Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF AN IOT BASED LAUNDRY NOTIFICATION SYSTEM WITH RAIN WATER SENSOR FOR CLOTHLINE USING MICROCONTROLLER

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Bachelor of Computer Engineering Technology (Computer Systems) with Honours

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DEVELOPMENT OF AN IOT BASED LAUNDRY NOTIFICATION SYSTEM WITH RAIN WATER SENSOR FOR CLOTHLINE USING MICROCONTROLLER

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in partial fulfillment of the requirements for the degree of
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DECLARATION

I declare that this project report entitled "**DEVELOPMENT OF AN IOT BASED LAUNDRY NOTIFICATION SYSTEM WITH RAIN WATER SENSOR FOR CLOTHLINE USING MICROCONTROLLER**" 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.

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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 Computer Engineering Technology (Computer Systems) with Honours.

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Date :

DEDICATION

I would like to express my gratitude to both of my parents, Abd Aziz bin Lisot and Siti Rohayawati Abdul Karim, for their support and encouragement during the completion of my senior Final Year Project. My parents always made sure to celebrate the little victories and give me words of encouragement whenever I accomplished something new. In addition to that, they made a pleasant space for me to work in so that I could generate concepts and find motivation to finish my duties.

ABSTRACT

In proportion to the growth of science and technology, human comfort and requirements are growing. Drying clothes is a time-consuming task if you must wait and maintain their dryness. This is because people are occupied with household chores or have busy working hours, leaving them with insufficient time to complete all domestic tasks, such as picking up clothing from their clothesline. In this project, hardware and software components are used to make it work. This project has three input sensors which are rain sensor, light, temperature and humidity sensor. Rain sensor works by detecting rain fall and notify the user when it rains. From here, the input from the rain sensor will determine whether the clothesline will extend or compress based on the conditions. Temperature and humidity sensor on the other hand works by monitoring the surrounding air of the clothesline and this will be displayed on the user interface of Blynk Application while light sensor will just indicate if it is bright or dark outside. NodeMCU ESP8266 will act as microcontroller where it will communicate with Blynk Application via Internet of Things (IoT) to send notification or data to the user's mobile phone. To extend or compress the clothesline, a servo motor will be used either after the rain sensor detects the presence of water or manually by the user. The software part that is used in this project are Arduino IDE and Blynk Application. Arduino IDE works as a coding platform for the working of NodeMCU ESP8266 and for the system to run whereas Blynk Application will act as a medium for the notification or data to be displayed for the user. This project has a significant influence on busy people by relieving them of their anxieties about their garments outside, allowing them to focus on other vital matters.

ABSTRAK

Selaras dengan pertumbuhan sains dan teknologi, keselesaan dan keperluan manusia semakin meningkat. Mengeringkan pakaian adalah tugas yang memakan masa jika anda mesti menunggu dan mengekalkan kekeringannya. Ini kerana orang ramai disibukkan dengan kerja rumah atau mempunyai waktu kerja yang sibuk, menyebabkan mereka mempunyai masa yang tidak mencukupi untuk menyelesaikan semua tugas domestik, seperti mengambil pakaian dari jemuran mereka. Dalam projek ini, komponen perkakasan dan perisian digunakan untuk menjadikannya berfungsi. Projek ini mempunyai tiga sensor input iaitu sensor hujan, cahaya, suhu dan kelembapan. Penderia hujan berfungsi dengan mengesan hujan turun dan memberitahu pengguna apabila hujan. Dari sini, input daripada sensor hujan akan menentukan sama ada tali jemuran akan memanjang atau memampat berdasarkan keadaan. Sensor suhu dan kelembapan sebaliknya berfungsi dengan memantau udara sekeliling jemuran dan ini akan dipaparkan pada antara muka pengguna Aplikasi Blynk manakala sensor cahaya hanya akan menunjukkan sama ada di luar cerah atau gelap. NodeMCU ESP8266 akan bertindak sebagai pengawal mikro di mana ia akan berkomunikasi dengan Aplikasi Blynk melalui Internet of Things (IoT) untuk menghantar pemberitahuan atau data ke telefon mudah alih pengguna. Untuk memanjangkan atau memampatkan tali jemuran, motor servo akan digunakan sama ada selepas sensor hujan mengesan kehadiran air atau secara manual oleh pengguna. Bahagian perisian yang digunakan dalam projek ini ialah Arduino IDE dan Aplikasi Blynk. Arduino IDE berfungsi sebagai platform pengekodan untuk kerja NodeMCU ESP8266 dan untuk sistem berjalan manakala Aplikasi Blynk akan bertindak sebagai medium untuk pemberitahuan atau data untuk dipaparkan kepada pengguna. Projek ini mempunyai pengaruh yang ketara kepada orang yang sibuk dengan menghilangkan kebimbangan mereka tentang pakaian mereka di luar, membolehkan mereka memberi tumpuan kepada perkara penting yang lain.

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I would like to express my gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for both the financial aid the university gave me and for the fact that it made it possible for me to finish the project. Not to mention my bestfriend Ainul Balqis binti Hairuddin for the fact that she was willing to discuss her thoughts and views on the project.

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Finally, I would want to express my gratitude to myself. I would want to thank myself for having faith, for putting in all this effort, for not taking any days off, for never giving up, for constantly being a giver and attempting to give more than I receive, and for having no days off.

TABLE OF CONTENTS

	PAGE
DECLARATION	
APPROVAL	
DEDICATIONS	
ABSTRACT	**i**
ABSTRAK	**ii**
ACKNOWLEDGEMENTS	**iii**
TABLE OF CONTENTS	**i**
LIST OF TABLES	**iii**
LIST OF FIGURES	**iv**
LIST OF APPENDICES	**vi**
CHAPTER 1 INTRODUCTION	**1**
1.1 Background	1
1.2 Problem Statement	2
1.3 Project Objective	3
1.4 Scope of Project	3
CHAPTER 2 LITERATURE REVIEW	**4**
2.1 Introduction	4
2.2 Wi-Fi Module	5
2.3 Rain Sensor	6
2.4 Temperature and Humidity Sensor	7
2.5 Previous Related Project	10
2.5.1 Smart Clothline System Based on Internet of Thing (IoT)	10
2.5.2 An IoT based Home Automation Using Android Application	12
2.5.3 Design of Laundry Box as Supporting Smart Laundry System Based on Internet of Things	13
2.5.4 Development of Laundry-work Assistance Robot by Using IoT Technology	15
2.5.5 Design and Implementation of Clothesline and Air Dryer Prototype Base on Internet of Things	16
2.6 Similar Projects	17
2.7 Summary	19
CHAPTER 3 METHODOLOGY	**20**
3.1 Introduction	20
3.2 Project Flowchart	20

3.2.1 Project Implementation Flowchart 20
3.2.2 Project Development Flowchart 21
3.2.3 Project Block Diagram 22
3.3 Hardware Specification 24
3.3.1 NodeMCU ESP8266 24
3.3.2 Rain Sensor 25
3.3.3 DHT22 Humidity and Temperature Sensor 26
3.3.4 LDR Sensor 27
3.3.5 Servo Motor 28
3.4 Software Specification 29
3.4.1 Arduino IDE 29
3.4.2 Blynk Application 30

CHAPTER 4 RESULT AND ANALYSIS 31
4.1 Introduction 31
4.2 Project Schematic Diagram 31
4.3 Software Development 33
4.4 Hardware Development 35
4.5 Prototype Development 36
4.6 Project Integration 38
4.6.1 Connection of NodeMCU ESP8266 38
4.6.2 Login to Blynk 39
4.6.3 Blynk Notification 40
4.6.4 Servo Motor Button 41
4.7 Data Analysis 42
4.7.1 The accuracy of notification sent based on the volume of raindrop and degree of rooftop 42
4.7.2 The accuracy of temperature and humidity sensor by comparing the data value with weather forecast and measured data in different cities 43
4.7.3 The distance of light from the LDR sensor 45
4.7.4 The accuracy of servo motor based on the condition of the weather read by the rain sensors 45
4.8 Summary 46

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS 47
5.1 Conclusion 47
5.2 Future Works 48

REFERENCES 49

APPENDICES 51

LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1	Differences between ESP32 and NodeMCU ESP8266 [6][7]	5
Table 2.2	Rain Sensor Test Result [9]	7
Table 2.3	Differences between DHT11 and DHT22 [8]	7
Table 2.4	Humidity Sensor Test Result <65% [9]	9
Table 2.5	Humidity Sensor Test Result >65% [9]	9
Table 2.6	Comparison table of previous projects	17
Table 3.1	Pin configuration of Rain Sensor [10]	25
Table 3.2	Technical Specification of DHT22 [8]	26
Table 3.3	Pin configuration of LDR Sensor	27
Table 3.4	Wire Configuration of Servo Motor [12]	28
Table 4.1	Widgets used on Blynk Application	34
Table 4.2	Different view of the prototype	36
Table 4.3	Rain Sensor Volume Notification Test Result	42
Table 4.4	Rain Sensor Degree Notification Test Result	42
Table 4.5	Temperature and Humidity Test Result in Ayer Keroh, Melaka at 1:00PM	43
Table 4.6	Temperature and Humidity Test Result in Durian Tunggal, Melaka at 1:00PM	43
Table 4.7	Comparison of temperature and humidity in Ayer Keroh, Melaka at 1:00PM	44
Table 4.8	Comparison of temperature and humidity in Durian Tunggal, Melaka at 1:00PM	44
Table 4.9	LDR Sensor Test Result	45
Table 4.10	Automation Test Result	45

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1	Schematic Diagram of Rain Sensor [10]	6
Figure 2.2	Block Diagram of Smart Clothline System	11
Figure 2.3	Block Diagram of Home Automation System	12
Figure 2.4	Block Diagram of Smart Laundry System	14
Figure 2.5	Block Diagram of Laundry-work Assistance Robot System	15
Figure 2.6	Design Prototype of the system	16
Figure 3.1	Project Workflow	20
Figure 3.2	Flowchart of the Project	21
Figure 3.3	Block Diagram of the Project	22
Figure 3.4	NodeMCU ESP8266 [6]	24
Figure 3.5	Pin-Out Configuration [6]	24
Figure 3.6	Rain Sensor [10]	25
Figure 3.7	DHT22 [8]	26
Figure 3.8	LDR Sensor	27
Figure 3.9	Servo Motor [12]	28
Figure 3.10	Arduino IDE Startup	29
Figure 3.11	Blynk Application Icon	30
Figure 3.12	Example of project dashboard	30
Figure 4.1	Schematic diagram of the project	31
Figure 4.2	Project Dashboard on Mobile Application	33
Figure 4.3	Hardware configuration of the project	35
Figure 4.4	Draft prototype for the project	36
Figure 4.5	Final prototype design	37

Figure 4.6	Block Diagram of internet connection with NodeMCU ESP8266	38
Figure 4.7	Login page on Blynk Application	39
Figure 4.8	Servo motor moves to 0° when rain is detected	40
Figure 4.9	Servo motor moves to 90° when no rain detected	40
Figure 4.10	Servo motor moves to 90° when user switch to ON	41
Figure 4.11	Servo motor moves to 0° when user switch to OFF	41

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix A	Gantt Chart PSM 1	51
Appendix B	Gantt Chart PSM 2	51
Appendix C	Source Code	52

CHAPTER 1

INTRODUCTION

1.1 Background

In our standard of living, we devote a great amount of time to cleaning our clothes. Laundry is typically dried outside since sunlight has antibacterial and effective properties. [1]. However, the temperature has an effect on the laundry since it may be hard to do the laundry when rain is predicted, and clothing becomes wet when it rains suddenly. This also becomes an issue when people neglect to remove their garments from the clothesline when it rains. In addition, [2] Malaysia's location above the equator causes rain and humidity throughout the year. This will produce in clothing that are neither dry nor odor-free. Increasingly, it relies on information technology to improve productivity and assist daily operations. [2]. Therefore, a large number of innovations were produced with the assistance of the internet in order to facilitate simple communication between all devices that are linked to the internet. That means that any and all gadgets may be accessed in real-time.

