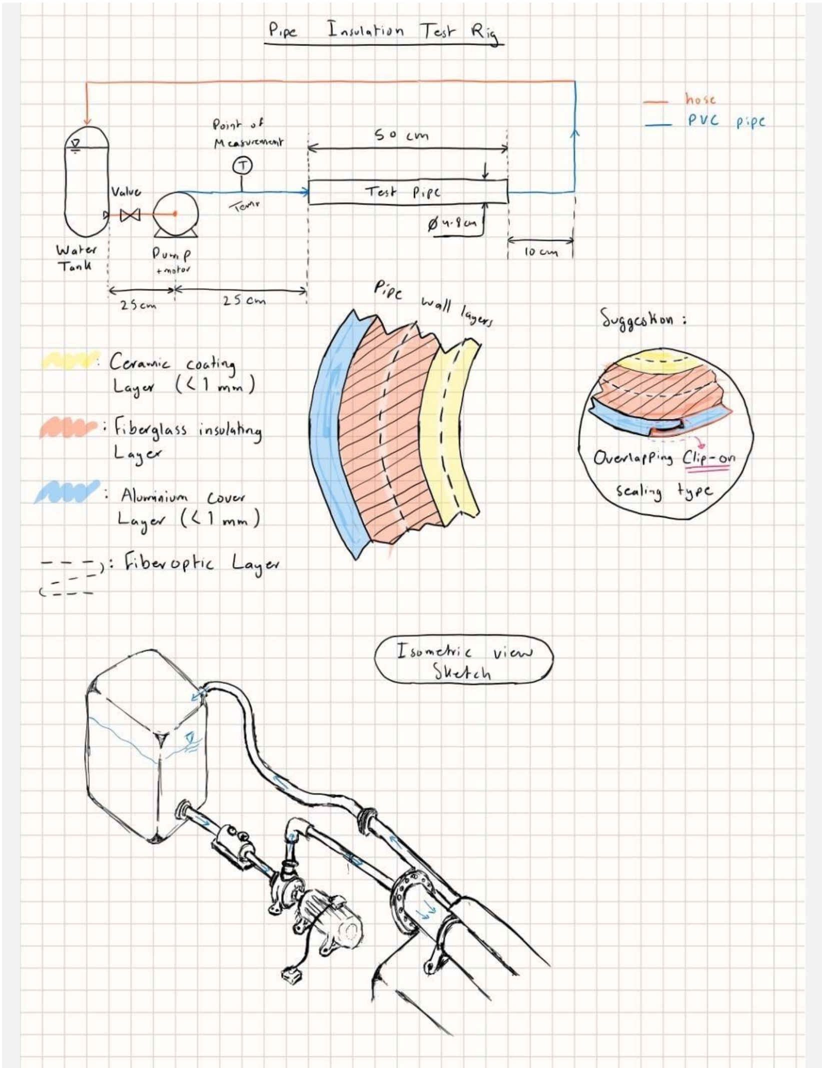

Figure 3.4 the Proposed design of the system

Figure 3.5 MRCG lab

components that I need. The staff in the lab store were really helpful they helped to improve the design and choose the right materials, I also went to E01 to use the heavy machinery there like lathe machine, milling machine, and the electrical saw as well as rust removal tool.

During week 6, I was able to examine a steam plant which is situated in E04 and which had been closed for maintenance for DOSH regulation in the Malaysia. The purpose of this maintenance was comprehensively subdivided into two which focused on maintaining the health, safety and welfare of the employees involved within the plant, as well as preventing other people from suffering from harm which may be as a result of the plant's operations. During this visit my focal tasks were to try and find out possible causes of system failure and to familiarize myself with the parts utilized in the steam plant.

