Faculty of Electrical Technology and Engineering

DEVELOPMENT OF IOT-BASED SMART RIVER CLEANING SYSTEM BY USING MICROCONTROLLER

GOH ZHONG ZE

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

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DEVELOPMENT OF IOT-BASED SMART RIVER CLEANING SYSTEM BY USING MICROCONTROLLER

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DEDICATION

This project report is dedicated to my dear father, Goh Kiek Meng, who has been a constant and supportive presence throughout my research journey until its completion. I extend my gratitude to my beloved mother, Sim Peik Hian, who has provided unwavering encouragement and attentive support over the past months, fostering an environment of genuine confidence. Additionally, I dedicate this project to all those individuals who have worked diligently to assist me to complete this project.

ABSTRACT

This project aims to develop an IoT-based smart river cleaning system using microcontrollers. The primary objective is to tackle the growing problem of waste accumulation in rivers, particularly non-biodegradable materials such as plastic, which pose significant environmental risks. The system will collect waste that is unreachable by traditional manual cleaning methods. The collected waste will be safely stored for proper disposal. Furthermore, the system will incorporate safety features to protect river cleaners during the cleaning process. The project's scope encompasses the comprehensive design, development, and optimization of both hardware and software components, ensuring their seamless integration. Testing and performance validation will be conducted to ensure the system's efficiency and effectiveness. The anticipated outcome of this project is a cost-effective, environmentally friendly, and scalable solution that significantly improves the efficiency of river cleaning operations. By developing this IoT-based smart river cleaning system, the project aims to set a foundation for future initiatives in similar water bodies, fostering cleaner and healthier environments.The expected result of this project is a optimized IoT-based smart river cleaning system that effectively reduces plastic waste and other pollutants in rivers, enhances the safety of river cleaners, and efficiently collects waste from hard-to-reach areas. The system will be capable of autonomously collecting floating waste, especially plastic, on the river's surface and in inaccessible areas where manual cleaning is not feasible. It is expected to demonstrate accuracy, consistency, and reliability in waste detection and collection, providing valuable feedback from users. In conclusion, the development of an IoT-based smart river cleaning system using microcontrollers offers a promising solution to combat river pollution and waste accumulation. The integration of sensors and safety features ensures effective waste detection and collection while prioritizing the well-being of river cleaners. The anticipated outcome of this project is a cost-effective, eco-friendly, and scalable solution that significantly improves the efficiency of river cleaning operations. By addressing the challenges posed by waste accumulation in rivers, this project contributes to creating cleaner and healthier environments for both aquatic life and surrounding communities.

ABSTRAK

Projek ini bertujuan untuk membangunkan sistem pembersihan sungai pintar berasaskan IoT menggunakan mikropengawal. Objektif utama adalah untuk menangani masalah pengumpulan sisa yang semakin meningkat di sungai, terutamanya bahan tidak terbiodegradasi seperti plastik, yang menimbulkan risiko alam sekitar yang ketara. Sistem ini akan mengumpul sisa yang tidak boleh dicapai dengan kaedah pembersihan manual tradisional. Sampah yang dikumpul akan disimpan dengan selamat untuk dilupuskan dengan betul. Tambahan pula, sistem ini akan menggabungkan ciri keselamatan untuk melindungi pembersih sungai semasa proses pembersihan. Skop projek merangkumi reka bentuk komprehensif, pembangunan dan pengoptimuman kedua-dua komponen perkakasan dan perisian, memastikan penyepaduan lancar mereka. Ujian yang ketat dan pengesahan prestasi akan dijalankan untuk memastikan kecekapan dan keberkesanan sistem. Hasil jangkaan projek ini ialah penyelesaian yang kos efektif, mesra alam dan berskala yang meningkatkan kecekapan operasi pembersihan sungai dengan ketara. Dengan membangunkan sistem pembersihan sungai pintar berasaskan IoT ini, projek ini bertujuan untuk menetapkan asas bagi inisiatif masa depan dalam badan air yang serupa, memupuk persekitaran yang lebih bersih dan sihat. Hasil yang diharapkan daripada projek ini ialah pembersihan sungai pintar berasaskan IoT yang berfungsi sepenuhnya dan dioptimumkan. sistem yang berkesan mengurangkan sisa plastik dan bahan pencemar lain di sungai, meningkatkan keselamatan pembersih sungai, dan mengumpul sisa dari kawasan yang sukar dicapai dengan cekap. Sistem itu akan mampu mengumpul sisa terapung secara autonomi, terutamanya plastik, di permukaan sungai dan di kawasan yang tidak boleh diakses di mana pembersihan manual tidak dapat dilaksanakan. Ia dijangka menunjukkan

ketepatan, konsistensi dan kebolehpercayaan dalam pengesanan dan pengumpulan sisa, memberikan maklum balas yang berharga daripada pengguna. Kesimpulannya, pembangunan sistem pembersihan sungai pintar berasaskan IoT menggunakan mikropengawal menawarkan penyelesaian yang menjanjikan untuk memerangi pencemaran sungai dan pengumpulan sisa. Penyepaduan penderia dan ciri keselamatan memastikan pengesanan dan pengumpulan sisa yang berkesan sambil mengutamakan kesejahteraan pembersih sungai. Hasil jangkaan projek ini ialah penyelesaian yang kos efektif, mesra alam dan berskala yang meningkatkan kecekapan operasi pembersihan sungai dengan ketara. Dengan menangani cabaran yang ditimbulkan oleh pengumpulan sisa di sungai, projek ini menyumbang kepada mewujudkan persekitaran yang lebih bersih dan sihat untuk hidupan akuatik dan masyarakat sekeliling.

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CHAPTER 1

INTRODUCTION

1.1 Background

Natural and artificial rivers are an integral part of the beautiful living environment, but increasing human activities have led to a surge in pollution of floating waste, including plastic, on river surfaces. The water flow velocity in the lakes/rivers is observed to be very low, and most of the floating waste accumulates near the river bank. Currently, one of the solution is manual cleaning, which is time-consuming, costly, and inefficient. To address this problem, a river cleaning boat has been designed to clean the floating waste on the river. The boat has a conveyor made of lightweight, durable materials. It is powered by a motor and equipped with a floating barrier and mesh material to collect the waste. The collected waste is stored in a compartment. This innovative solution is cost-effective, efficient, and environmentally friendly, ensuring a cleaner and healthier environment for all.

1.2 Problem Statement

The increasing pollution of rivers due to waste, especially plastic, is a major environmental challenge that requires an effective and efficient cleaning system. Traditional river cleaning methods are often time-consuming, labor-intensive, and ineffective in removing all pollutants. Additionally, river cleaners' safety is at risk due to the hazardous waste they handle. Furthermore, some areas of the river are inaccessible to manual cleaning methods, leaving waste behind.

To address these challenges, there is a need to develop an IoT-based smart river cleaning system that can reduce waste, increase safety, and collect waste in hard-to-reach areas. The system will leverage ESP32 microcontrollers and various sensors.

The system will also feature an autonomous cleaning mechanism that can collect waste and debris, especially plastic, that floats on the river's surface. The autonomous cleaning mechanism will have the capability to collect waste in hard-to-reach areas where manual cleaning is not feasible. Additionally, the system will prioritize the safety of river cleaners by reducing their exposure to hazardous waste.

Overall, the development of an IoT-based smart river cleaning system using ESP32 aims to provide an efficient and effective solution to reduce river pollution, increase safety for river cleaners, and collect waste in hard-to-reach areas.

1.3 Project Objective

The main aim of this project is to proposed the system consists of a floating boat with a surface waste collection unit and sensors to monitor the waste.

a) To develop a smart river cleaning system that can effectively reduce plastic waste and other pollutants in the river, increase safety for river cleaners, and collect waste in hard-to-reach areas.

b) To integrate smart river cleaning system with IoT application using ESP32 microcontrollers and sensors that can be controlled via a smart phone.

c) To analyse the accurary and consistency of the device in terms of result and feedback of the users

1.4 Scope of Project

The scope of this project are as follows:

a) Design smart river cleaning system.

b) Integrate the system with IoT application using ESP 32 microcontrollers and sensors.

c) Test the functionality of the overall system and collect data and results

d) Run an analysis to compare the functionality of the system under controlled environment and real situation

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The growing environmental concern in recent times revolves around the mounting pollution of rivers and other water bodies.. Traditional river cleaning methods have been used for decades but are increasingly insufficient due to the scale of pollution and the hazardous nature of the waste being removed. The need for innovative and effective solutions to tackle this problem has led to the development of new technologies, including the Internet of Things (IoT), which offers a promising approach to improving river cleaning systems.

2.2 Importance of clean surface water in the river

Kamarudin, Nurul Anis Syahira Nordin, Ili Najaa Aimi Mohd Misman et al [1] designed the garbage collector designed for the cleaning of small-scale lakes, narrow rivers, and drains has been developed in Malaysia. The robot's navigation is facilitated through wireless Bluetooth communication, which is controlled by a smartphone application. The efficiency of the water garbage collector in terms of maneuvering control and garbage collection load capacity was subjected to testing and evaluation. Results from experiments conducted in a swimming pool revealed that the robot can operate effectively within a 4-meter range. Impressively, it demonstrated the ability to collect 192 grams of small to medium-sized recyclable garbage, including food packages, water bottles, and plastics, within a mere 10-second timeframe. This innovative solution showcases promising potential for addressing pollution concerns in water bodies through technological means.

Kandare, Dharmesh N Kalel, Aniket N Jamdade, et al [2] designed this project and construction of a mechanism dedicated to cleaning rivers. This system has demonstrated enhanced efficiency in removing floating solid waste from the river surface. By addressing and overcoming the limitations observed in previous river surface cleaning methods, the project has successfully developed a remote-operated river cleaning machine. This innovative solution contributes to effective, efficient, and eco-friendly river surface cleaning. The primary objective is to minimize manpower, reduce time consumption, and ultimately enhance the cleaning machine's efficiency. The operational control of the river cleaning process in this project relies on a motor, coupling, and a remote control arrangement, offering a streamlined and technologically advanced approach to river cleaning.

Jishnu Satheesh, Anagha P Nair, Devipriya M, Chithra A, Govind Mahesh, Jayasree P R[3] design the Wireless Communication based Water Surface Cleaning Boat. The project aims to develop a waste collecting boat to scavenge the water body and abolish the floating waste. This is done by employing a conveyor belt connected to the front line of the boat. Boat movement is established using a remote-control application by incorporating an RF module along with an encoder-decoder pair. This method will reduce the cost of operation because of less human involvement and labour.

Saran Raj, B. Murali, L. Vijayaparamesh et al [4] design an Internet of Things (IoT) based boat designed for cleaning water surfaces and checking water quality to address the substantial deposition of garbage in water bodies annually. It is concerning that large amounts of waste accumulate in these areas. Monitoring the water quality in contemporary times is crucial. The boat operates through Bluetooth control, offering user-friendly operation for individuals. Ensuring good water quality in rivers and streams is advantageous for both human well-being and the aquatic ecosystem. The objective of this initiative is to create an affordable and wireless water quality monitoring system that facilitates continuous measurements of water conditions, contributing to effective environmental management.Finally, clean surface water in rivers contributes to the overall quality of life and well-being of communities. Rivers are often integral to the cultural and recreational activities of communities, and clean rivers provide opportunities for activities such as swimming, fishing, and boating. Overall, the importance of clean surface water in rivers cannot be overstated. It is essential to implement measures to protect and maintain the quality of river water, and the development of an IoT-based smart river cleaning system can contribute to this goal.

2.3 Design and controlling river cleaning system

Shah, Aayush Mishra, Abhishek Sahu, Aditya [5] designed and controlling the river cleaning system via IOT. Traditionally, the conventional method for collecting water debris, trash, and plastic from water bodies relies on manual labor or the use of boats and trash skimmers. This process involves gathering the impurities floating on the water or collecting them using boats and skimmers, then transporting the collected waste to the river shore for disposal. However, this manual approach demands a significant amount of manpower, making it a risky, expensive, and time-consuming method.

Mohammed, M. N. Al-Zubaidi, S. Kamarul Bahrain et al [6] designed the loT-based surface water cleaning robot. In this project, a battery-operated boat equipped with a belt conveyor is employed to efficiently gather garbage in both small and large water bodies. The conveyor facilitates the collection of various types of waste, including plastic bags and bottles. The hardware component of the project incorporates sensors capable of measuring the pH level of the water along with other relevant parameters.

Rumahorbo, Brilyan Nathanael Josef, Antonio Ramadhansyah et al [7] design a robot capable of transporting surface waste in a river.. The creation of a river cleaning robot is envisioned as a solution to mitigate the proliferation of waste on Earth. This robot incorporates Robot Vision technology, utilizing Python as its programming language, to detect and identify trash in its vicinity. The detected waste is then transported into a storage tank. Numerous projects and designs aimed at addressing plastic pollution have been explored, including autonomous, mechanical, and human-based computation designs. Many individuals have endeavored to develop prototype robots dedicated to cleaning plastic waste. In this particular project, the primary objective is for the machine to lift debris from the water surface and deposit it into a tray. This is achieved through a conveyor system mounted on a motor shaft, where the rotation of the motor facilitates the collection of water debris, waste, and plastics from water bodies.[8]. The process of designing and managing a river cleaning system demands meticulous attention to multiple factors, including waste detection, safety protocols, and control mechanisms. Through the creation of a river cleaning system that is both efficient and effective, we can safeguard the health of our waterways, ensuring they remain devoid of pollutants and continue to offer vital ecosystem services to the community.

2.4 Design and controlling lake cleaning system

Lakes play a crucial role in the Earth's landscape, serving as invaluable ecosystems that offer a diverse array of goods and services to humanity. Beyond being a vital source of precious water, lakes provide essential habitats for a variety of plants and animals. They play a key role in moderating hydrological extremes such as droughts and floods, influence microclimates, contribute to the aesthetic beauty of landscapes, and present numerous recreational opportunities. The multifaceted contributions of lakes underscore their significance in supporting both the environment and human well-being.[9]. Floating lake cleaner is used for management of aquatic issues or obstacles including streams, rivers, and canals. Due to its future availability in different sizes and designs this machine can be bought and used for individual purposes as well. Depending on the needs of this machine can work in conditions like extreme winter, spring, and summer. Companies which do not believe in large manpower but rather looks forward in using latest devices for their task can find this machine to be perfect for their work as this device does not need a specialized person to handle. Its user-friendly working and efficient performance make it an impressive device that can be easily adopted by local cleaning departments eventually saving a lot of manpower, trouble and time[10].

The Lake Cleaning System robot is capable of navigating water using DC motors controlled by a Raspberry Pi. It comprises two 30 rpm DC motors, a relay, ultrasonic sensor, gripper, IR sensor, 6V battery, trash bin, and a transistor. The relay connects the motors to the Raspberry Pi, facilitating the robot's movement. Motor speed is maintained at a nominal value for optimal motion. The ultrasonic sensor, linked to the Raspberry Pi, detects objects on the water surface as the robot moves. The sensor output serves as input for the gripper, positioned on the front with suitable ground clearance. Upon receiving input from the ultrasonic sensor, the gripper picks up objects after a brief delay, allowing living organisms like fish to escape. The collected waste is then deposited into a bin positioned directly behind the mechanism.[11].