1.2 Problem Statement

People in the current day is extremely active and competitive that they always find ways to ease their daily life routine because of their busy lifestyle.[2] Most people nowadays, both men and women, prioritize their careers, thus simple details like household chores are sometimes disregarded, such as drying clothes, which can take a long time if all of the processes must be done. The process of drying clothes might be difficult, especially now that the rainy season has arrived. As a result, technology keeps to grow and pitch as a quick fix to every issue that develops in mankind, including the difficulties that have been mentioned.

This issue can be mitigated with a laundry notification with automated clotheslines system, particularly for home settings. It was intended to help human beings to juggle between doing other household chores and managing their laundry while at home. While the clothes are hanged outside, this system will detect any changes in rain, temperature and humidity where the clothesline will compress or extend based on the conditions. This approach will enhance the effort to resolve the issue without requiring anyone to physically intervene.

1.3 Project Objective

The primary goal of this project is to provide a method that is both systematic and effective for with a level of accuracy that is acceptable. The following is a more detailed list of the objectives:

a) To develop a clothesline system that extend and compress based on specific conditions

b) To develop a laundry notification IoT-based system so users can monitor their clothes condition remotely using Blynk Application

c) To develop a system that can detect the presence of rain and compress clothesline without human intervention

1.4 Scope of Project

In order to eliminate any potential for confusion regarding the outcome of this project as a result of certain limitations and restrictions, the scope of the project has been established as follows:

a) Inform user if it rains and can view the light, temperature and humidity value in the user scope

b) Rain, light, temperature and humidity data are collected from the sensors

c) The data for temperature and humidity will be collected in real time and displayed in Blynk Application

d) During extending and compressing of the clothesline system, servo motor can only rotate in the range of 0° to 90°.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The research is based on a study completed within five years of the execution of the project. It is appropriate to be used as a reference. In addition, the applicability of the search strategy to the actual project will be studied, evaluated, and decided. The pros and cons of hardware and system must be taken into account in order to make the selection of hardware for assembly in this project more precise. Finally, previous study results and techniques will be compared and examined to ensure they serve as the most reliable and relevant source of information for this project.

2.2 Wi-Fi Module

In most cases, Wi-Fi Modules are surface-mount devices connected to the host PCB with solder (PCB). Some researchers have used ESP32 and NodeMCU ESP8266 in the past to build a link between devices and the internet. Low-cost Wi-Fi modules like the NodeMCU ESP8266 and ESP32 are frequently used in Internet of Things (IoT) projects. Using Wi-Fi, we can simply monitor and control the system from afar.

Both the ESP32 and NodeMCU ESP8266 are WiFi-centric SOCs (Systems on Chop). Both microcontrollers contain a 32bit CPU, with the NodeMCU ESP8266 operating at 160MHz single core [6] and the ESP32 operating at 80MHz to 240MHz twin core [7]. The NodeMCU ESP8266 and ESP32 are two distinct toolkits. The NodeMCU ESP8266 consumes less energy than its rival, while having more digital pins. ESP32 systems have greater GPIO, allowing them to work on projects that are more complicated and practical.

Table 2.1 Differences between ESP32 and NodeMCU ESP8266 [6][7]

ESP32	Model	NodeMCU ESP8266
BLE & Bluetooth 4.2	**Bluetooth**	No
Yes	**SRAM**	No
600 DMIPS Xtensa Dual-core 32-bit	**MCU**	L106 Xtensa Single-core 32-bit
160MHz	**Frequency of use**	80Mhz
Yes	**Flash**	No
34	**GPIO Pins**	17
Yes	**Sensor of temperature**	No
Yes	**Sensor of touch**	No
HT40	**Wi-Fi 802.11 b/g/n**	HT20

2.3 Rain Sensor

The rain sensor module is a straightforward instrument for determining the presence of rain [5]. It is possible to use a raindrop that passes through the rainy board as a switch, and it may also be used to determine how intense the rainfall is. The module features a power indicator LED, a potentiometer, and a separate rain board and control board for convenience [10]. Additionally, the sensitivity can be adjusted using the potentiometer. Changes in rainfall totals can be detected through analysis of the analog output.

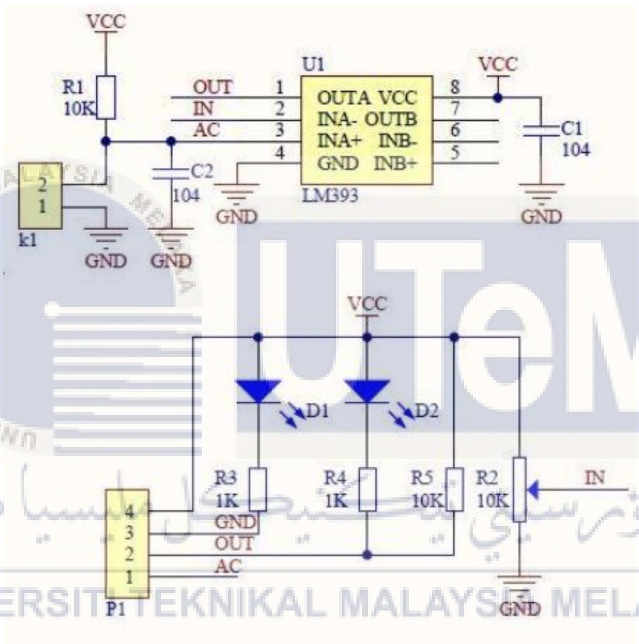


Figure 2.1 Schematic Diagram of Rain Sensor [10]

The testing of rain sensors involves simulating rain by pouring water over the sensor using a pipette. The quantity of water droplets in the experiment was varied. If the indication light illuminates when the sensor is wet and turns off when it is dry, this sensor is reliable and should be utilized.[9]

Table 2.2 Rain Sensor Test Result [9]

Test	Water (ml)	Indicator Light	Information
1	0	Off	dry
2	0,05	Off	1 drop pippete
3	0	Off	be dried
4	0,10	On	2 drop pippete
5	0	Off	be dried
6	0,15	On	3 drop pippete
7	0	Off	be dried
8	0,20	On	4 drop pippete
9	0	Off	be dried
10	0,25	On	5 drop pippete

Referring to Table 2.6, the sensor's sensitivity is intentionally tuned to be inactive when the input received is less than 0.1 ml (less than two drops of the pipette) in order to differentiate between rain inputs and inputs from other water sources such as dew, water vapor, etc. [9]

2.4 Temperature and Humidity Sensor

The DHT is a low-cost digital temperature and humidity sensor.[8] It makes use of a humidity sensor that is based on a capacitor in conjunction with a temperature sensor component, in order to obtain an accurate reading of the ambient temperature and humidity. After the digital signal created by the sensor has been sent, it should be transferred to the appropriate data pin. This sensor is accurate, and it can perform in a wide variety of environmental conditions regarding temperature and humidity.

Table 2.3 Differences between DHT11 and DHT22 [8]

DHT11	**Model**	DHT22
0 – 50°C / ±2°C	**Temperature Range**	-40 – 80°C / ±0.5°C
20 – 90% / ±5%	**Humidity Range**	0 – 100% / ±2 – 5%

1Hz	**Sampling Rate**	0.5Hz
15.5mm x 12mm x 5.5mm	**Body Size**	14mm x 18mm x 5.5mm
3 – 5V	**Operating Voltage**	3.3 – 6V
2.5mA	**Max Current During Measuring**	2.5mA

Based on Table 2.3, it can be seen that DHT22 is much more accurate in the temperature and humidity range. To test the humidity level, an experiment using hygrometer is used to measure it. Sensors and hygrometer are placed in rooms with varying humidity levels to acquire moisture fluctuations. Alternatively, a cloth that is moist or somewhat damp might be used.

Table 2.4 Humidity Sensor Test Result <65% [9]

Test	Hygro meter (%)	DHT (%)	Fan	Deviation	Error (%)
1	51	57	Off	6	11,76
2	53	59	Off	6	11,32
3	52	58	Off	6	11,53
4	52	57	Off	5	9,62
5	54	59	Off	5	9,26
6	53	58	Off	5	9,43
7	53	57	Off	4	7,55
8	53	58	Off	5	9,43
9	57	60	Off	3	5,26
10	56	59	Off	3	5,36
Average				4,8	9,05

Table 2.5 Humidity Sensor Test Result >65% [9]

Test	Hygro meter (%)	DHT (%)	Fan	Deviation	Error (%)
1	64	67	On	3	4,69
2	68	71	On	3	4,41
3	68	72	On	4	5,88
4	67	71	On	4	5,97
5	66	69	On	3	4,55
6	64	67	On	3	4,69
7	62	66	On	4	6,45
8	74	77	On	3	4,05
9	67	70	Off	3	4,48
10	68	73	On	5	7,35
Average				3,5	6,15

As seen in Table 2.4, all moisture samples identified by the sensor <65% have the indicator fan turned off. This means that the humidity sensor used has met one of two prerequisites for use. While in table 2.5, the indication fan is on for all moisture samples detected by the sensor that are greater than 65%. This ensures that the moisture sensor being utilized is worthwhile. It is also known that for humidity figures > 65%, the difference between the hygrometer measurement and the sensor's value on average is 3.5. [9]

2.5 Previous Related Project

To gain a better understanding of this project, I continue my research on previous related projects that are largely focused on using IoT. This information will assist in the project's implementation and completion. As a result, this section will provide some background information on a similar effort with a similar purpose of resolving some of laundry difficulty.

2.5.1 Smart Clothline System Based on Internet of Thing (IoT)

According to Zakiah Mohd Yusoff, Zuraida Muhammad, Amar Faiz Zainal Abidin, KA Nur Dalila, Noor Fadzilah Razali, Masmaria Abdul Majid, KK.Hasan [4], one are occupied with household chores or have a long working hours that stops them from managing their clothes. The authors' main idea for this project was to have a smart cloth line that can be used to avoid the clothes from getting drenched with rainwater. For this project, it uses rain sensor to detect if there is any water present. Whenever the rain sensor detects rain, the smart cloth line will compress and expand when it stops. As to measure the surrounding air, a capacitive humidity sensor and a temperature sensor were utilized. It changes the overall capacitance to deliver the signal to the data pin in digital.

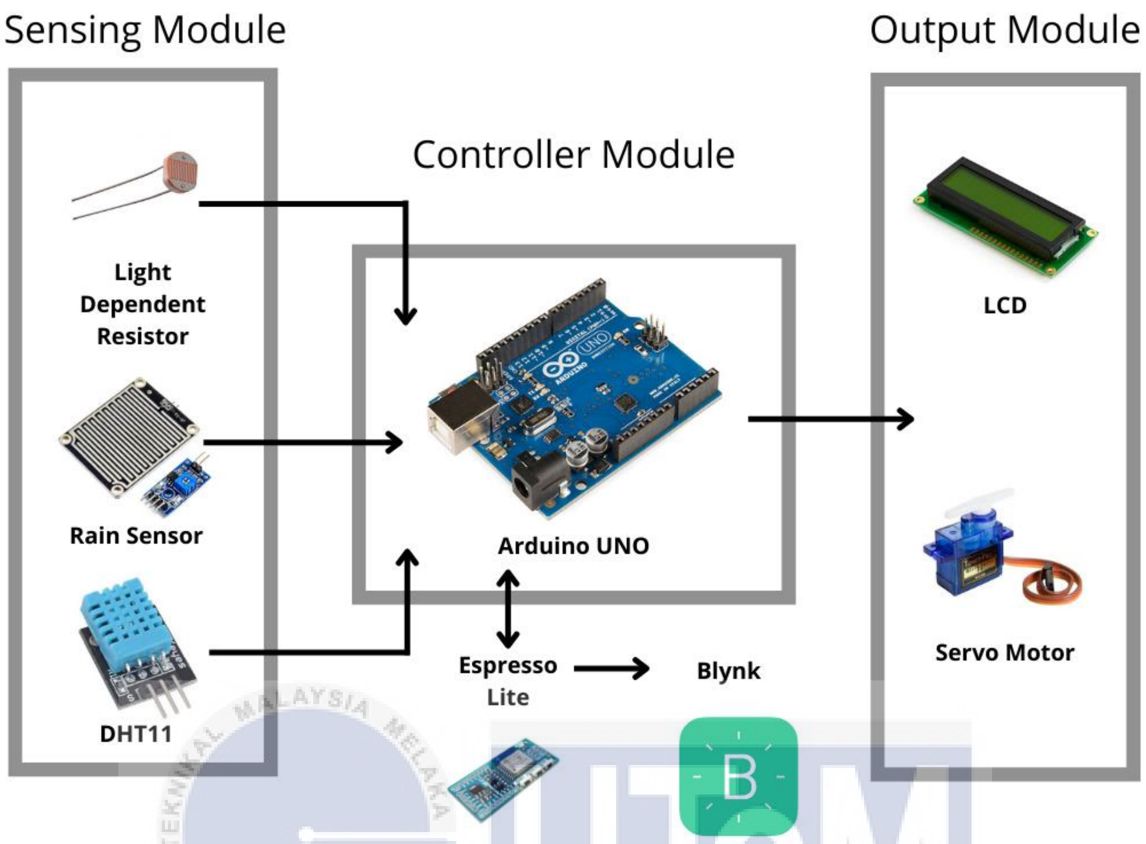


Figure 2.2 Block Diagram of Smart Clothline System

As can be seen in Figure 2.2, this project also uses Espresso Lite for sending notifications to the user through Blynk application purposes. All the sensors like Light Dependent Resistor (LDR), rain sensor, temperature and humidity sensor will act as input and give the information to the microcontroller, Arduino Uno. Arduino Uno will then calculate all the possibilities and decide whether to compress or expand the smart clothesline where this all will also be sent as a notification to the user via their mobile phone through Blynk application.