A steam plant is one of the great importance in industries because it generates steam by heating water in order to power generation or heating purposes. The major components of a steam plant include:

- Boiler: This is the most important part of the steam plant where water is turned to steam. Boilers are made of steel or cast iron in order to be able to handle high pressure as well as high temperatures.
- Turbine: The produced high-pressure steam is then passed through a steam turbine which turns the thermal or heat energy into mechanical energy. that then be converted to electrical energy or can be used to drive other machinery.
- Condenser: After the turbine the steam will then cool down in the condenser, where it forms water and can be used again in the boiler.
- Piping System: Several high –pressure pipes convey the steam to the turbine and the steam from the turbine to condenser. These pipes require insulation because the heat loss will result in condensation.
- Feedwater System: This system supplies water to the boiler, and water supplied must be treated to avoid scaling and corrosion of boiler.

Figure 3.6 Boiler

- Safety Valves: These are mounted on the boiler and other essential parts; it has a function of opening and letting go of pressure in the case when pressure levels get too high, thus preventing boiler explosions.

Every one of these components is important to allow safe and efficient operation of the steam plant. The materials applied to these systems are chosen considering the high pressure values and temperature, the corrosive influence, and the stability under stress value. For instance, there is an application of stainless steel due to its corrosion content, and cast iron is on the other end of low thermal stress.

Common types of failures that can occur in a steam plant include:

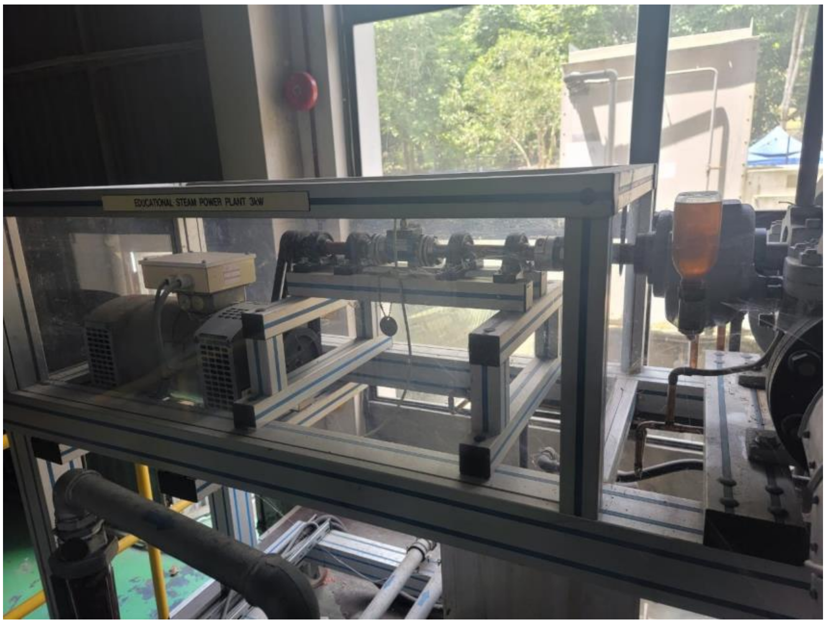

Figure 3.7 Turbine

(a) Boiler tube failures: These can be as a result of corrosion, scaling or thermal fatigue, in which case the efficiency of the plant can be reduced or it can shut down totally.

(b) Turbine blade erosion or corrosion: This may drag down the efficiency of the turbine, bring down the output level, or even cause mechanical breakdown.

(c) Condenser inefficiency: The condenser is essentially a heat exchanger which cools the steam that is produced in the plant; if the condenser is not operational the steam produced cannot be cooled hence there are pressure differences that cause system hitches.

(d) Pressure buildup: It should be noted that when the safety-valves stick or become jammed, high pressure is hazardous, causing boiler explosions which are disastrous.

(e) Pump failure: The feedwater pump's function is to provide water to the boiler and if this fails the boiler could dry up, overheat, explosive damage.

(f) Steam leakage: Piping system losses, as are breaches in the structure, can lead to high energy losses and safety hazards, if exposed.

