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Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

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DEVELOPMENT OF IOT-BASED AQUARIUM MONITORING SYSTEM

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A project report submitted in partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours



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DECLARATION

I declare that this project report entitled "DEVELOPMENT OF IOT-BASED AQUARIUM MONITORING SYSTEM" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



APPROVAL

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 Automation & Robotics) with Honours.

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DEDICATION

I would like to express my special dedication to people who support me with this thesis. I am grateful and acknowledge that both of my parent and sibling give me encouragement and endless support to me for completing this Bachelor Degree Project (BDP). Without them, I probably not reach this stage. Besides, special thanks for my fellow lecturer for advice, taught, and guidance through my studies. Not forgetting, all of my beloved friends throughout this wonderful journey. Finally, thank you to all people who help me directly or indirectly for the support in completing this project.



ABSTRACT

Many people and martial fish sellers feed pet fish in aquarium tanks that must be set up and kept properly or the fish will have an unpleasant and short life. The aquarium tanks, on the other hand, must be correctly set up and maintained, otherwise the fish will have a miserable and short life. As a result, it's vital to keep a constant eye on water conditions and work to enhance the water quality in aquarium tanks. The Internet of Things can help solve this challenge (IoT). This (IoT) technology is simple to operate using a smartphone. It may be used to easily install intelligent control for varied water conditions using (IoT). This system can also monitor the pH and temperature values that are appropriate for the type of fish life, as well as apply smart feeding, which allows the user to enjoy manual feeding while the fish are not underfed or overfed. It can also detect the water pump's operation and send a notification to our smartphone. Finally, this approach will make it easy for the user to maintain the state of their aquarium.

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ABSTRAK

Ramai orang dan penjual ikan bela diri memberi makan ikan peliharaan di dalam tangki akuarium yang mesti disediakan dan disimpan dengan betul atau ikan itu akan mempunyai kehidupan yang tidak menyenangkan dan pendek. Tangki akuarium, sebaliknya, mesti dipasang dan dijaga dengan betul, jika tidak, ikan akan mengalami kehidupan yang sengsara dan pendek. Akibatnya, sangat penting untuk terus memerhatikan keadaan air dan berusaha meningkatkan kualiti air di tangki akuarium. Internet of Things dapat membantu menyelesaikan cabaran ini (IoT). Teknologi (IoT) ini mudah dikendalikan menggunakan telefon pintar. Ini dapat digunakan untuk memasang alat kawalan pintar dengan mudah untuk berbagai kondisi air menggunakan (IoT). Sistem ini juga dapat memantau nilai pH dan suhu yang sesuai untuk jenis kehidupan ikan, serta menerapkan pemberian makanan pintar, yang memungkinkan pengguna menikmati pemberian makanan secara manual ketika ikan tidak kekurangan makanan atau terlalu banyak makan. Ia juga dapat mengesan operasi pam air dan menghantar pemberitahuan ke telefon pintar kami. Akhirnya, pendekatan ini akan memudahkan pengguna mengekalkan keadaan akuarium mereka.

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LIST OF SYMBOLS

v - Voltage c° - Celsius



LIST OF ABBREVIATIONS

- V Voltage
- IoT Internet Of Things
- AC Aalternatif Current
- DC Direct Currennt



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CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, the number of people holding fish continues to increase. Caring for an aquarium seems to be very difficult for an aquarium. The aquarium should well cared for make the fish healthy life. Current methods require the aquarium to manually detect and manage aquarium parameters such as fish feeding, lighting, water PH, temperature, oxygen motor, and so on. Fish should be fed twice a day, and because the fish keeper cannot control the aquarium when they are not present, the fish cannot be fed by the aquarium.. I created our project which is Development Of IoT-Based Aquarium Monitoring System. It is a system that is more efficient. It may be installed in any aquarium to replace human maintenance with an automated system. It can also save time and cost to care for fish in the long term.

1.2 Problem Statement

Aquarists play a critical role in maintaining the health of their fish in aquariums. Water feeding is a challenging activity for fish keepers while they are away from their station or when they travel out of station. Furthermore, for fish to live in good health, the temperature and pH of the water must be monitored on a regular basis. To allow fish to breathe easily, the oxygen supply within the water must be monitored. A system for continuous observation, control, and treatment of the fish must be established.

1.3 Project Objective

The major objective of this study is to develop an efficient system estimation approach. Specifically, the objectives are as follows:

- a) To design an aquarium controller supported with iot system
- b) To design system for motor pump, pH and temperature value
- c) To analys the perfomance of controller

1.4 Scope of Project

The scope of the project is:

- a) This smart aquarium is to create a design controller that connect to iot
- b) It cannot rely on a feeding system that was installed instead need to provide the feeding system manually.
- c) Suitable use for a small scale like an aquarium that can be found at house and not be used for large scale.



CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This Chapter discusses an overview of the whole aquarium and IoT projects. Past research related to aquarium technology. This study was made to plan the implementation to solve the problem of fish defenders in aquariums. The advantages and disadvantages of previous research will also be compared. This literature review is to review the source and validate the statement issued with research evidence relevant to the project.

2.2 Smart Aquarium

An aquarium is a tank, bowl, or form of glass that houses fish, aquatic animals, or living plants. It is also a structure where visitors can view exhibitions of maritime plants and animals. For the history of aquariums, in the last 4500 years, aquariums were known by the Sumerians who had made their ponds to store fish. While as early as 1000 BC, the Chinese may have been the first to breed goldfish for food successfully. Goldfish breeding as an ornament was introduced to Japan, where its breeding was perfect. The ancient Romans kept fish as their food and entertainment, and with a fresh supply of seawater, they built ponds.

Before the middle of the 19th century, the term aquarium was applied to describe the containers used to grow aquatic plants. Although the first known glass aquarium was developed in 1832 by the French-born naturalist Jeanne Villepreux-Power, in the writings of British naturalist Philip Gosse, the phrase first used a contemporary definition as a vessel on which aquatic animals, as well as plants, could be held. His research increased public interest in aquatic life. Fish, amphibians, and reptile farming became valuable in environmental studies in the 1850s.

The first public display aquarium debuted in 1853 in London's Regent's Park. It was followed by aquariums in Berlin, Naples, and Paris. The circus owner P.T. Barnum recognised the commercial potential of living aquatic animals and established the first private display aquarium at the American Museum in New York City in 1856. By 1928, the

world had 45 public or commercial aquariums, but growth stalled, and few major aquariums were built until after World War II. (EncylopaediaBritannica, 2018).