2.5 Comparison between lake cleaning system robot and river cleaning system robot

The comparison between the IoT-based smart river cleaning system and the IoT-based smart lake cleaning system by using Arduino primarily depends Depending on the nature of the water body. and the challenges that come with cleaning it. The river cleaning system must account for the faster flow rate and the types of waste that typically accumulate in rivers, which can include larger objects like tree branches and tires, as well as smaller items like plastics and paper. As a result, the sensors and control mechanisms used in a river cleaning system must be more robust to detect and collect waste efficiently. Conversely, a lake cleaning system is specifically engineered to function effectively in calm or slowly flowing water, thereby minimizing the complexity of waste detection and collection.. The lake cleaning system typically needs to collect floating debris and organic matter, which requires a collection system that can effectively trap and remove the waste. Both systems require the use of IoT technology to control and monitor the system, but the implementation of sensors and control mechanisms varies based on the water body's conditions. A river cleaning system requires more advanced sensors and control systems to navigate the fast-moving water and collect waste, while a lake cleaning system may require more specialized sensors and collection systems to effectively collect waste in still water. Overall, the comparison between the IoT-based smart river cleaning system and the IoT-based smart lake cleaning system by using Arduino depends on the specific conditions of the water body, the types of waste that need to be collected, and the sensors and control mechanisms required to detect and collect waste effectively.

Table 2:1 Devices control, tools and aims for research

Author	Devices control	Tools	Aims
Kamarudin, Nurul Anis Syahira	a. Brush DC gear motor b. Propeller	a. Arduino Uno b. DC Motor Drive L298N	The garbage collector is designed aimed for the cleaning of small-

Nordin, Ili Najaa Aimi Mohd Misman et al [1]	protector c. Trash net	c. Bluetooth module HC-05	scale lakes, narrow rivers, and drains in Malaysia.
Kandare, Dharmesh N Kalel, Aniket N Jamdade, et al [2]	a. Water wheel b. Inclined and flat conveyors c. DC gear motor d. Trash rack	a. RF transmitter b. RF receiver c. RC controller	The main aim of the project is to reduce the manpower, time consumption and thereby increasing the efficiency of the machine for cleaning the river.
Jishnu Satheesh, Anagha P Nair, Devipriya M, Chithra A, Govind Mahesh, Jayasree P R[3]	a. Conveyor belt b. Trash container c. DC motor	a. RF module b. RF receiver c. RF transmitter d. Motor driver L298N e. HT12E encoder f. HT12D encoder	The project aims to develop a waste collecting boat to scavenge the water body and abolish the floating waste.
Saran Raj, B. Murali, L. Vijayaparamesh et al [4]	a. Conveyor belt b. Trash container c. Bo motor	a. ESP 8266 b. ESP 32 c. PH sensor d. Driver IC e. Turbidity sensor f. Dabble g. L293D motor driver module	The aim of our work is to develop a low-cost, wireless water quality monitoring system that aids in continuous measurements of water conditions.
Shah, Aayush Mishra, Abhishek Sahu, Aditya [5]	a. Conveyor belt b. Blade cutter c. Turbines	a. NodeMCU b. L298 motor driver	This machine is remote operated so manpower does not required at all. So this machine is really advantageous for reducing the water pollution.
Mohammed, M. N. Al-Zubaidi, S. Kamarul Bahrain et al [6]	a. Conveyor belt b. BO motor	a. ESP 32 b. buzzer c. ultrasonic sensor d. WIFI e. Temperature sensor f, Motor driver	Designed with autonomous ship for cleaning the garbage floating.

2.6 Intelligent System for Garbage collection: IoT technology with Ultrasonic sensor and Arduino Mega

Najaf Ali , M. Awais, M. Muzammul and Ayesha Zafar[12] design proposes the implementation of a project named the IoT Based Smart Garbage System. This system incorporates an ultrasonic sensor to gauge the waste level and an Arduino Mega to oversee the system operations. Additionally, it possesses the capability to generate warning messages to the municipality via SMS when the garbage bin reaches full or near-full capacity, ensuring prompt waste collection. The primary objective of this initiative is to diminish human resources and efforts while aligning with the vision of a smart city. Moreover, it aims to enhance the efficiency of solid waste disposal management, contributing to overall improvements in waste management practices.

2.7 IMPROVING THE PERFORMANCE EFFICIENCY OF VILLAGE POND CLEANER USING ARDUINO IN THE BASIS OF BLUETOOTH CONTROLLED PROCESS by using Arduino Uno

Priya, P. Anuradha, T. Prabhu et al[13] design a village pond cleaner equipped with a system designed to eliminate waste debris from the water's surface and safely dispose of it within the pond. This pond cleaner utilizes Bluetooth technology to effectively remove drainage debris, plastic, and garbage, contributing to the maintenance and cleanliness of the village pond.

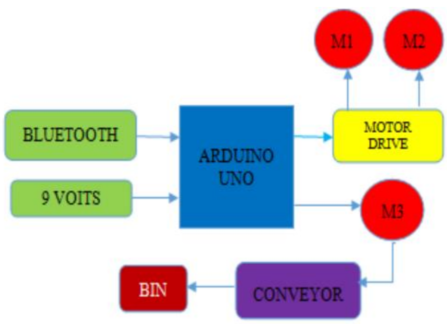

Figure 2.7 Block diagram of the proposed system[14]

Based on **Figure 2.7** above, the Bluetooth module and the motor driver are connected to the microcontroller, Arduino Uno. Arduino Bluetooth controller will control the project to move on the surface water. All the system are powered by 9 volts battery.

2.8 An Improved River Cleaning System by using ESP 8266

Kalyani Chandurkar, Parinay Lavatre, Dr. Narendra Bawane [15] design a river waste cleaning machine, addressing the pressing issue of pollution in our national rivers. The current state of these water bodies reveals significant contamination with substantial amounts of sewage, pollutants, toxic materials, and debris. The polluted water has resulted in the observation of various skin diseases in humans. In response to this environmental challenge, the project aims to mitigate water pollution by creating an efficient water cleanup machine.

Saran Raj, B. Murali, L. Vijayaparamesh et al also used ESP 8266 to run his product, IoT Based Water Surface Cleaning and Quality Checking Boat. The primary function of this project is to gather floating objects from the water's surface and deposit them into a trash container.

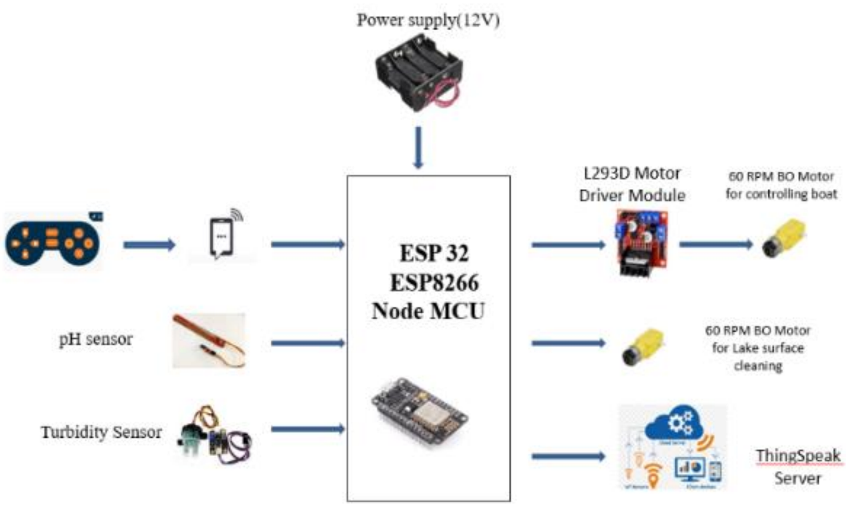

Figure 2.8 IoT Based Water Surface Cleaning and Quality Checking Boat[4]

The ESP8266 microcontroller governed the sensors, with the pH sensor linked to D7, D8, 5V, and GND, and the Turbidity sensor connected to the A0 pin. The data gathered by these sensors was transmitted to the cloud using the ThingSpeak IoT platform, accessible through the internet.Comparison of Arduino Mega, Arduino Uno, ESP 8266 and ESP32

Table 2.2 Comparison of Arduino Mega, Arduino Uno, ESP 8266 and ESP32

Feature	Arduino Mega	Arduino Uno	ESP8266	ESP32
Microcontroller	ATmega2560	ATmega328P	ESP8266	ESP32
Operating Voltage	5V	5V	3.3V	3.3V
Digital I/O Pins	54 (of which 15 provide PWM)	14 (of which 6 provide PWM)	17 (of which 1 provide PWM)	38(of which 26 provide PWN)
Analog Input Pins	16	6	1 (0-3.3V range)	18(12-bit ADC)
Flash Memory	256 KB (8 KB used by bootloader)	32 KB (0.5 KB used by bootloader)	4 MB (Flash)	Varies(4MB, 8MB)
SRAM	8 KB	2 KB	80 KB	520KB
EEPROM	4 KB	1 KB	None	None
Clock Speed	16 MHz	16 MHz	80 MHz	80 MHz
USB Interface	USB Type-B	USB Type-B	Micro USB	Micro USB

Wireless Connectivity	None	None	Wi-Fi	Wi-Fi, bluetooth

2.9 Summary

In Chapter 2 of this project, an exhaustive examination is presented, delving into previous projects associated with the design and control of river cleaning systems. The synthesis of information was drawn from diverse sources, including books, journals, and websites. This comprehensive review played a pivotal role in formulating the conceptual and methodological framework for the current project.

The review emphasizes the importance of Wi-Fi technology as a wireless communication medium for controlling and monitoring the river cleaning system. Additionally, it examines previous projects and the hardware used in them. Overall, this chapter's findings provide a foundation for the development of an effective IoT-based smart river cleaning system using ESP32 microcontrollers.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will elaborate on the construction methods employed in the project entitled “DEVELOPMENT OF IOT-BASED SMART RIVER CLEANING SYSTEM BY USING ESP32”. The report provides clear explanations about the methods to gather information and clearly state the materials used in the project. The methodology, which includes the process of investigating, observing, analyzing and designing, is explained through diagrams, making it easy to understand the steps involved.

3.2 Project Overview

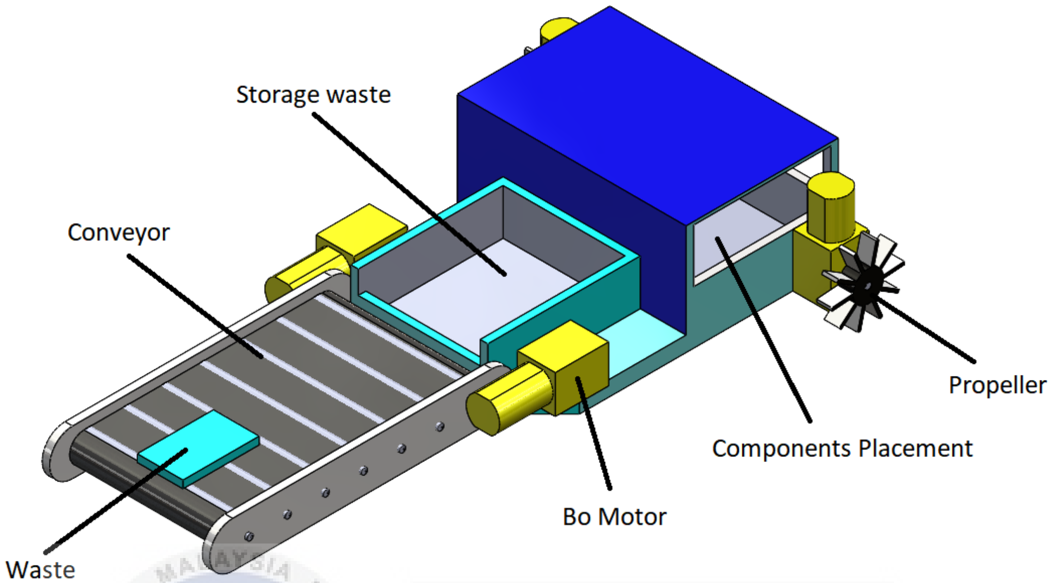

Figure 3.1 Project Overview

Based on Figure 3.1, The system described in Figure 3.1 of this project aims To tackle the problem. of river waste by employing a conveyor-based collection mechanism. Starting from the conveyor connected to a BO motor, the propeller is activated to drive the boat, enabling waste collection from the river. The boat's movement is controlled by an ESP32 microcontroller, which is linked to a Blynk application on the user's smartphone via a Wi-Fi module. This configuration enables users to monitor and control the boat's operations remotely, ensuring the effective collection of waste.

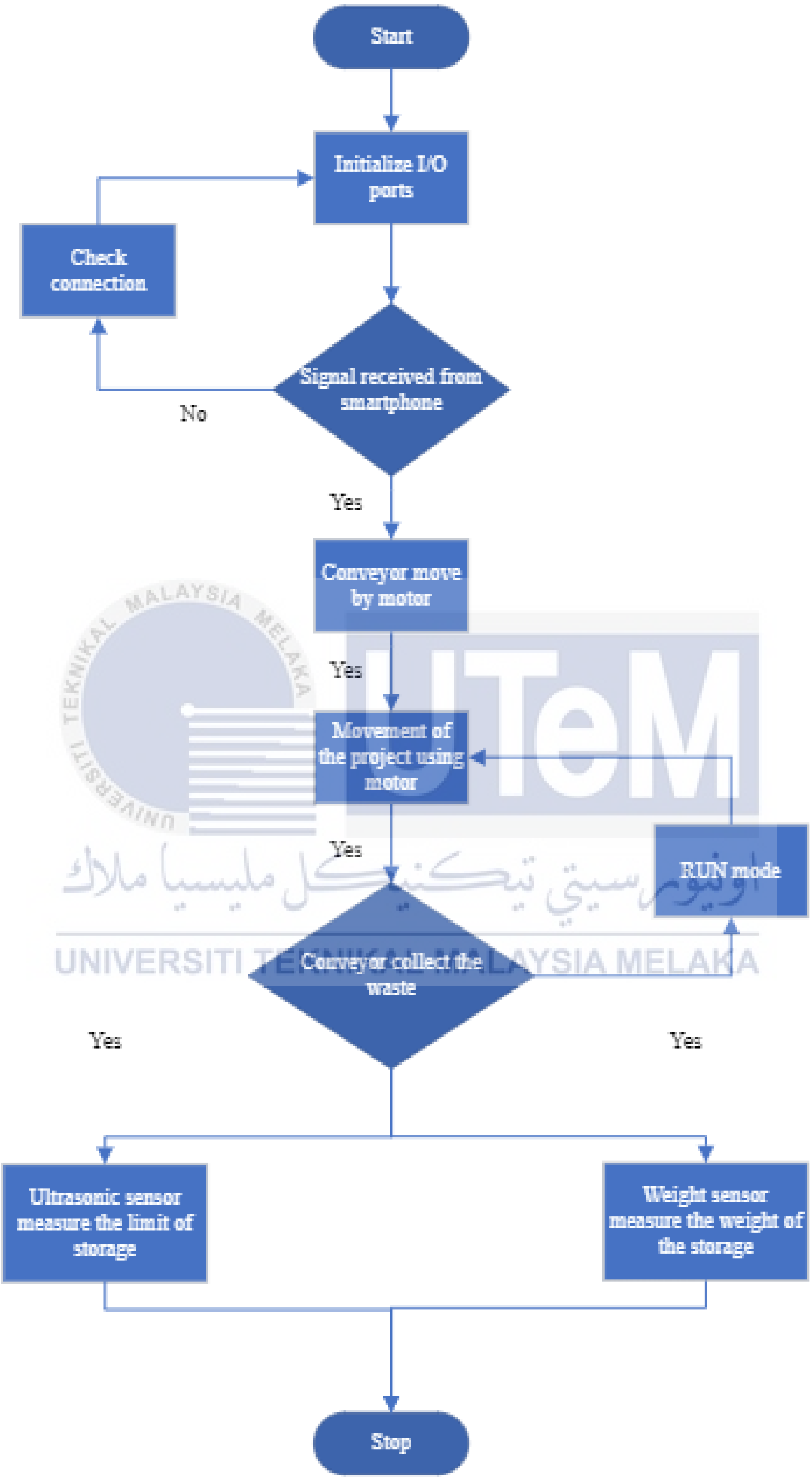

Figure 3.2 Overall Flowchart of The System

3.3 Experimental setup

In this section, the final year project report presents a comprehensive overview of the hardware and software components employed in the project. It includes a detailed explanation of the setup process, along with step-by-step instructions for establishing the connection between the microcontroller and the smartphone via the Wi-Fi system. Furthermore, it encompasses the necessary wiring connections that need to be made in order to facilitate seamless communication between the microcontroller and the smartphone.