Figure 3.8 Condenser

These are the components as well as possible explanation or causes of failure that were necessary to comprehend if the problems on the steam plant are to be diagnosed. Thus, indicating the problematic and failure areas, I contributed to the absence of damages during the operation of the plant, as well as during its maintenance.

After successfully completing both the monitoring system and the testing rig, my supervisor requested an additional task in week 12: to create a frame which would allow to combine all the components of the system together, using as less material as possible. Since this was my last week of my internship I knew I had to be very busy to ensure that I completed the project on time. I suggested a feather like frame concept that I knew would be inexpensive to construct but strong enough to bear the structure.

Figure 3.9 Piping System

The design was okay with my supervisor and I proceeded to acquire components for the project Since most of what was needed was steel.

Second, I moved to P23 to weld the structure beginning of the welding process. This was such a special moment for me I had to handle the welding equipment for the very first time. But due to previous training and research knowledge, I had was enough confident to go on with it. I used two types of welding techniques during this task:

(a) TIG Welding (Gas Tungsten Arc Welding): TIG stands for Tungsten Inert Gas welding and that uses the tungsten electrode to create the weld. This method affords accuracy and measure, and this was essential for the more challenging sections of the frame. It also offers high quality weld, free from weld defects such as porosity, cracks and inclusions.

(b) MIG Welding (Gas Metal Arc Welding): I decided to use MIG welding on the big and strong parts of the bicycle frame. Since MIG welding offers higher rates of welding and is easier to manage especially in big work projects, it is perfect in assembling the structural parts of the frame in a very short time.

Figure 3.10 Feedwater System

Figure 3.11 Safety Valves

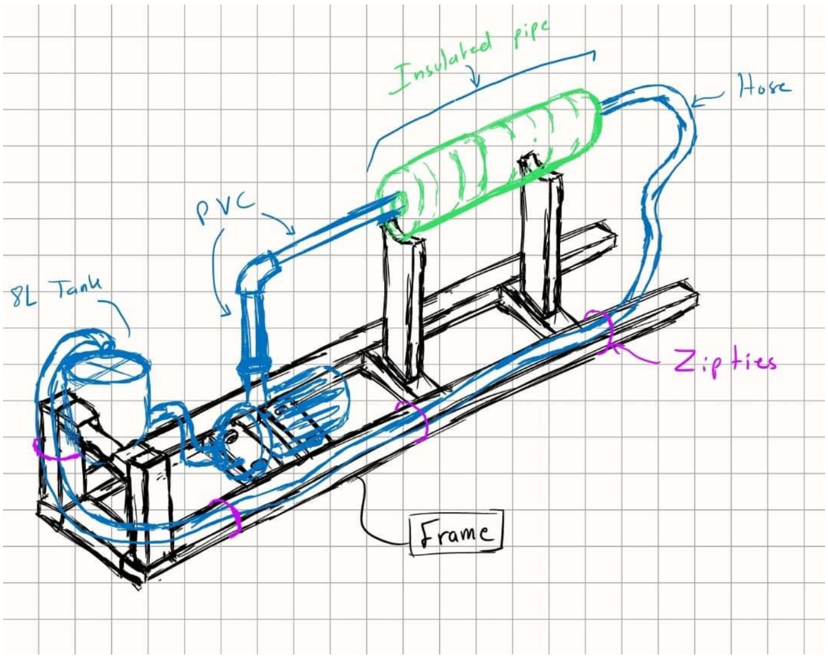

Figure 3.12 Frame Design

Figure 3.13 TIG Welding

Figure 3.14 MIG Welding

Even with limited time, I was able to do the welding and assembly of the frame work that combine all the parts together neatly and firmly using least amount of material a possible. This experience was invaluable as it afforded me the opportunity to apply a lot of my technical knowledge and practical skills to the test.

