Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IOT-BASED RAIN DETECTION AND NOTIFICATION SYSTEM

MUHAMMAD HAZWAN FIRDAUS BIN MOHAMAD HAZLI

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

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DEVELOPMENT OF IOT-BASED RAIN DETECTION AND NOTIFICATION SYSTEM

MUHAMMAD HAZWAN FIRDAUS BIN MOHAMAD HAZLI

A project report submitted
in partial fulfillment of the requirements for the degree of
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DECLARATION

I declare that this project report entitled “Development Of IoT-Based Rain Detection And Notification 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.

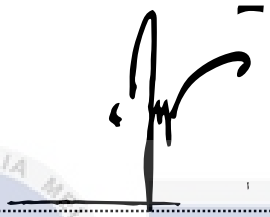
Signature : 

Student Name : MUHAMMAD HAZWAN FIRDAUS BIN MOHAMAD HAZLI

Date : 16/1/2023

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.

Signature : 

Supervisor Name : DR. SYED NAJIB BIN SYED SALIM

Date : 22/02/2022

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

In the Name of Allah, the Most Merciful, the Most Compassionate, Alhamdulillah all praises belongs to Almighty Allah, the Lord of the worlds and prayers and peace be upon Muhammad His servant and messenger.

First and foremost, I must acknowledge my limitless thanks to Allah, the Ever-magnificent, the Ever-Thankful, for His help and bless by giving me the opportunity, courage and enough energy to carry out and complete the entire thesis work titled "Development Of IoT-Based Rain Detection And Notification System" submitted in partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours in Techinal University Of Malaysia Malacca.

I would like to dedicate this thesis to my parents Mohamad Hazli Bin Mat Hashim and Siti Saleha Binti Hashim. Thank you so much for everything! Words can hardly describe my thanks and appreciation to you. You have been my source of inspiration, support, and guidance. You have taught me to be unique, determined, to believe in myself, and to always perservere. I am truly thankful and honored to have you as my parents.

Besides that, I am grateful to some people, who worked hard with me from the beginning till the completion of the present research and have assisted me throughout the completion of this research.

Last but not least, I want to thank me, I want to thank me for believing in me, I want to thank me for doing all this hardwork, I want to thank me for having no days off, I want to thank me for never quitting. I made it! Alhamdulillah.

ABSTRACT

Development of IOT-based rain detection and notification system are project that using motor to move the cloth rack to indoor preventing it from the rain. During rainy days, people frequently forget to bring in their clothes. Working people should be concerned about this because they don't have enough time to manage their everyday tasks and routines. Based on these examples, a solution was devised to avoid exposing clothes that have been dried outside to rain. Traditional clothes drying lines are unable to protect clothes from a heavy rain. The major control system function of this device is a microcontroller, which allows it to run autonomously. The main goal of this project is to use Proteus software to construct a rain sensor circuit and an LDR circuit. To create a controller code using an Arduino UNO system, as well as to build a rain sensor circuit and an LDR circuit. All of the applications in this device were implemented using an Arduino UNO, which are provided instructions for effectively operating this system, such as automatically fetching garments on sunny days and retrieving clothes on wet days. Then, as a key function, a DC motor, LDR, and rain sensor were required to make this system work properly. Aside from that, this device has the advantages of being energy and time efficient, as well as making it easier for employed people to accomplish duties at home indirectly.

ABSTRAK

Pembangunan sistem pengesanan dan pemberitahuan hujan berasaskan IoT adalah projek yang menggunakan motor untuk memindahkan rak kain ke dalam bangunan untuk mengelakkannya daripada hujan. Semasa hari hujan, orang sering terlupa untuk membawa masuk pakaian mereka. Orang yang bekerja harus mengambil berat tentang perkara ini kerana mereka tidak mempunyai masa yang cukup untuk menguruskan tugas dan rutin harian mereka. Berdasarkan contoh-contoh ini, penyelesaian telah dibuat untuk mengelakkan pakaian yang telah dijemur di luar terdedah kepada hujan. Talian pengeringan pakaian tradisional tidak dapat melindungi pakaian daripada hujan lebat. Fungsi sistem kawalan utama peranti ini ialah mikropengawal, yang membolehkannya berjalan secara autonomi. Matlamat utama projek ini adalah untuk menggunakan perisian proteus untuk membina litar sensor hujan dan litar LDR. Untuk mencipta kod pengawal menggunakan sistem Arduino UNO, serta membina litar sensor hujan dan litar LDR. Semua aplikasi dalam peranti ini telah dilaksanakan menggunakan Arduino UNO, yang mampu memberikan arahan untuk mengendalikan sistem ini dengan berkesan, seperti mengambil pakaian secara automatik pada hari cerah dan mendapatkan semula pakaian pada hari basah. Kemudian, sebagai fungsi utama, motor DC, LDR dan sensor hujan diperlukan untuk menjadikan sistem ini berfungsi dengan baik. Selain itu, peranti ini mempunyai kelebihan iaitu menjimatkan tenaga dan masa serta memudahkan orang yang bekerja untuk melaksanakan tugas di rumah secara tidak langsung.

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LIST OF ABBREVIATIONS

IoT	-	Internet Of Things
LDR	-	Light Dependent Resistor
LED	-	Light Emmiting Diode

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CHAPTER 1

INTRODUCTION

1.1 Background

Most individuals in the modern period, and women in particular, are struggling to pick up their hanging garments in the event of an emergency, such as a rainy day. For instance, if it were to suddenly rain while the house's female occupants were out at work or otherwise occupied, any clothing left on a balcony or anywhere outside would be soaked.

Those who are often on the go have to worry about the weather damaging their outdoor-dried garments. They don't have time to keep up with their wardrobes since they have so many other responsibilities. For households without maids or for those in which the occupant lives alone, this might significantly cut into their free time.

The washing and drying process are the primary focus of this research. This is a good choice for those who don't have a maid or who live alone and have a hard time keeping up with their laundry throughout the day because of the unpredictable nature of the weather.

The proposed technology, an automatic drying rack that can detect when it's about to rain, thats make people's lives simpler. Items may be hung out to dry on this rack without the user having to worry about the clothes becoming wet. When it starts raining at home, the user get notified on their smartphone through the Internet of Things' weather app.

1.2 Problem Statement

Unpredictable weather conditions sometimes make the process of drying the clothes outside the home area difficult. In addition, the weather patterns in Malaysia that received relatively high rainfall are a contributing factor to this problem as some of them are wet with rain.

For those who are busy working and at the same time not forgetting about the work of the home it is essential to find a modern and convenient solution. This is often associated with working women or among university students.

For those who have problems forgetting especially the elderly, it can be difficult to remember clothes that have been left outside especially if it is raining or forgetting to hang up the cloth for those who often sleep while waiting for clothes to be dried.

1.3 Project Objective

The following are the project's objectives:

a) To develop a system using sensors that can detect the presence of rain.

b) To control a low-cost laundry hanging prototype for household usage.

c) To remotely monitored system using internet and the data from the sensors that stored in the cloud by using Cayenne IoT platform.

1.4 Scope of Project

A few guidelines are proposed, by narrowing the needs for this project, to ensure that this project achieve its objectives. The scopes covered are:

a) This project is to focus on clothesline in order to make drying the cloth easier for those who always busy with their work and always not available at home.

b) Using Esp32 microcontroller in monitoring the weather for rain detection system.

c) This project works in two scenarios: first, when it rains, the rain sensor detect water and the hanger cloth automatically retrive in. Secondly, when the water sensor dry and the LDR sensor receive enough light it automatically retrieve-out the clothes.

d) To use the IoT application to control motors and monitor by developing an IoT platform for this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the literature review on the automated cloth hanger and development of IoT-based Rain Detection and Notification System is presented. This chapter first describes how the system is modeled after former researchers. The aim of this project is to prevent cloth getting wet when the weather changes in an open area. The control system with the help of rain sensor and power motor that moves the rail of the cloth from an open area to a close area to prevent the cloth from getting wet. The function of IOT is to notify the user if the sensor is triggered when they are not available at home.

2.2 System Design

The word "automation" is derived from two Greek words: "auto" (self) and "Matos" (movement). It is, thus, the mechanism for self-moving devices. As a result, automation can be defined as "a set of technologies that allows machines and systems to operate without requiring considerable human involvement and delivers performance superior to manual operation."[1] As a result of this investigation, an automated sliding door system that uses infrared sensors was developed. A sensor, a control unit, and a drive unit are used in conjunction with one another at the entry of a public facility in order to open and shut the doors. The primary objective of this research project is to gain an understanding of the fundamental concepts at play and to acquire specific information regarding the operation of an automatic door system that makes use of an AC variable speed control system and PLC

control electromechanical actuators to open and shut a door automatically. In the context of this project, the publisher is doing research into the operation of automated doors, defining an extensive circuit, and constructing a simple model. [2]

In this research work, we can said that the publisher developed Rain sensor alarm. It uses a rain drop sensor, SIM900 GSM module and Arduino Uno is uses for controlling and processing the data from the sensor. The purpose of this research work is to understand the detail about the system work which the system consists of a retractable roof which is build over the height of the flood lights so that the previous infrastructure of the stadium is not disturbed. [3] Automatic clothing protection against rain is provided by this technology. The publisher use relay to switch between drivers is controlled by an 8051 IC controller and a driven ULN 2803. Utilizing 555 timers and LDRs, a sensing system is developed. The tray is mounted directly below the roof, and the sensor equipment is fixed to the roof. Through a relay, the driver circuit controls the tray. They have utilised several software tools, including welpro software, which operates in intricate circuitry, and keil micro vision.[4]

Power traction mechanism is consisting of several parts mainly including main frame, DC motor, wheel, and overweight. [5] Clothes are automatically retrieved out on a sunny day and retrieved in when it is a rainy day. In this system, an Arduino UNO board was used to give instructions to the system via the programs installed on it. A DC gearbox motor moved clothes forward and backwards. A rain sensor circuit was designed. [6]

This mechanism may automatically pull the hanger in during a rainy day and push it out during a sunny day. The Atmega328P-PU is used in this project to install all of the coding programmed that give instructions on how to run the system properly. The LM7805 voltage regulator is also used to regulate the 5V supply. Rain sensors and Light Dependent Resistor (LDR) sensors are among the sensors used in this research. [7]

Automatic clothes dryer in a cabinet in this research are using wifi transmission to developed the project with a NodeMcu Esp8266 to operates its project. The sensor that been used by the publisher is temperature sensor to operate the measurement parameter with a computer. It also used an android application which is Linux-based mobile devices to create its own application. Heavy clothes had been used to relay information from the microcontroller about the state of the cabinet, and once a certain temperature is reached, the heater is turn off to avoid overheating. [8]

2.3 Internet Of Things (IoT)

The ultimate goal of IoT is to make it possible for everything, everywhere, and at any time to be linked to any service or network. The Internet of Things usher in a technological revolution in several fields [9]. Kevin Ashton used the phrase "Internet of Things" [10] to describe the approaching era in which all of matter is connected and managed by a single digital network. With the ever-falling prices of IoT-related gear and network connections, it's not hard to imagine a future in which every object and person is permanently linked to the web through a mobile device. Between 26 and 50 billion gadgets had beem online by 2020, according to estimates. [9].