3.4 Hardware and Software

In the final year project report, we distinguish hardware as the tangible and visible components of the system, including the microcontroller and BO motor, which are crucial for its operation. These physical devices serve as the building blocks of the system. Conversely, software consists of a set of instructions that enable the hardware to execute specific tasks or functions. It acts as a mediator between the user and the hardware, facilitating communication and control.

3.4.1 NODEMCU ESP32

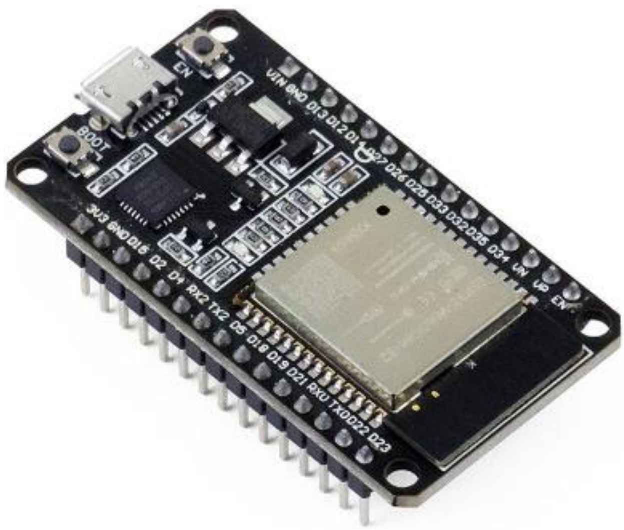

Figure 3.3 NODEMCU ESP32 Microcontroller

The ESP32 is a line of cost-effective, low-power system-on-a-chip microcontrollers featuring integrated Wi-Fi and dual-mode Bluetooth capabilities. Within the ESP32 series, there are variations with both dual-core and single-core configurations, each utilizing the Tensilica Xtensa LX6 microprocessor. These microcontrollers come equipped with built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules[6]. The Arduino Uno can be powered via a USB connection or by an external power supply. The Arduino Uno can receive power through either a USB connection or an external power source. It is a microcontroller board featuring the ATmega328P microcontroller chip. The board is centered around the ATmega328P and comprises 14 digital input/output pins, with 6 of them available for use as PWM outputs, along with 6 analog inputs. Other components include a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button[14] and among them, 6 have the capability to operate as PWM (Pulse Width Modulation) outputs. Additionally, it provides 6 analog inputs for reading analog signals. The board incorporates a 16 MHz ceramic resonator (CSTCE16M0V53-R0) to ensure accurate timing. Featuring a USB connection for programming and communication, a power jack for external power supply, an ICSP header for in-circuit programming, and a reset button to reset the microcontroller, the Arduino Uno board is well-equipped. All essential components to support the microcontroller are included, facilitating easy connection to a computer through a USB cable or powering it with an AC-to-DC adapter or battery. The ATmega328 is the controller employed on the Arduino Uno platform. This controller receives input from the smartphone and sensors, directing the boat and robotic arm to perform tasks as needed.[16]. This simplifies the process of getting started with programming and experimenting with the board.

The Arduino Uno R3 and Arduino Mega 2560 are two popular microcontroller boards with some key differences. The Uno R3 is based on the ATmega328P microcontroller, while the Mega 2560 uses the ATmega2560. The Mega 2560 offers more digital and analog pins, larger memory capacity, and a larger physical size compared to the Uno R3. Both boards operate at the same clock speed of 16 MHz. The choice between the two depends on project requirements, with the Uno R3 being more compact and cost-effective for smaller projects, while the Mega 2560 provides more I/O pins and memory for larger-scale applications. This project is implemented using Arduino and atmega microcontroller which was programmed using Arduino IDE[9].

Table 3.1 Comparison between Arduino Mega 2560, Uno and ESP32

Feature	Arduino Uno	Arduino Mega 2560	ESP32
Microcontroller	ATmega328P	ATmega2560	ESP32
Operating Voltage	5V	5V	3.3V
Digital I/O Pins	14 (of which 6 provide PWM)	54 (of which 15 provide PWM)	38
Analog Input Pins	6	16	18
Flash Memory	32 KB (0.5 KB used by bootloader)	256 KB (8 KB used by bootloader)	4MB
SRAM	2 KB	8 KB	520KB
EEPROM	1 KB	4 KB	Can emulate using flash memory
Clock Speed	16 MHz	16 MHz	240MHz
USB Interface	USB Type-B	USB Type-B	Micro USB
Power Jack	Barrel Jack	Barrel Jack	-
Size	68.6 mm x 53.4 mm	101.6 mm x 53.4 mm	25.5mmx18mm

3.4.2 2 Channel 5V Relay Module

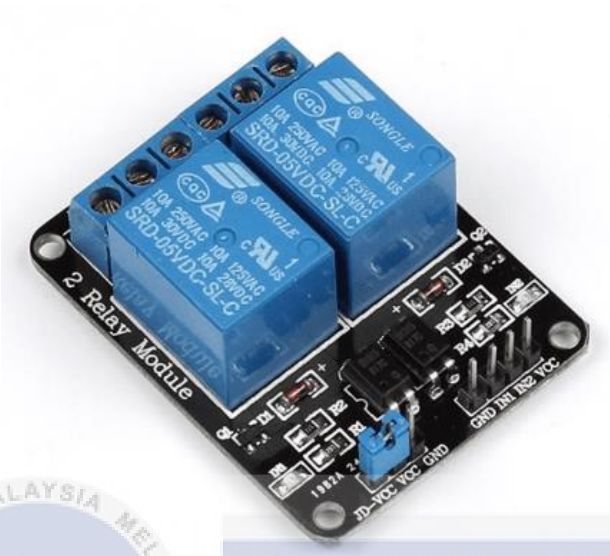

Figure 3.4 2 Channel 5V Relay Module

This module provides the protection to the microcontroller from the higher load current[14]. Operating as an electrical switch, a relay module is triggered by a low-power signal from a microcontroller, initiating the activation of an electromagnet.. This electromagnet, upon activation, mechanically shifts the relay's contacts to either open or close an electrical circuit. The low-power signal from the microcontroller guarantees a secure and regulated interaction, providing electrical isolation between the microcontroller's circuit and the high-power circuit under the relay's control.. With both normally open (NO) and normally closed (NC) contact configurations, relay modules find applications in diverse fields, from home and industrial automation to safety-critical systems, enabling the control of high-power circuits beyond the direct handling capabilities of microcontrollers[17].

3.4.3 Bo(Battery Operated) Motor

Figure 3.5 BO Motor

The project utilizes a BO Series 1, 100 RPM DC Motor with a plastic gear mechanism. This BO motor is employed to govern the boat's movements, operating on battery power. As a DC motor, the BO Motor transforms electrical energy into mechanical energy[18]. The rotation of the BO Motor facilitates the boat's movement in various directions, controllable through the Dabble mobile application. Renowned for its effective torque and low rpm at minimal power consumption, the BO Motor stands out. Its unique design, featuring a small loft with mismatching blades, is well-suited for the project's application. The motor's mounting holes and low mass make it suitable for on-circuit usage. The BO Motor can be paired with a 37mm radius wheel for synthetic motors or a 45mm radius single-purpose ring for synthetic blade rings. Additionally, it can be adapted for use as a metal blade DC ring. Operating within a power range of 5-15V, it is particularly advantageous for constructing substantial robot arms, available in 35 and 70 RPM variations[4].

3.4.4 Dual H-Bridge Motor Driver L298N

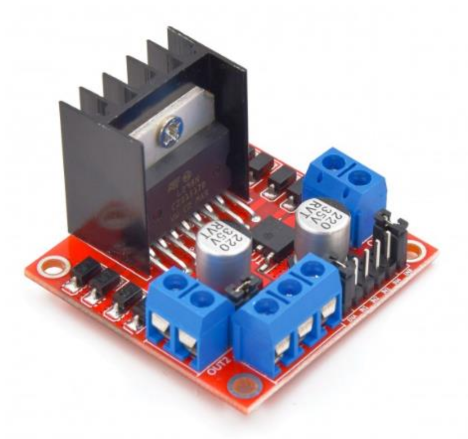

Figure 3.6 Dual H-Bridge Motor Driver L298N

The L298N, available in 15-lead Multiwatt and PowerSO20 packages, is a single chip designed to manage high voltage and current, making it well-suited for driving inductive loads such as relays, solenoids, DC motors, and stepper motors. As a versatile dual full-bridge driver, the L298N can accept standard TTL logic levels. In the project, the PWM signal from the Arduino is directed to the input pins of the L298N motor driver IC. The output pins of the driver connect to the ends of the motors, enabling simultaneous monitoring of the motion of the two motors[4]. Acting as an H-bridge bipolar motor driver, the L298N Module can control the direction and speed of the motors. It is proficient in driving two DC motors with voltages ranging from 5 to 35V, handling a peak current of up to 2A[20].

3.4.5 HX711 Weighing Sensor 24-bit A/D Conversion Adapter Load Module

Figure 3.7 HX711 Weighing Sensor 24-bit A/D Conversion Adapter Load Module

The Arduino Weight Sensor, an electronic device, is engineered for detecting a weight of 1kg and operates on the HX711, which is a precision 24-bit analog-to-digital converter. created for interfacing with bridge sensors in weight scale and industrial control applications. The HX711 ensures accurate and reliable measurements, making the Arduino Weight Sensor suitable for a range of applications where precise weight detection is required.

3.4.6 Ultrasonic Sensor (HC-SR04)

Figure 3.8 Ultrasonic Sensor

An ultrasonic sensor is an electronic device designed to measure the distance of a target object by emitting ultrasonic sound waves and converting the reflected sound into an electrical signal[15]. Employing high-frequency sound waves beyond the range of human hearing, the ultrasonic sensor can detect objects and measure distances. It achieves this by emitting sound pulses and then detecting the echoes reflected from nearby objects to determine the distance to the object.

3.4.7 Arduino IDE Software

Figure 3.9 Arduino IDE Software

The Arduino Software (IDE) serves as a comprehensive development environment encompassing a code-writing text editor, a message area, a text console, and a toolbar featuring frequently used function buttons, along with various menus. This environment facilitates the seamless connection and communication with Arduino hardware for program uploading. Within the IDE, sketches, representing the programs crafted using the Arduino Software, can be generated and edited in the text editor, then saved with the .ino file extension. The editor provides practical features such as cut/paste and search/replace functionalities. The message area offers feedback during saving and exporting operations, as well as displaying errors. The console provides textual output from the Arduino Software, including detailed error messages and other pertinent information. The configured board and serial port are displayed in the bottom right corner of the window, while the toolbar buttons allow for verification and uploading of programs, sketch creation, opening and saving, and access to the serial monitor.

3.4.8 Blynk

Figure 3.10 Blynk Application

The Blynk application is a mobile app that provides a robust platform for developing Internet of Things (IoT) projects. It allows users to easily create and control a wide range of IoT applications using a smartphone or tablet. With Blynk, users can build custom interfaces by dragging and dropping widgets, such as buttons, sliders, and graphs, onto a virtual canvas. These widgets can then be linked to various hardware components and sensors, allowing for real-time monitoring and control. The Blynk app is a versatile tool suitable for both beginners and experienced developers in the IoT space, offering features like cloud connectivity, data logging, and integration with popular IoT platforms.

3.4.9 Wiring Connection

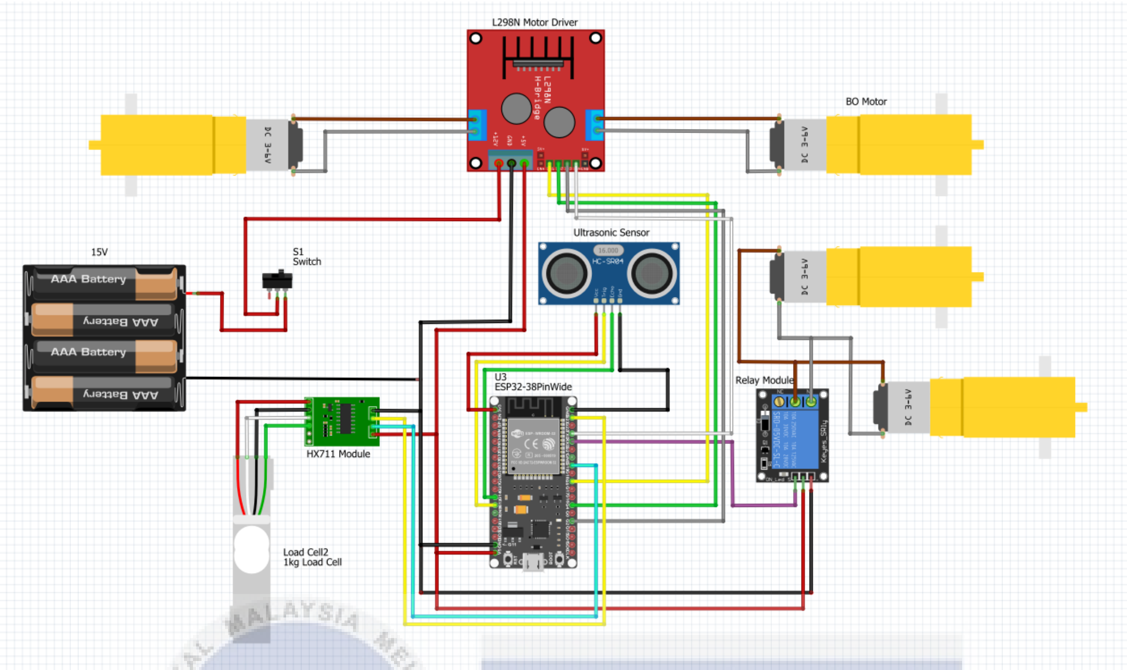

Figure 3.11 Wiring Connection of Project

The wiring shown in **Figure 3.11** connects all of the sensor, motor and the Wi-Fi module to the ESP32. The sensor is being connected to ESP32 board through red, black, yellow and green wires. The red wire is attached to the 5V pin on the ESP32 to supply power to the sensor. The green and yellow wires is connected to the digital input to allow sensor to send digital readings to the microcontroller. The black wire is linked to ground pin on the ESP32 to establish a common ground reference between the sensor and microcontroller. Besides that, the BO motor connected to the ESP32 through the motor driver and relay module. 2 motor connected to motor driver to run the conveyor of the project and 2 motor to run the project to move on the surface river. Yellow, green, gray and white colour wire connect pins 5, 4, 2 and 1 to motor driver, red colour wire from the 9V battery connected to motor driver and black colour wire connected to ESP32 board ground. Red colour wire from 5V ESP32, black wire from ground ESP32 and purple wire from pin 3 connected to relay module to run 2 motor to move the conveyor to collect waste.