3.4 Results of Training

To my best efforts I have worked hard to achieve the given objectives and to meet all the scope given span of this project. Not only did my work meet the projects technical specification but also the end product was designed to be sustainable, easy-to-use, and modular system. Below, I outline the results of each phase of my project:

Monitoring System: As shown in the figures, the monitoring system I have designed did meet its main goal, the monitoring of pressure, temperature and humidity. By integrating the system into an IoT platform, the data collection improved significantly. The system can now wirelessly send real-time data to the app that I also designed. The structure of the program is well organized, basic, and commented throughout, which is beneficial when other students or even I come back to it in the future to advance the system. The IoT system enables the Data to be stored on the cloud in that manner All collected information can be stored for further analysis without any interruption. Rig Design and Assembly: The idea for the test rig materialised in the form intended as designed. The aim was to design a sustainable, modular, and adjustable setup which can mimic realistic test conditions of CUI. To avoid wastage of water, the rig was developed with a closed loop, consisting of pump, water tank and piped system made of steel.

The specified insulation materials which include polyurethane (PU) in combination with mineral wool were obtained after consultations with lab personnel. The exhibited figures illustrate the sequence of making the PU mixture, cutting the insulation, and assembling the rig. I undertook great care in designing the layer of insulation in such a way that it could be easily swapped with another one as a mechanism of improving the effectiveness of the test in relation to improved research environment.