2.5.2 An IoT based Home Automation Using Android Application

This project proposed by P.Siva Nagendra Reddy, K.Tharun Kumar Reddy, P.Ajay Kumar Reddy, Dr.G.N.Kodanda Ramaiah, S.Nanda Kishor [5] has a goal that is to to design an android home automation system that is both virtual and practical. The key advantage of this system is that it allows us to manage the voltage levels of home appliances in our homes, such as fan speed based on temperature and brightness level, and we can also check the report of our appliances from our Android phones. In this project, different sensors like rain sensor, temperature sensor and Light Dependent Resistor (LDR) is used for different applications.

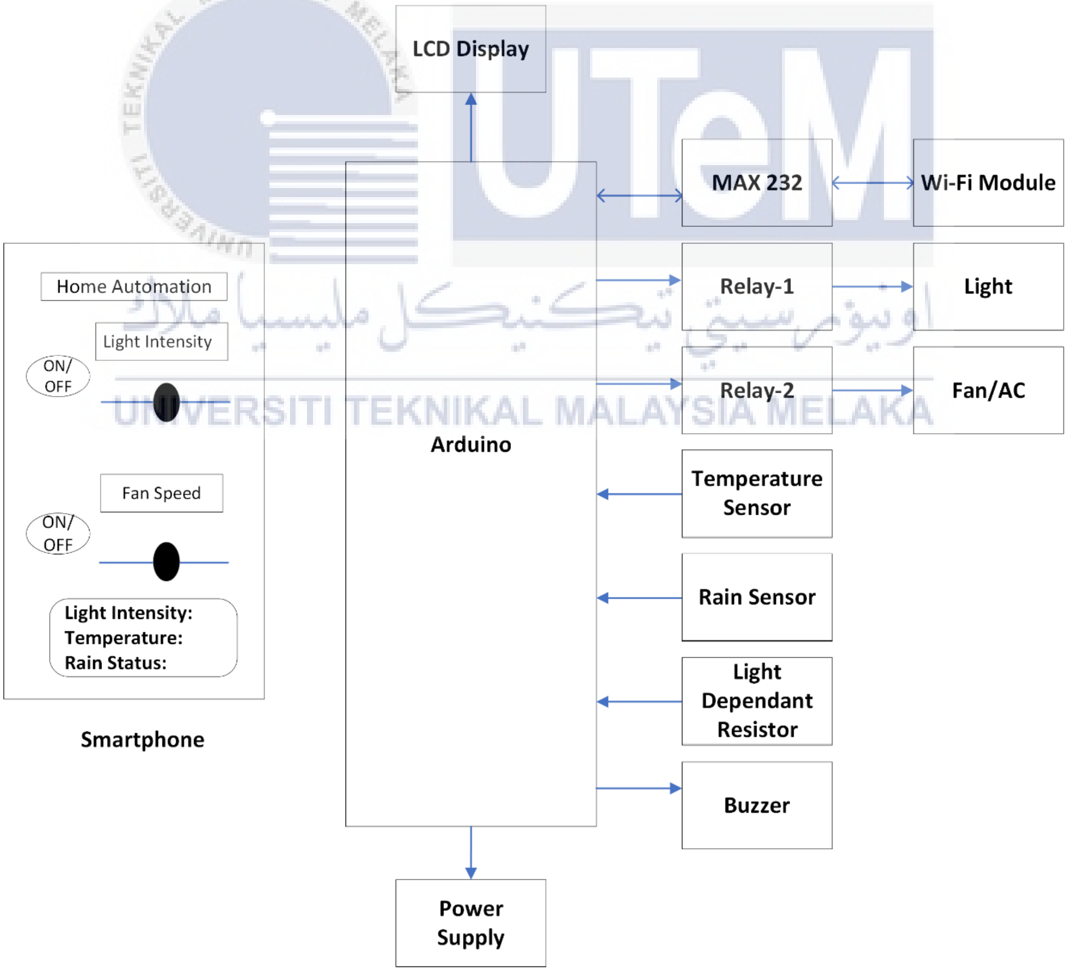


Figure 2.3 Block Diagram of Home Automation System

Based on Figure 2.3, we can see that the temperature sensor, Light Dependent Resistor (LDR), and rain sensor are all linked to the Arduino board so that the fan speed, brightness level, and rain detection can be managed. Depending on the temperature in our home, fan's speed can be changed. The LM35 sensor is used to measure temperature and while utilizing LDR, the brightness of light can be changed depending on the need. Rain sensor detects the presence of rain and displays the status on the LCD display and Android mobile. The LCD display also shows the status of the light and the fan. MAX232 is used to link the Wi-Fi module to the Arduino board. The Arduino board is connected to the light and fans through a relay that acts as a switch.

2.5.3 Design of Laundry Box as Supporting Smart Laundry System Based on Internet of Things

This project curated by Event Muhammad Rizki, Surya Michrandi Nasution, Anggunmeka Luhur Prasasti [3] proposes the idea of a laundry box that can assist someone who does not have time to go to the laundry. Those who wants to clean their clothing, this project will ensure that clothes are not stacked up and moldy since the laundry box will send a message to the laundry to carry clothes to where the laundry box is placed.

There are multiple sensors in this laundry box which are: a colour sensor, a load sensor, and a humidity sensor. The colour sensor detects the colour of the garments in the laundry box, which will show a 1 for not white and a 0 for white output. Humidity sensor determines the humidity of the clothes in the laundry box, ensuring that the garments do not develop mold due to the high humidity whereas the weight sensor determines the gram load of the garments in the laundry box. The sensors all work together to provide data to Antares in real time.

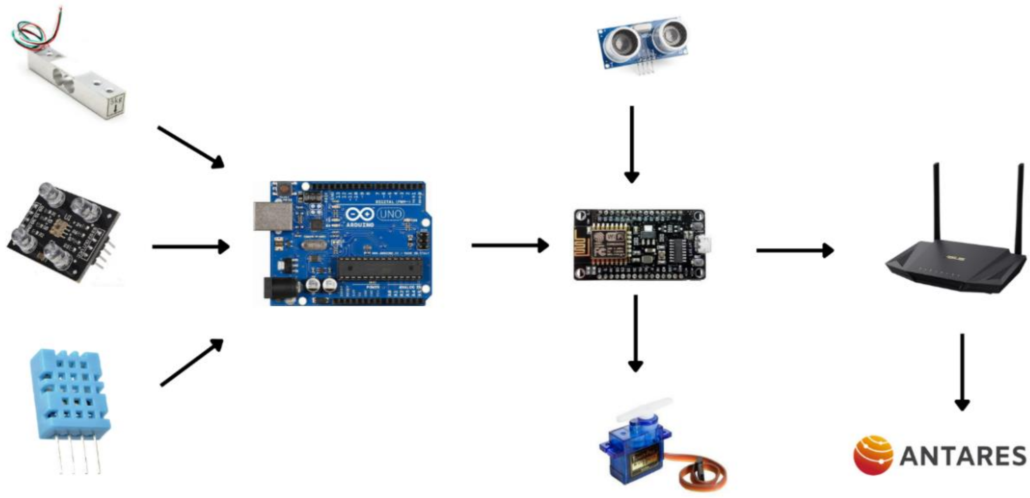


Figure 2.4 Block Diagram of Smart Laundry System

Figure 2.4 depicts the smart laundry system uses four devices with their respective functions. In this system it uses HX711 sensor as weight sensor, TCS3200 as colour sensor, DHT11 to measure humidity and HC-SR04 as ultrasonic sensor to measure the distance for opening and closing of the laundry box. Servo motor on the other hand helps in opening the automatic lid of laundry box.

Every working sensor will be powered by Arduino, which will process the data it generates. The processed data will be delivered wirelessly across the internet network through the node. The information will be forwarded to Antares. Humidity data in units (%), the result of the sum of loads in units (g), and colour in units 1 for colour and 0 for colorless are all included in the data supplied to Antares.

2.5.4 Development of Laundry-work Assistance Robot by Using IoT Technology

K. Kanazawa, S. Kazuno, Y. Shiozawa, M. Isshiki, M. Okumura [1] developed a robot that can shield laundry from sudden rain, taking in laundry if its raining and control all those operations remotely. Instead of battery, they use a solar panel that can reduce power consumption in this project. This system is made up of an uptake module for bringing in the laundry, a curtain module for controlling the curtains, and a server module for delivering data to each mechanism based on the user's actions in the application.

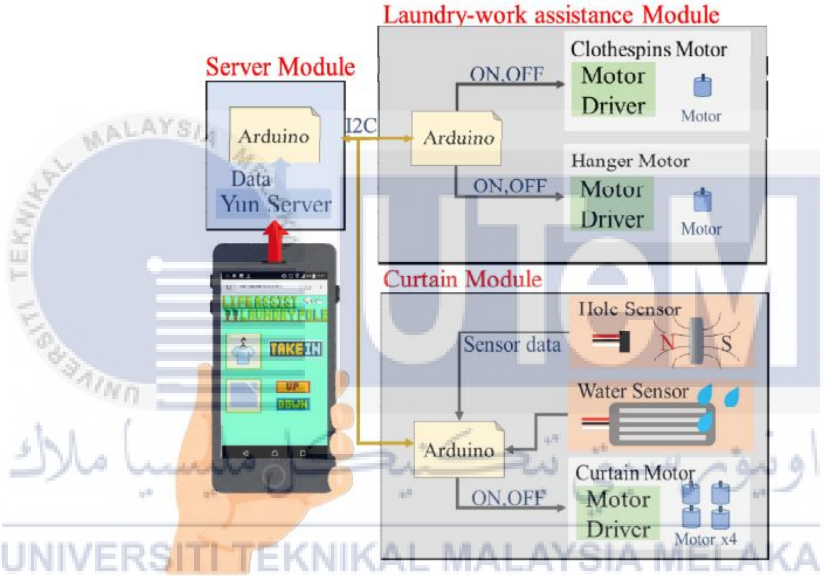


Figure 2.5 Block Diagram of Laundry-work Assistance Robot System

Referring to Figure 2.5, the web application is stored in the server module, which was designed by Arduino Yun. By using Arduino Yun, the user may control it. The program offers three buttons for laundry uptake, curtain up and down and can be controlled by a user operation. The Arduino Pro Mini uptake module controls a mechanism that opens the clothespins and a device that lowers the laundry from the hanger. This module's uptake function is only activated when the user interacts with the webpage. The curtain module is also constructed using an Arduino Pro Mini and is triggered when the water sensor detects moisture or the user interacts with the app.