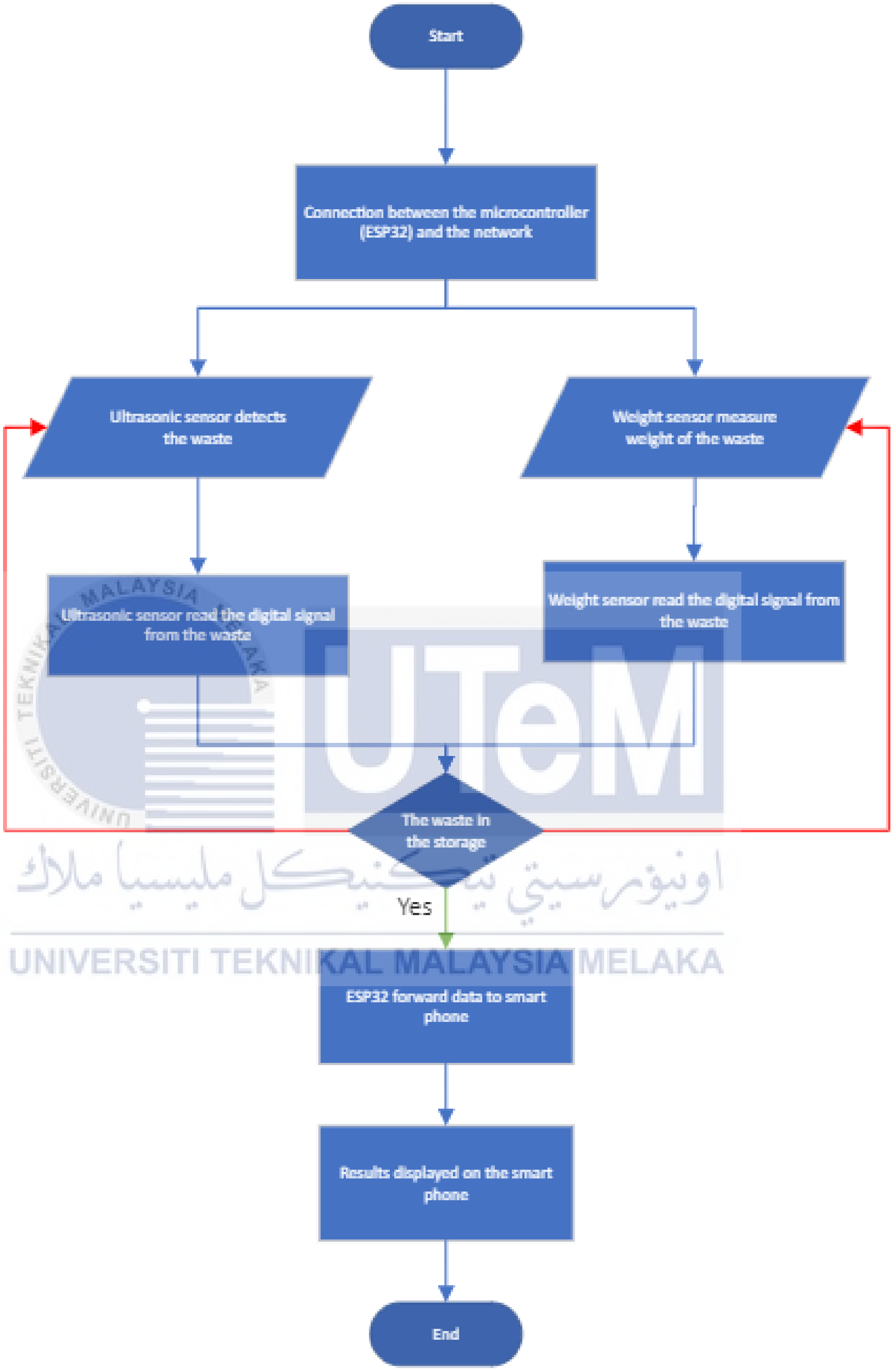

Figure 3.12 Flowchart of Microcontroller

3.4.10 Architecture of Proposed Methodology

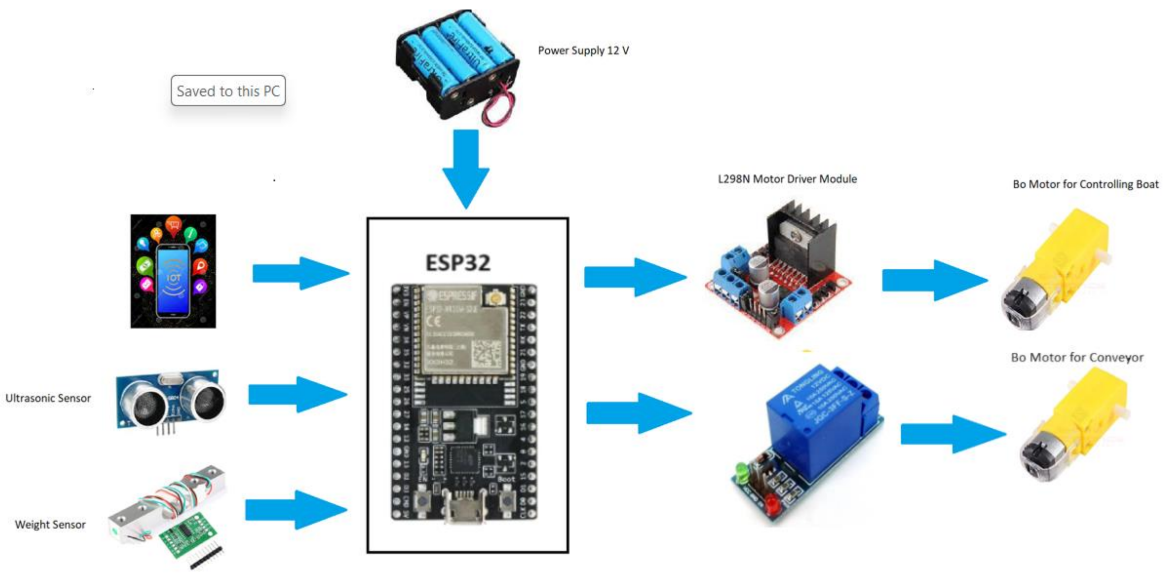

Figure 3.13 Architecture of Proposed Methodology

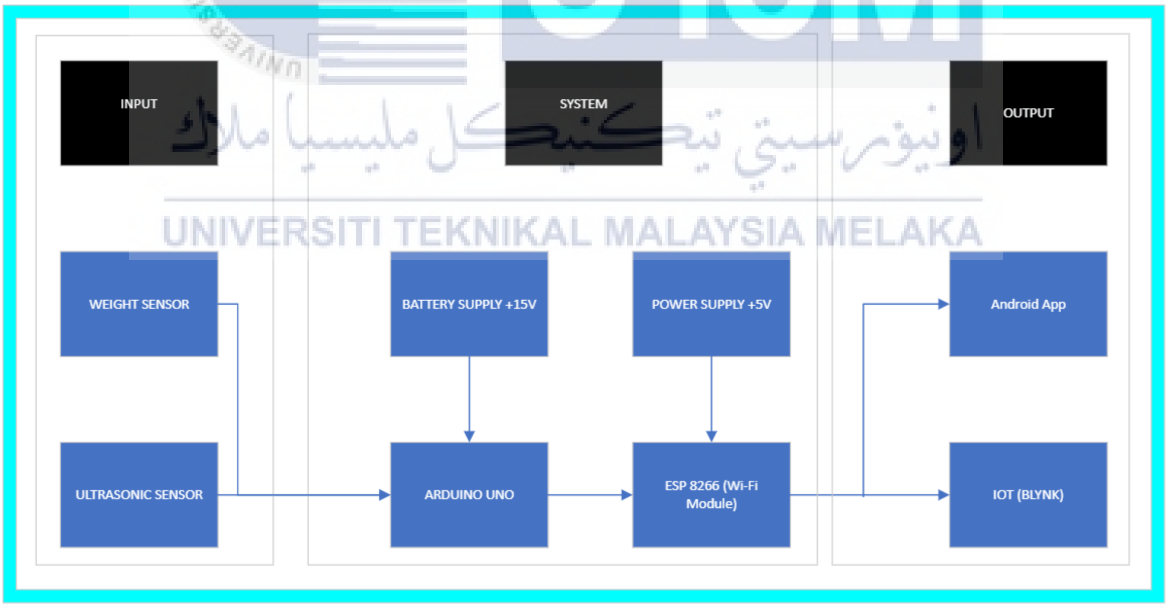

Figure 3.14 Block Diagram Input, System and Output

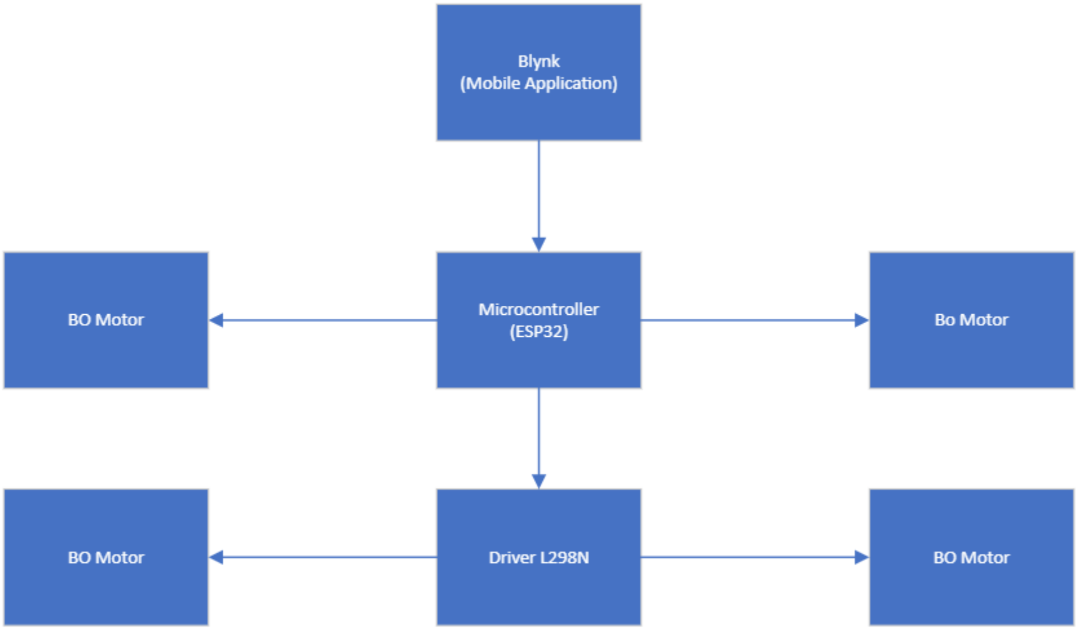

Figure 3.15 Block Diagram of Motor Operation

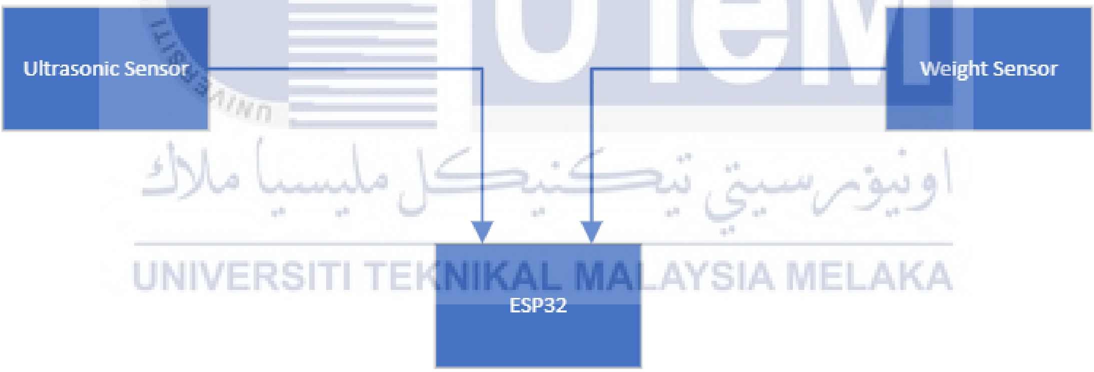

Figure 3.16 Block Diagram of Sensor Output

3.5 Limitations of proposed Methodology

Limitations refer to issues or events that arise during a study, which are beyond the researcher's control. They constrain the scope of a study and, in certain instances, may influence the overall outcome and the conclusions that can be drawn. Every study, regardless of how meticulously conducted or constructed, has inherent limitations.. In this study, one of the limitations is the budget allocated for the study is RM200. The total price of components used on the proposed system is RM 150. If more cost of expenditure is given, the motor and the battery can be upgraded and image processing camera can be added sense the waste more accurately in the river. Additionally, the accuracy and reliability of the sensor readings and data collected by the ESP32 may also pose limitations. Furthermore, the scalability and adaptability of the system to different river environments and conditions could be a limitation. The system's performance and effectiveness may vary based on factors such as river size, water flow, and the type and distribution of waste.