Figure 3.15 App Receiving data from Arduino

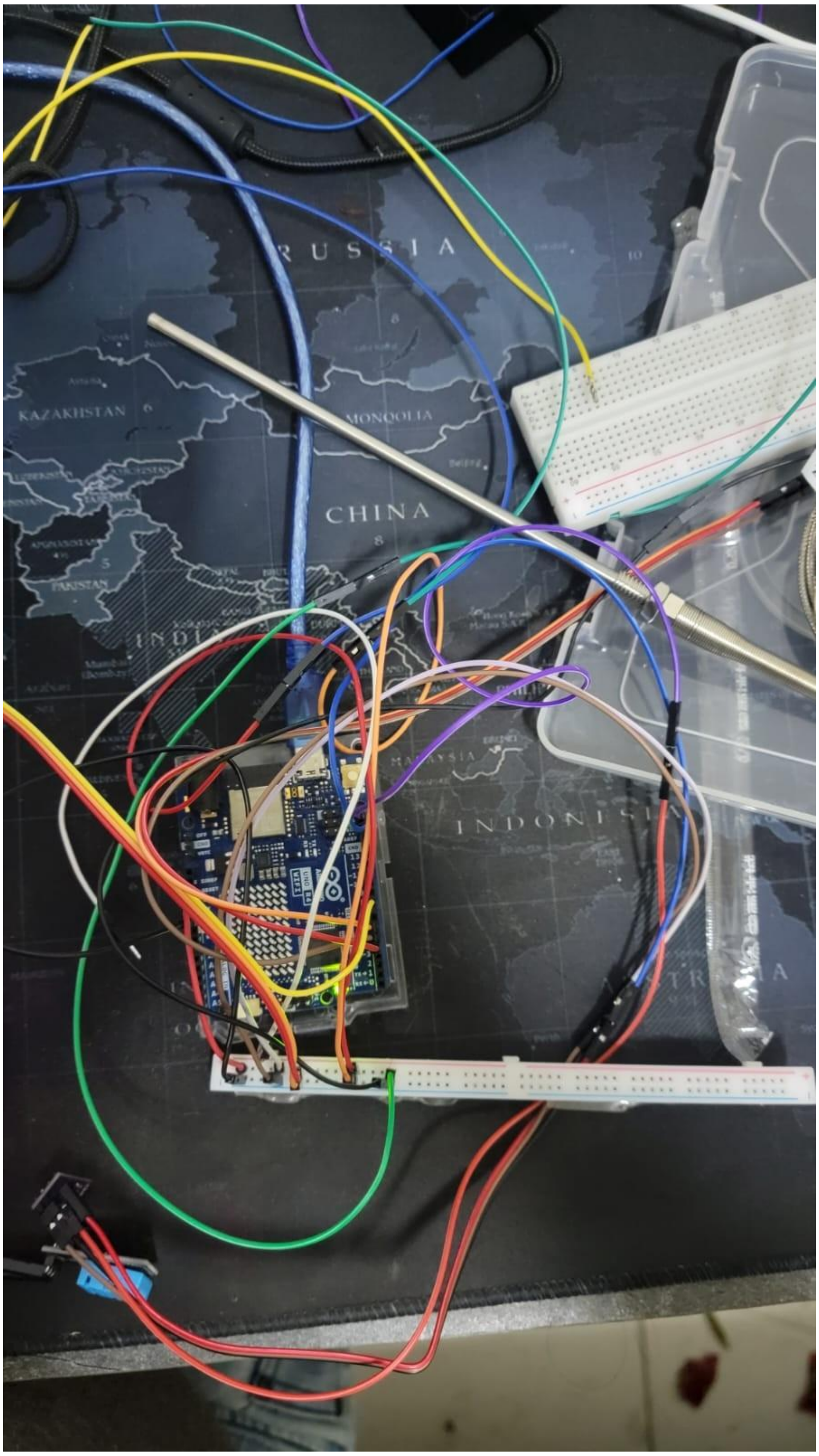

Figure 3.16 Arduino and the sensor connected throughout wiring

sketch_aug09a

```
#include "max6675.h"

int thermoDO = 4;
int thermoCS = 5;
int thermoCLK = 6;

MAX6675 thermocouple(thermoCLK, thermoCS, thermoDO);

void setup() {
  Serial.begin(9600);

  Serial.println("MAX6675 test");
  // wait for MAX chip to stabilize
  delay(500);
}

void loop() {
  // basic readout test, just print the current temp

  Serial.print("C = ");
  Serial.println(thermocouple.readCelsius());
  Serial.print("F = ");
  Serial.println(thermocouple.readFahrenheit());

  // For the MAX6675 to update, you must delay AT LEAST 250ms between reads!
  delay(1000);
}
```

Figure 3.17 Code

Code Development: I joined the software to gather information from the sensors—optical fibber for humidity and pressure, thermocouple for temperature, BME280, and DHT11 for the extra environment details. Some of the features include; The code is highly structured, easily modified and ready for future enhancements. The data collected is dumped to the connected app in real-time and stored there for future use. One of the advantages inherent in the system's construction is low data processing time, which results in precise and accurate measurements. Frame Fabrication: This structure which supports the whole system was intended to be lightweight and cheap with high resistance to breakage. The two diagrams represent cutting and welding of the steel members Keys points on figures: The knowledge I gained while working with TIG and MIG welding helped me assemble the frame with more complicated precision to guarantee the rig's stability while also being portable. This feature of the frame has the benefit that the system can easily be set up and taken apart to test under a variety of circumstances. Sustainability and Commercial Application: To reduce water wastage the rig and the monitoring system that was incorporated was designed on closed loop, adjustable insulation material which is industry compatible was also incorporated. This setup not only makes it possible to make the system simple to adapt to other research projects, but also affirms that the costs of paving way for other projects in the future

Figure 3.18 Frame after the first phase of welding

Figure 3.19 The complete rig with the frame

will not be much. Integrating the system with IoT also takes the design towards modern smart technology that direction is very relevant in the industry and research.

3.5 Skills Gained

Throughout this internship, I've developed a wide array of both technical and soft skills, including:

- IoT Systems and Coding: Built up and coded an IoT system for pressure, temperature and humidity monitoring, improving my programming skills. The follow-up of an uncomplicated process of writing and applying the code generates experience in applying technologies to the industrial systems.