Pet ownership has steadily increased over the last 20 years. Freshwater fish are now the most popular pet after cats and dogs. Fish aquarium maintenance is a difficult task in and of itself.. Aquaponics is a modern farming system that combining planted farming, which produces plants and fish. The way aquaponics works is to use nutrient-rich water as a provider of food and organic nutrients to help plant growth, whereas plants cleanse, filter, and recycle the water environment, thus creating a symbiotic relationship between plants and fish

Fish is an animal that is widely defended on this earth because of the beauty of the colour of the fish. With that, Smart Aquariums are created. Smart Aquarium is a project done to make it easier for users to take care of fish. With having this Smart Aquarium, the lifespan of this fish can be extended because most of the consumers who defend this fish forget to pay attention to their fish. They forget to feed the fish or even fail to look at the water quality for their fish. So with a Smart Aquarium, it is easier for the user.

2.3 Internet of Things (IoT) Technology

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IoT is an essential element for the success of this project. The ESP32 to Wi-Fi. It is activated with system commands and will be connected to the internet. This makes it easier for the user to monitor when the user is not at home. The system is easy to use by users as they can monitor the condition of the aquarium even when they are not at home.

The Internet of Things (IoT) is a network of physical objects or people referred to as "things" that are embedded with software, electronics, a network, and sensors to collect and exchange data. The Internet of Things aims to extend internet connectivity from standard devices such as a computer, mobile phone, or tablet to relatively simple devices such as a toaster.

The Internet of Things (IoT) transforms virtually everything into a "smart" system by leveraging the power of data collection, artificial intelligence algorithms, and networks to improve various aspects of our lives. IoT can also refer to a person implanted with a glucose monitor or an animal equipped with tracking devices.

2.4 Feeding System

A feeding system is an organisation that manages the provision of feed supplies to groups of animals during at least one production cycle. The feeding system, being part of the farming system, is influenced by whatever impacts the main system(Roggero, Bellon and Rosales, 1996). This system is the interdependence of two or more functional units that form a homogenous totality capable of receiving all available physical and sequential resources—choosing, directing, and arranging the parts for later handling and assembly.(TAD, 2020)This feeding system is a system used by most pet advocates to feed their pets automatically. This is because sometimes consumers are so busy with their affairs that they forget to feed their pets. This system simplifies their work.

To save time and increase the feed rate component, the feeding system is integrated with a standard installation channel since there will be a delay in the feeding rate during the presentation by hand. This system removes a lot of output and saves time when feeding. It may initially cost a bit, but it is very effective and saves labour, and they can do other jobs. With this system, the animal will eat enough of this because the feeding time of the animal will follow the time. This makes the animal will be healthier and less diseased.

2.5 Related Previous Research

Related previous research is a project related to the project that will be carried out, such as the previous project using IoT, and this project also uses IoT. means that they are related.

2.2.1 Related Previous Research on Smart Aquarium

Today's aquarium system is a typical aquarium. While the aquarium system on the market today is already interesting, with a collection of plants and fish, the issues that arise when the aquarium is stored indoors are less due to the aquarium's need for sunlight. Occasionally, the lights in an aquarium are not adapted to the needs of the aquarium's plants or fish. Another issue is the manual distribution of fish feed. This is particularly problematic if the aquarium's owner is highly active, as the risk of forgetting to feed the fish is extremely

high. To overcome the difficulties mentioned earlier, it is necessary to have an aquarium system that is visually appealing and completely automated, both in terms of lighting and fish feeding.(Hardyanto, Ciptadi and Asmara, 2019)

A Smart Aquarium is developed for a fish aquarium. The prototype incorporates Internet of Things technology, allowing fish keepers to remotely adjust fish requirements (water and feed) from anywhere and anytime. Temperature and turbidity sensors, an automatic water drain, and a live stream are all included in the system. The data collected will be processed on the Raspberry Pi to take action and send a report to the device's owner.(Afifah *et al.*, 2019)

A control center is used to obtain information about the state of animals and plants in an aquarium's main tank body, as well as to monitor water level, salinity, temperature, oxygen content, PH (potential of hydrogen) value, and illuminance in a water area environment via a vision capturing system and an environment monitoring system; the control center is also used to compile data about the state of animals and plants in the aquarium's main tank body.(Kaimal *et al.*, 2017)

2.2.2 Related Previous Research on Internet of Things (IoT)

The Internet of Things (IoT) is the era of communication that is about to begin. The Internet of Things enables physical objects to create, receive, and exchange data seamlessly. Multiple IoT applications are aimed at automating various tasks and at empowering inanimate physical objects to act autonomously. Existing and future IoT applications hold great promise for increasing users' comfort, efficiency, and automation. To implement such a world in an ever-growing manner requires a high level of security, privacy, authentication, and attack recovery. It is critical to make the necessary changes to the architecture of IoT applications to achieve end-to-end secure IoT environments.(Hassija *et al.*, 2019)

According to (Mekki *et al.*, 2019), by 2020, radio communications will connect more than 50 billion devices. Low power wide area networks (LPWANs) have become a popular low-distance radio communication technology due to the Internet of Things (IoT) market's rapid growth. Sigfox, LoRa, and NB-IoT are three leading low-power wide-area network (LPWAN) technologies vying for large-scale IoT deployment.

The Internet is rapidly evolving and introducing new methods of connectivity. The Internet of Things (IoT) is one of those methodologies that repurposes existing Internet communication for Machine-to-Machine (M2M) communication. Thus, IoT enables seamless connectivity between the physical world and cyberspace via physical objects embedded with various intelligent sensors. Many interconnected machines will generate and exchange enormous data, facilitate daily life, assist in complex decision-making, and provide beneficial services. The evolution and importance of IoT in everyday life, the general architecture, the most widely used protocols, the numerous possible applications, and concerns about security and privacy in IoT, real-world implementation of IoT systems using Arduino, and its future trends. The Internet of Things is likely to become one of the most popular networking concepts, as it can yield numerous benefits.(Tuwanut and Kraijak, 2016)

Based on research (Pasha Mohd Daud *et al.*, 2020), the Internet of Things (IoT) has an advantages on Wireless Sensor and Actuator Networks (WSAN) and the Pervasive Computing domain. The security was challenging based on the technology and how information was acquired and manipulated by this technology. The IoT is very important to addressing physical and environmental accessibility issues in everyday. IoT also suggest a methods that potentially to remove these barriers. IoT has benefits for developing the countries such as sustainable agriculture, water quality and use, healthcare, industry, and environmental management. The ITU (International Telecommunication Union), has proves that anyone can temporarily use the data that they can be clarified by the machine to complete certain task. Based on the activated technologies that created for the IoT, it can be split up into three categories of technologies which is use information actors, information processing and technologies to enhance security and privacy. There are a number of challenges that will be faced if iot is examined. if the device is from a different manufacturer and it does not use the same standard, then interoperability becomes more difficult because it requires additional gateways to convert from one standard to another. The use of IoT applications involves the integration of various types of information technology as well as communication in terms of hardware and software. The information that has been created should have the ability to draw conclusions from the translated information. in general, IoT is also used in the investment aspect where it is mostly used in terms of software development for smart homes as well as buildings by private investors.