Internet of Things (IoT) is a new internet revolution that allows us to connect everyday devices to a global network. Innovations in the Internet of Things are urgently required. IoT has many applications in areas as diverse as medicine, tourism, instruction, manufacturing, and commerce. In this study, the publisher used an IoT-connected mobile app to create an NFC tag that can be scanned from inside the fabric and then linked to a cloud-based database containing product information. [11]

You may simulate the LPG sensor, LDR sensor, toggle switch, ATMEGA microcontroller, motor control circuits, and DC motors with the help of the Proteus simulator. Espressif Systems is responsible for the creation of the ESP32 chip. The two cores may be clocked at speeds up to 240 MHz, making it a significant improvement over the 8266 processor. The articles below provide a concise summary of the many benefits offered by the ESP32 chip, including its cheap price, ease of use, and compatibility with Wi-Fi standards and protocols.[12]

Concepts that revolve around the Internet of Things (IoT), such as augmented reality, high-resolution video streaming, self-driving vehicles, smart environments, electronic health care, and many others, are becoming more and more commonplace. [13]. The concept of IoT revolves around the word ‘‘smartness’’ – ‘‘an ability to independently obtain and apply knowledge’ [14]. Thing Speak is an open application for the Internet of Things [15] that provides numerous advantages for developing an IoT-based system. Thing Speaks features include real-time data gathering, collected data visualizations and processing, and the ability to create plug-ins. It also incorporated web services, social media, and different APIs. [16] The Blynk programme, which is installed on this device and serves as the primary on/off switch, may be used to activate the gadget even when the users are in different parts of the globe. After being received from the sensor, the data are then sent to the microcontroller, which is already outfitted with an internet module. The FAVORIOT platform received data that the user may use to assist in monitoring the home, and it transfered an alarm to the user in real time. [17] In this research, the publisher designed and developed prototype for monitoring the water level in water wells. The IoT is applied in this project to monitor the project where it uses Cayenne application. The minimum application payload size for Cayenne visualisation is 4 bytes, consisting of 1 byte for the Cayenne channel, 1 byte for the data type, and 2 bytes for the water level percentage. [18]

2.4 DC Motor

Although a direct current (DC) motor is an older piece of machinery, its modern uses have become more important and complex. This article presents a novel method for controlling the speed of a DC motor using armature voltage control, armature resistance control, and field excitation control for shunt and series field constant flux motors. [19] Rapid progress was made in controlling DC motors. Because of its cheap cost, portability, and versatility, DC motors may be found in a wide variety of today's most popular gadgets, including toys, automobiles, games, and drones. Pulse width modulation is an effective technique for regulating the speed of DC motors (PWM). In PWM, an IR receiver and TV remote are used to send signals to an ATmega16 microcontroller. How fast and in which direction the motor spins is determined by this. A disc with holes in it is sandwiched between the LED and the photodiode, and the combination of the two is used to calculate an approximation of the velocity. [20]

DC motors are simpler and cheaper to manage and provide advantages over AC motors in a number of key areas, including beginning torque, starting speed, stopping speed, reversing, and changing speed with voltage input. [21] To lift and lower the window glass in a simple and quiet manner, we're employing a PMDC motor. A dc shunt motor can be utilized to provide the necessary speed and torque for window lift applications.[22]

One such vehicle part is the power window, often known as an electric window system. It's placed conveniently next to the car's entryway. The idea behind this innovation is to reduce the amount of physical labour required to raise and lower the door glass by replacing the traditional crank handle with a simple switch. The power window system consists of the motor, electrical circuits, control system, and various inputs and outputs.[23] We're using a PMDC motor to raise and lower the window glass in a simple and quiet

manner. For the application of window lift, a dc shunt motor can be used to provide the appropriate speed and torque.[22]

The Sim Power Systems block set may be used to simulate the DC motor and electrical circuit that power windows rely on. Building a model of the scissor mechanism (which raises and lowers the window pane) out of rigid bodies, joints, and other components from the Sim Mechanics block set allows you to link the DC motor's motion to the mechanism. The Virtual Reality Toolkit allows users to see the power window mechanism's actual structure and shape. [18].

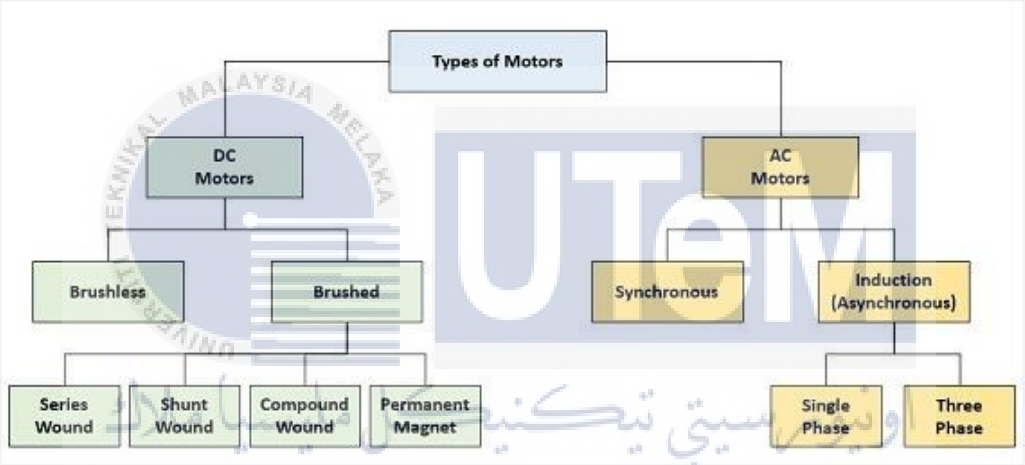


Figure 2.1 Type of Motors

Table 2.1 Comparison between AC Motor & DC Motor

AC Motors	DC Motors
Ac motors are powered from AC current.	DC motors are powered from DC current.
In AC motors conversion of current is not required.	In DC motors conversion of current is required like ac into dc current.
AC motors are used where power performance is sought for extended periods of time.	DC motors are used where motor speed required to be controlled externally.
AC motors can be single phase or three phase.	All DC motors are single phase.
In AC motors Armatures do not rotate while magnetic field continuously rotates.	In DC motors, the armature rotates while magnetic field does rotate.
Repairing of DC motors is costly.	Repairing of AC motors is not costly.
AC motor does not use brushes.	DC motor uses brushes.
AC motors have a longer life spam.	DC motors have not a longer life spam.
Speed of AC motors is simply controlled by varying the frequency of current.	Speed of DC motors is controlled by varying the armature winding's current.
AC motors require an effective starting equipment like capacitor to start operation.	DC motors do not require any external help to start operation.

2.5 Sensor

A rain sensor is a switching device that is engaged when it detects precipitation. It is also sometimes referred to as a rain switch. Rain sensors may be broken down into two distinct groups. The first one is a water-saving device that is linked to an automated irrigation system and causes the system to shut off whenever it rains. This helps save water. [25] The optical rain sensor is the kind that is suggested for use in detecting rain in outdoor settings. In comparison to many other kinds of rain detecting, optical rain sensors have a very quick reaction time, need very little maintenance, and have a lifetime that is far longer. The optical rain sensor is your best choice if you want to set up a rain detector in a manner that is uncomplicated and uncomplicated free of complications. [26]

Rain sensors are utilized in a variety of applications, including the environment, chemical industries, and automotive. Gravimetric, optical, capacitive, and resistive are all typical detecting principles. Capacitive sensors stand out among them because of their great sensitivity, inexpensive cost, and typically simple electrical circuitry. The change in electric permittivity caused by water is their detection principle. [27] In earlier studies, the Rain Sensor and LDR application were used for Automatic Car Lights in order to supply information to Arduino. As a result, the lights on the front and back of the vehicle would switch on automatically.[28] Rain sensors and light sensors are used to make automatic drying tools based on Arduino Uno. [23]– [25]

In [32]Rain sensor is a switching device that is moved based on water flow (rain). The rain sensor serves as a rain detector that provides a digital signal of rain and to move the position of the clothesline into the room and display the weather conditions on the LCD. [29] In this paper, when a rain sensor senses raindrops, it triggers a special protective layer to

cover the clothes. This is achieved with the help of two motors. A rotary knob switch was used to establish a drying period for the garments, and a DC motor was used to automatically remove the clothes after the drying time was done. [6]

A resistive rain sensor module is a low-cost sensor that is widely accessible on the market. A water detector or a water sensor is another name for the circuit. It is commonly used for rain detection and water level detection. [26] When the sensor is dry, the resistance that exists between both contacts is at an unusually high level (open circuit). When water drips down the surface of the board, it makes contact with the copper that is exposed and creates a connection that is resistive between the two copper strips. Because of the difference in resistance between dry and wet states, the circuit is able to differentiate between the two and can thus detect precipitation. [33]

Based on a resistive rain sensor, which is low-cost, high-efficiency, and has a wide output range. The sensor's corresponding electrical and mathematical model is constructed, simulated, and physically confirmed. The rain sensor's geometry is preset. As a result of the rainwater forming a layer on the sensor's surface, its resistance changes non-linearly. The sensor response must be linearized to improve the system's overall efficiency. [6]

We gained knowledge of the several sensor types used in wiper automation from the study paper that was presented to us. Windshield wipers are an essential component in the process of protecting the driver's safety while behind the wheel. Therefore, the fundamental objective of this study is to develop a system that controls an automatic operated wiper, also known as an automated operated wiper, which is based on an electronic sensor. This had been accomplished by creating a system that controls an automatic operated wiper. By using this method, we can significantly improve the safety of both the passengers and the drivers.

With the assistance of this tool, the motorist are able to focus more intently on the road ahead of them and avoid getting distracted while driving.[34]

2.6 Microcontroller

The microcontroller is an essential component of the many intelligent systems used in the modern world. A microcontroller is a single-chip control device that allows for the automation of a given system and control process while also delivering accurate results. This is made possible by the microcontroller's ability to provide exact outcomes. [35] The microcontroller has the ability to exercise control over the sensors in order to collect data from them; it then applies the analysis to the data collected from the sensors and sends it to the internet via the WIFI module. [36]

Both wireless and cable connections are used often in Arduino projects. In order to wirelessly update data, the Node MCU makes use of an ESP8266 WIFI module. Arduino's ability to rapidly publish data over a WIFI network is greatly enhanced by the Node MCU's inclusion of both a microcontroller and WIFI connectivity. On average, the ESP8266 WIFI module consumes 80ma of power. This project makes use of the widely-used, free, open-source Arduino IDE software for programming the board. [16]

In this project research, we can said that the publisher use nodeMCU ESP32 as the microcontroller so that the ESP32's ADC voltage range must be reached in order for the MQ-135's analogue output voltage with the presence of TSL2561 light sensor because they both communicate with the ESP32 using the I2C interface and share the same supply voltage of 3.3 volts. [37]

To build electrical projects, you may use the free and open-source Arduino platform. There are two main components to an Arduino kit: the physical programmable circuit board (also called a microcontroller) and the software (called an IDE) that runs on your computer and is used to write and upload code to the board. [38] The Arduino Uno's 8-bit CPU, the ATmega328P, operates at 32MHz. Arduino/Genuino Uno is a board that uses the ATMEGA328P microprocessor. The board has a USB port, a power jack, an ICSP header, a reset button, and 14 digital I/O pins as well as 6 analogue inputs and a 16 MHz quartz crystal. The microcontroller is ready to use right out of the box; all you need to do is plug it into a computer's USB port or provide power through an AC-to-DC converter or battery. [36]

In general, this microcontroller is suitable for simple jobs. This controller's primary coding language is an enhanced version of C++. The Arduino website includes an enhanced version of this language with a very user-friendly IDE (Integrated development environment). This allows users to generate and test code on the Arduino board quickly, which is ideal for development. The Arduino website also contains a wealth of information and examples on how to utilise the board.

2.7 Summary

Based on previous research, this project's purpose is to get the accuracy of automated cloth hanger by using NodeMCU Esp32 based model which triggered the DC motor when there is presence of rain and absent of light. A charming module with a microcontroller, built-in Wi-Fi receiver, and transmitter is the NodeMCU development board, based on ESP32. Numerous programming languages are supported by NodeMCU, making it relatively simple to upload programmes from any computer via a micro-USB interface which

is to be the main to receive information from the rain sensor and light dependent resistor sensor to measure the light intensity that had integrated with the controller. The Arduino Zero shares this limitation with the vast majority of other Arduino boards. They insist on the usage of an extra Ethernet shield. However, Wi-Fi functionality is built into the ESP32. Because of this, the ESP32 is more suited for Internet of Things applications. NodeMCU ESP32 has been chosen because it is simple to make connections using IOT and the cost is more affordable than other multi-controls. From the finding of research about sensors, I decided to use rain sensor and photoresistors know as light dependent resistor. Lastly, A review of the literature on this rain detection and notification system revealed that most of the studies were focused on rainy days that can be implanted using various sensors.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discusses the concepts, techniques, and methods used to accomplish the research's objectives. To complete the task, we suggest a project that explain the inner workings of an automated clothes hanger in great detail. The purpose of this section is to detail the project's underlying concept, its evolution, and the approach used to realise it. In this section, we'll talk about how we decided on the components and what we utilised for software. Classification and identification on the rain sensor works, which involves identification the type and viscousity of the liquid. Volume of water also had been studied to identify the weather types. The purpose of this study is to avoid the cloth hanging from the rain from getting wet. Then evaluating the accuracy when used for inferencing in real-time. Then, using NodeMCU esp32 to communicate with the dc motor to control the system and notification applied through IoT application. In this case we can represent the system's actuation.