3.6 Preliminary result

3.6.1 Operation of Motor Conveyor

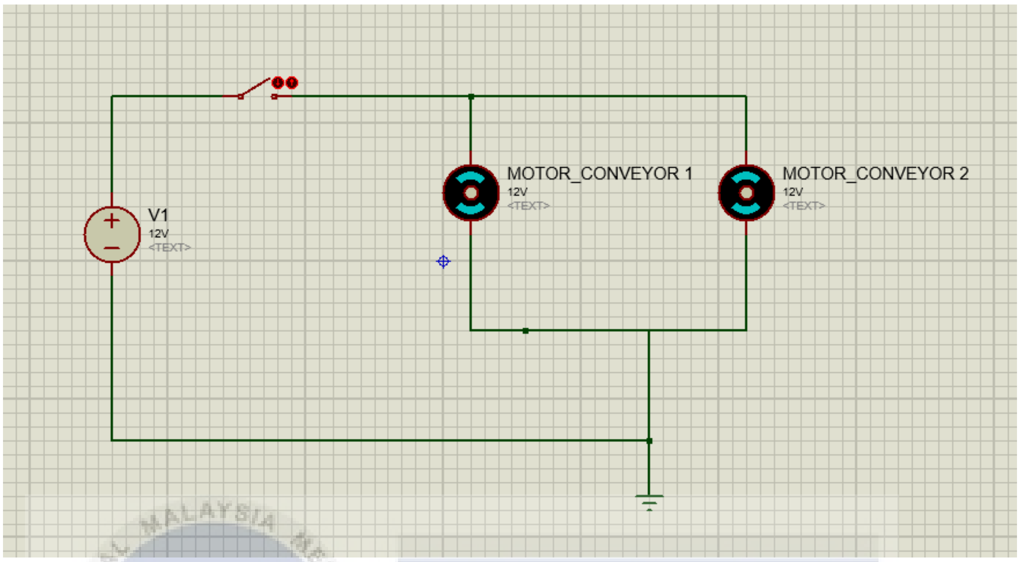

Figure 3.16 Operation of Motor Conveyor

3.6.2 Operation of Motor Direction

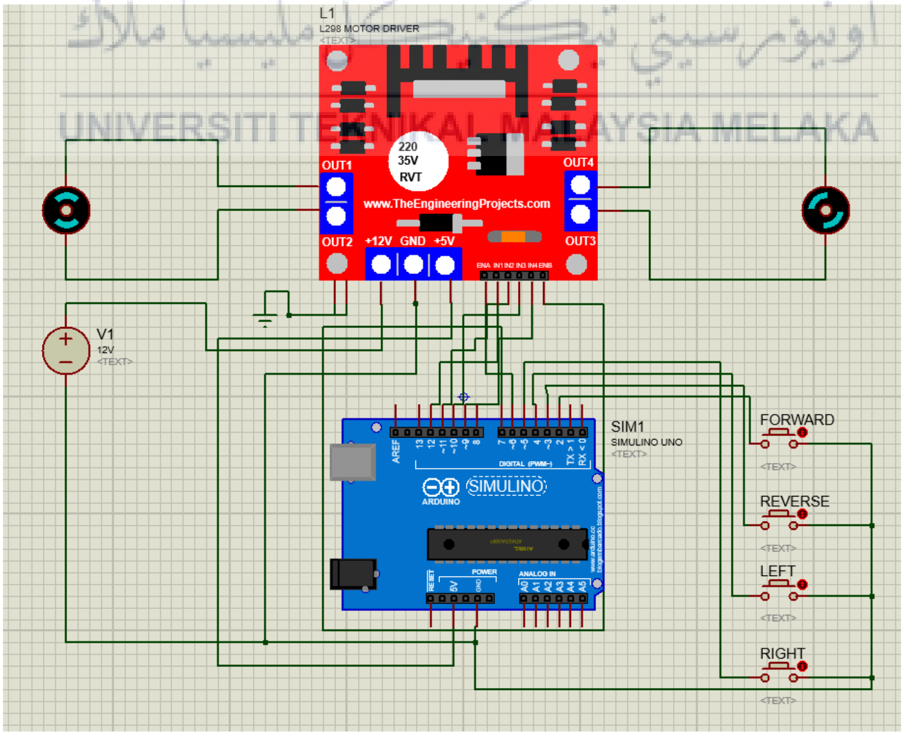

Figure 3.17 Operation of Motor Direction

3.6.3 Ultrasonic Sensor to Detect Waste Storage

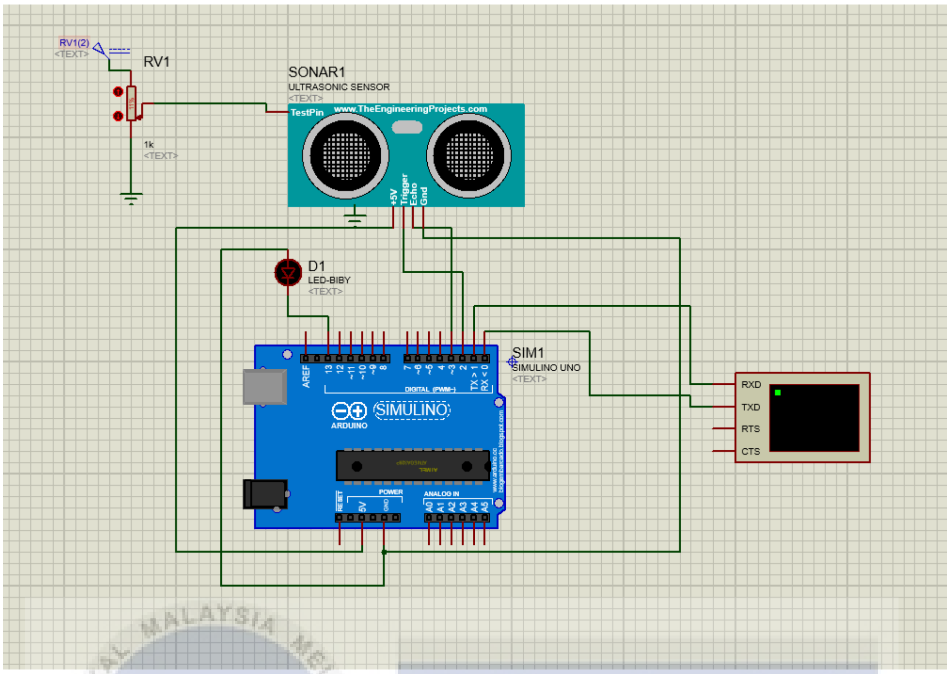

Figure 3.18 Ultrasonic to Detect Waste Storage

3.7 Summary

The methodology is devised to accomplish the objectives of this project, aiming to develop an IoT-based smart river cleaning system for the retrieval of waste from the river surface. The proposed approach involves employing the ESP32 as a microcontroller to manage the entire network of the project. The Arduino microcontroller is chosen for its capability to operate various devices, including a Wi-Fi module and sensors. The project incorporates ultrasonic and weight sensors. This chapter details the working principle of the project through a flowchart, outlines the hardware and software setup, and discusses the limitations of the methodology.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings and analyses from the development of an IoT-based smart river cleaning system by using microcontroller for collect waste on the surface of water. The case studies are performed to demonstrate the applicability of the system to identify the waste that can be collected. The case study is based on bore waters obtained from 5ft x 10in swimming pool and Tasek Ayer Keroh. It is important to note that the purpose of these case studies is to demonstrate the proposed methodology regardless of locations of data identify saiz of the waste can be obtained. The storage limitation values are obtained by using the smartphone Blynk app. To collect data on the different of battery, record can move and collect how many waste in 5 minit in a swimming pool.

4.2 Prototype

The project prototype required a number of phases to be completed. The prototype is made up of a PLC board, mineral bottle, wheel, conveyor belt, 15V battery, an ESP32, a ultrasonic sensor, weight sensor, a relay module, a push button switch, 4 BO motor and a DC connection before we get to the procedures. The system was powered by Direct Current (DC) from a 15V battery source. Before turning on the power supply, each connection between the components must be made securely. The prototype's case was designed to conceal the wires as well as other components once the results were accurate and dependable. A boat that can float on the water to collect the waste on the surface on the water was created to demonstrate how the project prototype would be utilized in the water.

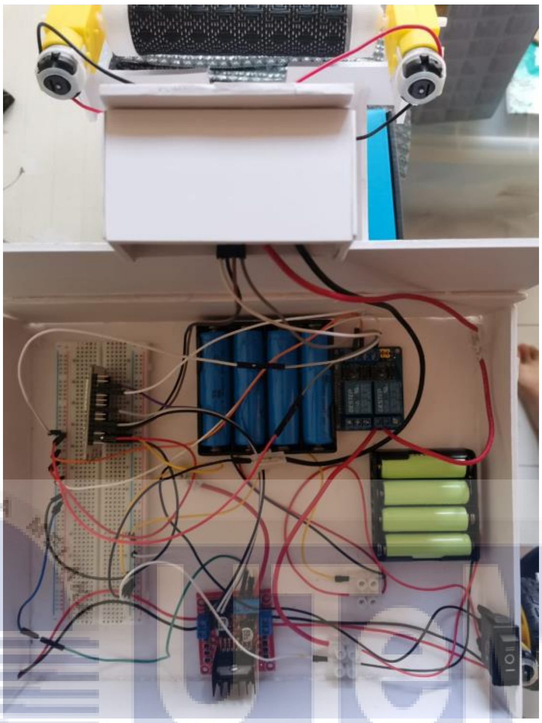

Figure 4:1 Inside view of Project prototype

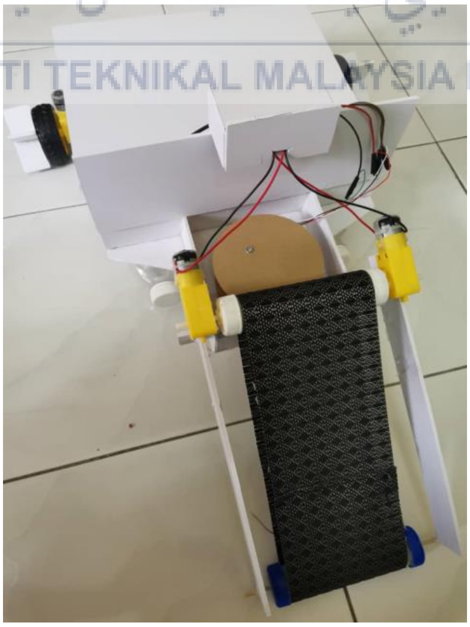

Figure 4:2 Project prototype with PVC board and bottle

4.3 Results

The results were obtained through ultrasonic sensing to gauge the storage waste level, collect waste in the pool area, and identify the types of waste that can be gathered, all based on available information. In addition, a weight sensor was incorporated to measure the weight of the storage. The initial storage waste data was collected using the Blynk app on a smartphone, focusing on a 5ft x 10inch swimming pool. Additionally, the second set of results pertained to the timing of waste collection operations in the pool area, determined by specific operational considerations. Subsequently, data on the types of collectible waste were gathered from the 5ft x 10-inch swimming pool. Result of data storage waste.

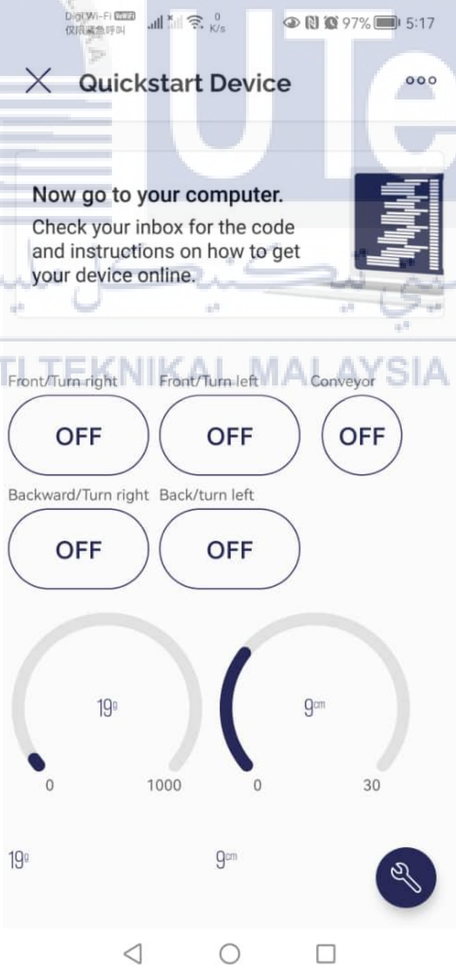

Figure 4:3 The data represent the range between the ultrasonic sensor with the waste in the storage

The data show that now the range between the ultrasonic sensor and the waste in the storage was 11 mm so the storage was not full yet.

Figure 4:4 Distance ultrasonic sensor with the waste in the storage

Figure 4:5 The Blynk notification show that the storage is almost full

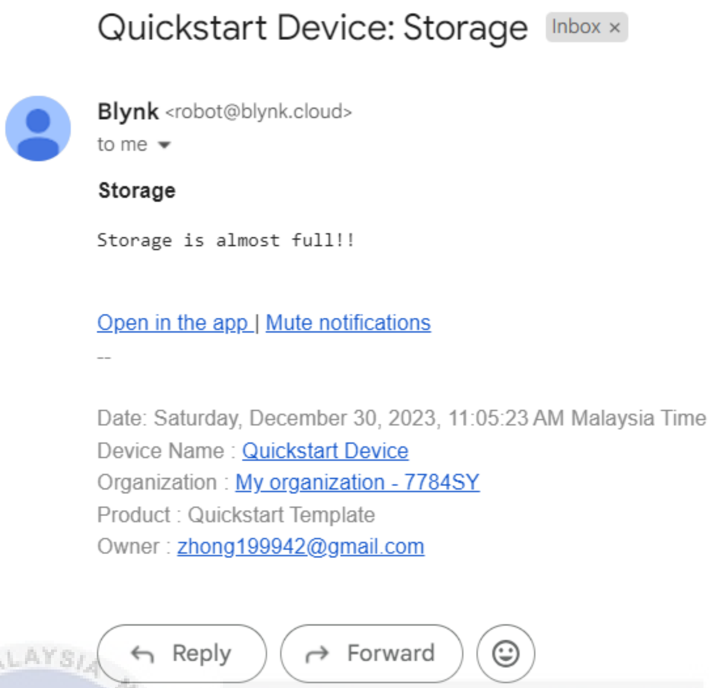

Figure 4:6 The email notification show that the storage is almost full

The Blynk app is programmed to send a notification, both through the app and via email, when the distance between the ultrasonic sensor and the waste in the 5ft x 10 inch swimming pool is less than 6mm. This alert serves to inform the user that the waste storage is nearing full capacity.

Figure 4:7 Waste in the 5ft x 10in swimming pool

The swimming pool size was 10ft x 10in, and it contained 12 units of waste. The waste collection process was carried out using three different voltage supplies—5V, 9V, and 15V. The results detailing the time taken to collect the waste in the swimming pool are as follows:

Table 4:1 Type of the Waste

No	Type of waste	Description
1	Small twigs and dry leaves	Can be collected
2	Plastic foods and plastic begs	Can be collected
3	PVC waste	Can be collected
4	Plastic bottle	Cant be collected
5	Big twigs and big food scraps	Cant be collected
6	Oil, chemical and fuel	Cant be collected

In Table 4.2, the categorization of waste as either collectible or non-collectible provides a comprehensive overview of the waste landscape under consideration. The identification of collectible waste, ranging from small twigs and dry leaves to plastic foods and PVC waste, offers a nuanced understanding of materials suitable for collection. On the contrary, the enumeration of non-collectible waste, including plastic bottles, big twigs, big food scraps, as well as oil, chemical, and fuel, outlines materials that present challenges for collection.