- Rig Design: Acquired great experience related to designing and building the sustainable, adjustable, and modular test rig focused on practical application with the use of both, theoretical and practical knowledge to make the rig effective and making it suitable for practical usage.
- Welding and Heavy Machinery: Learnt practical experience in using TIG and MIG welds and also got to use heavy machinery such as lathes, milling machines and saws. These skills have enriched your capacity to work in industrial settings ,using the tools and materials appropriately.
- Chemical Processes: Knowledgeable about polyurethane (PU) mixed with mineral wool for insulation, which provides my understanding the chemical make-up of material science particularly in industries.
- Research and Analytical Skills: Enhanced my skills in searching for information on corrosion prognosis; To evaluate the behavior of materials under certain conditions, and the important parameters such as pressure, temperature and humidity subsequently used in monitoring.
- Problem-Solving and Decision Making: In situations such as equipment being unavailable, materials being a problem and decisions needed to be made swiftly, I developed and used my problem solving abilities, by being innovative but realistic in ensuring these challenges were met.
- Soft Skills: Much of my skills in communication, leadership, and teamwork were sharpened as I often interacted with colleagues, supervisors and lab technicians, make presentations, and work together on some aspects of the project.
- Time Management: Working on assignments with time constraints especially in the closing stages of a project. Technical Documentation: Documenting writing and code for using it in the future or giving an idea to others to continue it.
- Adaptability: Fluctuating between a designer and a doer, solving emergence problems such as a shortage of technicians on the sites, or raw material shortages.

- Attention to Detail: Minimizing accuracy confining errors in measurement, calibration, and assembling rig components and elements of insulation.
- Analytical Thinking: Research on corrosion parameters and testing of various sensors with an aim of incorporating them into a working IoT platform.
- Practical Application of Theories: Using knowledge from one's academic course in practice, for instance, programming for a smart device and using material knowledge to construct a rig.
- Safety Compliance: Sticking to safety measures in steam plant and when operating big equipment.
- Collaboration: Collaborating with different sectors and offices to purchase materials and support.

CHAPTER 4

CONCLUSION

4.1 Conclusion

In conclusion, this 12-week industrial training has been one of my greatest experiences that has enhanced my technical and personal competencies as a whole. I was able to combine academic theory with practical work in monitoring corrosion under insulation (CUI) with IoT system, creating a modular and sustainable testing rig as well as using better coding strategies. I designed a data acquisition system to acquire important parameters like pressure, temperature and humidity while interacting with different types of sensors including optical fibers, thermocouples, pressure and humidity sensors. Furthermore, tasks that include welding, working with heavy machinery, as well as using or creating chemical solutions for instance polyurethane insulation for the pipe, have improved significantly.

The training was good to get a feel of technical working as well as problem solving, communication and team building sessions. I learned that challenges such as short supplies of materials and limited availability of technicians fine-tuned my problem solving and flexibility strategies, interactions with different departments expanded my information sources. The last activity of welding the frame for the rig helped to demonstrate my development in operating large equipment and both TIG/MIG types of welding, which stressed the applicability of my skills.

In general, I guess that this internship help me build up self-confidence when entering the working world with improved problem-solving skills and leadership skills. I was also able to enhance the skills in designing, coding and implementing functional systems that can support the idea that knowledge learned can effectively be applied on a system. This experience can undoubtedly be a springboard for further engineering activities.

4.2 Future Recommendation

As for the further advice, the next students should consider more choosing the direction of examining the various types of insulation material. As for the work with optical fibber, it is most advantageous to pay especial attention to the operation and the processes connected with fibber since fibber will be at the disposition in the future work. Furthermore, they should deepen their understanding of the three key parameters: humidity, pressure and temperature. Further work needs to be carried out in order to determine other variables that could be measured or incorporated within the insulation such as the optical fibre and other parameters that may be more reliable for determining corrosion. This could provide for even more detailed monitoring systems to achieve more effective anti-corrosive coatings' protective characteristics in actual operating conditions.

Moreover, to increase the rig usefulness, further improvement of the rig and making it more modular and effective should be assigned as a priority task. This includes fine tuning of the design to take into consideration such factors as form, fit, and finishes for accommodating a number of forms of insulation while concurrently enhancing the actual assemble and disassembly processes of the rig and enhancing the actual adaptability of the rig for different testing conditions. Improving the capability of the rig will not only benefit the sessions that are to take place in the future, but it will also make it possible to conduct more elaborate tests in extreme environments, which should lead to a better understanding of corrosion behavior and how it might be addressed.