3.2 Project Flowchart

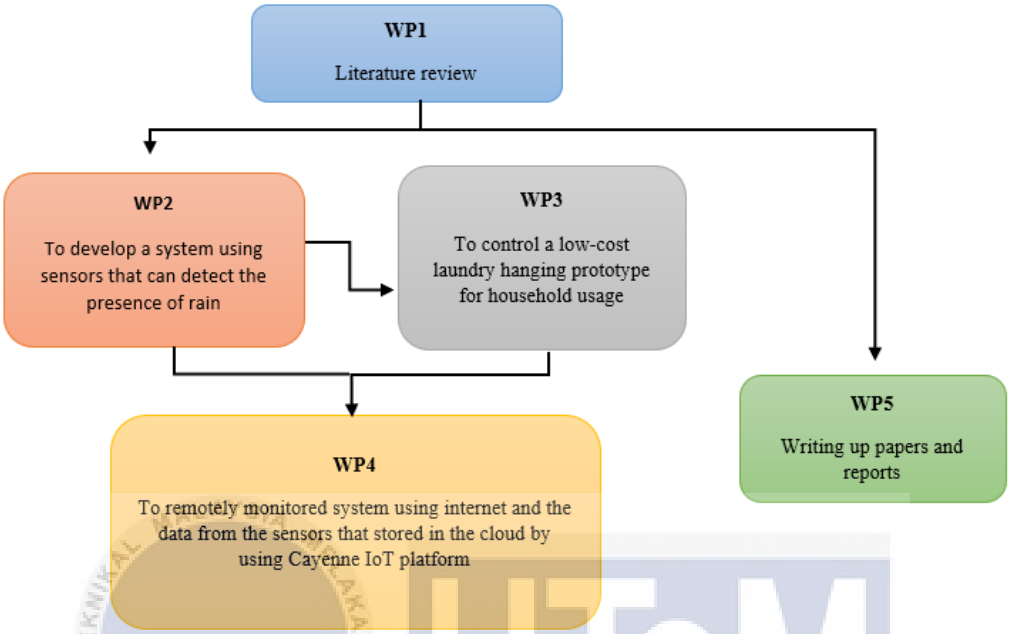


Figure 3.1 Flowchart of Methodology

This research study had took one year to accomplish and is divided into five work packages: (1) literature review, (2) to develop a system using sensors that can detect the presence of rain, and (3) to control a low-cost laundry hanging prototype for household usage. (4) to remotely monitored system using internet and the data from the sensors that stored in the cloud by using Cayenne IoT platform; and (5) compose papers and reports. The image below depicts the flow of the work packages.

3.3 Work Package 1: Literature Review

3.3.1 Task 1: Literature review

Firstly, this project's objectives were determined with the supervisor. The literature review for this project is completed when all the objectives have been determined. The goal of a literature review is to have a general understanding of past research conducted by scholars or institutions. Ideas and information regarding the component used, solutions to manage the problem, and the analytic approach were gathered from previous studies. Then, the supervisor approved the scopes that had cover the objectives. The flow chart of literature review as shown in Figure 3.3.

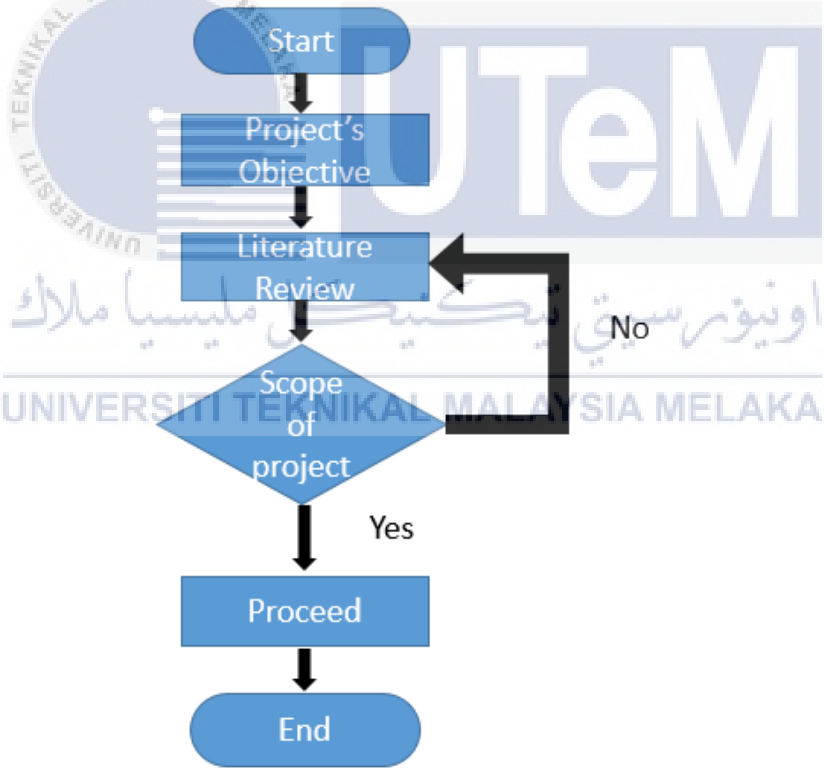


Figure 3.2 Flowchart of Literature Review

3.4 Work Package 2: To develop a system using sensors that can detect the presence of rain

3.4.1 Task 1: Designing the systems automatic cloth hanger

A flowchart must be created to assist and direct the planned project in achieving its goal. This guarantees that the process or step used to create the system software is created in accordance with the specifications necessary for the system. Figure 3.4.1 below displays the system's overall flowchart.

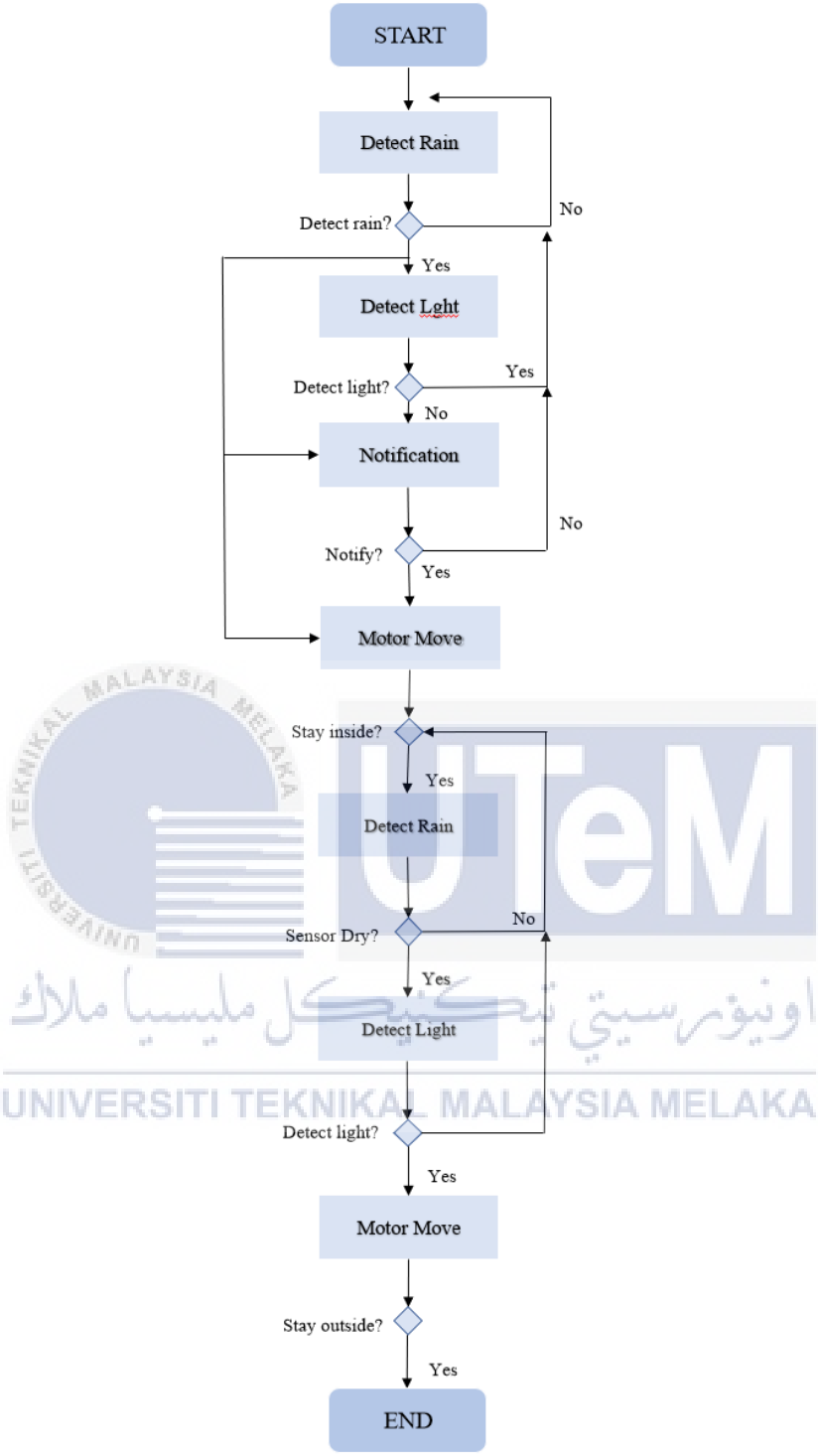


Figure 3.3 Testing Algorithm flowchart for automated cloth hanger

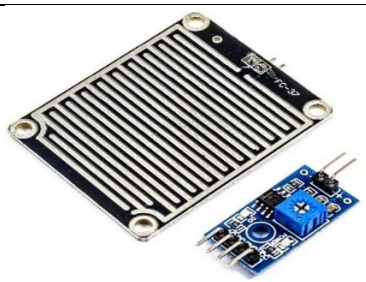
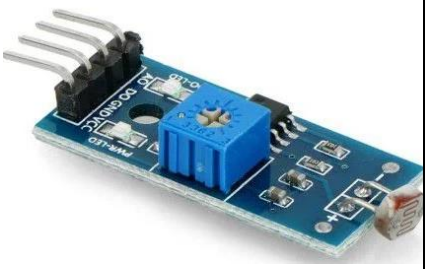
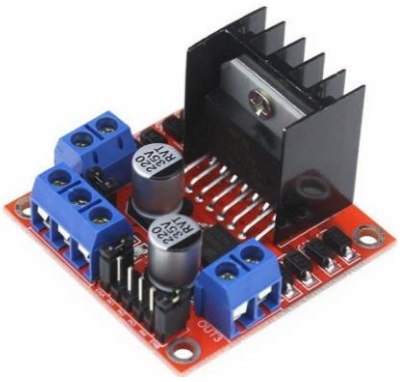
As depicted above, the system works as so.The rain triggered the rain sensor. As there is two condition which is the motor moves if it just raining but presence of light and the other condition it is where the motor move if it is raining and absence of light. A notification had been send to the users through the IoT application and link through telegram application. They received whether the motor is move and the weather is raining. When the cloth hanger is inside, it move outside if both rain sensor and ldr sensor in the desired condition. The rain sensor need to be dry and the ldr sensor need to be presence the amount of light so that the motor move the cloth hanger to the outside.

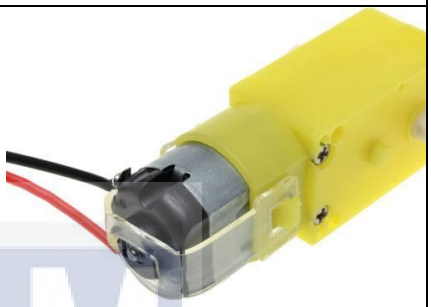
3.4.2 Task 2: Selection of hardware components

Based on figure , the system requires devices and components to be able to accomplish the targeted algorithm proposed. By that, following is a table of equipment's and components used to suffice the needs of the project.