This analytical breakdown aids in formulating targeted waste management approaches, promoting efficient cleanup strategies while recognizing the limitations associated with specific waste types.

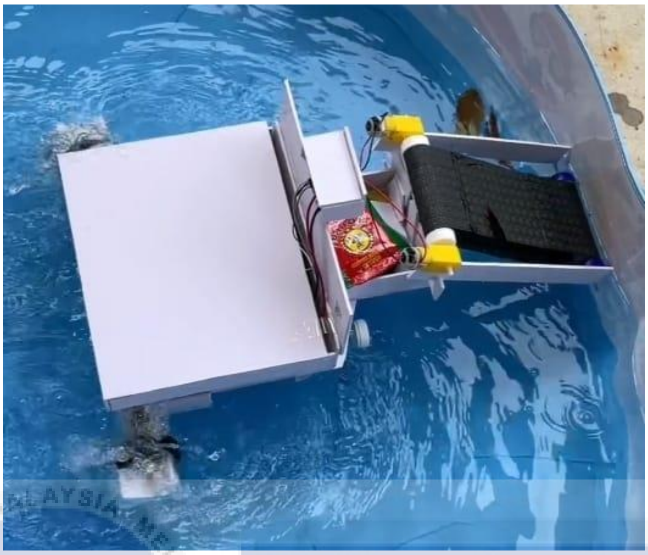

Figure 4:8 Collect small twigs and dry leaves

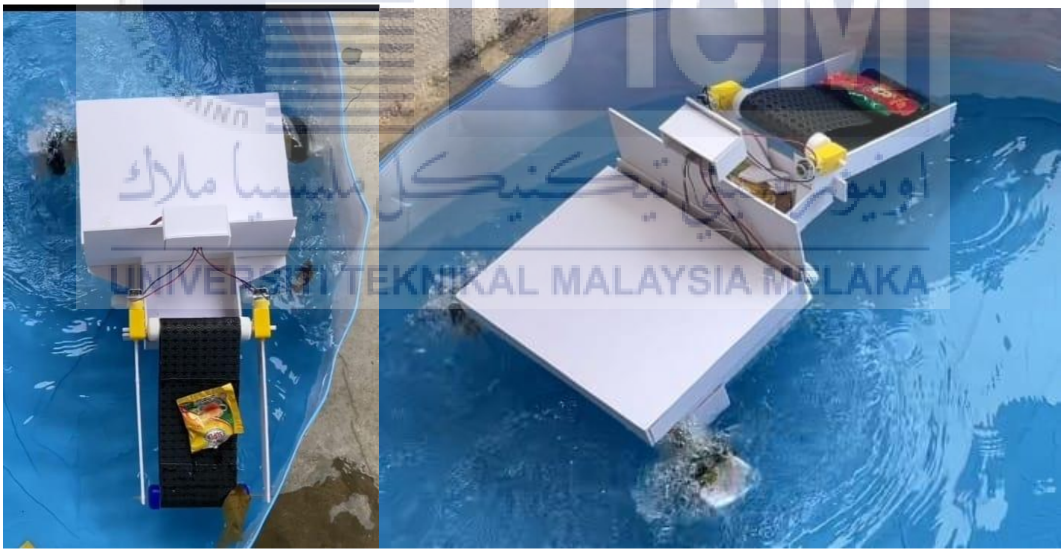

Figure 4:9 Collect plastic beg and plastic food

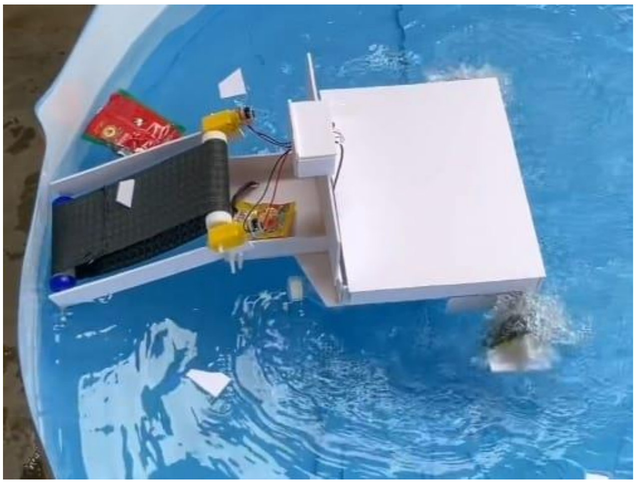

Figure 4:10 Collect small PVC waste

Figure 4:11 Collect PVC waste in the corner of the river

Figure 4:12 Collect plastic waste at the river corner

Figure 4:13 Collect dry leaves at the river corner

4.3.1 Result of data weight storage

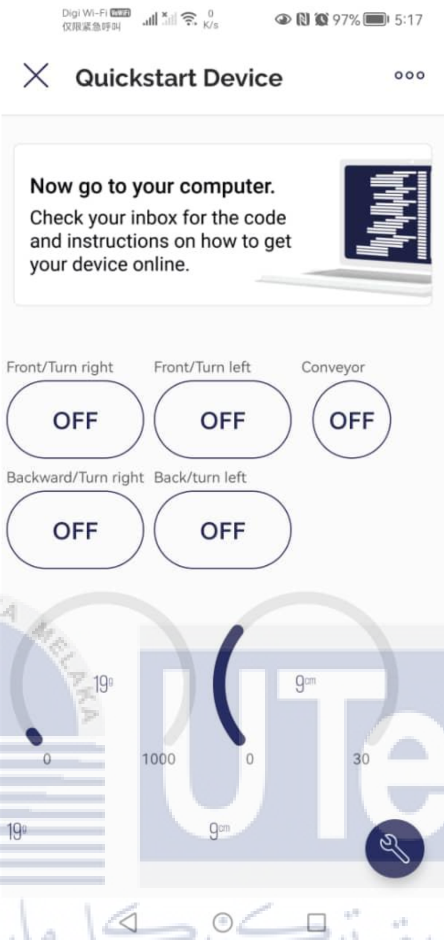

Figure 4:14 The data represent the weight measurement in the storage waste

Figure 4:15 The material used for measurement

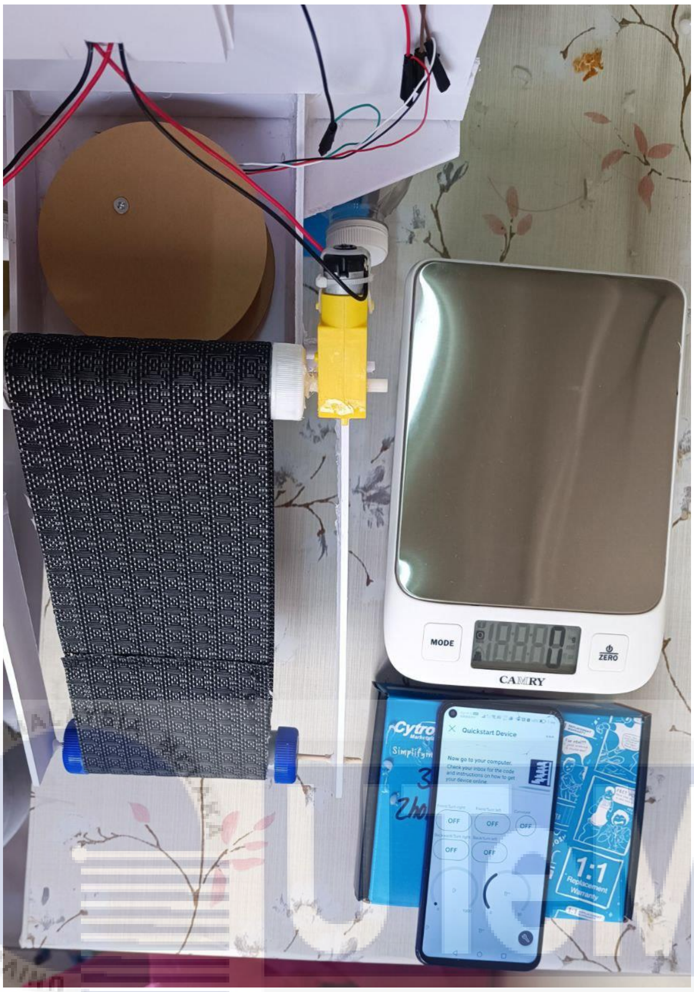

Figure 4:16 The electronic scale and blynk app connect to weight sensor to collect the measurement data

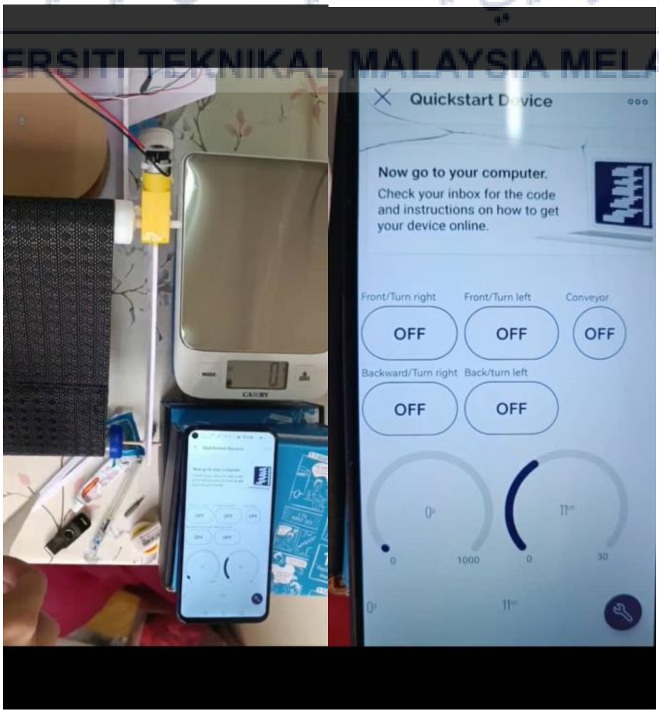

Figure 4:17 When no waste on weight sensor, the measurement read 0 gram

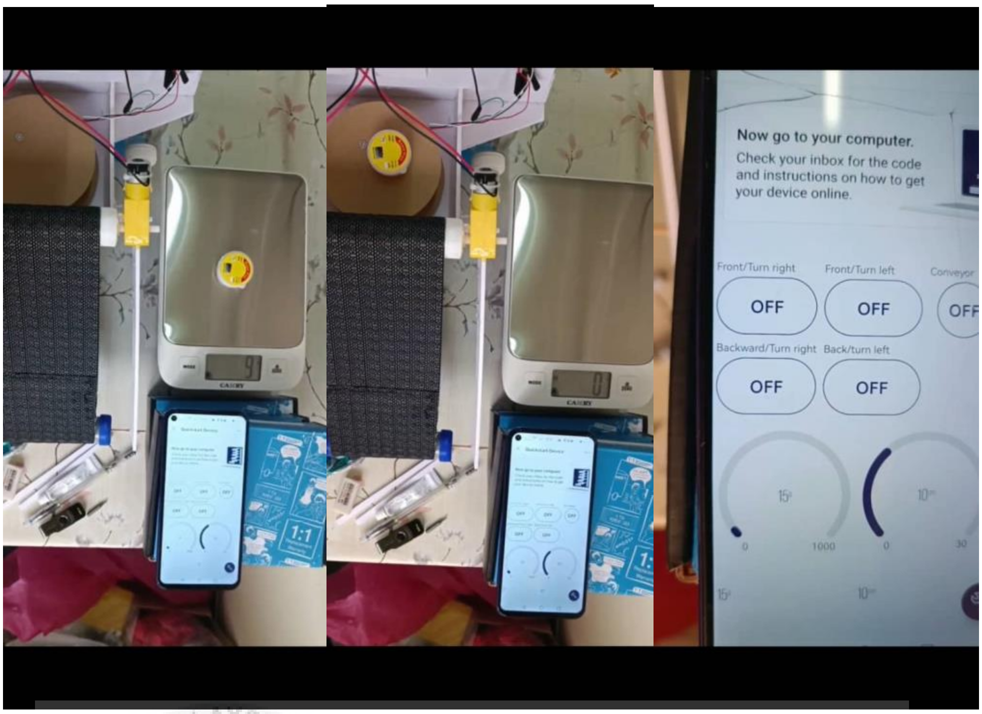

Figure 4:18 The measurement for small plastic box on the electronic scale was 9 grams, while the weight sensor registered 15 grams

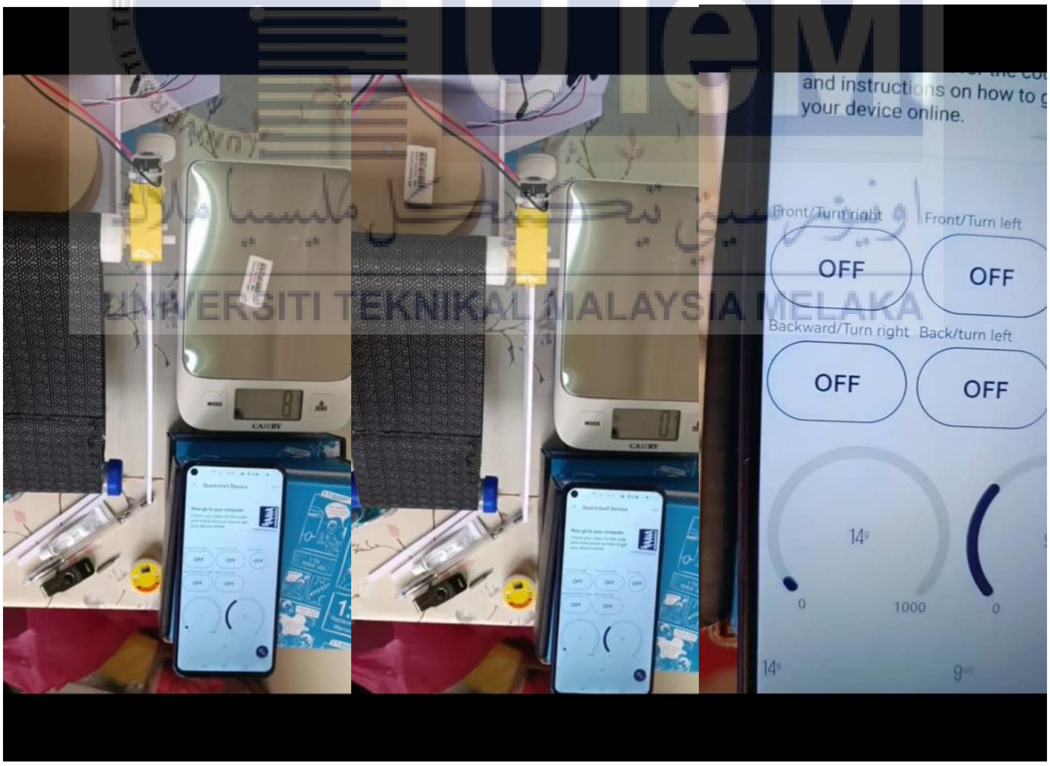

Figure 4:19 The measurement eraser on the electronic scale was 8 grams, while the weight sensor registered 14 grams