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4.3 Appendix 1: Gallery

Figure 4.1 Material Store

Figure 4.2 E01 lab

Figure 4.3 Making the Pu insulation

Figure 4.4 Grinding the steel for welding process

Figure 4.5 Grinding the steel for welding process

Figure 4.6 Welding


Figure 4.7 Electric saw


Figure 4.8 Lathe machine

Figure 4.9 Presentation

4.4 Appendix 2: Monitoring System & Mobile Application Code

```
#define BLYNK_PRINT Serial
#define BLYNK_TEMPLATE_ID "TMPL6B0-nMSa1"
#define BLYNK_TEMPLATE_NAME "CUI project"
#define BLYNK_AUTH_TOKEN "mtbecmxMMytTObIW_ImG5KE4qNiaT6cn"

#include <BME280I2C.h>
#include <Wire.h>
#include "DHT.h"
#include "max6675.h"
#include <SPI.h>
#include <WiFiS3.h>
#include <BlynkSimpleWifi.h>
int thermoDO = 4;
int thermoCS = 5;
int thermoCLK = 6;
```

```
#define SERIAL_BAUD 9600
#define BLYNK_PRINT Serial

#define DHTTYPE DHT11 // DHT 11
#define DHTPIN 8

char ssid[] = "MONKES-TIME_2.4GHz";
char pass[] = "A7ASHIBSHIBDA3";
MAX6675 thermocouple(thermoCLK, thermoCS, thermoDO);

BME280I2C bme;    // Default : forced mode, standby time = 1000 ms
                  // Oversampling = pressure ×1, temperature ×1, humidity ×1, filter off,

DHT dht(DHTPIN, DHTTYPE);



//////////////////////////////////////////////////////////////////
void setup()
{
  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);

  Serial.begin(SERIAL_BAUD);

  Serial.println("DHTxx test!");

  dht.begin();


  while(!Serial) {} // Wait

  Wire.begin();

  while(!bme.begin())
  {
    Serial.println("Could not find BME280 sensor!");
    delay(1000);
  }

  switch(bme.chipModel())
  {
     case BME280::ChipModel_BME280:
       Serial.println("Found BME280 sensor! Success.");
       break;
     case BME280::ChipModel_BMP280:
       Serial.println("Found BMP280 sensor! No Humidity available.");
       break;
     default:
       Serial.println("Found UNKNOWN sensor! Error!");
  }
}

void printBME280Data
(
   Stream* client
)
```

```
{
  float temp(NAN), hum(NAN), pres(NAN);

  BME280::TempUnit tempUnit(BME280::TempUnit_Celsius);
  BME280::PresUnit presUnit(BME280::PresUnit_Pa);

  bme.read(pres, temp, hum, tempUnit, presUnit);


  client->print("\t\tPressure: ");
  client->print(pres);
  client->println("Pa");
  float p = pres;

  Blynk.virtualWrite(V4, p);

  delay(1000);
}
//////////////////////////////////////////////////////////////////
void loop()
{
  Blynk.run();

  printBME280Data(&Serial);

  float h = dht.readHumidity();
  Serial.print("The temperature is C = ");
  Serial.println(thermocouple.readCelsius());
  float t = thermocouple.readCelsius();
  // Check if any reads failed and exit early (to try again).
if (isnan(h)) {
Serial.println("Failed to read from DHT sensor!");
return;
}

// Compute heat index
// Must send in temp in Fahrenheit!


  Serial.print("Humidity: ");
  Serial.print(h);
  Serial.print(" %\t");



  Blynk.virtualWrite(V2, h);
  Blynk.virtualWrite(V8, t);






  delay(500);
}

//////////////////////////////////////////////////////////////////
```