Table 3.1: List of devices and components that involved in the project

NodeMCU ESP32	Run finalized code and used as a wifi to connected with cayenne	
Rain Sensor Module	Detect the presence of water droplet from the rain to give is signal that it is raining	

		
LDR Sensor Module	To detect the presence of light whether the surrounding is sunny day or night.	
3.7V Rechargeable LI -ION Battery 18650 4200mAh	Supply power to the project to work.	
L298N DC Motor Driver	Control DC motor gear to move forward or reverse direction and control the speed of rotation.	

Lighte Emmiting Diode (LED)	To show that the system is active when it is on.	
DC Gear Motor	Acts as controller to move the cloth hanger inside or outside	
Arduino IDE	Programming language used for coding	
Cayenne	IoT platform that being use to monitor notification	

3.4.3 Task 3: Block Diagram

The system proposed is meant to monitor and control automated cloth hanger, which includes telegram notification. The block diagram shown below is a IoT based monitor system and manual actuation.

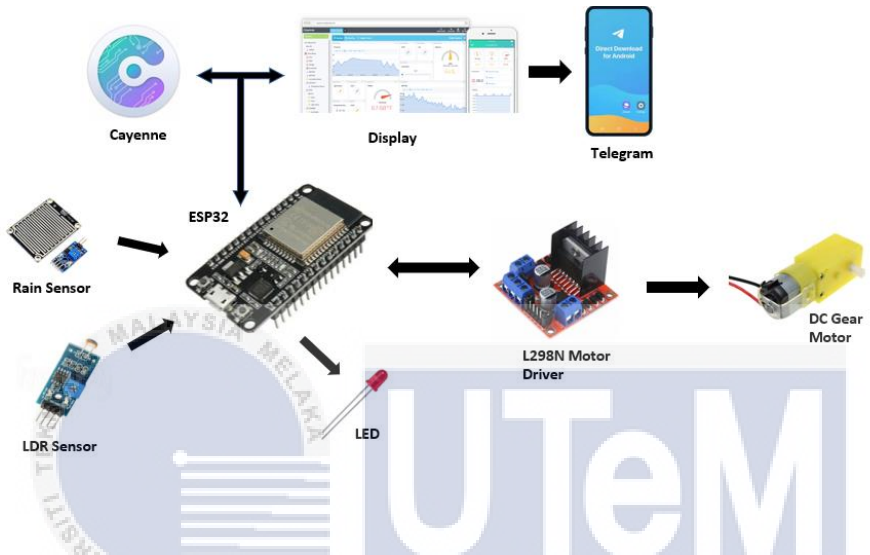


Figure 3.4 Block diagram of Iot Based Rain Detection And Notification System

Figure shows the demonstrates of the whole home automation system. this project is comprised of a microcontroller, which serves as the "brain" of the system and directs the behaviour of the other components based on how the system is designed. The input part of this project consists of two sensors. Each sensors sense the input the the ESP32 and then ESP32 send to the cloud which is cayenne to display and monitor. For the safety purpose, if the sensor hit the trigger, it automatically send the message that had been set to the telegram group to notify the user. For the display, we can used it to monitor and control the dc motor to move the cloth hanger manually. To control the dc gear motor, user need to hit the button at the display. The command is send to ESP32 and then to the L298N motor driver. The motor driver which control both dc gear motor to move.

3.4.4 Task 4: Wiring and connection

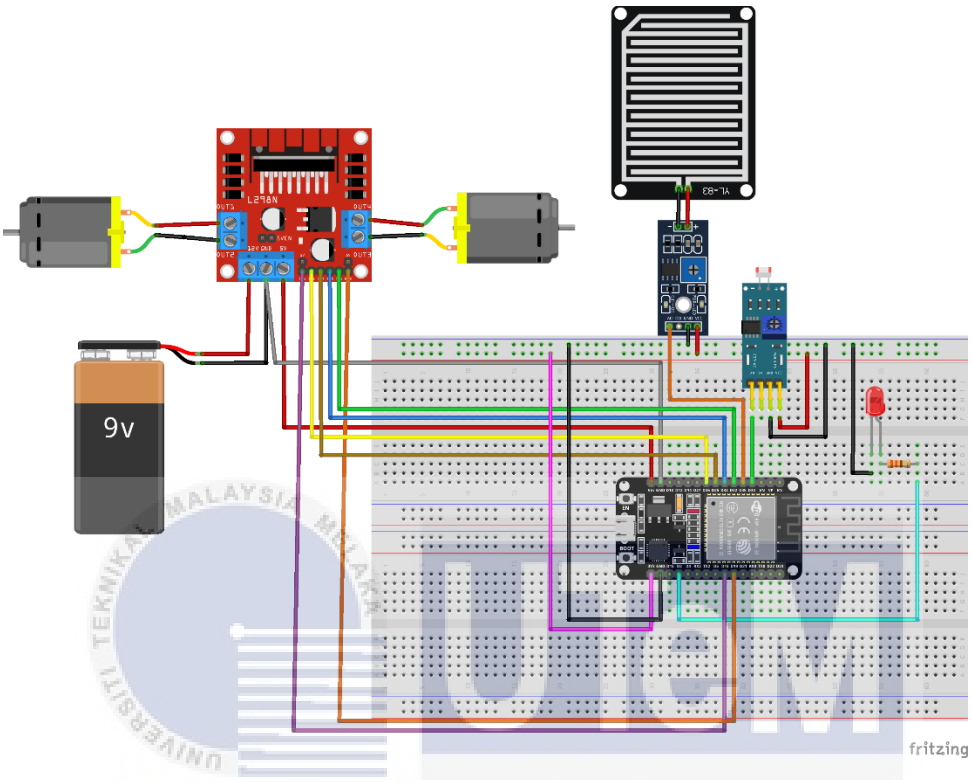


Figure 3.5 Circuit drawing for automated cloth hanger using fritzing

Figure above shows the connection of the IoT based rain detection and notification system circuit drawing using fritzing. As we can see, the NodeMCU Esp32 acts as the brain main system to receive input and give output for each component. The input part of this project consists of two sensor, one led, one motor driver, two dc motor gear and one power supply.` For the rain sensor, analog ouput pin is connected to the GPIO35 on the esp32. The LDR sensor analog output is connected to the GPIO34 pin on the esp32. The vcc and gnd of both sensors is connected to the breadboard. The led anode is connected to the GPIO2 pin on the esp32. The l298n motor driver pin for enA,enB,IN1,IN2,IN3,IN4 is connected to the GPIO18,19,26,25,33,32. On the motor driver, for the Out1 and out2 is connected to dc motor

gear and same for other dc motor gear which connected to out3 and out4. Lastly, batteries are connected to 12v pin on motor driver to supply the motor gear and the esp32.

