Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF MICROCONTROLLER BASED CLOTHES FOLDING SYSTEM

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Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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

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2021

DECLARATION

I declare that this project report entitled "DEVELOPMENT OF MICROCONTROLLER BASED CLOTHES FOLDING 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 : NUR ALIAH AIMAN BINTI ALIAS

Date : 10/01/2022

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 Electronics Engineering Technology (Industrial Electronics) with Honours.

Signature : 

Supervisor Name : Ir. Ts. Mohd Syahrin Amri Bin Mohd Noh

Date : 10 / 1 / 2022

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

These studies are dedicated to my dear parents, Alias bin Sa'ad and Ruhizah binti Saad, who were a source of inspiration for me and of strength when I felt like giving up and still give moral and spiritual support.

I would like to express my heartfelt appreciation and gratitude to Ir. Ts. Mohd Syahrin Amri Bin Mohd Noh, my main project, for the project's encouraging, inspiring, critical, and advice-giving, and motivating nature throughout its implementation.

I'd also want to thank my course mates and those who helped me with the research for this project by offering advice, ideas, and support.

ABSTRACT

Electronics has become one of the sectors where technological advances have seen significant expansion in our environment, such as in daily activities and business industries. Electronics technology is one element of assisting in the facilitation of human activity, creating a variety of practical and efficient electronic equipment to assist humans in meeting their demands. Folding clothes is one of the most common jobs. However, folding a lot of clothes takes a lot of time and energy. Working women who are unable to manage time at home often face this problem. These problems have resulted in solutions that make activities easier and save time. Some of the tasks that people normally perform today may be performed by automated machines with faster working procedures to help improve the results of laundry operations. Folding clothes can be done semi-automatically with a machine that can be operated using an android-based mobile phone. The purpose of this project is to demonstrate basic clothes folding machine as well as a semi-automatic system that combines mechanical and electrical design. The project also includes a description of electromechanical devices that can fold shirts, pants, towels, and other clothing. The machine can also calculate how many items are folded automatically. The project requires an Arduino Uno as a microcontroller, a Servo Motor as an actuator, a Wi-Fi Module, an IR Sensor, and software components. The data communication procedure in this system is controlled by an Arduino Uno microcontroller. With the use of infrared sensors and servo motors, this machine can also work semi-automatically. The servo motor movement that drives the folding board is the output system of the machine. The clothes-folding device uses a microcontroller with a servo motor as a practical means for folding clothes. The results show that by using this technology, people can save a lot of time folding clothes when compared to the traditional way. This project's outcomes may also be used to test and determine how many items of clothes have been folded using different measures depending on the kind of clothes.

ABSTRAK

Elektronik telah menjadi salah satu sektor di mana kemajuan teknologi telah menyaksikan pengembangan yang signifikan di persekitaran kita, seperti aktiviti harian dan industri perniagaan. Teknologi dalam bidang elektronik adalah salah satu bahagian dalam membantu memudahkan kerja manusia, mencipta pelbagai peralatan elektronik yang praktikal dan cekap untuk membantu manusia memenuhi keperluan mereka. Melipat pakaian adalah salah satu pekerjaan biasa. Namun, melipat banyak pakaian memerlukan banyak masa dan tenaga. Wanita yang bekerja yang tidak dapat menguruskan masa di rumah sering menghadapi masalah ini. Masalah-masalah ini telah menghasilkan penyelesaian yang menjadikan aktiviti lebih mudah dan menjimatkan masa. Beberapa tugas yang biasanya dilakukan oleh orang sekarang mungkin dilakukan oleh mesin automatik dengan prosedur kerja yang lebih cepat untuk membantu meningkatkan hasil operasi cucian. Lipat pakaian boleh dilakukan secara semi-automatik dengan mesin yang dapat dikendalikan menggunakan telefon bimbit berasaskan android. Tujuan projek ini adalah untuk memperlihatkan mesin lipat baju asas serta sistem semi-automatik yang menggabungkan reka bentuk mekanikal dan elektrikal. Projek ini juga merangkumi penerangan mengenai alat elektromekanik yang dapat melipat baju, seluar, tuala, dan pakaian lain. Mesin ini juga dapat mengira berapa item yang dilipat secara automatik. Projek ini memerlukan Arduino Uno sebagai mikrokontroler, Servo Motor sebagai penggerak, Modul Wi-Fi, IR Sensor, dan komponen perisian. Prosedur komunikasi data dalam sistem ini dikendalikan oleh mikrokontroler Arduino Uno. Dengan penggunaan sensor inframerah dan motor servo, mesin ini juga dapat berfungsi secara semi-automatik. Pergerakan motor servo yang menggerakkan papan lipat adalah sistem output mesin. Peranti lipat pakaian menggunakan mikrokontroler dengan motor servo sebagai medium praktikal untuk melipat pakaian. Hasilnya menunjukkan bahawa dengan menggunakan teknologi ini, orang dapat menjimatkan banyak masa melipat pakaian jika dibandingkan dengan cara tradisional. Hasil projek ini juga dapat digunakan untuk menguji dan menentukan berapa banyak pakaian yang telah dilipat menggunakan ukuran yang berbeza bergantung pada jenis pakaian.