2.5.5 Design and Implementation of Clothesline and Air Dryer Prototype Base on Internet of Things

The author of this project, Mohammad Haekal Gifari, Irfan Fahmi, Ajid Thohir, Abdullah Syafei, Rina Mardiati, Eki Ahmad Zaki Hamidi [9] states that drying garments takes a long time if we have to wait for them to dry completely. Garments that have been dried outside usually become wet again due to rain, and no one take them in for numerous reasons.

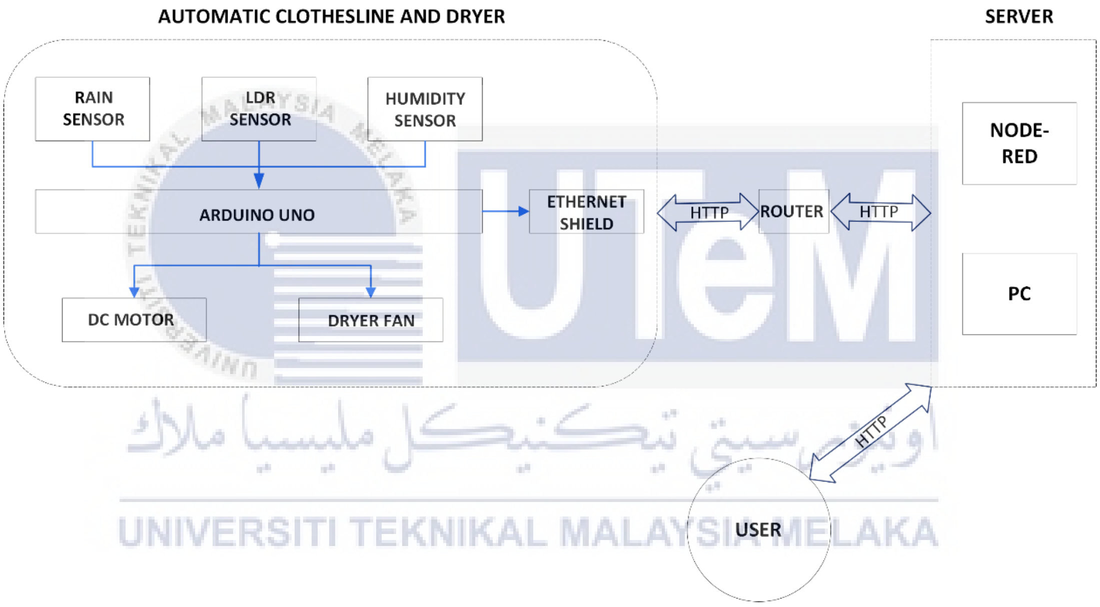


Figure 2.6 Design Prototype of the system

Based on Figure 2.6, the tool parts, the server, and the user make up the design of the prototype based on IoT. The sensor detects the tool section's parameters/stimulus and delivers them as input to the microcontroller, Arduino Nano. The light sensor detects the quantity of exposure, the humidity sensor monitors the humidity level in the storage room, while the rain sensor detects the presence of rain. In addition, the microcontroller will process the inputs before sending a command signal to the driver and relay based on the information collected.

2.6 Similar Projects

Table 2.6 Comparison table of previous projects

Bil	Reference	Features	Advantage	Disadvantage
1.	Smart Clothline System Based on Internet of Thing (IoT) [4]	The mechanical sections of the fabric line compress and expand when raining, when it stops, they expand. Sends a notification when it rains to the user's phone automatically	1. Easy to implement in every household 2. Affordable	1. Can only send notification and not control the system remotely,
2.	An IoT based Home Automation Using Android Application [5]	Can control home device's voltage levels and set fan speed according to the temperature	1. A low-cost, safe, and widely accessible project that can be controlled remotely 2. Help to reduce electric usage remotely	1. The application does not support iOS
3.	Design of Laundry Box as Supporting Smart Laundry System Based on Internet of Things [3]	NodeMCU is used to collect all sensor data and deliver it straight to the cloud in real time.	1. Uses a load cell that can weight clothes in real time	1. Expensive as it uses a lot of sensors

Bil	Reference	Features	Advantage	Disadvantage
4.	Development of Laundry-work Assistance Robot by Using IoT Technology [1]	The Assisstance Robots can protect laundry from rain, collect laundry, and be remotely controlled	1. Does not need man power to handle 2. Uses solar power instead of battery for the Assistance Robot	1. Costly to implement
5.	Design and Implementation of Clothesline and Air Dryer Prototype Base on Internet of Things [9]	Clothesline will be compressed if the system detects that it is nightime or when it is raining. If the humidity is high, dryer fan will be turned on	1. Has a dryer fan that can dry clothes when the clothes are pulled under roof 2. Has an automated mode that works based on sensor inputs	1. Not suitable for every household

2.7 Summary

Based on the research that was conducted as part of a previous relevant project, we can state that there are numerous ways that can be used to protect garments from rain. The information acquired can help achieve the major objectives throughout the project’s life cycle. Many elements must be considered, including the type of components used, the cost of those components, and how they will be deployed. As a result, we can see that every project has benefits and drawbacks, but as long as it benefits society, it should be implemented.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter outlines the research methods utilized to construct the project and achieve its goals. In order to sustain the project’s momentum, extensive research was conducted on the employed hardware to gain a better grasp of how to handle it and the right model for this project. It is also essential for acquiring a thorough comprehension of the project flowchart. The process flow is given in great depth, followed by the hardware specifications.

3.2 Project Flowchart

To determine and ensure a project's efficacy, it is essential to create an organized and efficient workflow chart. A well-organized and well-thought-out plan is vital to the success of an activity. After you have done your planning, the next step is to undertake research. To simplify matters, it is necessary to implement a project. Every potential issue can be recognized and avoided during project implementation due to exhaustive investigation. Consequently, the project's design is developed, followed by its implementation. After the project was done, it was analyzed to determine its efficacy.

3.2.1 Project Implementation Flowchart

Figure 3.1 Project Workflow

Defining project objectives is the initial phase in the planning process, so that the project's execution goals are clear. The objective of this project is to develop a laundry notification system that can read data from rain, temperature, and humidity sensors. In order to meet the objective requirements that have been established, a number of factors are analyzed and reviewed. Additionally, the project's scope is established so that its limits can be defined.

3.2.2 Project Development Flowchart

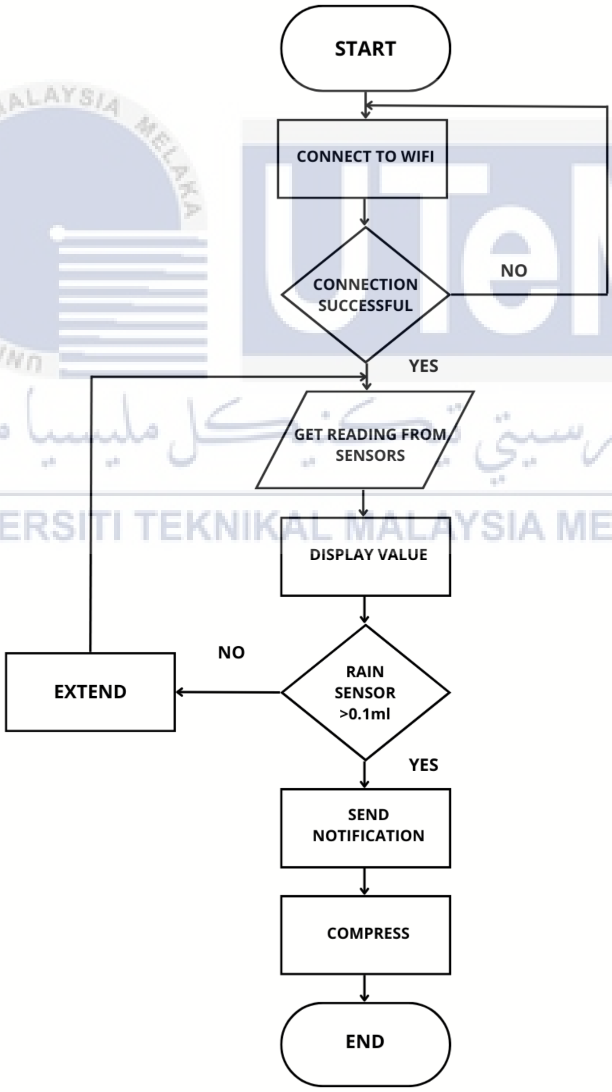


Figure 3.2 Flowchart of the Project

Based on Figure 3.2, the system will initially connect to the Wi-Fi and if the connection is successful it will generate the value of sensors and display the value on the dashboard of the user. Following the transmission of input data to the microcontroller by the sensor, which occurs when it detects rain, the clothesline will compress if the rain drops is more than 0.1ml. However, the clothesline will extend if the water sensory detects rain drops to be less than 0.1ml and at the same time, will keep on reading the humidity and temperature value of its surrounding for the users to monitor.

In order to coordinate the system, a microcontroller called NodeMCU ESP8266 will be used. This microcontroller will calculate the input from all of the sensors to either compress or extend the system. After that, the system will contact the user by way of their mobile phone and the Blynk application for the purpose of sending notification.

3.2.3 Project Block Diagram

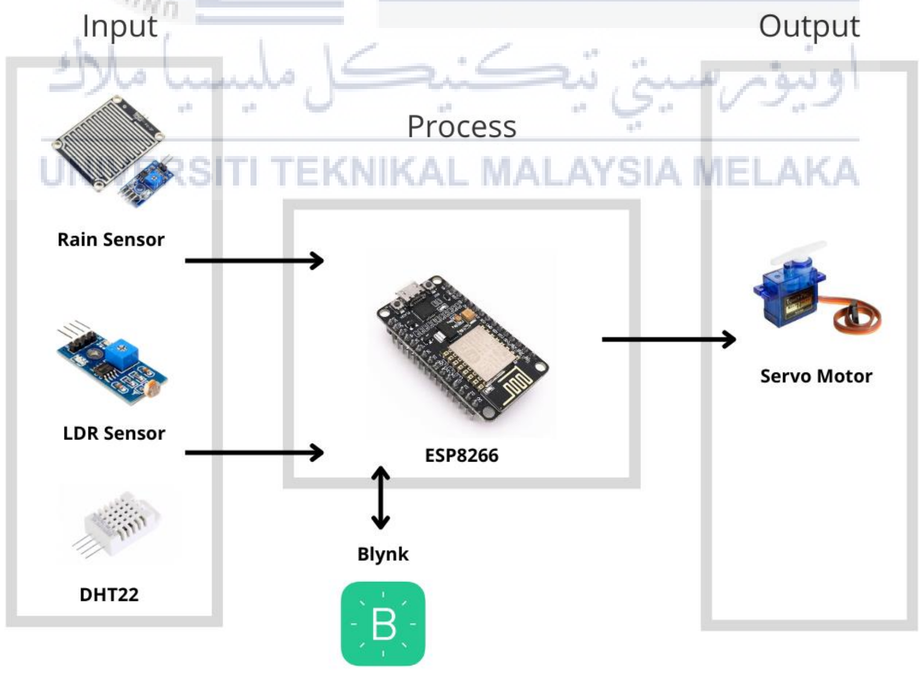


Figure 3.3 Block Diagram of the Project

In Figure 3.3, the DHT22 sensor, LDR sensor as well as the rain sensor, make up the input. DHT22 will read the value of both temperature and humidity of the surrounding area while LDR sensor will determine if it is bright or dark. The way that LDR sensor works is by changing the resistance value alongside the difference in amount of rain fall onto it. The rain sensor is responsible for determining whether or not rain is actually falling outside. The rain will have the same effect as a variable resistor, meaning that the resistance value will decrease as more water accumulates on the board. DC motors are what the output consists of. The maximum amount of rotation that the DC motor is capable of is 180 degrees.

Once the shaft has reached the required point, the potentiometer will stop moving because it will have reached that position. The value of the resistance can be altered through the usage of the potentiometer in accordance with the rotation of the DC motor. After that, the control unit will determine whether the motion will turn right or left depending on what it determines. The Blynk program was integrated into the controller module, which consists of a NodeMCU ESP8266. The addition of these components was made with the intention of sending notifications to the user.