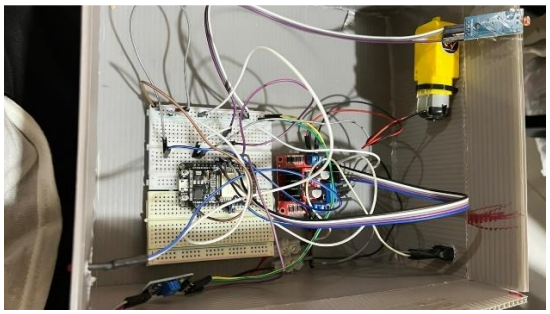


Figure 3.6 Install wiring for auto cloth hanger

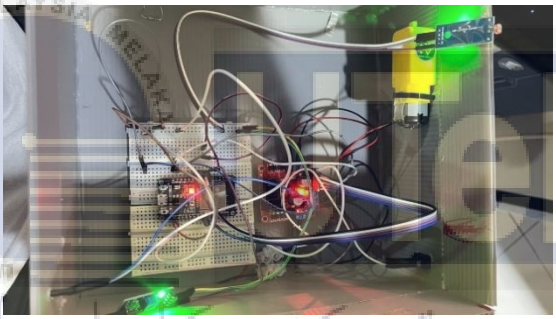


Figure 3.7 Continuity wiring test and voltage check

3.4.5 Process of build automated cloth hanger

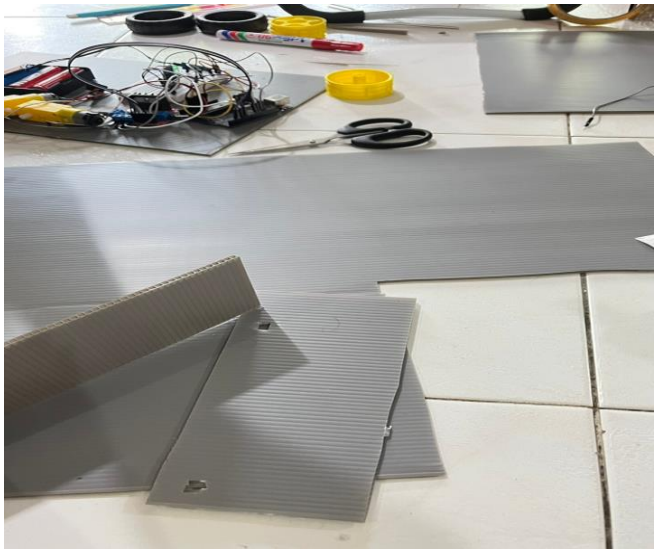


Figure 3.8 Cutting the board to make the house

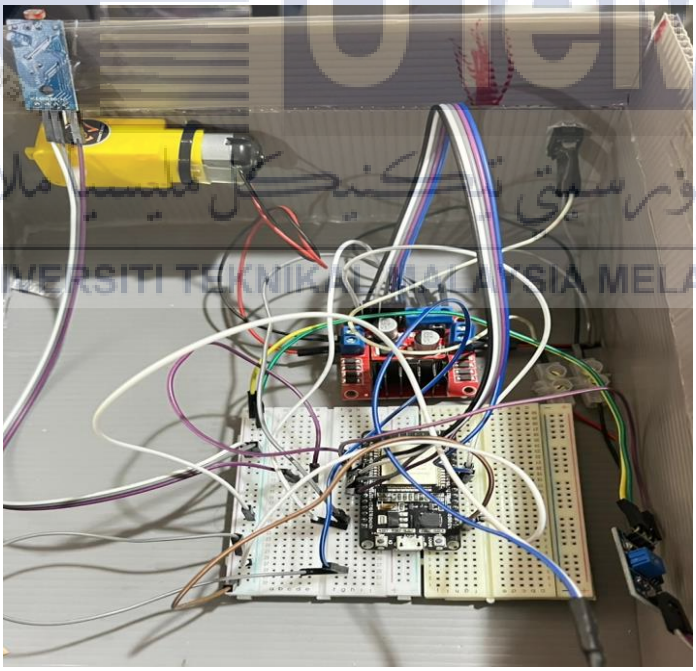


Figure 3.9 Placement of component in the house structure

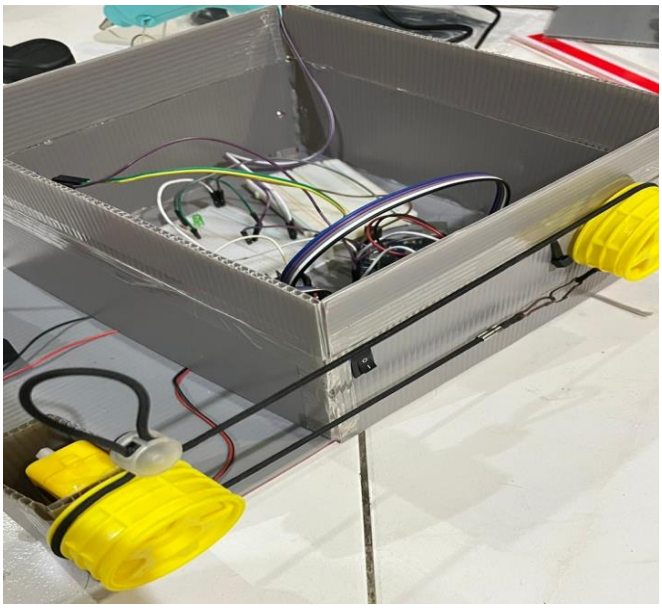


Figure 3.10 Installing gear motor which acts as the cloth hanger

Figure 3.11 Project model from outside view

3.5 Work Package 3: To control a low-cost laundry hanging prototype for household usage

3.5.1 Remote monitoring system flow

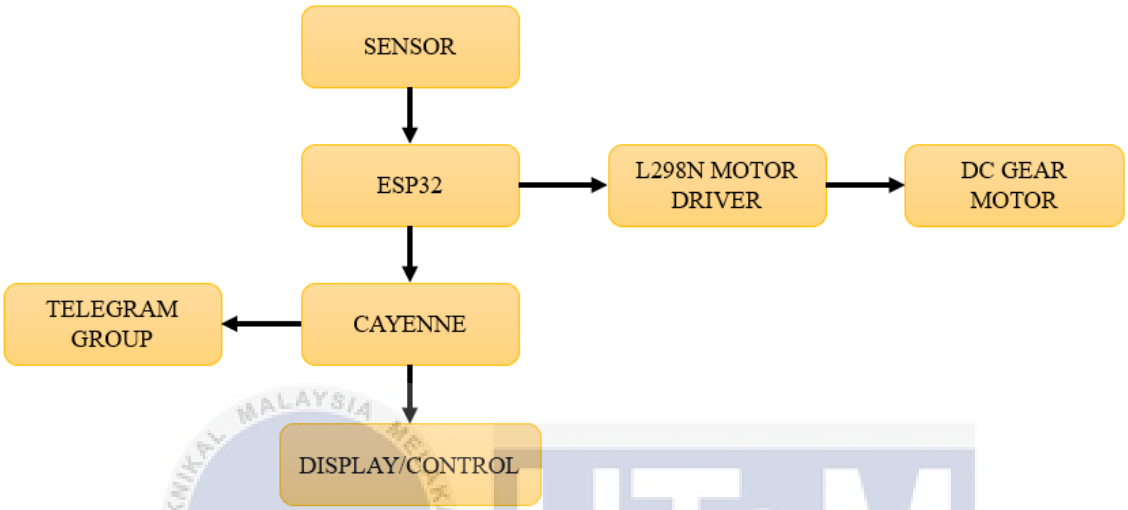


Figure 3.12 The flow of remote monitoring system work

The sensor triggered when it detects something, it send information to the ESP32. The data that collected in the esp32 had been transferred to IoT platform which is Cayenne. The esp32 need to have an internet connection so that makes it work with the IoT platform to control or monitor from the application. After cayenne receive the data from the Esp32, it displayed the data in the dashboard. We able to use smartphone or laptop to open and monitor the data as well as control it. To control the dc motor, when we tap on at the cayenne, the instruction had been send from cayenne to the Esp32. After then that, from Esp32 to the motor driver and motor driver act as a controller to move the dc gear motor whether forward or reverse. Lastly, for precaution or easy access, client's smartphone well get notification from telegram group to be monitored.

3.5.2 Setup IoT platform (Cayenne)

Figure 3.13: Step1: For new user, we need to sign up to use the application

Figure 3.14: Step 2: Hardware setup

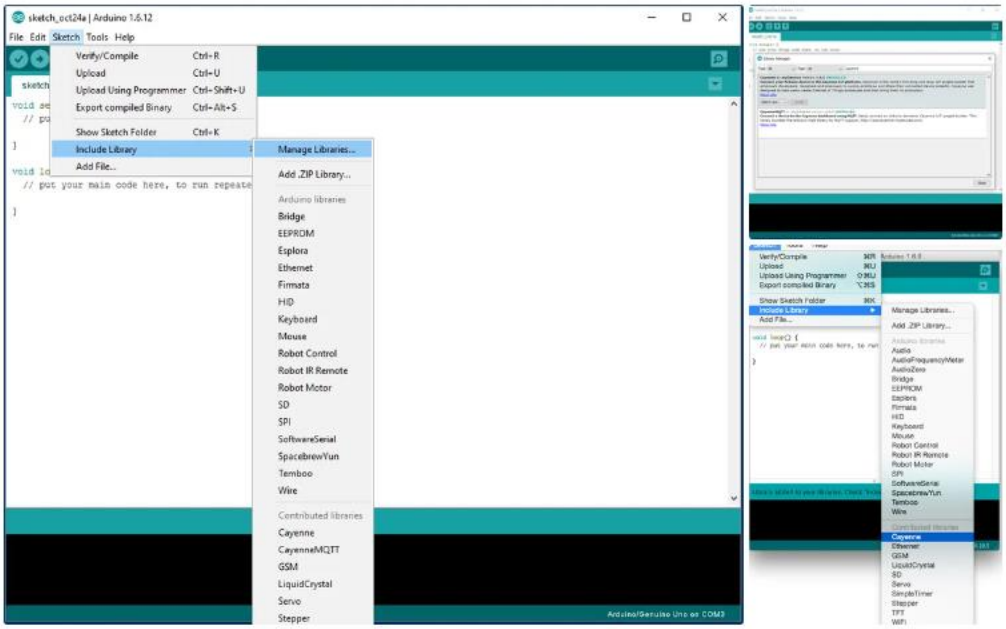


Figure 3.15: Step3: Add Cayenne Library to Arduino IDE

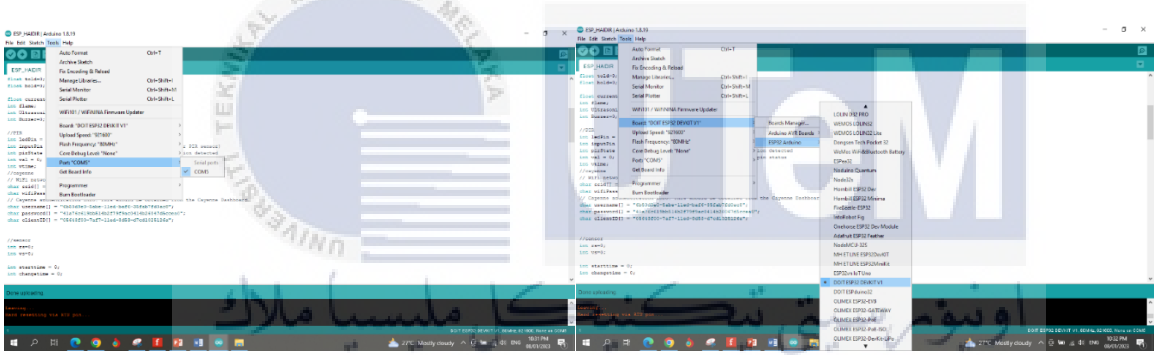


Figure 3.16: Step 4: Configure Arduino IDE

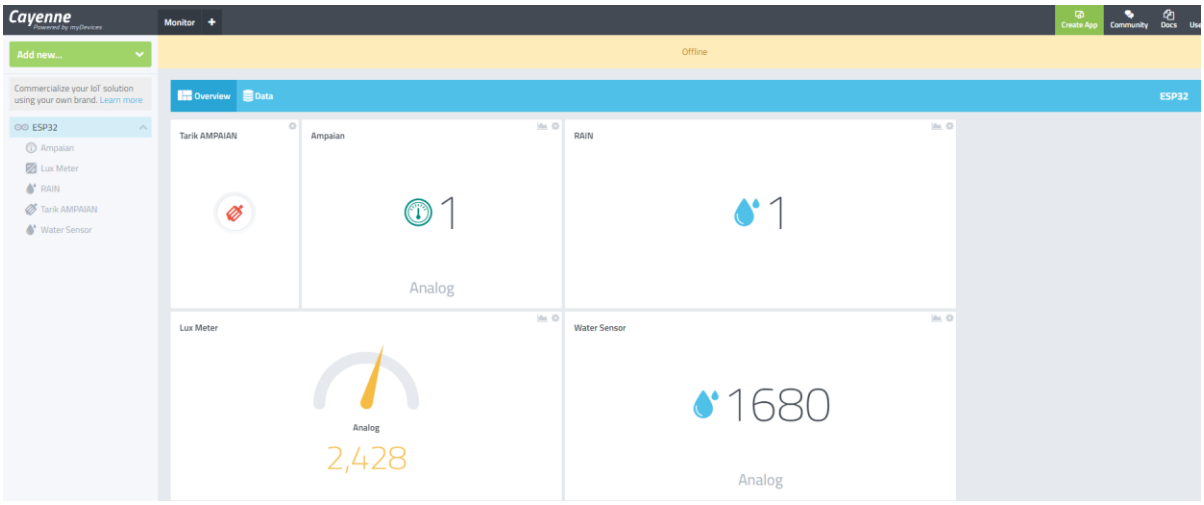


Figure 3.17: Step 5: Connect ESP32 to Cayenne IoT auto cloth hanger

3.5.3 Add Telegram Group Notification

In this part we had discuss the development of IoT platform with telegram application to be notified which used to monitor and control the cloth hanger.

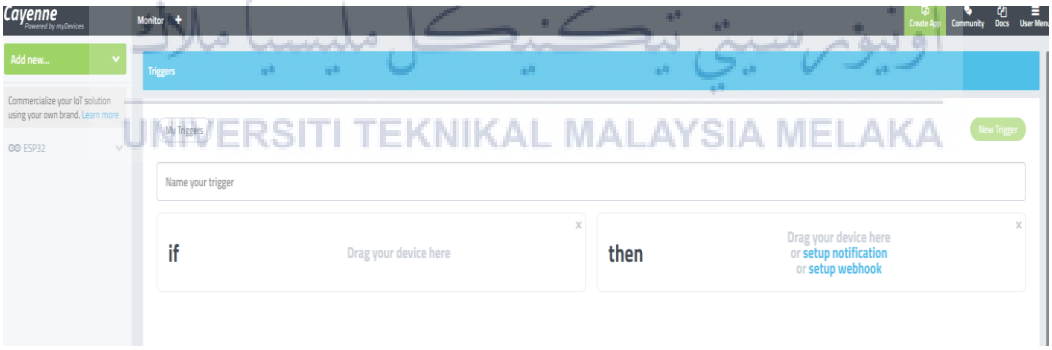


Figure 3.18: Step 1: Add a new trigger to be notified through telegram

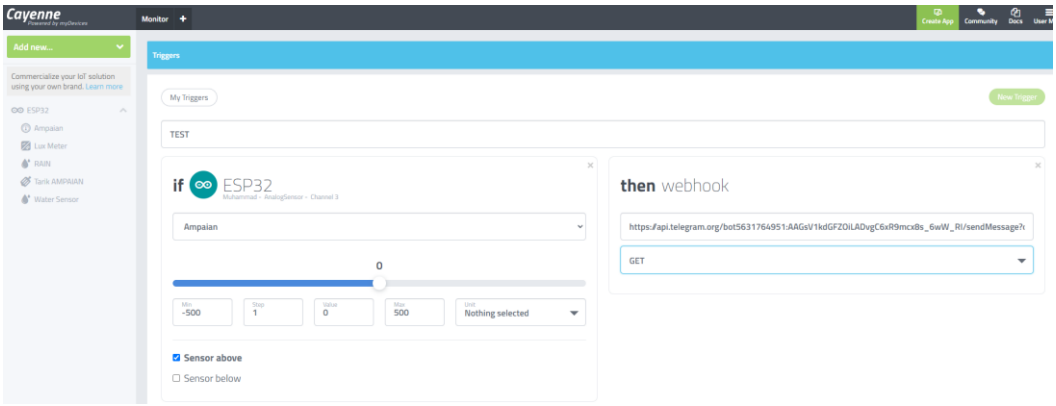


Figure 3.19: Step 2: Add if and then in the trigger

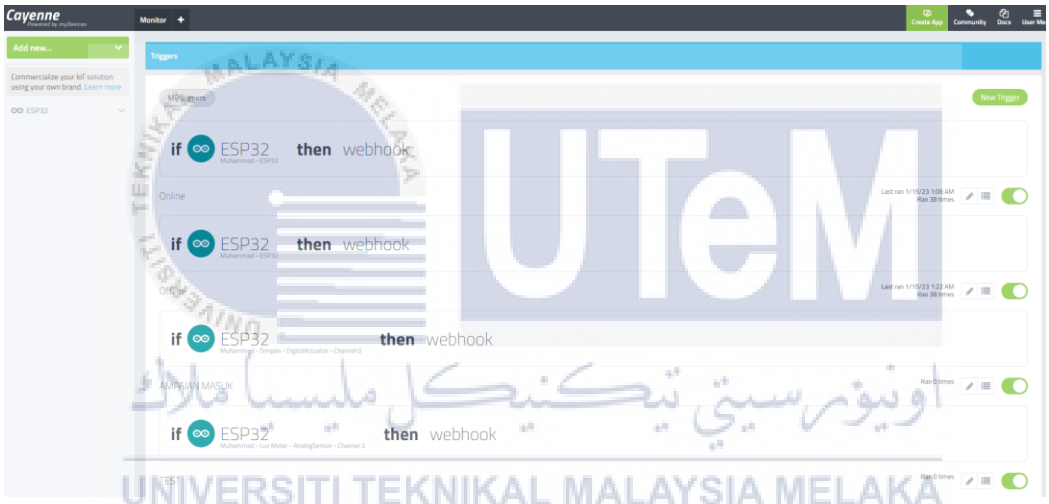


Figure 3.20: Step 3: Repeat step 2 for other sensor or other trigger to be notify

3.6 Work Package 4: To remotely monitored system using internet and the data from the sensors that stored in the cloud by using Cayenne IoT platform

The procedure of analysis and testing is detailed in this section. The testing of component functionality and data analysis are the first steps in the process.