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First and foremost, I want to thank Almighty Allah for allowing me to finish my report on “DEVELOPMENT OF MICROCONTROLLER BASED CLOTHES FOLDING SYSTEM”.

Completing any sort of project successfully necessitates the assistance of a lot of individuals. I also got assistance in the development of this study from a variety of sources. There is now a little effort to express my heartfelt thanks to that wonderful individual.

I'd like to express my heartfelt thanks to my supervisor at Universiti Teknikal Malaysia Melaka, Ir. Ts. Mohd Syahrin Amri Bin Mohd Noh (UTeM). This research would have been less effective if it hadn't been for his kind supervision and excellent instruction. His supervision and direction were vital in ensuring that this report was produced flawlessly at every stage of the project.

Then, I'd want to express my gratitude to my parents and friends for their invaluable advice and ideas. They've been quite helpful at different phases of the project's completion.

Last but not least I would also like to thanks my course mates who give a clear idea about this project.

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δ	-	Voltage angle
Hertz	-	Frequency
Mbps	-	Megabytes

LIST OF ABBREVIATIONS

V	-	Voltage
AC	-	Alternating Circuit
DC	-	Direct Current
RPM	-	Rotation Per Minute
NO	-	Normally Open
NC	-	Normally Closed
I2C	-	Inter Integrated Circuit
TW1	-	Two Wire Interface
CPU	-	Central Processing Unit
ADC	-	Analog to Digital Converter
DIP	-	Dual-inline package
PLC	-	Programmable Logic Controller
GM	-	General Motors
NC	-	Normally Closed
I2C	-	Inter Integrated Circuit
IoT	-	Internet of Things

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CHAPTER 1

INTRODUCTION

1.1 Background

Initially, we were thinking of something we could make to help people in their daily lives. Today, people live their normal lives on a close schedule. All of this complex electrical and electronic technology is used on a daily basis in modern times. Furthermore, with today's technology, I may learn how to perform things in a more indirect manner by utilizing existing technologies. Thus, I learned a single creation with many uses when we agreed to come up with a project called the Microcontroller Based Clothes Folding System. The Microcontroller Based Clothes Folding System is an automatic, motor-controlled, clothes folding machine powered by an Arduino system. The aim of this project is to fold the clothes when they are detected on the IR sensor. The clothes folding system is semi-automatic where one has to place the t-shirt on the folding board and it automatically folds when detected with an IR sensor. Usually, a person uses a conventional method to fold the clothes by hand. People nowadays have to live with a tight schedule in their daily life. The household chores, despite the gender discrepancy, have been a burden for many. This work is a burden for many and can sometimes be tiring depending on the amount of clothing and the number of people in a house.

In addition, most of the clothes folding machines on the market are either for industrial use or too expensive. I am trying to build a portable semi-automatic clothes folding system with a low cost to serve most people. The operation of the machine requires less

manpower involvement, which is significantly useful for people who are not willing to organize their clothes.

1.2 Problem Statement

For now, the process of folding clothes is deeply affecting women out there, especially housewives, college students, and anyone else involved in this problem. Women who don't have enough time are burdened as a result of this issue, and they don't have time to fold their clothes. This is due to the fact that most people work or have other commitments. After a day of work, most people feel tired and they will buy something to help make their day easier. So, this semi-automatic clothes folder is designed to help people fold their clothes easily and quickly.

The business industry, especially the laundry sector, is also facing the same problem. Service from the laundry sector will be slow when a lot of clothes are received from customers. It's because it takes quite a long time to fold a lot of customers' shirts. As a result, this project also implements this technology to help the laundry industry fold clothes in large quantities in a short period. The technology has also been upgraded to be automatic to determine how many clothes have been folded. It can also automatically display the number of folding clothes it on the mobile phone.