3.3 Hardware Specification

3.3.1 NodeMCU ESP8266

Referring to Figure 3.4, NodeMCU ESP8266 is a WiFi module with an IP/TCP protocol stack and a self-contained or complete chip (SOC). The ESP8266 provides access to any microcontroller over a WiFi connection and can host any program or offload all WiFi networking functionality. It is extremely durable and can resist the most demanding industrial environments. This microcontroller has extensive inbuilt processing and storage capabilities, enabling its usage with sensors and other applications.

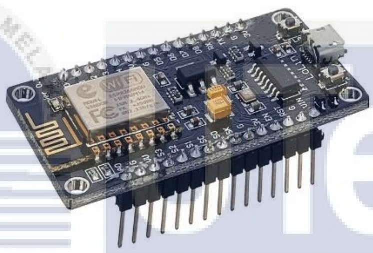


Figure 3.4 NodeMCU ESP8266 [6]

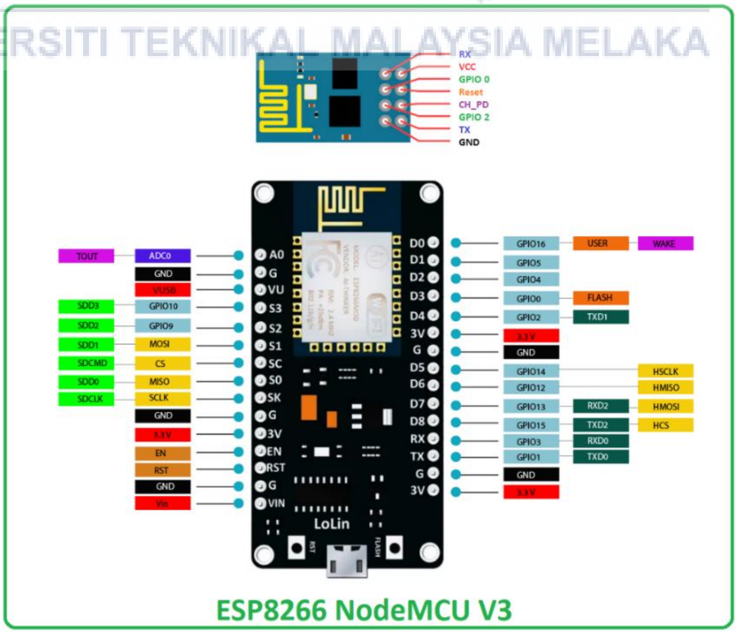


Figure 3.5 Pin-Out Configuration [6]

3.3.2 Rain Sensor

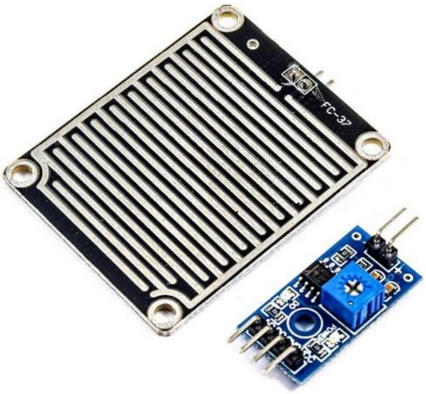


Figure 3.6 Rain Sensor [10]

The rain sensor is a straightforward instrument for detecting rainfall. The sensor in Figure 3.6 can be used to measure rainfall, and when rain lands on the sensor board, a switch is activated. Two components make up this sensor: the controller and the rain board. This sensor is a member of the family of analog sensors. Among the characteristics of this sort of sensor are the following: It operates on 5 volts, has digital and analog output, is simple to install and use, has anti-oxidation features, is of excellent quality and has a potentiometer to adjust the sensitivity [10].

Table 3.1 Pin configuration of Rain Sensor [10]

Name	**Function**
VCC	Connects supply voltage of 5V
GND	Connects to ground
D0	Digital pin to get digital output
A0	Analog pin to get analog output

3.3.3 DHT22 Humidity and Temperature Sensor

Figure 3.7 DHT22 [8]

Based on Figure 3.7, DHT22 is a sensor that measure temperature and humidity in the air, and it is capable of producing a score that is quite accurate. A microcontroller such as an ESP8266 may be utilized in order to exercise control over this sensor. A score in air humidity that falls within the range of 0-100 can be read off of a DHT22 sensor [8]. The output of the sensor is a digital signal that must be sent to the appropriate information pin. This sensor measures a wide variety of temperature and humidity factors precisely and effectively. The higher the humidity score, the more humidity there will be in the air.

Table 3.2 Technical Specification of DHT22 [8]

Model	DHT22
Operating Voltage	3.3 – 6V
Temperature Range	-40 – 80°C / ±0.5°C
Humidity Range	0 – 100% / ±2 – 5%
Sampling Rate	0.5Hz
Body Size	14mm x 18mm x 5.5mm
Max Current During Measuring	2.5mA

3.3.4 LDR Sensor

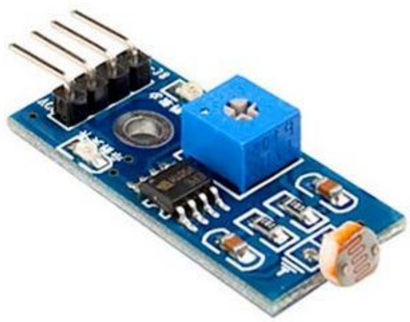


Figure 3.8 LDR Sensor

Based on Figure 3.8, photoresistors, which are also known as light dependent resistors (LDR), are put to use for a variety of purposes, the most frequent of which are to detect the presence or absence of light and to determine the strength of the light. An LDR is a component that changes its resistance, which is a variable, in response to the quantity of light that it is exposed to. This demonstrates photoconductivity since the resistance of the material reduces when the amount of light that is hitting it becomes more intense. The sensor that was recommended has four input pins, and these are denoted by the letters VCC, GND, digital pin D0, and analogue pin A0 respectively. The digital pin D0 is the one responsible for sending the signal from the sensor to the microcontroller in the event that instantaneous signalling reactions are required.

Table 3.3 Pin configuration of LDR Sensor

Name	**Function**
VCC	Connects supply voltage of 5V
GND	Connects to ground
D0	Digital pin to get digital output
A0	Analog pin to get analog output

3.3.5 Servo Motor

Figure 3.9 Servo Motor [12]

In Figure 3.9, servo motor is a small and lightweight component, with a high-power output [12]. It is a specific kind of motor that rotates with an exceptionally high degree of accuracy. It often come equipped with a control circuit that offers feedback on the present position of the motor shaft. As a result of this feedback, servo motors are able to rotate with a high degree of accuracy. When it is necessary to rotate an object at a predetermined angle or distance, a servo motor is the tool of choice. Servo motors is implemented in this project to extend or compress clothesline if the rain water sensor detects any value that is more or less than 0.1ml [9].

Table 3.4 Wire Configuration of Servo Motor [12]

Wire Color	Function
Orange	PWM
Red	VCC
Brown	Ground

3.4 Software Specification

3.4.1 Arduino IDE

Figure 3.10 Arduino IDE Startup

The Arduino Integrated Development Environment in Figure 3.10 was developed using the Java programming language (IDE). It enables user to develop a program and then upload it to the Arduino board so that users may control any device, whether it be mechanical or electrical. The Integrated Development Environment (IDE) for Arduino supports the programming languages C and C++ and uses its own rules for the structure of code. In addition to that, it consists of a software library that was generated from the wiring project and contains a variety of input and output activities that are typical.

3.4.2 Blynk Application

Figure 3.11 Blynk Application Icon

Blynk is a platform that gives you the ability to rapidly construct interfaces for controlling and monitoring your hardware projects using your iOS or Android mobile. After installing the Blynk software on your device, you will have the ability to construct a project dashboard on which you can place widgets such as buttons, sliders, graphs, and more. You are able to turn pins on and off as well as display data from sensors when using the widgets.

Figure 3.12 Example of project dashboard

CHAPTER 4

RESULT AND ANALYSIS

4.1 Introduction

This chapter describes the development of a laundry notification system's outcomes and analysis. All simulation test findings prior to data completion, operational conditions, and data analysis are presented. The final results of these reviews and evaluations serve as a reference for deciding if the project's objective has been attained using simulations involving Arduino IDE and Blynk Application to describe the project's functionality.

4.2 Project Schematic Diagram

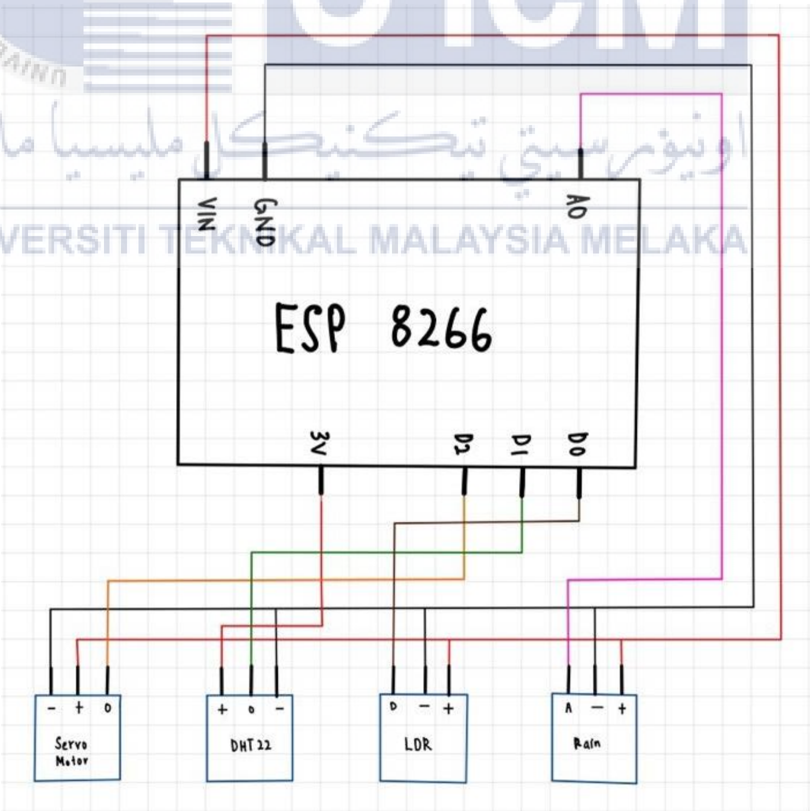


Figure 4.1 Schematic diagram of the project

Figure 4.1 demonstrates that 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 three sensors, one of which is a rain sensor, and each of these sensors has three pins. The analogue pin is attached to the ESP8266's A0 pin, the GND pin is connected to the Ground of the supply, and the VCC pin is connected to the supply voltage VIN of ESP8266. The next component is the LDR sensor. The digital pin of the LDR sensor is connected to D0 of the ESP8266, the GND pin is attached to Ground of the supply, and the VCC pin is connected to the supply voltage VIN of the ESP8266. The DHT22 is the following sensor, and its input pin is attached to D1 of the ESP8266. The GND pin is connected to Ground of the supply, and its VCC pin is connected to the 3V pin of the ESP8266. The servo motor is the component of this project that will be designated as output. The input pin is connected to D2 on the ESP8266, the GND pin is connected to Ground on the supply, and the VCC pin is connected to the ESP8266's own supply voltage VIN.