2.2.3 Related Previous Research on Feeding System

An automatic fish feeder is a device/product that automatically feeds the appropriate amount of fish food at a predetermined time, allowing the aquarist to feed their pet fish while on vacation or otherwise unable to maintain a regular feeding schedule. Additionally, it ensures that their pet fish are fed in a healthy manner and on time. The aquarist can specify the daily feeding time, the amount of food to be fed, the number of repetitions with a time delay, and other optional parameters. It is capable of accurately repeating its task on a daily basis.(Premalatha, Maithili and Nandhini, 2017)

Smart Fish Feeder is an automatic fish feeder controlled via an Android smartphone. Fish owners can easily adjust the feeding schedule to the recommended feed dose and schedule aquarium cleanings with this tool. An Arduino microcontroller and prototype feeding devices are used to implement automatic fish feeding systems.(Harani, Sadiah and Nurbasari, 2019)

Feeding is a collection of behaviours that organisms engage in in order to acquire and process the energy necessary for survival and reproduction. Thus, it is likely that feeding system morphology is subject to selection in order to maintain or improve feeding performance. Not only can relationships between feeding system morphology, feeding behaviour, and diet be used to explain the morphological diversity of extant primates, but they can also be used to reconstruct feeding behaviour and diet in fossil taxa.(Ross and Iriarte-Diaz, 2014)

Effective fish feeding is critical for the health and growth of fish in aquarium environments. However, due to their hectic lifestyles, aquarium owners face a significant challenge in maintaining proper feeding cycles. Numerous smart aquarium solutions have emerged as a result of the advancement of technologies, including the Internet of Things.(Auliar and Bekaroo, 2020)

2.6 Summary

In conclusion, aquariums have existed since 4500 years ago. In those days, aquariums were only used as a place to store food. Smart Aquariums are created when too many people defend fish used as a hobby but cannot manage it well. Smart Aquariums come automatically or manually. Usually, aquariums have essential care equipment, but some aquariums do not have such necessary equipment. Smart Aquariums will come with an IoT system, but some smart aquariums do not have an IoT system. The IoT system can be run in the form of Bluetooth, GSM or web server but the ESP32 is not widely used in smart aquariums. In addition, this smart aquarium also comes with a feeding system. Each smart aquarium has a different type of feeding system.

CHAPTER 3

METHODOLOGY

3.1 Overview

This chapter discusses the construction of the Development Of IOT-Based Aquarium Monitoring System. Only the design and mechanical parts are part of this project. The project will be carried out step by step, and the following method flow to document the stated project objectives. In addition, this chapter will cover project schedules and routines. The project schedule and routine will list the activities that should be done and the time frame for each activity. This is important to ensure that the project can be carried out on time.

3.2 Project Flow Chart

Figure 3.1 describes the whole process flowchart for the Development of IoT-based Aquarium Monitoring System project. The work makes this project run more orderly and has no significant interruptions or significant errors. The first is research and data collecting to discuss doing a project and choosing items for this project. Next is to learn about Smart Aquariums and feeding systems. This is because this project uses existing Smart Aquarium ideas and ways to make a feeding system.

Meanwhile, learn ways to develop pH sensors and temperature sensors because, in this project, the sensors are used. Upon completion of all, equipment and hardware will be selected for the project. For milestone one is for controller design simulation and coding about IoT. after that run and test. If there is a problem, it will be troubleshot by restarting the design simulation and followed by coding, and if there is no problem, it will be continued. The next step is milestone two, which runs the design simulation circuit project and coding once. Next, the existing sensors need to be calibrated first.

After that, it will be run with coding to see if there is a problem or not. If there is a problem, it will be restarted by looking at the circuit and followed by the program code. If there is no problem, it will proceed with milestone three, which is connecting the circuit with the hardware. Once completed, it will be tested and run. If there is a problem, it will be troubleshot first and reviewed at milestone one and milestone two.. If there is no problem, the project analysis data will be taken and recorded. The project is complete.







Figure 3.1 Project overall process flowchart

3.3 Milestone 1: Design IoT

This milestone is about ways to construct circuits and coding which relate to mobile applications (Blynks). The ESP32 can be connected Blynks app to make it easier for users to monitor the condition of connected items remotely. This process is called the development of IoT.

The ESP32 is a low-cost System on Chip (SoC) Microcontroller developed by Espressif Systems, the company behind the popular ESP8266 SoC. It is the successor to the ESP8266 SoC and features Tensilica's 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.

As with the ESP8266, the ESP32 incorporates integrated RF components such as a Power Amplifier, a Low-Noise Receiver Amplifier, an Antenna Switch, Filters, and an RF Balun. Due to the small number of external components, developing hardware for the ESP32 is a breeze. Another significant feature of the ESP32 is its use of TSMC's ultra-low-power 40 nm process. Thus, designing battery-powered applications such as wearables, audio equipment, baby monitors, and smartwatches should be a snap with the ESP32.

Due to the fact that the ESP32 has a far greater feature set than the ESP8266, it is difficult to include all of the specifications in this Getting Started with ESP32 guide. As a result, I've collected a list of the most critical ESP32 specifications here. However, I strongly suggest you to study the Datasheet for a complete set of specifications.

- Single or Dual-Core 32-bit LX6 Microprocessor with clock frequency up to 240 MHz.
- 520 KB of SRAM, 448 KB of ROM and 16 KB of RTC SRAM.
- Supports 802.11 b/g/n Wi-Fi connectivity with speeds up to 150 Mbps.
- Support for both Classic Bluetooth v4.2 and BLE specifications.
- 34 Programmable GPIOs.
- Up to 18 channels of 12-bit SAR ADC and 2 channels of 8-bit DAC
- Serial Connectivity include 4 x SPI, 2 x I2C, 2 x I2S, 3 x UART.
- Ethernet MAC for physical LAN Communication (requires external PHY).
- 1 Host controller for SD/SDIO/MMC and 1 Slave controller for SDIO/SPI.
- Motor PWM and up to 16-channels of LED PWM.
- Secure Boot and Flash Encryption.
- Cryptographic Hardware Acceleration for AES, Hash (SHA-2), RSA, ECC and RNG.