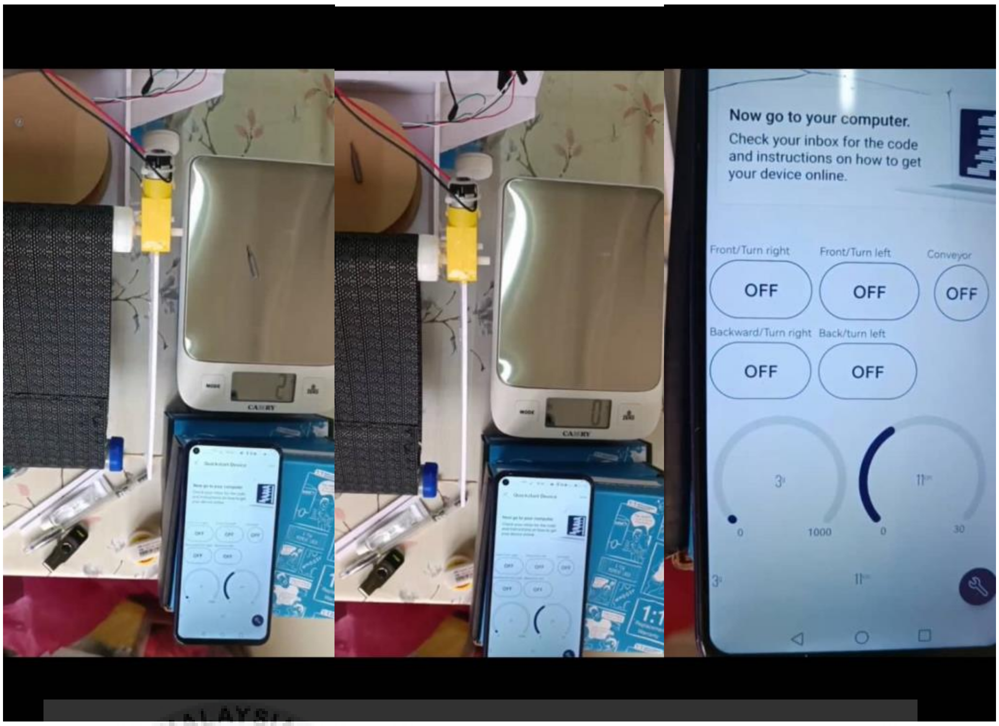

Figure 4:20 The measurement for small aluminium on the electronic scale was 2 grams, while the weight sensor registered 3 grams

Figure 4:21 The measurement for PVC waste on the electronic scale was 3 grams, while the weight sensor registered 7 grams

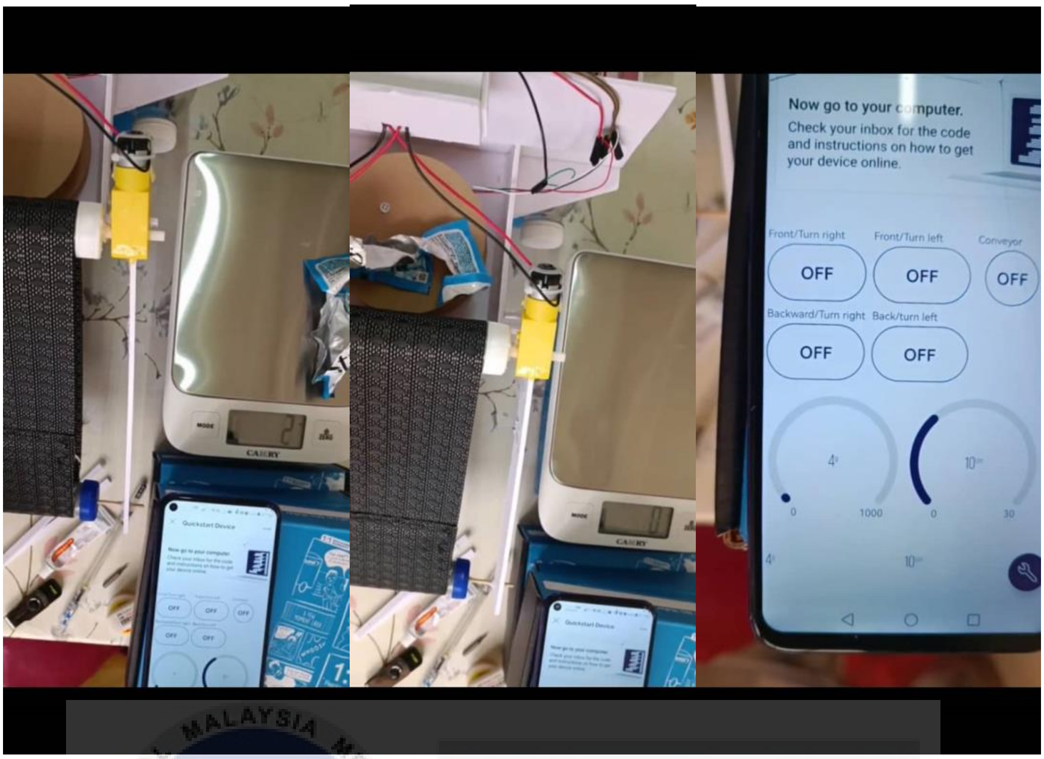

Figure 4:22 The measurement for aluminium plastic on the electronic scale was 2 grams, while the weight sensor registered 6 grams

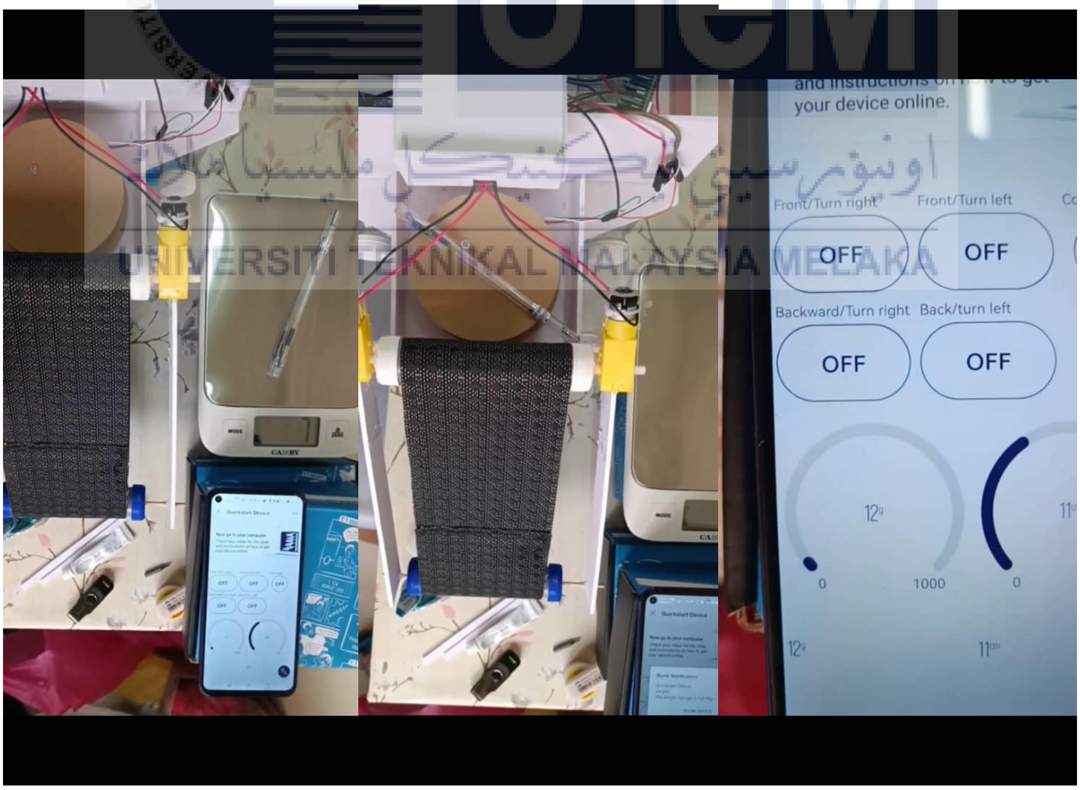

Figure 4:23 The measurement for plastic pen on the electronic scale was 7 grams, while the weight sensor registered 12 grams

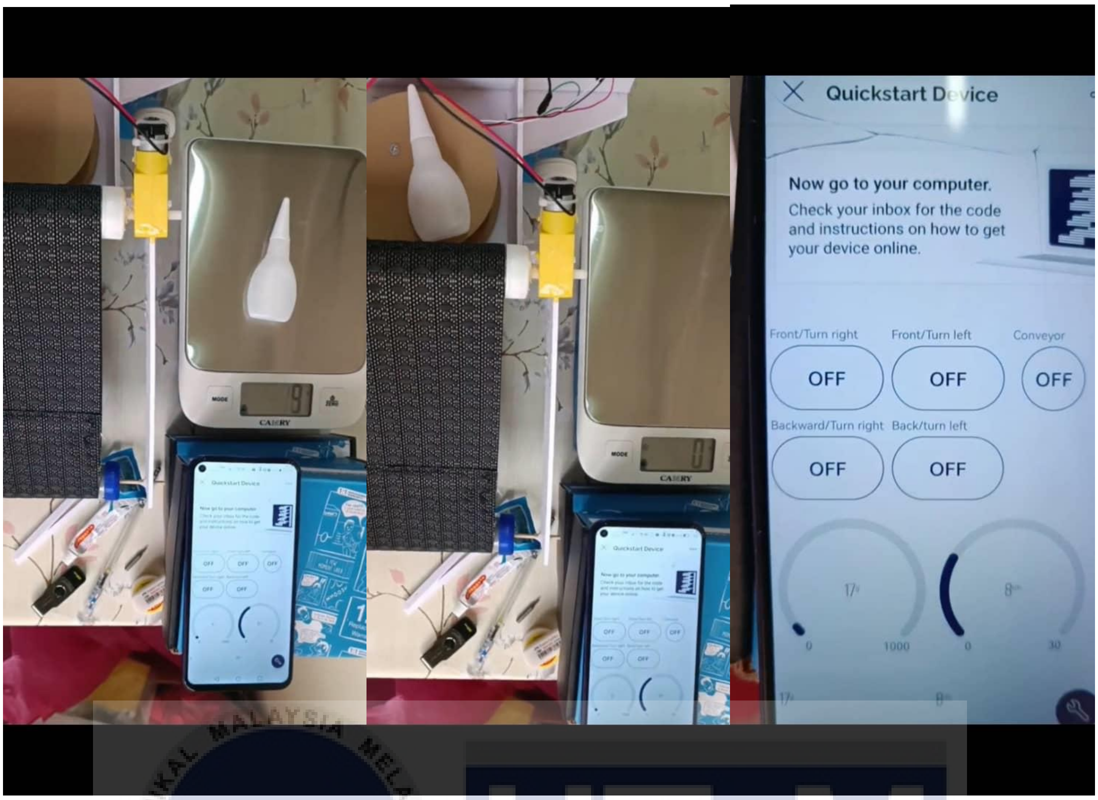

Figure 4:24 The measurement for 3 second gun on the electronic scale was 9 grams, while the weight sensor registered 17 grams

The figures from 4:11 to 4:21 provide a visual representation of the weight measurements and materials used in the study. Figure 4:13 illustrates the setup, showing the electronic scale and Blynk app connecting to the weight sensor for measurement data collection. Notably, Figure 4:14 demonstrates that when the weight sensor has no waste, the measurement reads 0 grams, indicating a baseline measurement. The subsequent figures (4:15 to 4:21) present detailed comparisons between measurements obtained from the electronic scale and the weight sensor for various materials such as a small plastic box, eraser, small aluminum, PVC waste, aluminum plastic, plastic pen, and a 3-second gum pack. These side-by-side measurements highlight variations between the two measurement methods and provide insights into the precision and consistency of the collected data, offering valuable information for the study's evaluation and interpretation.

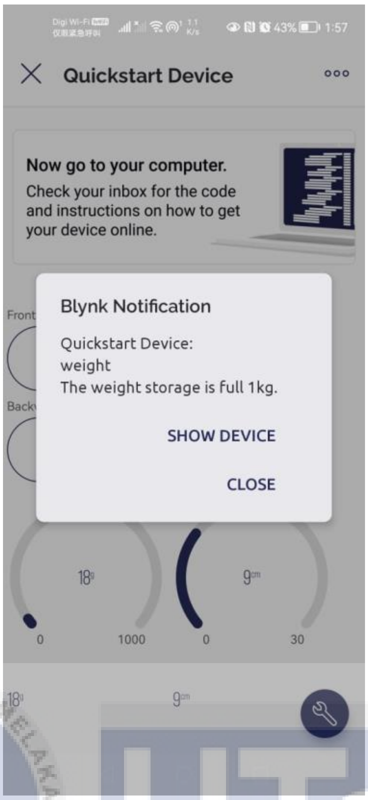

Figure 4:25 The Blynk notification show that the weight storage is full 1kg

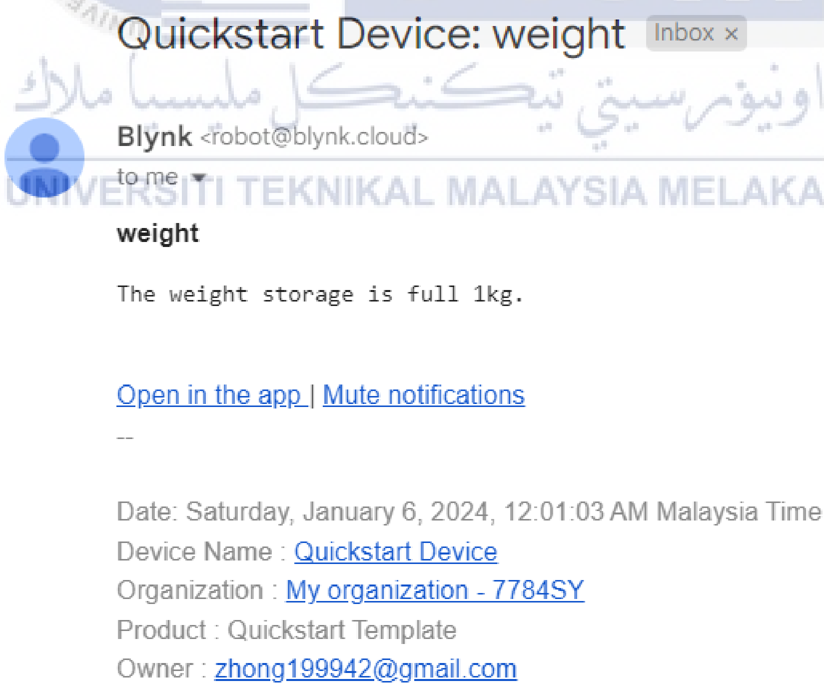

Figure 4:26 The Blynk send gmail notification to smartphone

The programming of the Blynk app includes a feature that triggers notifications, sent both within the app and via email, when the weight storage value hits a full 1kg. This notification system is implemented to effectively inform users when the waste storage has reached its maximum capacity.