4.3 Software Development

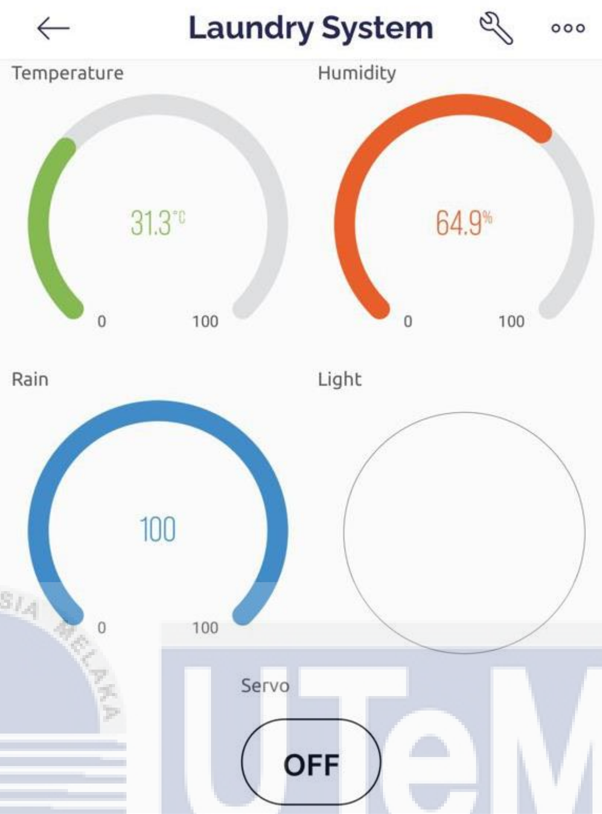


Figure 4.2 Project Dashboard on Mobile Application

Figure 4.2 shows the project dashboard on Mobile Application using Blynk. The Blynk is an application that is developed to remotely operate hardware, show data from sensors, store and then visualise it. In this project, Blynk is utilised to display values obtained from the input sensors, control the button to manually compress or extend the clothesline system and notify users when it becomes clear that it is raining. Blynk can communicate with what we programmed in Arduino IDE by using an authentication token that is suited only for one device. Once the Blynk is connected, the value from sensors is collected and immediately displayed to Blynk Application. In addition to displaying the value of sensors that are being utilized for this project, this dashboard is equipped with three gauge widgets for temperature and humidity sensor, light and rain value, and an LED for LDR sensor.

Table 4.1 Widgets used on Blynk Application

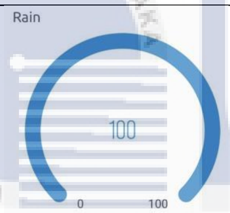
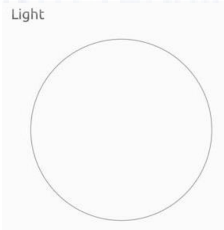
Widget	Function
 (a) Temperature value	Display temperature for user to monitor. The unit for temperature is Celcius (°C).
 (b) Humidity value	Display humidity for the user to monitor. The unit for humidity is Percent (%).
 (c) Rain value	Display rain value and detect if rain drop is more or less than 0.1ml and send notification to the user
 (d) Light	Changes colour if sunlight is detected
 (e) Button	User can manually press the button to compress or extend the clothesline

Table 4.1 shows the list of widgets used in developing the software part of this project. Each of the widgets used have their own functions in making this project a success.

4.4 Hardware Development

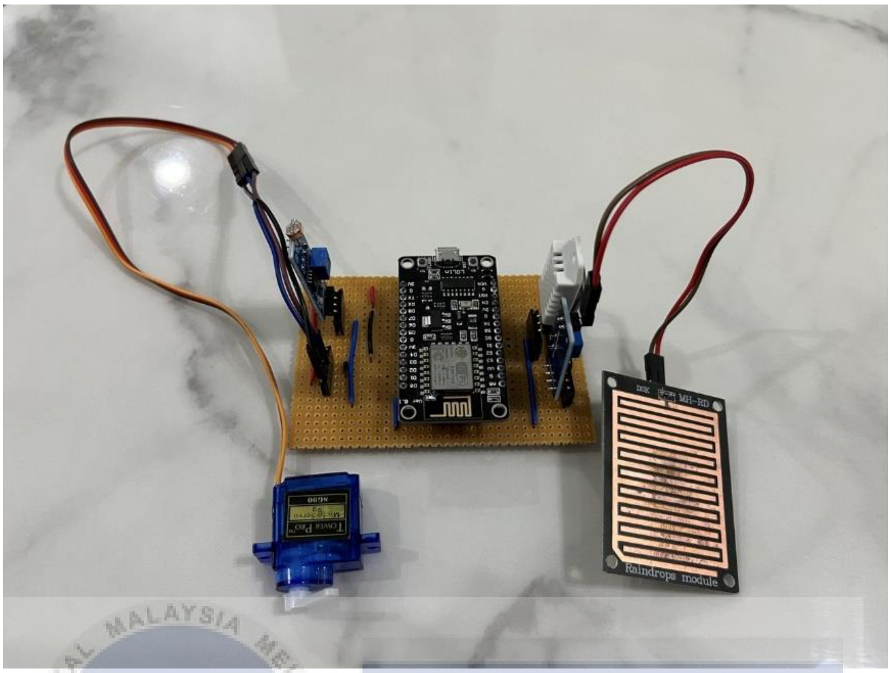


Figure 4.3 Hardware configuration of the project

Figure 4.3 shows the hardware configuration of the project that are soldered onto a stripboard. On this stripboard, the wire of rain sensors and servo motor are made longer so that they can be placed outside of the box to read inputs and transmit output respectively. The size of circuit is sized down in order to fit into the final design of the prototype.

4.5 Prototype Development

Figure 4.4 Draft prototype for the project

The draft prototype in Figure 4.4 was made by first sketching it roughly so that it is easier to finalise the design. Table 4.2 presents a another perspective on the prototype, highlighting the significance of the sketch in determining the optimal placement of the microcontroller and the sensors to ensure that the device performs precisely as intended by the software.

Table 4.2 Different view of the prototype

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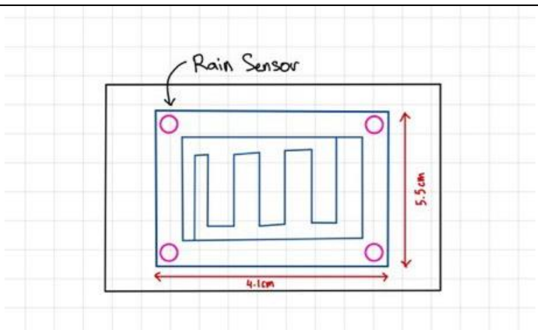
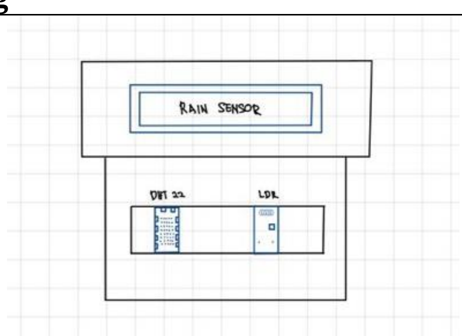
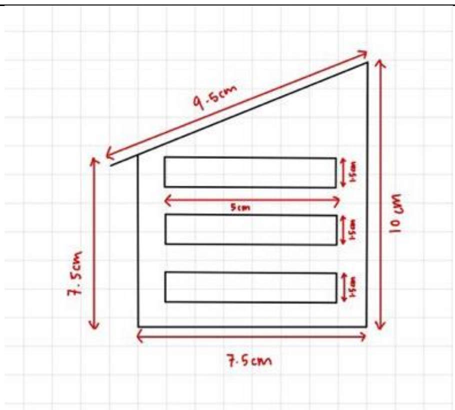
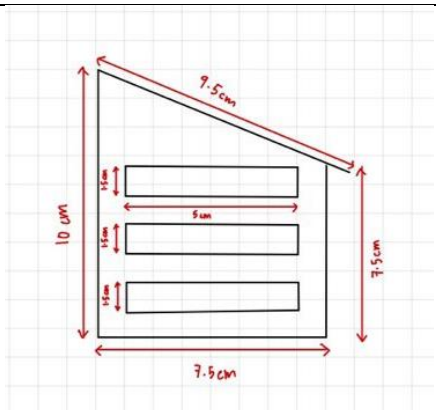
<tr>
<td>

(a) Top View</td>
<td>

(b) Front View</td>
</tr>
</table>



(c) Right Side View



(d) Left Side View

After that, a further improvement is made to the initial prototype shown in Figure 4.4 by glueing it together using a hot glue gun. Holes have been cut all the way around the box to allow for ventilation, which is necessary for the temperature, humidity, and light sensor to work effectively. If there were no holes, the data that is collected will not be as accurate. In addition to this, a door hinge has been installed on the sloping corner of the rooftop so that the box may be opened and closed with ease in the event that there is a problem with the circuit as can be seen in Figure 4.5.

Figure 4.5 Final prototype design

4.6 Project Integration

4.6.1 Connection of NodeMCU ESP8266

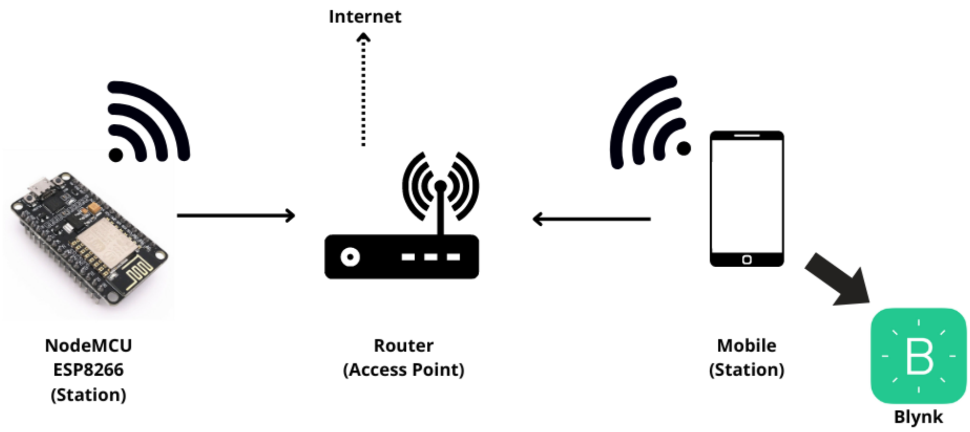


Figure 4.6 Block Diagram of internet connection with NodeMCU ESP8266

Figure 4.6 shows how NodeMCU ESP8266 is connected to the internet to communicate with the Blynk Application in the user's mobile. NodeMCU ESP8266 as the microcontroller will read all the data from input sensors then send it to the user via Internet of Things (IoT).

4.6.2 Login to Blynk

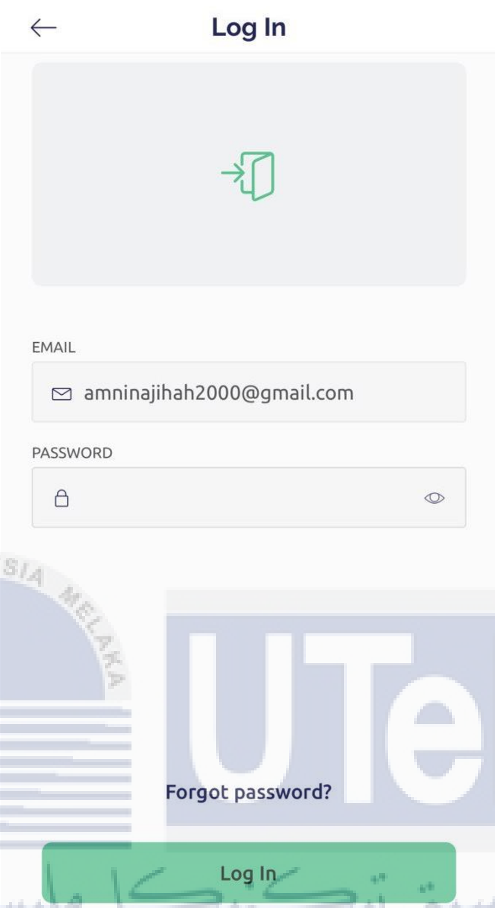


Figure 4.7 Login page on Blynk Application

User will then have to log into their Blynk account with their email and password for security purposes as shown in Figure 4.7. User can get access to their account using multiple devices so they can still monitor their clothes even with a different mobile phone.

4.6.3 Blynk Notification

Figure 4.8 and Figure 4.9 shows the demonstration of how the rain sensor works in conjunction with the servo motor. When the rain sensor detects a rain drop that is more than 0.1ml and moves the servo motor to 0°, it shows that the notification was sent to the user. The user may know if it is raining outdoors or not by having this notification system delivered to their Blynk Application.