Analysis and testing purpose is to test the system reliability performance of the IoT-based Rain Detection and Notification System. The different types of sensor and different types of conditions which the rain detection and notification system needs to perform had been tested by simulation. The performance of the IoT-based rain detection and notification system in terms of detecting the rain with the help of sensor and notifying the user is observed.

3.6.1 Functionality Test

The testing is carried out at the outdoor environment based on weather.

	Type Of test	Aim of test	Knowledge gain	Units	Material Tested	Output Measurement
1	Rain Drop Test	To test how many drop of water to active the system		Mililiter	Rain Sensor	Activation of Dc gear motor
2	Condition of weather	To check when the cloth hanger active	It tiggered when detect rain,even is sunny day		Sensors and Motor	Condition of system trigger
3	Measure voltage	To measure voltage drop when changes in weather	Voltage changes when resistance in sensor change	Voltage	Sensors	Voltage drop for each sensor after value change

4	IoT monitoring	To monitor the status of weather	Timestamp monitoring		IoT application	Changes in value of resistance sensor

3.6.1.1 Rain Drop Test

This provides a summary of the results, including the rain rate, sensor reading, and cloth hanger state in detecting rain. Thetest also includes the test case description, like the rainfall rate in ml. This format allows for easy comparison of the results and can be used to highlight the accuracy of the rain sensor in detecting different rain conditions.

3.6.1.2 Condition Of Weather

This provides a summary of the results, including the date, time, weather condition, rainfall and status of cloth hanger. This format allows for easy comparison of the results and can be used to analyze the weather condition over a period of time. It also can be used to show how the different weather parameters are correlated with the weather condition.

3.6.1.3 Measure Voltage

This provides a summary of the results, including the voltage, sensor reading, voltage drop and resistance value. This format allows for easy comparison of the results and can be used to analyze the relationship between the voltage and the voltage drop. The test can also be used to show the sensitivity of the sensor to changes in voltage and the degree of voltage drop.

3.6.1.4 IoT Monitoring

This provides a summary of the results, including the date, time, device ID, sensor reading, and status. This format allows for easy comparison of the results and can be used to analyze the performance of the IoT devices over a period of time. The test can also be used to show how the different devices are correlated to each other and the environment they are monitoring.

3.7 Work package 5: Report, Paper, and Journal writing

In practice, the conference paper and article writing occur concurrently with the completion of the other work packages. Additionally, after the conclusion of this study endeavour, a comprehensive report had been published.

3.8 Summary

This chapter covers the methods recommended to design a modern, effective, and comprehensive IoT based rain detection and notification system solution. The fundamental

objective of the suggested technique is to achieve a simple, less rigorous, and effective estimate without significantly degrading the accuracy of the findings. The solutions are also meant to use the limited and publicly accessible network and load data from power utilities. The ultimate goal of the strategy is not to achieve the maximum level of precision, but rather efficiency, usability, and flexibility on a wide distribution network.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

In this chapter,the findings and results on the iot based rain detection and notification system had been discussed and analysed the flow of this chapter is based on the detailed flowchart discussed in chapter three.

4.2 Project Prototype

Figure 4.1 below shows the prototype of the IoT based rain detection and notification system . This system consist of two sensor which are rain sensor and ldr sensor. Each sensor have different function to the system. One LED is installed to show the status of the cloth hanger position. 12V battery are used to supply the system. The microcontroller that involved is ESP32. Lastly, L298N motor driver had been used to control the dc gear motor movement.

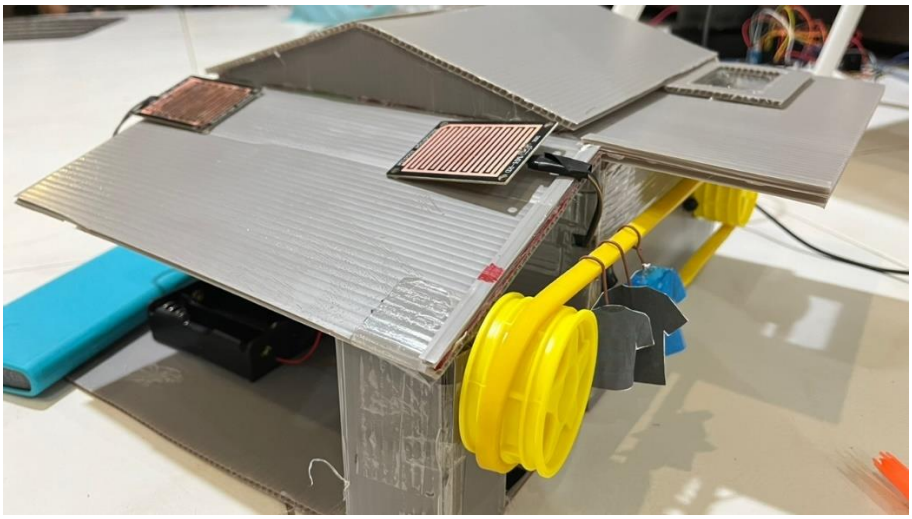


Figure 4.1 Auto cloth hanger prototype

4.3 Project Demonstration

Figure 4.2 shows the block diagram of the internet connection between Esp-32 with the access point of the internet which is the Wi-Fi router and mobile hotspot

Figure 4.2 Block Diagram of internet connection to ESP32

4.4 Monitoring automatic cloth hanger using mobile or laptop

Just click the link and make sure have a stable internet connection in mobile phone or laptop.

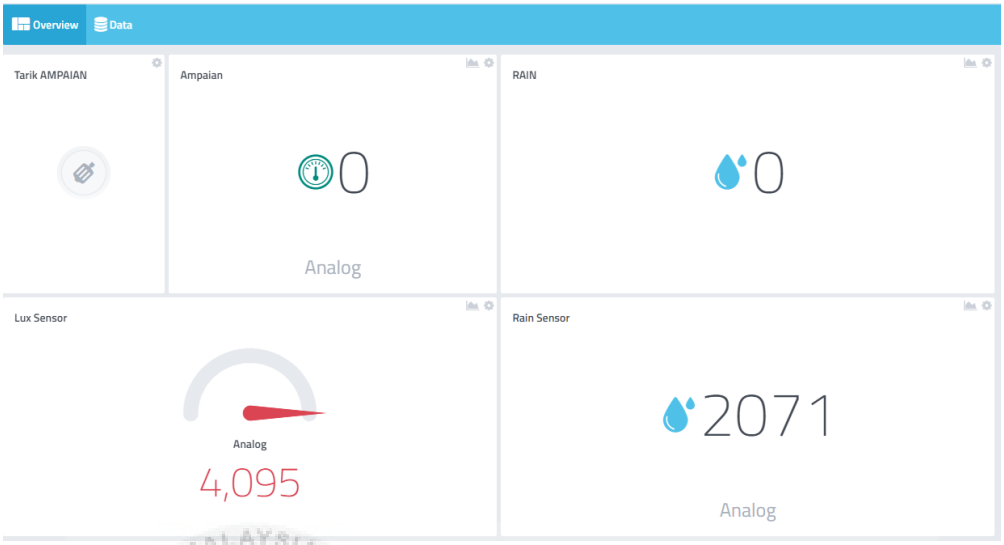


Figure 4.3 View using laptop

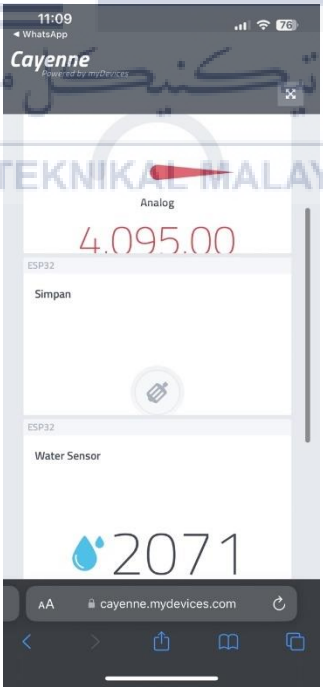


Figure 4.4 View using phone

There are two things that we can monitor for this IoT based rain detection and notification system. The client can check the weather and rain status for their outside environment. Other than that, the client can monitor whether the cloth hanger is inside or outside condition as well as be able to control it just by clicking at motor gadget button. Lastly, users can receive notification through telegram application.

4.4.1 Ldr sensor

For this part, there is two part which is monitor and notification. For the monitoring and notification system, the status of ldr sensor is display thru smartphone using IoT cayenne and the client can monitor the instensity of light, if the light is more than set value it notify through telegram application. The only requirement that the client need is stable connection and make sure it connected with ESP32.

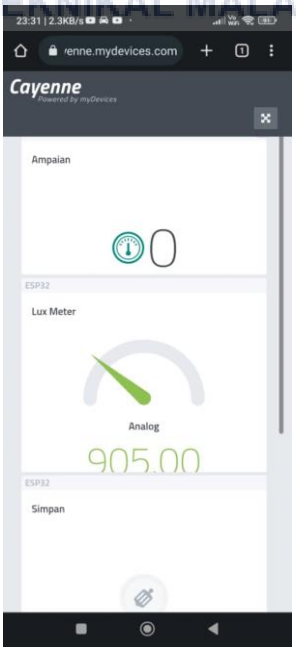


Figure 4.5 Display from smartphone status presence light

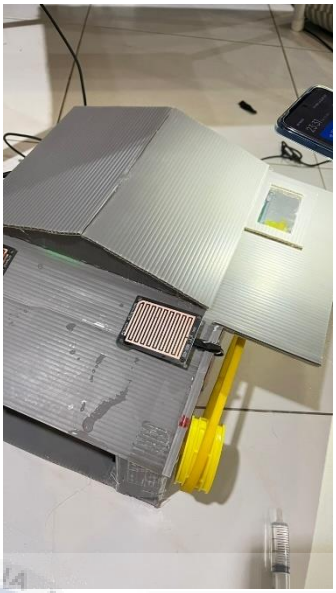


Figure 4.6 Presence of light on ldr sensor

Figure 4.7 Display from smarthphone status absence light

Figure 4.8 Absence of light on ldr sensor

Figure 4.9 Message sent to telegram group after the light intensity is below than certain level

4.4.2 Rain Sensor

Other than that, the sensor that are involve in this section is rain sensor. When rain sensor detect water on the sensor, the rain is notify through telegram notification. The intensity of rain sensor on the cayenne display drop if there presence of water.