Figure 3.2. ESP32 Board Pin Out

This figure (3.2) explains all the pins of the board. The chip is used in conjunction with the board's 48 GPIO. Nonetheless, it cannot be used across all development boards. As indicated in the image above, the ESP32 devkit contains 36 pins on the board, 18 on each side. It features 34 GPIO pins, each of which supports various functions that may be set via dedicated registers. There are numerous GPIO kinds available, including digital input, digital output, analogue input, analogue output, capacitive touch, and UART connection.

3.2.2 Blynk UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Blynk (Figure 3.3) is a platform that includes iOS and Android apps for controlling Arduino, Raspberry Pi, and other similar devices over the Internet. It's a digital dashboard that allows you to create a graphical interface for your project by dragging and dropping widgets.



Figure 3.3 Application Blynk

Blynk was created with the Internet of Things in mind. It can control hardware remotely, display sensor data, store data, visualize it, and do a variety of other cool things. There three major components in platform:

- Blynk App makes it possible for you to create stunning interfaces for your projects by utilizing the various widgets we provide.
- Blynk Server is in charge of all communications between the smartphone and its hardware counterparts You can either use our Blynk Cloud or set up your own private Blynk server on your own computer. Open source, it is capable of supporting thousands of devices with ease, and it can even be launched on a Raspberry Pi.
- Blynk Libraries Communication with the server and processing of all incoming and outgoing commands are enabled for all popular hardware platforms.

As soon as you press the button in the Blynk app, the massage is sent to the Blynk cloud, from where it eventually makes its way to the hardware device. It works the same in the opposite direction and everything happens in a Blynk of an eye.



The figure(3.4) above is an explanation of how the blynk is work. Blynk was designed for the Internet of Things. It can control hardware remotely, and it can display sensor data, it can store data, visualize it and do many other cool things.

Now imagine: every time press a Button in the Blynk app, the message travels to space the Blynk Cloud, where it magically finds its way to hardware. It works the same in the opposite direction, and everything happens in a Blynk of an eye.

3.4 Milestone 2: Design Circuit And Coding

Milestone two is the main circuit part. It has to design the circuit and coding to see the function of the project to be or not. before it can be made real, it needs to be made using simulation first.

3.2.1 Block Diagram



Figure 3.5 Block Diagram for Development of IoT-Based Aquarium Monitoring System

Figure 3.5 shows a block diagram for the project circuit Development of IoT-Based Aquarium Monitoring System. It is started with an ESP32 connected to a mobile application (Blynk). In addition, the pH sensor, temperature sensor and stepper motor are connected directly to the ESP32. The pump motor and motor feeder must be connected to the relay first and followed by the ESP32. This is because to control the power along with switching the smaller current values in a control circuit.

3.2.2 2-Channel Relay Module

This module allows you to use Arduino to control two high-powered devices simultaneously. It is equipped with two relays, each of which can handle 250VAC or 30VDC up to 10A per channel. On the relay module, there are two LEDs that indicate the current relay position. When a relay activated, the LED associated with that relay will illuminate. One of the most advantageous aspects of these modules is that contain two integrated circuits (ICs) that provide excellent relay and Arduino isolation from the optocoupler.



Figure 3.6 2 Relay Module

3.4.2.1 Output Terminal

In relay it have three channels, each of which is broken down into blue screw pin terminals. Normal closed (NC) and normally open (NO) channels are distinguished by the letters COM, NC, and NO respectively (NO). When it comes to the sleep switch, the names of the channels explain the current state of the channel.. COM (Common): This is the pin to which you will connect the signal (mains electricity in our case). NC (Normally Closed): When want to turn the relay off by default, you use a normally closed configuration. The relay is always closed in this configuration and will remain closed until you send a signal from the Arduino to the relay module to open the circuit.. NO (Normally Open): A normally open configuration is the inverse of a normally closed configuration in that the contactor is always open until a signal is sent from the Arduino to the relay module to close the circuit..



Figure 3.7 Output Terminal Blocks

3.2.3 Type Sensor

A sensor is a device that measures physical input from its environment and converts that data into information that can be interpreted by either a person or a machine. However, some sensors, such as a glass thermometer, are simpler and provide visual data rather than electronic data (because the data is converted into electronic information). Among many other things, sensors are used to measure temperature, gauge distance, detect smoke, regulate pressure, and perform a plethora of other tasks. Analog and digital electronic sensors are the two types of electronic sensors available. Analog sensors convert physical data into analogue signals, which are then processed. In comparison to digital sensors, analogue sensors are much more precise because they are limited to a finite set of possible values. In the following diagram, you can see the difference between analogue and digital signals:


Figure 3.8 Chart between analog and digital

Figure 3.8 is a chart between analog sensors and digital sensors. The analog Sensor can measure over continuous range and their readings may form a curve. For the digital, its jumps between values, though if the steps are small, they may not be detected by human eye.

3.4.3.1 pH Sensor

A pH sensor is one of the essential tools that's typically used for water measurements. This type of sensor can measure the amount of alkalinity and acidity in water and other solutions. pH sensors, when used correctly, can ensure the safety and quality of water. A pH sensor measures water's acidity or alkalinity, with a value ranging from 0 to 14. The water becomes more acidic when the pH falls below seven. Any number greater than seven indicates that the body's pH is higher.. Each type of pH sensor measures the quality of water in a different way. The pH of water can help determine its quality. Measuring pH can also reveal pipe corrosion, solids buildup, and other harmful byproducts of an industrial process.

In an environmental context, changing pH could be an early indicator of increased pollution. If the pH level rises above 8.5, the water is considered hard and will most likely cause scale buildup in boilers and pipes. Liquid pH0-14 is used for this project.



Figure 3.9 Liquid PH0-14 Value Detect Sensor Module and PH Electrode Probe BNC for Arduino

 Table 3.1 pH of Daily Uses Substance

Substance	PH Range
Lemon Juice	2.2 to 2.6
Vinegar	2.5 to 2.9
Apple Juice RSITI TEKNIKAL	. MALA3.5IA MELAKA
Coffee	5.0 to 5.5
Milk	6.5
Water	7.0
Seawater	8.0
Soap	9.0 to 10.0
Bleach	13.0

The pH metre functions similarly to a voltmeter. The combinatorial setup's pair of electrodes can measure small changes in voltage (also known as potential difference) on the order of millivolts. Potential changes are caused by the loss of electrons, which corresponds to the loss of H+.

3.4.3.2 Temperature Sensor

A temperature sensor is an electronic device that measures the temperature of its surroundings and converts the input data into electronic data to record, monitor, or signal temperature changes. Temperature sensors are available in a wide range of shapes and sizes. Some temperature sensors (contact temperature sensors) require direct contact with the object being monitored, whereas others measure an object's temperature indirectly (non-contact temperature sensors).