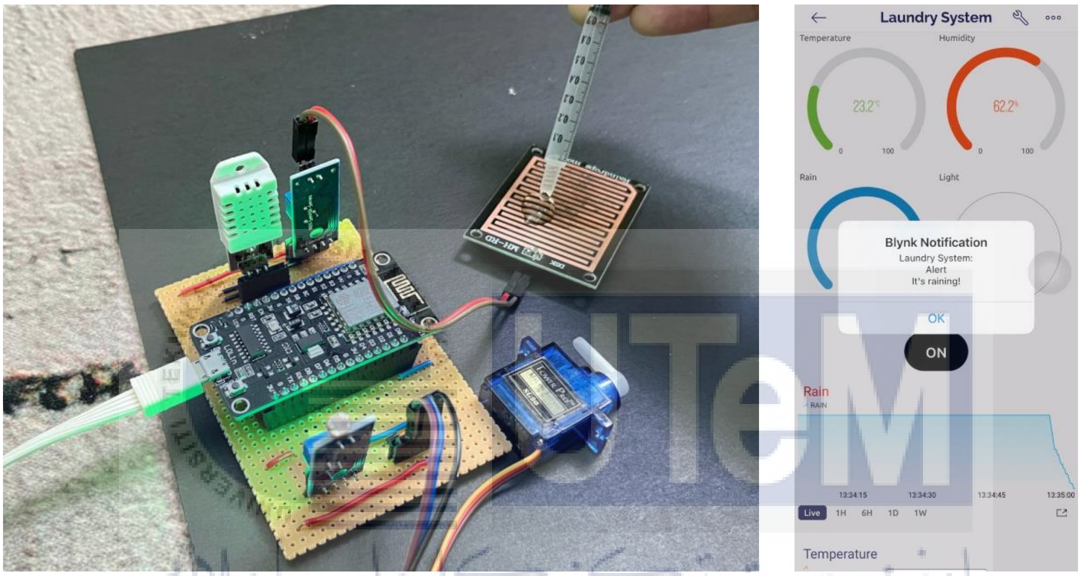


Figure 4.8 Servo motor moves to 0° when rain is detected

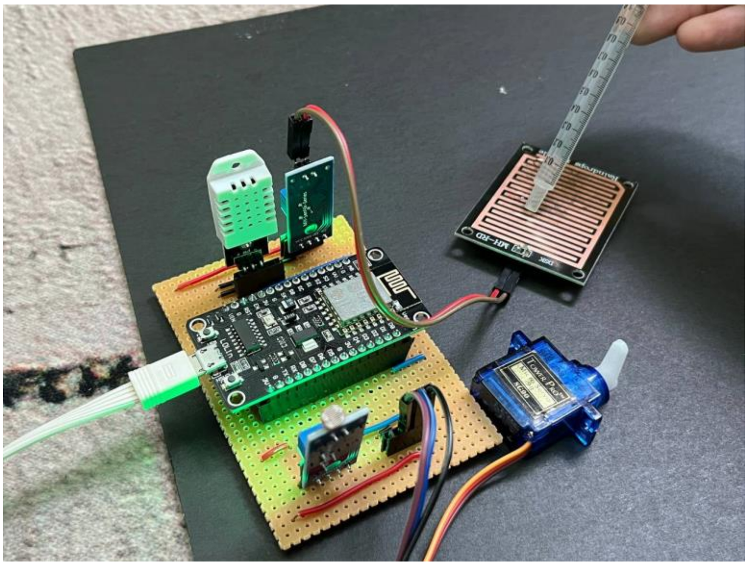


Figure 4.9 Servo motor moves to 90° when no rain detected

4.6.4 Servo Motor Button

Figure 4.10 and Figure 4.11 shows the demonstration of how the button works in conjunction with the servo motor. When the user switch on the button, the servo will extend to 90° while when the user switch off the button, servo will compress to 0°. This button allows the user to manually control their clothesline system remotely.

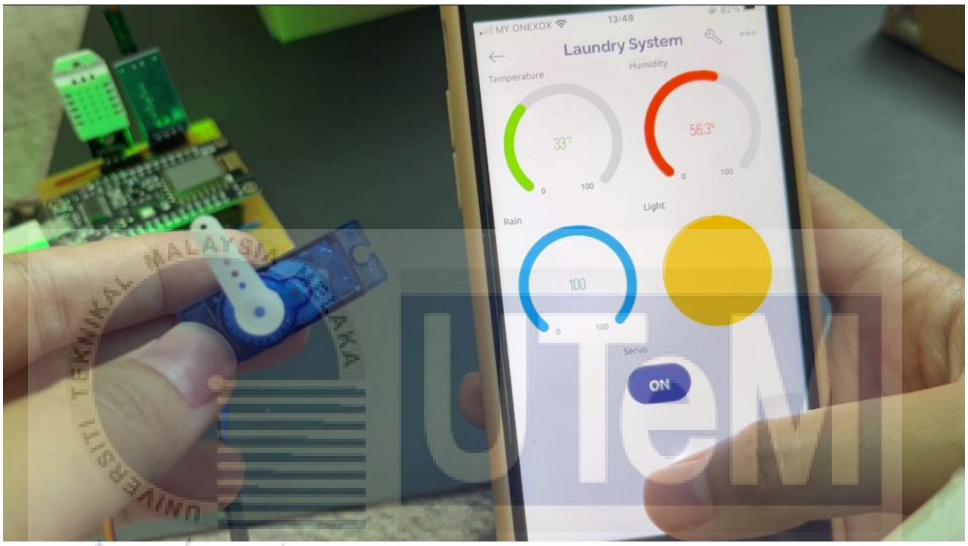


Figure 4.10 Servo motor moves to 90° when user switch to ON

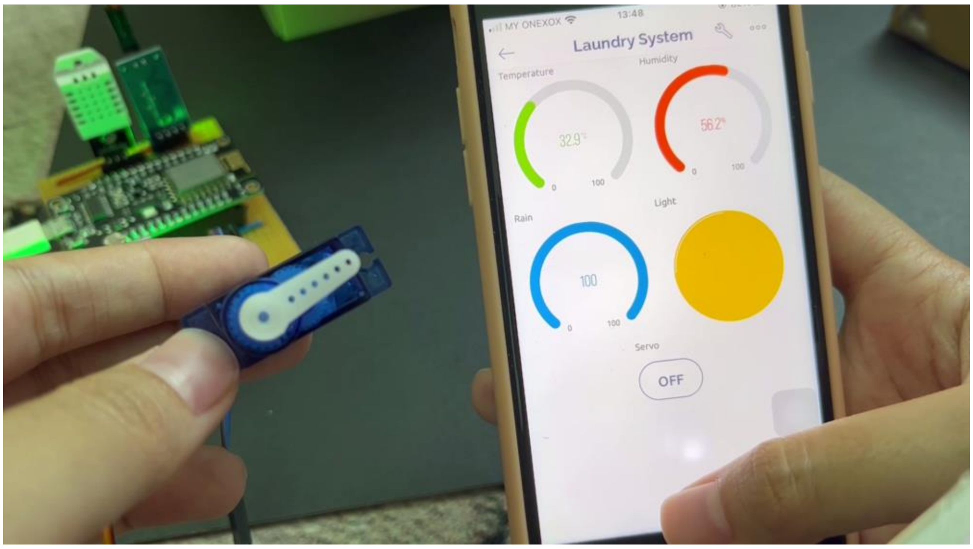


Figure 4.11 Servo motor moves to 0° when user switch to OFF

4.7 Data Analysis

4.7.1 The accuracy of notification sent based on the volume of raindrop and degree of rooftop

In order to test whether the notifications are working, water is dropped onto the sensor using a syringe to simulate rain. The experiment involved changing the quantity of water droplets used and the degree of the rooftop as shown in Table 4.3 and Table 4.4. If a notification is sent to the user when there is water droplets and no notificaition is sent if there is no water droplets, the sensor is accurate.

Table 4.3 Rain Sensor Volume Notification Test Result

Volume (ml)	Rain Value	Notification (YES/NO)
0	100	NO
0.05	100	NO
0.10	89	YES
0.15	77	YES
0.20	74	YES
0.25	71	YES
0.30	68	YES
0.35	64	YES

Table 4.4 Rain Sensor Degree Notification Test Result

Volume (ml)	Degree (°)	Rain Value	Notification (YES/ NO)
1.0	0	100	NO
	10	100	NO
	20	100	NO
	30	100	NO
	40	99	YES
	50	92	YES
	60	89	YES
	70	88	YES
	80	84	YES
	90	66	YES

4.7.2 The accuracy of temperature and humidity sensor by comparing the data value with weather forecast and measured data in different cities

In this experiment, the sensors are placed at the same location and time on consecutive days to measure the temperature and humidity. Based on Table 4.5 and Table 4.6, data are taken from two different cities to see the range of the results in the span of five days.

Table 4.5 Temperature and Humidity Test Result in Ayer Keroh, Melaka at 1:00PM

Day	Weather component	Weather Forecast	Measured Data
1	Temperature	29.00	28.70
	Humidity	71.00	70.20
2	Temperature	30.00	29.70
	Humidity	65.00	64.30
3	Temperature	31.00	31.20
	Humidity	64.00	63.40
4	Temperature	30.00	29.80
	Humidity	66.00	65.80
5	Temperature	31.00	30.60
	Humidity	70.00	68.70

Table 4.6 Temperature and Humidity Test Result in Durian Tunggal, Melaka at 1:00PM

Day	Weather component	Weather Forecast	Measured Data
1	Temperature	35.00	34.70
	Humidity	71.00	70.60
2	Temperature	33.00	32.90
	Humidity	65.00	64.50
3	Temperature	33.00	33.40
	Humidity	64.00	63.90
4	Temperature	35.00	34.70
	Humidity	70.00	70.10
5	Temperature	31.00	30.90
	Humidity	75.00	74.40