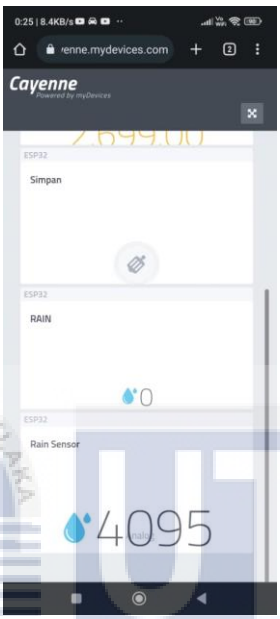


Figure 4.10 Display from smartphone not raining

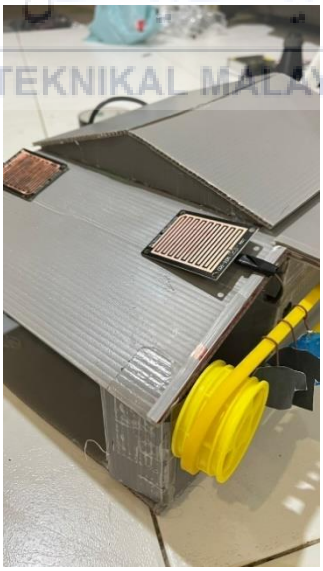


Figure 4.11 Not raining

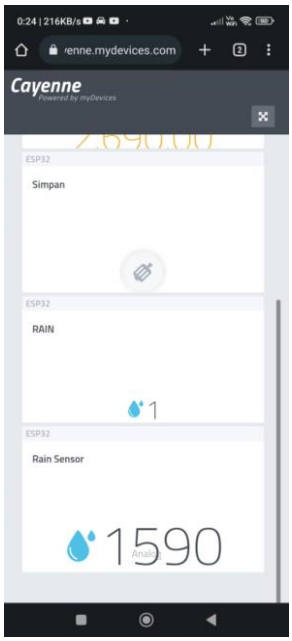


Figure 4.12 Display from smartphone raining

Figure 4.13 Raining

Figure 4.14 Notification from telegram application

4.5 Result Data

The comparison results for three different sections of IoT based rain detection and notification system are shown in Table 4.1, Table 4.2 and Table 4.3. These sensors include a rain sensor and ldr sensor.

4.5.1 Rain Drop Test

Table 4.1 Result for rain drop test

Test Case	Rainfall rate (ml)	Resistance value on sensor	Cloth hanger state
1	0	4095	Outside
2	0.2	3420	Outside

3	0.4	2860	Outside
4	0.6	2250	Inside
5	0.8	1870	Inside

4.5.2 Weather Condition

Table 4.2 Results for condition of weather

Test Case	Date	Time	Condition	Rain	Cloth Hanger
1	27.11.2022	10.21am	Sunny	No	Outside
2	3.12.2022	8.50pm	Night	Yes	Inside
3	8.12.2022	7.50am	Clear	No	Outside
4	15.12.2022	3.25pm	Cloudy	Rain	Inside
5	23.12.2022	9.11pm	Night	No	Outside

4.5.3 Measure on each sensor

Table 4.3 Voltage drop for rain sensor

Test Case	Voltage(v)	Sensor Reading(v)	Voltage Drop(V)	Rain value (ml)
1	3.37	3.275	0.095	0
2	3.37	3.273	0.097	0.2
3	3.37	3.263	0.107	0.4
4	3.37	3.256	0.114	0.6

5	3.37	3.251	0.119	0.8

Table 4.4 Voltage drop for ldr sensor

Test Case	Voltage(v)	Sensor Reading(v)	Voltage Drop(V)	Resistance Value on Sensor
1	3.37	3.268	0.102	4095
2	3.37	2.758	0.612	3280
3	3.37	1.831	1.539	2098
4	3.37	1.683	1.687	1328
5	3.37	0.432	2.938	223

4.5.4 IoT Monitoring

Table 4.5 IoT Monitoring

Test case	Date	Time	Rain Sensor Value	LDR Sensor Value	Status
1	3.12.2022	7.50am	4095	3360	Outside
2	4.12.2022	12.35pm	4095	0	Outside
3	17.12.2022	3.15pm	1975	2034	Inside
4	18.12.2022	8.50pm	3920	4095	Outside
5	25.12.2022	6.10pm	4095	2700	Outside

CHAPTER 5

CONCLUSION AND FUTURE WORKS

5.1 Conclusion

Finally, this project has been effective in examining prior studies on relevant themes to acquire an overview and recommendations on improvements for a IOT-based rain detection and notification system on ESP32 through the proposal that has been carried out.

Next that, the project was successful in defining the components required, which include hardware and software, which would be implemented in the real life. The components used are also inexpensive, simple to use, and portable, in keeping with current minimalist trends, while still achieving the project's main goal of analyzing the performance of a rain detection and notification system that displays a wide spectrum of that those sensors can synchronize to make the DC motor move the cloth hanger for the project to be success.

An IoT-based rain detection and notification system has proven to be accurate and dependable in terms of rain detection, according to test results. The system has the ability to identify rain in a given location and promptly notify users. The system was also discovered to be scalable, which means that it can be utilised in various places and for various purposes.

It is crucial to remember that the system needs to be tested and verified to make sure it is legitimate, accurate, and dependable. By adding more sensors or creating more sophisticated rain detection algorithms, additional research might be done to enhance the system.

To sum up, an IoT-based rain detection and notification system can be a useful device for keeping an eye on and warning people about rain in a given area. The system is precise, dependable, and scalable, but it might be made better with additional study and development.

Lastly, the results of my Cayenne software are successful in monitoring and controlling the cloth hanger. For the detection of rain, a rain sensor is used. The ldr sensor was used to detect the presence of sunlight whether it is sunny day or night day. If there is rain or no sunlight, the rain sensor and light sensor status had been displayed via a virtual terminal. Next, for the notification system, the esp32 notify the user via IoT application whether is it raining or not. A signal would be sent to the phone using the platform Telegram to update on the current state of the cloth hanger.

5.2 Future Works

i) For The following enhancements might be made to the findings of this project in order to make the project better:

   a. To apply this project on the real live house
   b. To monitor all movement of the cloth hanger
   c. Get notify about all weather condition
   d. Use a better sensor and dc motor gear to get the accuracy of the rain

REFERENCES

[1] Paul Hollis, 'Role of Linear Actuators in Industrial Automation', 2019.

[2] O. M. Oluwatomi and Obakin O, 'DESIGN AND CONSTRUCTION OF AN AUTOMATIC SLIDING DOOR USING INFRARED SENSOR', 2014. [Online]. Available: www.cisdijournal.net

[3] V. Divakar and C. G. R, 'This work is licensed under a Creative Commons Attribution 4.0 International License 86 Rain Detector with Alarm', *International Advanced Research Journal in Science, Engineering and Technology*, vol. 8, 2021, doi: 10.17148/IARJSET.2021.8714.

[4] P. Hegade, S. Nayak, P. Alagundi, and K. M. R, 'IJARCCE Automatic Protection of Clothes from Rain', *International Journal of Advanced Research in Computer and Communication Engineering*, vol. 5, 2016, doi: 10.17148/IJARCCE.2016.5492.

[5] N. LIN *et al.*, 'The Development of New Intelligent Clothes Hanger System', *DEStech Transactions on Engineering and Technology Research*, no. iceea, Mar. 2017, doi: 10.12783/dtetr/iceea2016/6709.

[6] F. L. Aryeh, E. K. Eshun, and M. K. Antwi, 'Design and Implementation of an Automated Drying Line System (ADLS)', *International Journal of Computer Science and Information Security (IJCSIS) Are Facing In A Cloud Comput ing Environment Journal of Comput er Science IJCSIS Journal of Comput er Science*, vol. 19, no. 7, 2021, doi: 10.5281/zenodo.5164236.

[7] Z. Jusoh, H. Husni, and H. Ja'afar, 'DEVELOPMENT OF ARDUINO SMART CLOTHES HANGER EMBEDDED SYSTEM FOR DISABLED', vol. 12, no. 10, 2017, [Online]. Available: www.arpnjournals.com

[8] H. Nugraha, 'Design an automatic clothes dryer in a cabinet with wi-fi transmission', in *IOP Conference Series: Materials Science and Engineering*, Jul. 2020, vol. 852, no. 1. doi: 10.1088/1757-899X/852/1/012041.

[9] O. Vermesan and P. Friess, 'Internet of Things-From Research and Innovation to Market Deployment'. [Online]. Available: http://riverpublishers.com/river

[10] K. Ashton, 'That "Internet of Things" Thing'.

[11] N. G. Kishore Kumar Reddy and K. Rajeshwari, 'Interactive clothes based on IOT using NFC and Mobile Application', in *2017 IEEE 7th Annual Computing and Communication Workshop and Conference, CCWC 2017*, Mar. 2017. doi: 10.1109/CCWC.2017.7868339.

[12] M. Babiuch, P. Foltynek, and P. Smutny, 'Using the ESP32 microcontroller for data processing', in *Proceedings of the 2019 20th International Carpathian Control Conference, ICCC 2019*, May 2019. doi: 10.1109/CarpathianCC.2019.8765944.

[13] K. Shafique, B. A. Khawaja, F. Sabir, S. Qazi, and M. Mustaqim, 'Internet of things (IoT) for next-generation smart systems: A review of current challenges, future trends and prospects for emerging 5G-IoT Scenarios', *IEEE Access*, vol. 8. Institute of Electrical and Electronics Engineers Inc., pp. 23022–23040, 2020. doi: 10.1109/ACCESS.2020.2970118.

[14] E. Ahmed, I. Yaqoob, A. Gani, M. Imran, and M. Guizani, 'Internet-of-things-based smart environments: State of the art, taxonomy, and open research challenges', *IEEE Wirel Commun*, vol. 23, no. 5, pp. 10–16, Oct. 2016, doi: 10.1109/MWC.2016.7721736.

[15] M. A. G. Maureira, D. Oldenhof, and L. Teernstra, 'ThingSpeak-an API and Web Service for the Internet of Things', 2014.

[16] M. J. Alam, S. A. Rafi, A. A. Badhan, M. N. Islam, S. I. Shuvo, and A. M. Saleque, 'Low Cost IoT based weather station for real-time monitoring', in *2020 IEEE 2nd International*

Conference on Circuits and Systems, ICCS 2020, Dec. 2020, pp. 127–133. doi: 10.1109/ICCS51219.2020.9336596.
[17] M. Azlan Abu, S. Fatimah Nordin, M. Zubir Suboh, and A. Faiz Ramli, 'Design and Development of Home Security Systems based on Internet of Things Via Favoriot Platform IoT For Electrical Systems View project Agricultural Prediction model using machine learning View project', 2018. [Online]. Available: http://www.ripublication.com
[18] Z. D. Y. Alshekhly, 'Development and design of a prototype for monitoring the water level in water wells using LoRaWAN', 2018.
[19] H. F. Frayyeh, M. A. Mukhlif, A. M. Abbood, and S. S. Keream, 'Speed Control of Direct Current Motor Using Mechanical Characteristics', *Journal of Southwest Jiaotong University*, vol. 54, no. 4, 2019, doi: 10.35741/issn.0258-2724.54.4.25.
[20] I. G. A. P. R. Agung, S. Huda, and I. W. A. Wijaya, 'Speed control for DC motor with pulse width modulation (PWM) method using infrared remote control based on ATmega16 microcontroller', in *Proceedings - 2014 International Conference on Smart Green Technology in Electrical and Information Systems: Towards Greener Globe Through Smart Technology, ICSGTEIS 2014*, Feb. 2014, pp. 108–112. doi: 10.1109/ICSGTEIS.2014.7038740.
[21] MET Motors, 'Why use DC motors instead of AC motors?', 2016.
[22] K. Niruba and S. Boopathi, 'Advanced power window motor using permanent Magnet DC motor', in *2014 Power and Energy Systems Conference: Towards Sustainable Energy, PESTSE 2014*, 2014. doi: 10.1109/PESTSE.2014.6805316.
[23] R. Kumar and A. Kumar, 'Design and hardware development of power window control mechanism using microcontroller', in *2013 International Conference on Signal Processing and Communication, ICSC 2013*, 2013, pp. 361–365. doi: 10.1109/ICSPCom.2013.6719813.
[24] S. Prabhu, S. M. Prabhu, and P. J. Mosterman, 'Model-Based Design of a Power Window System: Modeling, Simulation and Validation Model-Based Design of a Power Window System: Modeling, Simulation, and Validation'.
[25] AZO, 'RAIN SENSORS', 2018.
[26] https://www.pic-control.com/rain-sensor/, 'Rain sensor', 2015.
[27] I. Bord, P. Tardy, and F. Menil, 'Influence of the electrodes configuration on a differential capacitive rain sensor performances', *Sens Actuators B Chem*, vol. 114, no. 2, pp. 640–645, Apr. 2006, doi: 10.1016/j.snb.2005.06.049.
[28] M. H. Widianto, 'Pengaplikasian Sensor Hujan dan LDR untuk Lampu Mobil Otomatis Berbasis Arduino Uno', vol. 1, no. 2.
[29] V. Surya, P. ; Yusuf, and P. Yudatama, 'PROTOTYPE JEMURAN OTOMATIS MENGGUNAKAN SENSOR LDR, SENSOR HUJAN DAN SENSOR KELEMBAPAN BERBASIS ARDUINO UNO', [Online]. Available: www.bsi.ac.id
[30] Y. P. Y. V. S. P. Yayan Hendrian1, 'JemuranOtomatis Menggunakan Sensor LDR, Sensor Hujan Dan SensorKelembaban Berbasis Arduino Uno'.
[31] S. B. E. D. G. O. K. Togap M Banjarnahor1, 'JemuranPintarDenganSensorLdr, SensorHujan, SensorSuhuDanSensorKecepatanAnginBerbasisArduino'.
[32] S. W. Deny Siswanto1, 'JEMURAN PAKAIAN OTOMATIS MENGGUNAKANSENSOR HUJAN DAN SENSOR LDR BERBASISARDUINO UNO'.
[33] J. Okafor, 'DESIGN AND IMPLEMENTATION OF A RAIN SENSOR AS A PROTECTIVE SYSTEM', 2018, doi: 10.13140/RG.2.2.34760.47366/1.
[34] K. Nishant, K. Mohit, S. Amit, P. Vipul, and B. E. Research Student, 'Automatic Rain Operated Wiper System in Automobile: A Review', 2015. [Online]. Available: www.ijsrd.com