Figure 3.10 DS18B20 Waterproof Sensor

The DS18B20 temperature sensor is fairly precise and does not require any external components to function. It has a temperature range of -55°C to +125°C and an accuracy of 0.5°C.The temperature sensor's resolution can be set to 9, 10, 11, or 12 bits. The default resolution at power-up, however, is 12-bit (i.e. 0.0625°C precision).The sensor requires only 1mA during active temperature conversions and can be powered by a 3V to 5.5V power supply.

Power Supply	3V to 5.5V
Current Consumption	1mA
Temperature Range	-55 to 125°C
Accuracy	± 0.5 °C
Resolution	9 to 12 bit
Conversion Time	<750 ms

Table 3.2 Specification of DS18B20 Waterproof Sensor

3.2.4 AC TO DC Power Supply

A power supply (Figure 3.11) is an electrical device that converts the electric current from a power source, such as the power mains, to the voltage and current values required to power a load, such as a motor or electronic device. The goal of a power supply is to provide the proper voltage and current to the load. The current must be supplied in a controlled and accurate manner to a wide range of loads, sometimes simultaneously, without allowing changes in the input voltage or other connected devices to affect the output. A power supply can be external, as seen in laptops and phone chargers, or internal, as seen in larger devices like desktop computers. There are two types of power supplies: regulated and unregulated. Changes in input voltage have no effect on output voltage in a regulated power supply. In contrast, in an unregulated power supply, the output is affected by any changes in the input. All power supplies have one thing in common: they take electric power from a source at the input, transform it in some way, and deliver it to a load at the output.

Alternating current (AC) or direct current (DC) power can be used at the input and output:

- Direct current (DC) is when current flows in only one direction. It is typically generated by batteries, solar cells, or AC/DC converters. For electronic devices, direct current (DC) is the preferred power source.
- Alternating current (AC) occurs when an electric current inverts its direction on a regular basis. AC is the method of delivering electricity to homes and businesses via power transmission lines.

As a result, if AC is the type of power delivered to your home and DC is the type of power required to charge your phone, you will require an AC/DC power supply to convert

the AC voltage delivered by the power grid to the DC voltage required to charge your phone's battery. Figure 3.11 is are example Ac to Dc power supply



Figure 3.11 Ac to Dc Switching Power Supply

Table 3.3	Linear vs.	Switching	Power	Supplies
-----------	------------	-----------	-------	----------

	Linear AC/DC power Supply	Switching AC/DC Power Supply
Size and	Large transformers are required,	When necessary, higher frequencies
Weight	significantly increasing the size and	enable the use of considerably smaller
	weight.	transformers.
Efficiency	Transformer losses are the only	Transistors have low switching losses
	substantial source of efficiency loss	because to their low resistance. This
	when unregulated. High power	permits the use of high-power
	applications, if not regulated, will have	applications in an efficient manner.
	a detrimental influence on efficiency.	
Noise	While unregulated power supplies can	When transistors switch at a high rate,
	generate large noise as a result of	noise is generated in the circuit.
	voltage ripple, regulated linear AC DC	However, for audio applications, this
	power sources can provide extremely	can be filtered away or the switching

	low noise. That is why they are used in	frequency increased above the
	sensing applications in medicine.	threshold of human hearing.
Complexity	A linear alternating current/direct	Due to the additional noise generated
	current power supply often has fewer	by the transformers, massive,
	components and simpler circuitry than a	complicated filters, as well as control
	switching alternating current/direct	and regulation circuitry for the
	current power supply.	converters, must be included.

3.2.5 Software

Software is a set of instructions that instructs a computer on what to do. The entire collection of programmes, procedures, and routines associated with the operation of a computer system is referred to as software. The term was coined to distinguish these instructions from hardware, which refers to the physical components of a computer system. A programme, also known as a software programme, is a set of instructions that directs the hardware of a computer to perform a task.

3.4.5.1 Proteus

The Proteus is an electronic circuit design software that includes schematic capture, simulation and PCB (Printed Circuit Board) modules. This project is used to create a circuit breaker and connect it to the coding in the Arduino IDE to run the circuit. This simplifies the work before the hardware installation takes place. Figure 3.12 shown example circuit in Proteus.



3.4.5.2 Arduino IDE

The Arduino IDE(Figure3.13) is open source software used primarily to write and compile code into Arduino Modules. This is the official Arduino software, making coding too easy so that ordinary people with no prior technical knowledge can familiarize themselves with the learning process. These are readily available for operating systems such as MAC, Windows, Linux and running on the Java Platform equipped with built-in functions and commands that play an essential role in debugging, editing and compiling code in the environment. This project is used to write the coding and find out if there is a problem with the coding. it will also be connected to the hardware Arduino for coding transfer so that the circuit can run



3.5 Milestone 3: Combine All

The third milestone is a complete circuit, which implies that the circuit and code have been combined with the aquarium and need to be tested. It will also be put to the test in a variety of ways. For example, the pH sensor will be tested with varied aquarium water. The temperature sensor will be tested at various temperatures in the same way. The moto pump and fan cooler will also be tested, and the results will be used in the project analysis.

3.6 Summary

This chapter focuses on project methodology and discusses it in depth. The most significant chapter in project management is project methodology, which ensures that the project can be finished systematically guided by the correct project techniques. The technique has four stages that guide the developer: building the project structure plan, developing the project system operation, project determination, and complete project integration.

Based on the past study and a review of the literature, the appropriate parameters that must be controlled are determined while building the project structure plan. The project system development was later formed. This stage aims to investigate and identify all of the project's components and regulated elements. The stage of project determination is when the mechanical, electronic, and software designs have been designed and developed. Following that, the entire project integration will be tested and troubleshot repeatedly to ensure that the project's objectives are met. To guarantee effective time management



CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the result and review of the entire project will be further elaborated in this chapter. It includes all the resulting project testing from virtual reality to real-time project testing, data analysis, and condition of project operation. The result of these tests and analyses will be the reference point for determining whether or not the project goals are archived.

4.2 Control System

The control for this project is to control the system. The control system that can be used in this project is all auto. To make it auto is through IoT. This IoT needs to be connected to blynk and the nearby Internet. This control system and the Internet need to be connected using Esp32 for control and monitoring

4.3 ProcessNIVERSITI TEKNIKAL MALAYSIA MELAKA

How it works is by the way all components are connected to Esp32, and the data will be read through the blynk application. To turn on the system using the power supply unit and reduce the voltage using the DC-DC Step-down module from 12V to 5v. After that, it is connected directly to Esp32 to turn on the system.