Table 4.7 Comparison of temperature and humidity in Ayer Keroh, Melaka at 1:00PM

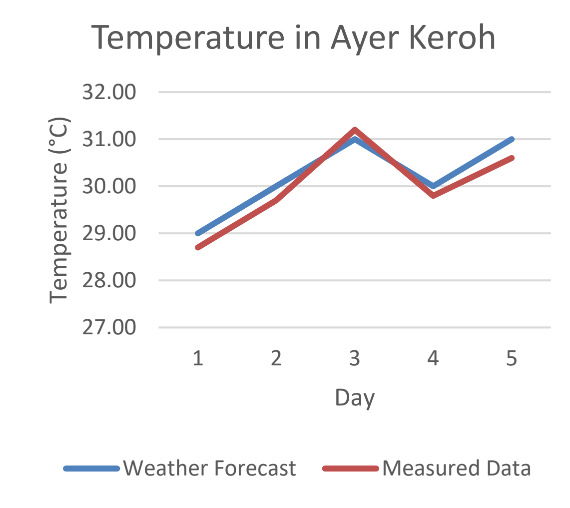
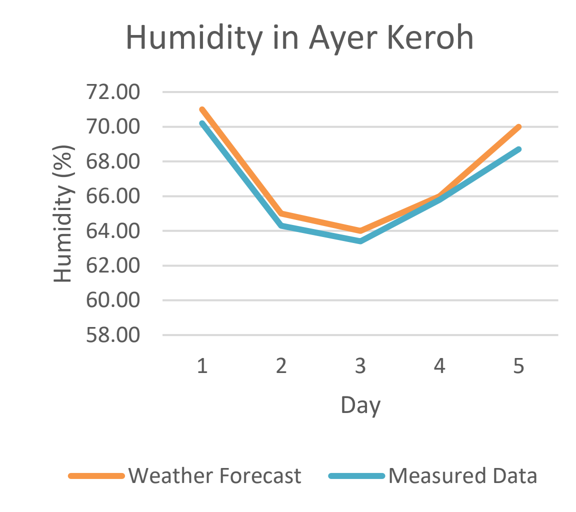
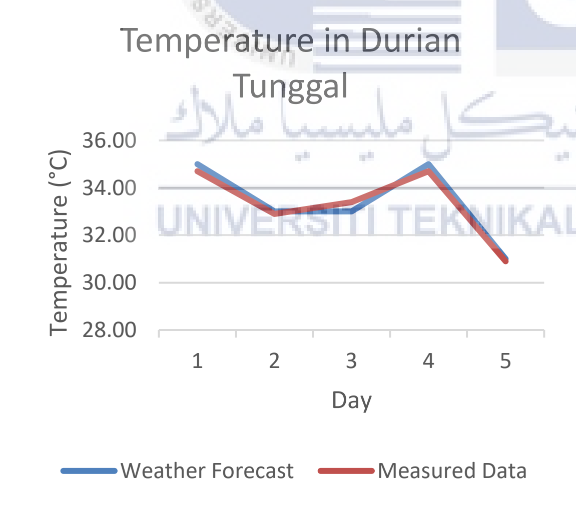
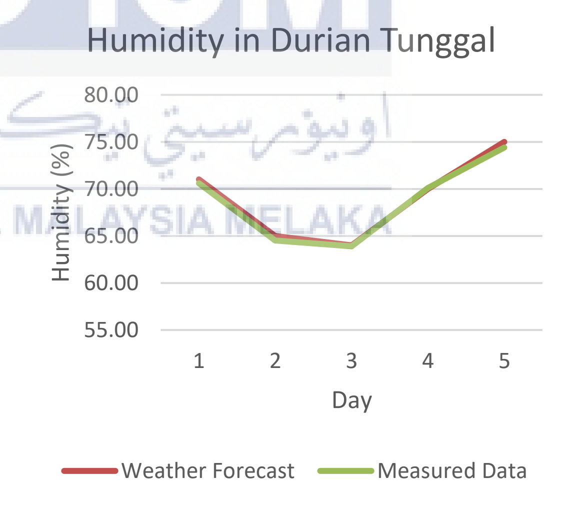
Graph of Day Against Temperature and Humidity	
 (a)	 (b)

Table 4.8 Comparison of temperature and humidity in Durian Tunggal, Melaka at 1:00PM

Graph of Day Against Temperature and Humidity	
 (a)	 (b)

Based on Table 4.7 and Table 4.8, it can be seen that there are not much difference in the value since the data plotted are almost at the same point for both temperature and humidity. Due to the small differences in value between the data taken, the sensors can be deemed as accurate.

4.7.3 The distance of light from the LDR sensor

A flashlight is used to examine the light sensor during testing. To achieve different exposure levels, the flashlight is moved closer or further from the LDR sensor. Based on Table 4.9, the distance are taken in centimeters (cm) so that the results varies.

Table 4.9 LDR Sensor Test Result

Distance (cm)	LED Indicatior (ON/OFF)
0	ON
5	ON
10	ON
15	OFF
20	OFF

4.7.4 The accuracy of servo motor based on the condition of the weather read by the rain sensors

This test seeks to determine the system reaction delay as well as the correctness of the tool's system response to different internet access's speed. If the input rain sensor, meets the condition set, the clothesline will operate according to the program. Using a stopwatch, the delay time is determined starting when the input is read and ending when the servo motor move.

Table 4.10 Automation Test Result

Input	Output (Motor)	
Rain Volume (ml)	**Status (Extend/Compress)**	**Time (s)**
0.05	Extend	0
0.10	Compress	1.03
0.15	Compress	1.02
0.20	Compress	1.03
0.25	Compress	1.04
Average		0.82

4.8 Summary

According to the findings of the study presented above, it is clear that each sensor is performing as expected in light of its assigned role. Since the experiment includes varying the amount of rain that was falling, using a syringe with a volume of 1.0 ml was helpful in producing accurate findings. This is important because the amount of precipitation that falls as rain always varies and is never the same. In addition to this, it is essential to test the rooftop degree because water might remain on the rain sensors even after the rain has stopped falling. As a result, an angle of 80° was decided upon in order to achieve the desired result.

When determining the temperature and humidity, it is helpful to compare the findings from multiple locations over the same time period. This ensures that the findings will stay the same by a significant amount. By taking into account how accurate DHT22 is, the figure that we obtain is still within acceptable parameters.

Based on the results of the LDR sensor measurements, we are able to draw the conclusion that the intensity of the light decreases as the distance from the source of the light increases. Therefore, the positioning of the light indicator is essential to the accomplishment of the goals set for this project.

Last but not least, rain volume and the delay time taken by the rain sensor to read and the servo to process is on average less than 1, which means that the result is deemed to be correct.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion of this project, the design of the laundry system was completed with success. In addition, the user has the ability to operate their clothesline system by either waiting for the rain sensor to detect the presence of rain or manually pressing the on and off buttons. The user can additionally acquire the value of temperature, humidity, and light that can be monitored through Blynk apps. This is in addition to the previously mentioned capability. When this laundry system is put into place, it will be able to assist a great number of people who are disabled as well as other people in their ability to carry out their daily tasks without restriction, particularly when it comes to their clothing. Due to the fact that everything can be controlled through the Blynk application, they can be outside while yet remotely monitoring their clothing because the use of smart homes may be of assistance to so many different individuals and organizations located beyond the neighborhood.

During the course of this time, a few challenges have been overcome so that this project can be successful. Some of these include that the Blynk application has a few restrictions, such as a daily limit of 100 events that can be sent out as notifications. Due to this, I am unable to test my project, which is frustrating given that achieving success in this project depends on sending out notifications. In the end, I was able to solve this problem by implementing a certain condition that restricts the sending of notifications to cases in which they are required. Based on the findings of the tests, it is possible to draw the conclusion that the system satisfies the requirement of making people's lifestyles easier.

5.2 Future Works

For future improvements, the accuracy of the project can be enhanced by adding light sensor for the automation of clothesline system along with rain sensor. With these two sensors combined, user can control their clothesline system even if it is dark and not raining. Other than that, this project focuses only on the natural sunlight to dry their clothes so in the future, user can choose to place a dryer system and a camera to further monitor their clothes.

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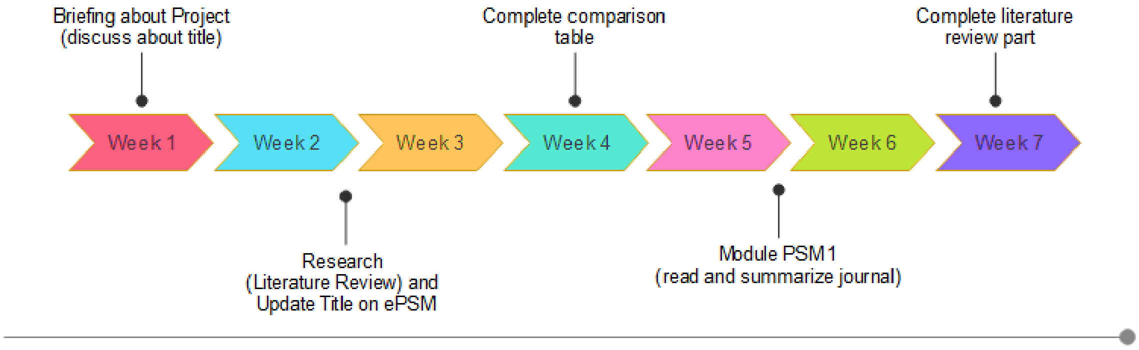
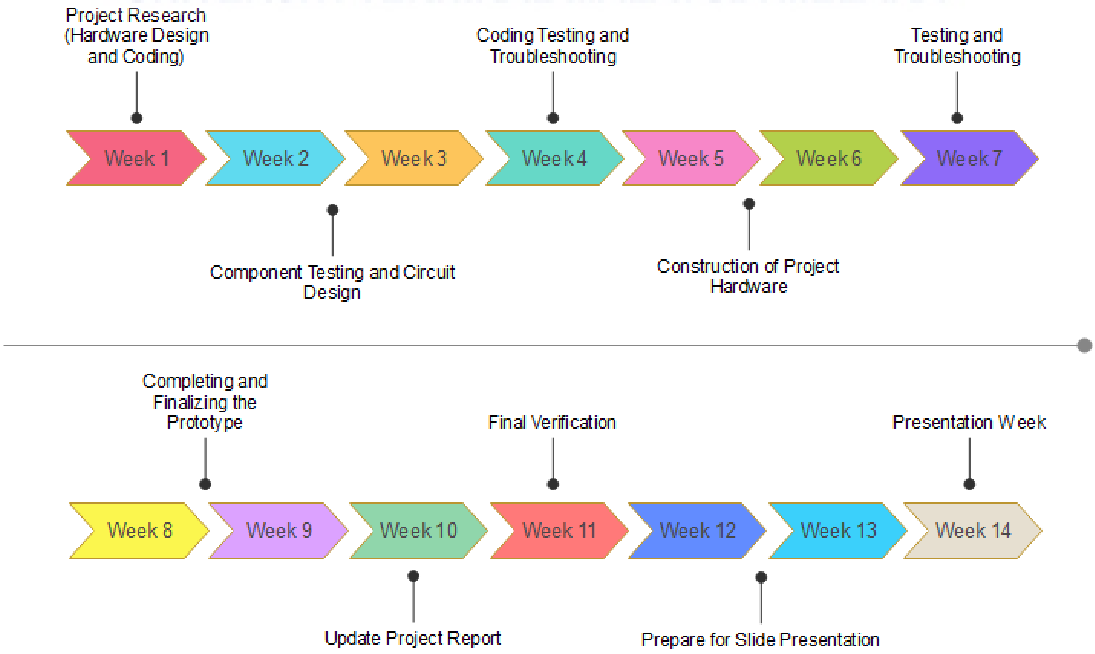
APPENDICES

Appendix A Gantt Chart PSM 1



Appendix B Gantt Chart PSM 2



Appendix C Source Code

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <Servo.h>
#include <DHT.h>

char auth[] = "ZIhfZ2iIyHk5PukWdBgBK-XFp22HEcs4";//Enter your Auth token
char ssid[] = "Siti Rohayawati";//Enter your WIFI name
char pass[] = "azizct123";//Enter your WIFI password

Servo servo;
DHT dht(D1, DHT22);//(DHT sensor pin,sensor type)
BlynkTimer timer;

//Define Rain and LDR pins
#define rain A0
#define light D0

void setup() {
  Serial.begin(9600);
  servo.attach(D2);
  pinMode(light, INPUT);

  Blynk.begin(auth, ssid, pass, "blynk.cloud", 80);
  dht.begin();

  //Call the functions
  timer.setInterval(100L, DHT22sensor);
  timer.setInterval(100L, rainSensor);
  timer.setInterval(100L, LDRsensor);
}

//Get the DHT22 sensor values
void DHT22sensor() {
  float h = dht.readHumidity();
  float t = dht.readTemperature();

  Blynk.virtualWrite(V0, t);
  Blynk.virtualWrite(V1, h);
}

  bool alert = false;      // Flag to track if an alert has been sent for
rain event
  float threshold = 100;  //Send an alert if rain is less than this value
//Get the rain sensor values
```

```
void rainSensor() {
  int value = analogRead(rain);
  value = map(value, 0, 1024, 0, 100);
  Blynk.virtualWrite(V2, value);

  if ( value < threshold )
  {
    Blynk.logEvent("alert", "It's raining!");
    servo.write(0);
    alert = true;

    Serial.println("It's raining!");
  }
  else if (value >= threshold )
  {

  }
}

//Get the LDR sensor values
void LDRsensor() {
  bool value = digitalRead(light);
  if (value == 0) {
    WidgetLED LED(V3);
    LED.on();
  } else {
    WidgetLED LED(V3);
    LED.off();
  }
}

BLYNK_WRITE(V4){
  servo.write(param.asInt());
  int pinValue = param.asInt(); // assigning incoming value from pin V4 to
a variable

  if (pinValue == 0){
      servo.write(0);
  } else if (pinValue == 1) {
      servo.write(90);
  }
}

void loop() {
  Blynk.run();//Run the Blynk library
  timer.run();//Run the Blynk timer
  }
```