[35] G. M. Debele and X. Qian, ‘AUTOMATIC ROOM TEMPERATURE CONTROL SYSTEM USING ARDUINO UNO R3 AND DHT11 SENSOR’, 2020, doi: 10.1109/ICCWAMTIP51612.2020.9317307/20/$31.00.
[36] M. M. Tiwari, D. Narang, P. Goel, A. Gadhwal, A. Gupta, and A. Chawla, ‘WEATHER MONITORING SYSTEM USING IOT AND CLOUD COMPUTING’, *International Journal of Advanced Science and Technology*, vol. 29, no. 12s, pp. 2473–2479, 2020.
[37] Sami Kankaristo, ‘DEVELOPMENT OF A SECURE SENSOR SYSTEM FOR THE INTERNET OF THINGS-Gathering and visualizing data from IoT sensors’, 2019.
[38] B_E_N, ‘What is an Arduino?’, 2018.

APPENDICES

Appendix A Coding for esp32

ESP32_AMPAIAN | Arduino 1.8.19

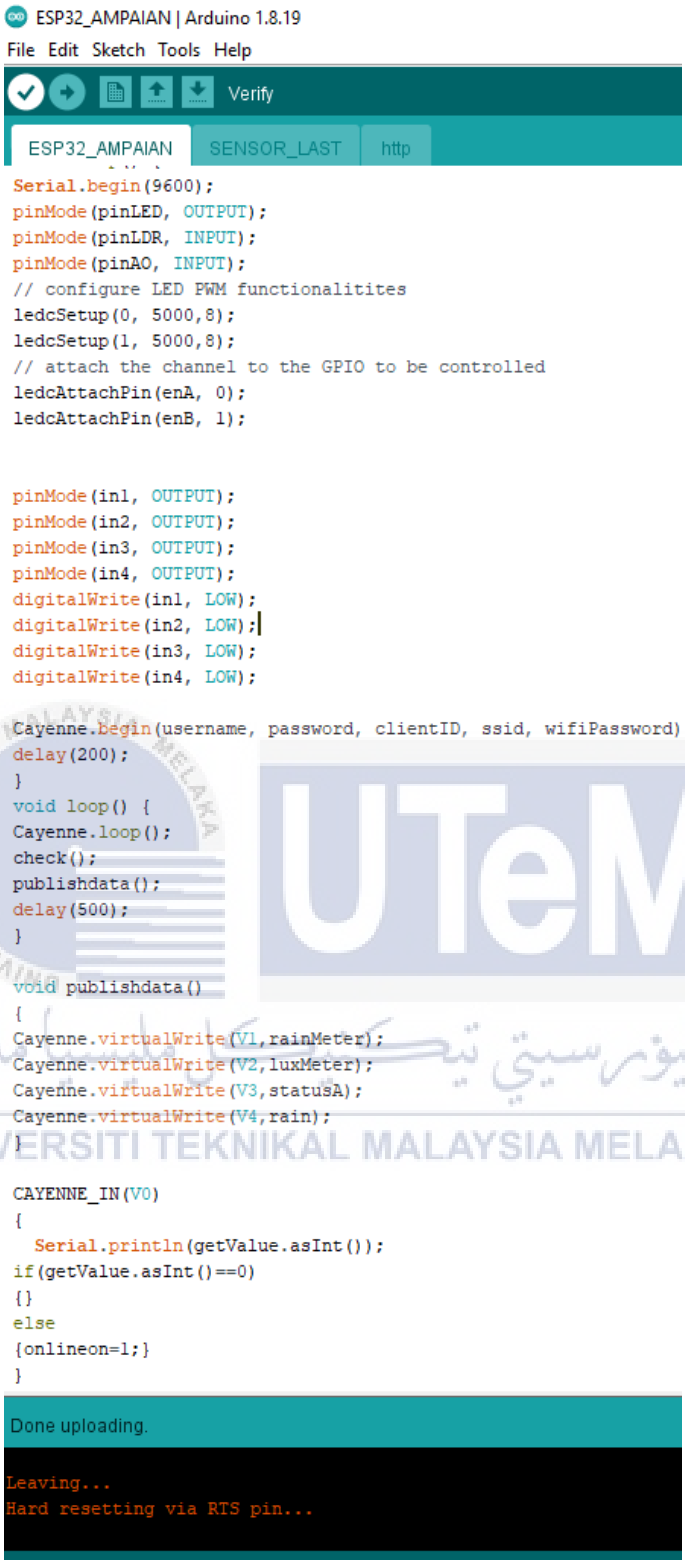
File Edit Sketch Tools Help

ESP32_AMPAIAN | SENSOR_LAST | http

```
#include <HTTPClient.h>
#define CAYENNE_PRINT Serial
#include <CayenneMQTTESP32.h>
// WiFi network info.
// WiFi network info.
char ssid[] = "BEEA";
char wifiPassword[] = "b08191ftk";

// Cayenne authentication info. This should be obtained from the Cayenne Dashboard.
char username[] = "cc4e3a00-8bdf-11ed-8d53-d7cd1025126a";
char password[] = "834580062cedb452f9312b8808627aa8c36217cf";
char clientID[] = "77c47e70-9046-11ed-8d53-d7cd1025126a";

const int pinLED = 2;
const int pinLDR = 34;
int s=0;
int pinAO = 35;
int val_analog;
int enA = 18;
int in1 = 26;
int in2 = 25;
int enB = 19;
int in3 = 33;
int in4 = 32;
int luxMeter = 0;
int rainMeter = 0;
int statusA = 0;
int pusin=1000;
int flag=0;
int onlineon = 0;
int onlineset =0;
int rain=0;
void setup() {
Serial.begin(9600);
pinMode(pinLED, OUTPUT);
pinMode(pinLDR, INPUT);
pinMode(pinAO, INPUT);
// configure LED PWM functionalitites
ledcSetup(0, 5000,8);
ledcSetup(1, 5000,8);
// attach the channel to the GPIO to be controlled
ledcAttachPin(enA, 0);
ledcAttachPin(enB, 1);


pinMode(in1, OUTPUT);
```

Done uploading.

```
Leaving...
Hard resetting via RTS pin...
```



Appendix B Coding for Sensor

ESP32_AMPAIAN - SENSOR_LAST.ino | Arduino 1.8.19

File Edit Sketch Tools Help

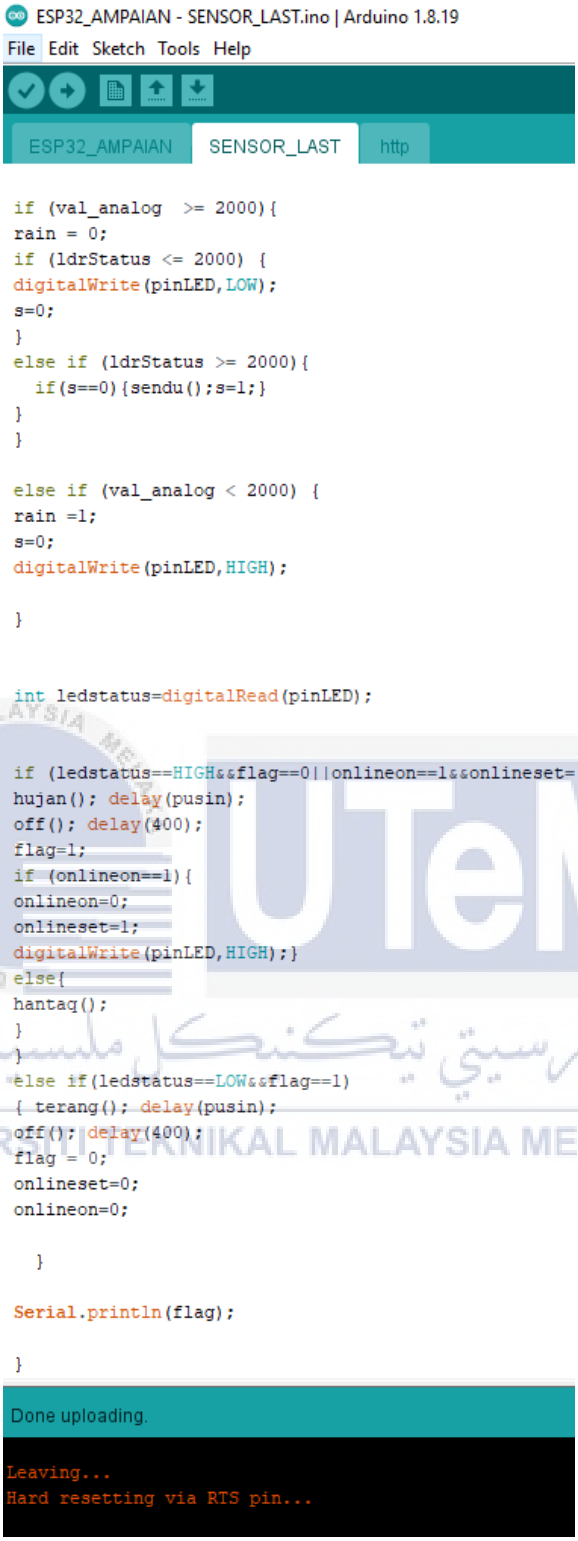
Verify

ESP32_AMPAIAN | SENSOR_LAST | http

```
void hujan() {
ledcWrite(0,60);
digitalWrite(in1,LOW);
digitalWrite(in2,HIGH);

ledcWrite(1,60);
digitalWrite(in3,LOW);
digitalWrite(in4,HIGH);
statusA = 1;
Serial.println("masuk");
}

void terang() {
ledcWrite(0, 60);
digitalWrite(in1,HIGH);
digitalWrite(in2,LOW);

ledcWrite(1,60);
digitalWrite(in3,HIGH);
digitalWrite(in4,LOW);
statusA = 0;
Serial.println("keluar");
}

void off() {
digitalWrite(enA,LOW);
digitalWrite(in1,LOW);
digitalWrite(in2,LOW);

digitalWrite(enB,LOW);
digitalWrite(in3,LOW);
digitalWrite(in4,LOW);
Serial.println("sleep");
delay(100);
}

void check() {
int ldrStatus = analogRead(pinLDR);
luxMeter = ldrStatus;
Serial.print("ldr : ");
Serial.println(ldrStatus);
val_analog=analogRead(pinAO);
rainMeter = val_analog;

Serial.println(val_analog);
```

Done uploading.

```
Leaving...
Hard resetting via RTS pin...
```



Appendix C Coding for Notification