Figure 4.2 Circuit Controller system for Development Of IOT-Based Aquarium Monitoring System



Figure 4.3 Schematic Circuit Controller system for Development Of IOT-Based Aquarium Monitoring System

4.4 Data and Analysis

In this part, the data is collected and make an analysis for several parts. This aims to complete this project again in the future

4.4.1 Temperature Reading

Water temperature is essential for fish in the aquarium. This part of the experiment tests the temperature values in aquariums 1(Blue) and 2(Pink) and compares them with other temperature meters. It is also tested with conditions when the pump is opened and closed. The temperature is taken within an hour. The way to handle this temperature is to use the Digital Thermometer Measuring Tool to compare. Data taken and recorded. after that, make an error calculation for the temperature of each tank.

Digital thermometer measuring tool figure (4.4) is a tool used to compare readings with temperature sensor readings. It will be submerged to take readings (figure 4.5). Wait until the new stable reading is taken, this is because there is a delay in changing the reading in small numbers. After the reading is taken, it will be compared with the reading in the blynk (figure 4.6) to get the percentage error. Percentage error can be obtained by using the formula:



Figure 4.5 Digital Thermometer Measuring Tool Went Measuring



Figure 4.6 Reading Temperature in Blynk

Percent Error = $\frac{|\text{measured} - \text{real}|}{\text{real}} x \ 100\%$

Example 1 at 12.00 PM tank 1 open pump:

$$Percet \ Error = \frac{|30.6 - 31.3|}{31.3} \ x \ 100\%$$

$$Percent \ Error = \ 2.24\%$$

Example 2 at 12.00 PM tank 2 open pump:

$$\frac{Percet \ Error}{31.8} = \frac{|31.4 - 31.8|}{31.8} \times 100\%$$

$$Percent \ Error = 1.27\%$$
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Example 3 at 12.00 PM tank 1 close pump:

Percet Error = $\frac{|28.3 - 28.9|}{28.9} \times 100\%$ Percent Error = 2.08%

Example 4 at 12.00 PM tank 2 close pump:

 $Percet \ Error = \frac{|28.8 - 29.2|}{31.8} \ x \ 100\%$ $Percent \ Error = \ 1.26\%$

Table 4.1 the readings taken from 9.00 am to 2.00 am with the pump open. We can see at 10.00 am the temperature is rising slightly and it will maintain until 8.00 pm it has already started to go down. While table 4.2, we get a reading with the water pump closed. Here we can see that the temperature readings increase and drastically decrease the cause of the unstable water temperature.

	Τe	emperature With Pump O	pen	
WAKTU	TANK 1	TEMPERATURE READING DIGITAL THERMOMETER	TANK 2	TEMPERATURE READING DIGITAL THERMOMETER
9.00 AM	29.1	29.8	29.9	30.4
10.00 AM	29.8	30.5	30.4	31.0
11.00 AM	30.3	31.0	31.0	31.5
12.00 PM	30.6	31.3	31.4	31.8
1.00 PM	31.0	31.6	31.6	32.0
2.00 PM	31.1	31.8	31.8	32.1
3.00 PM	31.2	31.9	31.9	32.2
4.00 PM	31.3	31.9	31.9	32.3
5.00 PM	31.3	31.9	31.9	32.3
6.00 PM	/ _{Mn} 31.3	31.9	31.9	32.3
7.00 PM	31.2	31.9	31.9	32.3
8.00 PM	31.3	31.9	31.7	32.1 و نبو م
9.00 PM	31.3	31.9	31.8	32.1
10.00 PM	31.3		31.8	1 AKA 32.1
11.00 PM	31.2	31.9	31.8	32.1
12.00 AM	31.1	31.9	31.7	32.0
1.00 AM	30.9	31.6	31.5	31.9
2.00 AM	30.5	31.2	31.1	31.5

Table 4.1 Data For Water Temperature With Pump Open

	Temperature With Pump Close				
WAKTU	TANK 1	TEMPERATURE READING DIGITAL THERMOMETER	TANK 2	TEMPERATURE READING DIGITAL THERMOMETER	
9.00 AM	26.9	27.5	27.4	27.8	
10.00 AM	27.4	28.0	27.9	28.3	
11.00 AM	27.8	28.3	28.4	28.7	
12.00 PM	28.3	28.9	28.8	29.2	
1.00 PM	29.0	29.7	29.6	30.0	
2.00 PM	29.5	30.1	30.2	30.5	
3.00 PM	30.2	30.8	30.8	31.3	
4.00 PM	30.8	31.4	31.3	31.6	
5.00 PM	30.3	30.9	30.9	31.3	
6.00 PM	30.1	30.6	30.8	31.1	
7.00 PM	30.1	30.6	30.7	31.1	
8.00 PM	29.9	30.5	30.4	30.8	
9.00 PM	29.6	30.0	30.0	30.5	
10.00 PM	29.5	30.0	29.9	30.4	
11.00 PM	29.1	29.7	29.7	30.2	
12.00 AM	28.8	29.4	29.4	29.9	
1.00 AM	28.6	29.2	29.2	29.7	
2.00 AM	28.4	28.9	28.9	29.3	

Table 4.2	Data For	Water	Temperature	With	Pump	Close

Based on the Graph below we can see the difference between an open pump and a closed pump:



Figure 4.7 Temperature Tank 1 Open Pump



Figure 4.8 Temperature Tank 1 Close Pump



Figure 4.9 Temperature Tank 2 Open Pump



Figure 4.10 Temperature Tank 2 Close Pump

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For figure 4.7(tank 1) and figure 4.9 (tank 2) shown graph that temperature when the water pump is open while figure 4.8(tank 1) and figure 4.10 is the temperature when water pump is close. Clearly, when water pump is open, the graph will increased stability while when water pump is closed, it will depend on surrounding temperature.

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4.4.2 Reading Of pH Value

The pH is important for this fish is because to maintain the pH of the water so that the fish is not affected by disease. In this experiment the readings were taken and compared using a Portable Digital pH Meter(Figure 4.11) to make a comparison with the pH readings in blynk. In figure 4.12 that shown the reading are taken in two aquarium. pH Value will also calculate the error.

		pH reading		
HARI	TANK 1	Portable Digital pH Meter	TANK 2	Portable Digital pH Meter
MONDAY	6.95	6.89	7.06	7.00
TUESDAY	6.89	6.82	7.03	6.98
WEDNESDAY	6.84	6.79	7.00	6.95
THURSDAY	6.79	6.73	6.98	6.93
FRIDAY	6.75 📎	6.70	6.95	6.90
SATURDAY	6.71 🔓	6.66	6.92	6.88
SUNDAY	6.69	6.63	6.89	6.85

Table 4.3 Data For pH Water



Figure 4.11 Portable Digital pH Meter



Figure 4.12 Portable Digital pH Meter is reading a value



Figure 4.13 pH Reeading In Blynk

Figure 4.12 shows the Portable Digital pH Meter(figure 4.11) immersed in an aquarium to take readings. after the reading is taken, it will be compared with the reading in the blynk (figure 4.13) to get the percentage error. Percentage error can be obtained by using the formula:

$$Percent \ Error = \frac{|\text{measured} - \text{real}|}{\text{real}} \ x \ 100\%$$





Figure 4.14 pH Reeading In tank 1



Figure 4.15 pH Reeading In tank 2

4.4.3 Results Motor Feeder

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Food is an obligatory thing for the life cycle of every living thing. This is because food can give us the energy to move on with life. This feeder motor(figure 4.16) serves to feed the fish in case the keeper forgets nor they outstation. This can keep the pet fish healthy and live longer. The figure 4.17 shown that component that use to make the feeder moter works. Feeder motor works in what way when pressed or the timer that has been set reaches the time it will rotate using the dc motor and stop when the limit switch is pressed.