4.4 Analysis

4.4.1 The type of waste that can be collected.

Table 4:2 Time waste collect in swimming pool and river area

	Operation in pool area (10ft x 10in)			Operation in river area		
Trial	1	2	3	1	2	3
Battery voltage before operation(V)	4.98V	8.94V	15.13V	4.98V	8.94V	15.13V
Battery voltage after operated(V)	4.97V	8.91V	14.97V	4.97V	8.91V	14.97V
Time taken to complete waste collection (s)	Cant move	>= 5 min	2 min	Cant move	Hard to move if river flow fast	Can move but depend to river flow

4.4.2 The weight of the waste

Table 4:1 The comparison of weight measurement by sensor and weight scale

Type of the waste	Measure by electronic scale (gram)	Measure by 1kg load cell weight sensor (gram)
Small plastic box	9	15
Eraser	8	14
Aluminium	2	3
Pen	7	12
Orrepaste pack	4	7
PVC waste	3	6
Aluminium plastic	2	4
3 second gum pack	9	17

The results from Table 4:3 detailing the measured weights of different types of waste using both an electronic scale and a 1kg load cell weight sensor highlight variations in the recorded values. The results show that the weight sensor didn't give accurate measurements. For different types of waste, the sensor consistently showed higher weights compared to the electronic scale. This suggests a problem with the sensor's accuracy. To improve the reliability of future experiments or applications involving waste weight measurements, it's important to carefully calibrate and evaluate the weight sensor. This way, we can ensure more precise and trustworthy data for better decision-making. For instance, small plastic boxes, erasers, pens, correction paste packs, PVC waste, small plastic packs, and 3-second gum packs consistently registered lower weights on the electronic scale.

4.4.3 The level of storage waste

Table 4:4 The comparison of distance measurement by ultrasonic sensor

Type of the waste	Distance between ultrasonic sensor dan waste (cm) (Original 12 cm)
Small plastic box	8
Eraser	11
Aluminium	11
Pen	11
Orrepaste pack	10
PVC waste	11
Aluminium plastic	10
3 second gum pack	11
Plastic bubble wrap	7

The ultrasonic sensor was employed to measure the distances between the sensor and various types of waste in this project. The original distance set for comparison was 12 cm. The obtained results revealed distinct measurements for each type of waste, indicating the sensor's ability to detect variations in distance based on the composition and size of the objects. Notably, the small plastic box registered a measurement of 8 cm, while the eraser, aluminium, pen, Orepaste pack, and PVC waste exhibited similar readings of 11 cm. The Aluminium plastic and 3-second gum pack recorded measurements of 10 cm and 11 cm, respectively. The plastic bubble wrap, on the other hand, showed a measurement of 7 cm. These findings provide valuable insights into the sensor's performance in distinguishing between different types of waste materials based on their reflective properties, thus contributing to the development of efficient waste management systems.

4.5 Summary

A very helpful tool for collecting the waste on the surface of the water for customers around the world is the smart river cleaning system. The device can collect the waste in hard reaches area and ensure the safety of the cleaner. In addition, the devices can collect data of the waste storage. Users can detect the waste storage condition and make their own decision to move the device.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The IOT is utilized to present a wireless approach for the suggested smart river cleaning system to move on the water, collect the waste on the surface of the water and measure the level and the weight of the waste storage. The test of the devices conducted on the devices validate the reliability and practicality of the system for real-life application. Depending on the user's needs, the device can be control by using the smartphone. In its implementation, the system proves effective in reducing plastic waste and other pollutants in rivers. Simultaneously, it enhances safety for river cleaners and excels in collecting waste from challenging and inaccessible areas.

In conclusion, the proposed system succeeded in achieving all three objectives which are to developed an IoT-based smart river cleaning system that can effectively reduce plastic waste and other pollutants in the river, increase safety for river cleaners, and collect waste in hard-to-reach areas. This could be proven as the movement and data waste collected of the devices can be accessed by the user through a smartphone via an app called "Blynk". The next objective has also been accomplished because already create an IoT-based smart river cleaning system using ESP32 microcontrollers and sensors that can collect hazardous waste and increase the safety of river cleaners. Finally, the last objective is to analyse the accurary and consistency of the device in terms of result and feedback of the users. The proposed system can be used in daily life because the device cost just about RM180. In addition, the device is handy because users don't have to go down to the river to collect waste. This makes it a great choice for consumers who want to easily check the device's quality.

5.2 Project Commercialization

The project is poised for commercialization, leveraging an IoT-based smart river cleaning system designed to autonomously navigate water surfaces, collect waste, and measure waste storage levels. Rigorous testing has confirmed the system's reliability and practicality, making it suitable for real-world applications. With smartphone-controlled functionality through the "Blynk" app, users can seamlessly operate the device. The system not only effectively reduces plastic waste and pollutants in rivers but also enhances safety for river cleaners, excelling in waste collection from challenging areas. The successful accomplishment of key objectives, including system development, waste reduction, and improved safety, positions the project for commercial success. Moreover, its affordability (priced at approximately RM180) and user-friendly design make it a compelling choice for consumers seeking an efficient and convenient solution for waste management in rivers.

5.3 Future Works

For future works, the smart river cleaning system could be enhanced as follows:

i. Add the number of sensors, such as those that can measure the weight of size and the other factors that assist the measuring waste.

ii. Add the image processing system to detect the type of waste on the surface of the water so it can recognize the waste which one is collectable or non-collectable.

iii. Add the external antenna for ESP32 to increase the range to control the device.
iv. For increased precision in weight measurements, consider substituting the current weight sensor with a high-quality alternative to attain more accurate values.
v. To enhance the movement efficiency of the current design, it is essential to take into account the speed of the water flow. This consideration is crucial for optimizing the power and effectiveness of the design's motion.
vi. In the future, make sure the project materials are tough and durable.

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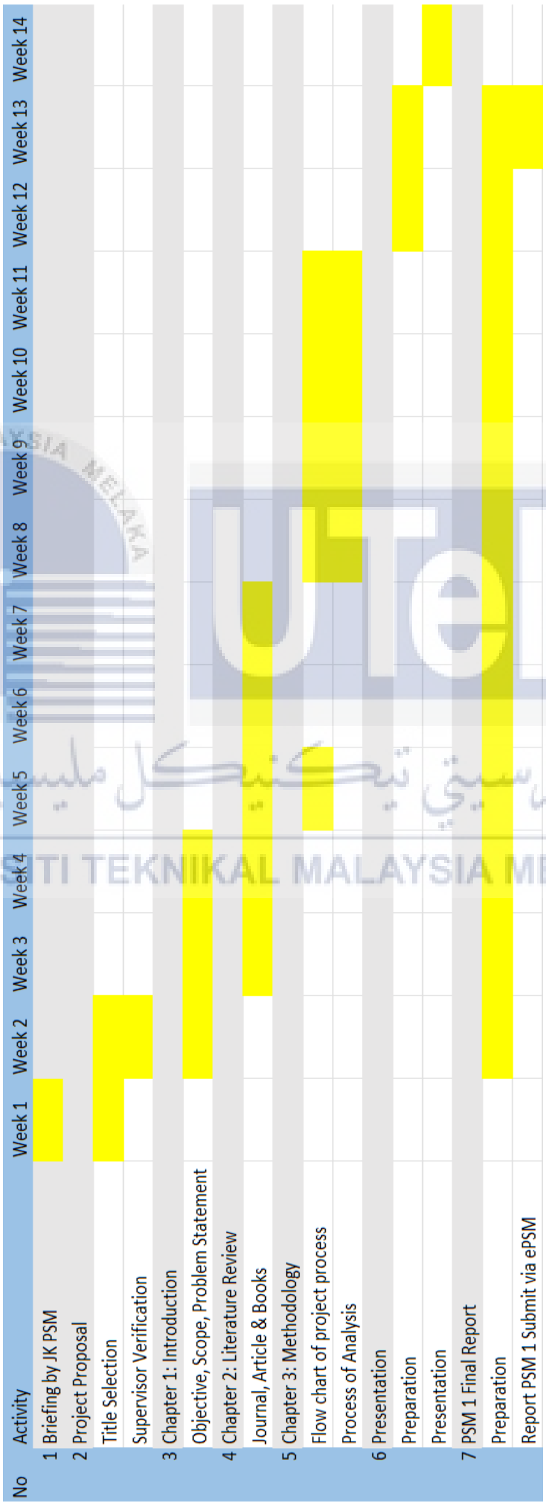
APPENDICES

Appendix A   Gantt Chart PSM 1



Appendix B Gantt Chart PSM 2

No	Activity	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
1	Devices testing & instrument		■	■	■	■	■	■	■						
2	Electrical design & Mechanical Design			■	■	■	■	■	■	■					
3	Discussion with Supervisor		■	■	■	■	■			■	■	■	■	■	
4	Formation of Chapter 1,2 and 3	■	■	■	■										
5	Creation of Chapter 4,5 & poster									■	■	■	■	■	
6	Presentation Preparation												■	■	■

Appendix C Project Coding PSM 2

```
#define BLYNK_TEMPLATE_ID "TMPL6K1LFPgJW"
#define BLYNK_TEMPLATE_NAME "Quickstart Template"
#define BLYNK_AUTH_TOKEN "GvLFWbSbnvB7hx4CueHhqxAnK5XRZ89X"
#define BLYNK_PRINT Serial
#define echoPin 14
#define trigPin 12


#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>
#include <HCSR04.h>

char auth[] = BLYNK_AUTH_TOKEN;

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "GOHHP";
char pass[] = "12345678";

int IN1 = 5;
int IN2 = 4;
int IN3 = 2;
int IN4 = 1;
int startDevice;
const int relayPin = 3;
```

```
BLYNK_WRITE(V0) {
  startDevice = param.asInt();

  if (startDevice == 1) {
    Serial.println("DEVICE ON");
  }
  else {
    Serial.println("DEVICE OFF");
  }
}
BLYNK_WRITE(V4)  {

  if (startDevice == 1) {
  int backwardButton = param.asInt();
  if (backwardButton ==1)
  {
    goBackward();
    //open valve
  }
  else if (backwardButton ==0) {
    StopM();
  }
}else {
    StopM();
  }
}
```

```
BLYNK_WRITE(V1)  {

  if (startDevice == 1) {
  int leftButton = param.asInt();
  if (leftButton ==1)
  {
    turnLeft();
    //open valve
  }
  else if (leftButton ==0) {
    StopM();
  }
}else {
    StopM();
  }
}

BLYNK_WRITE(V2)  {

  if (startDevice == 1) {
  int rightButton = param.asInt();
  if (rightButton ==1)
  {
    turnRight();
    //open valve
  }
  else  if (rightButton ==0) {
    StopM();
  }
}else {
    StopM();
  }
}
```

```
void goForward()                                //forward with speed val
{
  digitalWrite(IN1, HIGH);
  digitalWrite(IN2, LOW);
  digitalWrite(IN3, HIGH);
  digitalWrite(IN4, LOW);
  Serial.println("Forward");
}

void goBackward()                              // secont function
{
  digitalWrite(IN1, LOW);
  digitalWrite(IN2, HIGH);
  digitalWrite(IN3, LOW);
  digitalWrite(IN4, HIGH);
  Serial.println("Backward");

}
void turnRight()                                //forward with speed val
{
  digitalWrite(IN1, LOW);
  digitalWrite(IN2, HIGH);
  digitalWrite(IN3, HIGH);
  digitalWrite(IN4, LOW);

  Serial.println("Right");
}
```

```
void turnLeft()                    // secont function
{
  digitalWrite(IN1, HIGH);
  digitalWrite(IN2, LOW);
  digitalWrite(IN3, LOW);
  digitalWrite(IN4, HIGH);
  Serial.println("Left");
}

void StopM()                    //third function
{
  digitalWrite(IN1, LOW);
  digitalWrite(IN2, LOW);
  digitalWrite(IN3, LOW);
  digitalWrite(IN4, LOW);
  Serial.println("Stoped");
}


BLYNK_CONNECTED()
{
  Blynk.syncVirtual(V0);
  Blynk.syncVirtual(V1);
  Blynk.syncVirtual(V2);
  Blynk.syncVirtual(V3);
  Blynk.syncVirtual(V4);

}
```

```
void setup()
{
  // Debug console
  Serial.begin(115200);


  pinMode(IN1, OUTPUT);
  pinMode(IN2, OUTPUT);

  pinMode(IN3, OUTPUT);
  pinMode(IN4, OUTPUT);


  //Blynk.begin(auth, ssid, pass);
  // You can also specify server:
  Blynk.begin(auth, ssid, pass, "blynk.cloud", 8080);
  //Blynk.begin(auth, ssid, pass, IPAddress(192,168,1,100), 8080);
}
void setup() {
  Serial.begin(115200);
  Blynk.begin(auth, ssid, pass);
  pinMode(relayPin, OUTPUT);
}

void loop() {
  // Read the potentiometer value (0-4095)
  int potValue = analogRead(potentiometerPin);

  // Map the potentiometer value to the delay range (50-1000 ms)
  int delayTime = map(potValue, 0, 4095, 1000, 50);

  // Turn on the relay
  digitalWrite(relayPin, HIGH);
```

```
#define DOUT_PIN 23
#define SCK_PIN 19

char auth[] = BLYNK_AUTH_TOKEN;

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "GOHHP";
char pass[] = "12345678";

#define echoPin 14
#define trigPin 12
HX711 scale;

long duration, distance;
void setup() {
  Serial.begin(9600);
  Blynk.begin(auth,ssid ,pass ,"blynk.cloud",80);
    pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  Serial.println("Place a 1kg weight on the scale...");
  delay(5000); // Allow time to place a 1kg weight on the scale

  // Initialize the scale and set the calibration factor
  scale.begin(DOUT_PIN, SCK_PIN);
  scale.set_scale(-270.0);  // Set the calibration factor based on your calibration (adjust this value)
}
```

```
void loop() {
  Blynk.run();
{
  // Your existing code here
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  distance = duration / 58.2;
  String disp = String(distance);

  Serial.print("Distance: ");
  Serial.print(disp);
  Serial.println(" mm");

  Blynk.virtualWrite(V5, distance);  // Send the distance value to a virtual pin (V1 in this case)

  if (distance < 5) {
    Blynk.logEvent("storage");
  }
  delay(1000);
}

    if (scale.is_ready()) {
    float weight = scale.get_units();

    if (weight <= 1000.0) {
      Serial.print("Weight: ");
      Serial.print(weight, 2);
      Serial.println(" grams");

      Blynk.virtualWrite(V7, weight, 2);

      if (weight < 1000) {
        Blynk.logEvent("weight");
      } else {
        Serial.println("Weight exceeds 1 kg. Check the load on the scale.");
      }

      delay(1000);
    } else {
      Serial.println("Weight exceeds 1 kg. Check the load on the scale.");
    }
  } else {
    Serial.println("Error reading from the scale. Check wiring and try again.");
  }

  delay(1000);
}
```