Figure 4.16 Motor Feeder



Motor Feeder	Tank 1	Tank 2
Start	\checkmark	\checkmark
Stop	\checkmark	\checkmark
Timer	\checkmark	\checkmark

Based on the table above, shown the result that are tick are function. That means when it starts to twisting it go and when it has to stop it stop. The start and stop are running smoothly. And the timer runs according to a set time.

4.4.4 Result Motor Pump Filter

The water pump is one of the important things in the aquarium. This is because this water pump aims to maintain the cleanliness of the water and maintain the temperature in the water. To keep the cleanliness of the water, it will suck the water that has fish faeces and filter in the pump and re-release the water that has been filtered. To maintain the temperature when it inhales water, it will also inhale outside air from the existing airways, and when the water is released, it will produce bubbles in the water to provide oxygen in the water and also maintain the temperature according to the environment. Figure 4.18 and figure 4.19 showns the hardware the flow water pump an figure 4.20 in application blynk that use to on and off the motor pump:



Figure 4.18 The Flow water Pump

Water pump	Blynks	Works
Tank 1	\checkmark	✓
Tank 2	\checkmark	✓

Table 4.5 Show the result that it works in blynk



Figure 4.20 The iot In Blynk works

4.5 Discussion

Development Of IOT-Based Aquarium Monitoring System is made for monitoring and control of multi-aquariums. from here we can make all the analysis and tests the performance to get good performance and run smoothly. temperature and pH value of our sensor can further reduce the error on the sensor. in addition, other tools can be tried to ensure more readings with more accurate sensors and take more readings. Figure 4.21 shown the hold application that use in this project.



Figure 4.21 Full Screen Application Blynk

4.6 Summary

The aim of this project is to control and monitoring multi akuarium using Esp32 with Blynk. The Esp32 and Blynk is are medium to use to collect data and monitoring. It a multiakuarium can be monitaring



CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Overview will include the end the goal set out in the early introduction portion and future work of the project. Hence, the outcome that satisfies the goals, and the overview of this project has been included in this chapter. Next, this chapter also addresses the suggestion for potential improvement of this project in this chapter.

5.2 Conclusion

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In conclusion, this project is about Development Of IOT-Based Aquarium Monitoring System. The primary objective of this system is to assist the aquarium user in more conveniently and easily maintaining and monitoring the aquarium. This aquarium monitoring system is dependable, with the ability to update users on the current situation in real time. Additionally, the system made its own decisions based on pre-programmed instructions without user intervention. Above all, the aquarium monitoring system should be user-friendly and capable of being operated by a non-technical individual. From this finding, which relies on data fusion and machine learning, has developed a low-cost design and successfully implemented remote monitoring of smart aquariums via the IoT. The water quality is monitored using a temperature sensor and a pH sensor to ensure that it is suitable for freshwater fish cultivation. Development Of IoT-Based Aquarium Monitoring System. This project can monitor, control and retrieve data with multi -aquariums. When an aquarium has fish, it needs to be given attention because these fish are more susceptible to disease and die if the water pH is too low, the temperature is too high or they forget to feed. So with this system they will never forget to feed with the feeder motor set the timer. So the fish will get food every day based on the set time.

So, the conclusion of this project is successful and all the objectives are achieved by developed this aquarium monitoring system based on the result taken. Every result taken to ensure the project was conducted successfully.

5.3 Future Works

For future improvements is to add a fan or chiller to reduce the water temperature if the ambient temperature is high. This is because when the temperature is high there is no coolant to cool the water.

In addition can add a water turbidity sensor to see the water turbidity and when it needs to be changed. this is because if the water is turbid while we are outstation about will not know because the moss there will affect the pH and Temperature



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APPENDICES

Appendix A

#include <BlynkSimpleEsp32.h> #include <OneWire.h> #include <DallasTemperature.h> #define auth "6ZfBUp85zPI-K3R8xV6VO1cZM2ompM9p" #define ssid "TuaDegilCorp@unifi" // Enter Wifi Name #define pass "PNL51419" // Wifi Password 34 #define PH_Sensor_1 #define PH Sensor 2 35 #define Temperature_Sensor_1 32 #define Temperature_Sensor_2 33 AYSIA #define Limit_Switch_1 23 #define Limit Switch 2 22 #define Water_Pump_1 19 #define Water Pump 2 18 #define Motor_Feeder_1 17 #define Motor_Feeder_2 16 BlynkTimer timer; OneWire oneWire1(Temperature_Sensor_1); // setup a oneWire instance OneWire oneWire2(Temperature_Sensor_2); // setup a oneWire instance DallasTemperature sensors1(&oneWire1); // pass oneWire to DallasTemperature library DallasTemperature sensors2(&oneWire2); // pass oneWire to DallasTemperature library float vin1; float vin2 : float vout1; float vout2; long value1; long value2; float ph_ave1; float ph_ave2; float ph_value1; float ph_value1_to_blynk; float ph_value2; float ph_value2_to_blynk; int temp1 = 0; int temp2 = 0;

int temp_ph1 = 0;

```
int temp_ph2 = 0;
int array_ph1[10];
int array_ph2[10];
int x, i, j;
int realtime = 0;
bool toggle_state1 = 0;
bool toggle_state2 = 0;
bool state 1 = 0;
bool state2 = 0;
float temperature_value1; // temperature in Celsius
float temperature_value2; // temperature in Celsius
const float R1_1 = 9900.0;
const float R2_1 = 19700.0;
const float R1_2 = 9900.0;
const float R2_2 = 19600.0;
const float c1 = 23.07 - 0.1;
const float c^2 = 24.21 + 0.25;
const float m1 = -6.4; LAYS/
const float m^2 = -7;
const float ph_Offset = 11;
// Virtual Switch to control water Pump 1
BLYNK_WRITE(V1)
{
 digitalWrite(Water_Pump_1, param.asInt());
}
// Virtual Switch to control water Pump 2
BLYNK_WRITE(V2)
                             TEKNIKAL MALAYSIA MELAKA
{
 digitalWrite(Water_Pump_2, param.asInt());
}
// Virtual Switch to control Motor Feeder 1
BLYNK_WRITE(V3)
{
 toggle_state1 = param.asInt();
 if (toggle_state1 == 0)
 ł
  state 1 = 1;
 }
 else {
  state 1 = 0;
 }
```

```
}
// Virtual Switch to control Motor Feeder 2
BLYNK_WRITE(V4)
ł
 toggle_state2 = param.asInt();
 if (toggle_state2 == 0)
 {
  state2 = 1;
 }
 else {
  state2 = 0;
 }
}
// To update state of virtual button every miliseconds
BLYNK_CONNECTED()
                 WALAYSIA
{
 Blynk.syncVirtual(V1, V2, V3, V4);
}
void setup() {
 pinMode(Limit_Switch_1, INPUT_PULLUP);
 pinMode(Limit_Switch_2, INPUT_PULLUP);
 attachInterrupt(Limit_Switch_1, changestate, RISING);
 attachInterrupt(Limit_Switch_2, changestate, RISING);
 pinMode(Water_Pump_1, OUTPUT);
                                      AL MALAYSIA MELAKA
 pinMode(Motor_Feeder_1, OUTPUT);
 pinMode(Water_Pump_2, OUTPUT);
 pinMode(Motor_Feeder_2, OUTPUT);
 digitalWrite(Water_Pump_1, HIGH);
 digitalWrite(Water_Pump_2, HIGH);
 digitalWrite(Motor_Feeder_1, HIGH);
 digitalWrite(Motor_Feeder_2, HIGH);
 Serial.begin(115200);
 Blynk.begin(auth, ssid, pass);
 timer.setInterval(10L, motorfeedermanual);
 timer.setInterval(80L, PHSensor);
 timer.setInterval(80L, TemperatureSensor);
}
void loop() {
 Blynk.run();
```

```
timer.run();
}
void PHSensor() {
// PH Sensor read 10 times and save in array
 for (int x = 0; x < 10; x++)
 ł
  array_ph1[x] = analogRead(PH_Sensor_1);
  array_ph2[x] = analogRead(PH_Sensor_2);
 }
// Arrange the value in array from small value to big value in ascending for PH Sensor 1
 for (j = i + 1; j < 10; j++)
 ł
  if (array_ph1[i] > array_ph1[j])
  ł
   temp1 = array_ph1[i];
   array_ph1[i] = array_ph1[j];
   array_ph1[j] = temp1; 3/4
  }
 }
// Arrange the value in array from small value to big value in ascending for PH Sensor 2
 for (j = i + 1; j < 10; j++)
 ł
  if (array_ph2[i] > array_ph2[j])
  {
   temp2 = array_ph2[i];
   array_ph2[i] = array_ph2[j];
   array_ph2[j] = temp2;
                                EKNIKAL MALAYSIA MELAKA
  }
 }
ph_ave1 = 0;
 ph_ave2 = 0;
// Take 6 value from the center of the array
 for (x = 2; x < 8; x++)
 {
  temp_ph1 = array_ph1[x];
  ph_ave1 = temp_ph1 + ph_ave1;
  temp_ph2 = array_ph2[x];
  ph_ave2 = temp_ph2 + ph_ave2;
 }
```

```
// Calculate the average
```

```
ph ave1 = ph ave1 / 6;
ph_ave2 = ph_ave2 / 6;
// Convert analog value to 3.3V
vout1 = (ph_ave1 * 3.3) / 4096.0;
vout2 = (ph_ave2 * 3.3) / 4096.0;
// Convert 3.3v to 5v
 vin1 = vout1 / (R2_1 / (R1_1 + R2_1));
 vin2 = vout2 / (R2_2 / (R1_2 + R2_2));
// Convert voltage to Ph value
ph_value1 = vin1 * m1 + c1;
ph value2 = vin2 * m2 + c2;
ph_value1_to_blynk = ph_value1 + ph_Offset;
ph_value2_to_blynk = ph_value2 + ph_Offset;
// Display PH Value on Blynk Apps
 Blynk.virtualWrite(V5, ph_value1_to_blynk);
Blynk.virtualWrite(V6, ph_value2_to_blynk);
// Display Ph Value on Serial Monitor
// Serial.print("PH Value Sensor 1 : ");
// Serial.println(ph_value1);
// Serial.print("Voltage Value Sensor 1 : ");
// Serial.println(vin1);
// Serial.print("PH Value Sensor 2 : ");
// Serial.println(ph_value2);
// Serial.print("Voltage Value Sensor 2 : ");
// Serial.println(vin2);
// Serial.println();
                       SITI TEKNIKAL MALAYSIA MELAKA
}
```

void TemperatureSensor() {

// Read Temperature Sensor 1
sensors1.requestTemperatures(); // send the command to get temperatures
temperature_value1 = sensors1.getTempCByIndex(0); // read temperature in Celsius

// Read Temperature Sensor 2
sensors2.requestTemperatures(); // send the command to get temperatures
temperature_value2 = sensors2.getTempCByIndex(0); // read temperature in Celsius

// Display Temperature Value on Blynk Apps Blynk.virtualWrite(V7, temperature_value1); Blynk.virtualWrite(V8, temperature_value2);

// Display Temperature Value on Serial Monitor
// Serial.print("Temperature Value Sensor 1 : ");
```
// Serial.println(temperature_value1);
 // Serial.print("Temperature Value Sensor 1 : ");
 // Serial.println(temperature value2);
 // Serial.println();
}
// To control relay fo motor feeder 1 and 2
void motorfeedermanual() {
 if (state 1 = 1)
 {
  digitalWrite(Motor_Feeder_1, LOW);
  Blynk.virtualWrite(V3, LOW);
  state 1 = 1;
 }
 if (state1 == 0)
 {
  digitalWrite(Motor_Feeder_1, HIGH);
  Blynk.virtualWrite(V3, HIGH);
 }
 if (state2 == 1)
  digitalWrite(Motor_Feeder_2, LOW);
  Blynk.virtualWrite(V4, LOW);
  state2 = 1;
 }
 if (state2 == 0)
  digitalWrite(Motor_Feeder_2, HIGH);
 ł
  Blynk.virtualWrite(V4, HIGH);
 }
}
// To stop the feeder motor 1 and 2 if limit switch activated
void changestate() {
 if (digitalRead(Limit_Switch_1) == HIGH)
 {
  state 1 = 0;
 }
 if (digitalRead(Limit_Switch_2) == HIGH)
```

```
57
```

{

state2 = 0;



}

}

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Appendix B