1.3 Project Objective

The primary goal of this project is to propose a systematic and effective methodology for estimating the automatic system of shirt folding machines that can assist people in simplifying and speeding up the shirt folding process. Specifically, the objectives are as follows:

a) To develop semi-auto clothes folding system.

b) To design new IoT based clothes folding system to replace the conventional folding method.

1.4 Scope of Project

The scope of this project is as follows:

a) This scope project only includes clothing such as adult shirts and pants, and towels.

b) This scope project process is performed on a semi-automatic machine; it is not fully automated.

c) This scope project covers the Arduino Uno as a main microcontroller.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The proposed work clarifies the T-shirt folding mechanism, which is simple and useful in this world. This project's goal is to fold a t-shirt with just a smartphone button. This folding machine is completely self-sufficient.Place the t-shirt on the board and hit the start button to have it folded in a second. Working women who have to do domestic tasks face a variety of issues. This concept would be beneficial to working women. With this automated t-shirt folding machine this energy and time can be saved and used in any other jobs. People usually get tired of folding their clothes after they have been washed, so they leave them in the cupboard as they are. It prepared an economical machine to detect the t- shirt and fold to solve the above-mentioned problem. This computer requires less human participation. [1]

2.2 Components

2.2.1 Power Supply

A power supply is a component of any electronic system that provides power. Batteries, solar panels, and adapters will also be used as a power source for the power supply. The voltage supplied by this part will be determined by the voltage required by the electronic circuit. The converter power supply is an electrical system that decreases and converts AC (Alternating Current) voltage to DC (Direct Current) voltage for use in electronic devices.[2] The components of a good power supply adapter are seen in Figure 2.1 as the block diagram of the power supply below:

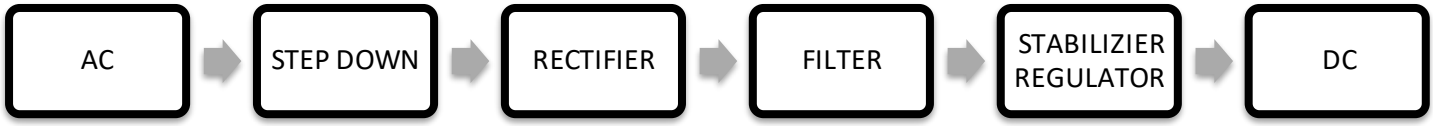

Figure 2.1 : Block diagram of power supply

2.2.2 DC Motor

Electric motors are the workhorse of the industry, an AC or DC motor drives all mechanical movement. The engine usually consists of six basic components such as rotor, switch, brush, axle, and magnet field. The DC engine consists mainly of two permanent magnets and two windings. The coil is powered by the brushes and the commutator. The electromagnet's magnetic polarity would change. The winding direction of the two magnet windings will also be reversed. As a result, one electromagnet will point north, while the other will point south. [3] Figure 2.2 shows the basis of a DC motor.

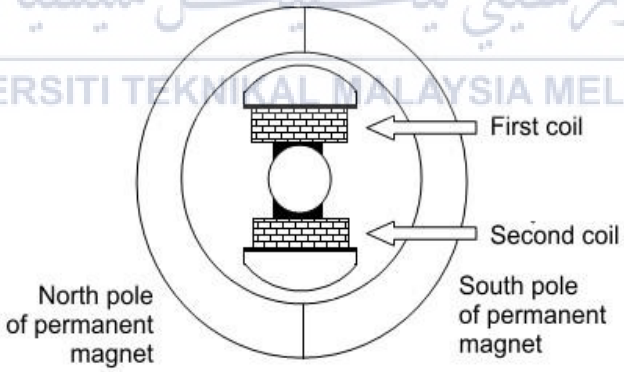

Figure 2.2 : The basis of a DC motor.

2.2.2.1 DC Motor gear

A 200rpm 12V DC gear motor was used to lift the folding material. The direction of a DC gear motor can be maintained without drifting. The DC gear motor can rotate and return to the desired position precisely. The engine shaft will only raise the folded material so that a steel rod is welded onto the motor shaft. As seen in Figure 2.3, the DC motor is welded together with the shaft. A T-shaped PVC is attached to the top of the steel rod and linked to the folding material. The polystyrene is strengthened by the engine. [3] Figure 2.4 depicts a base for the DC motor placement.

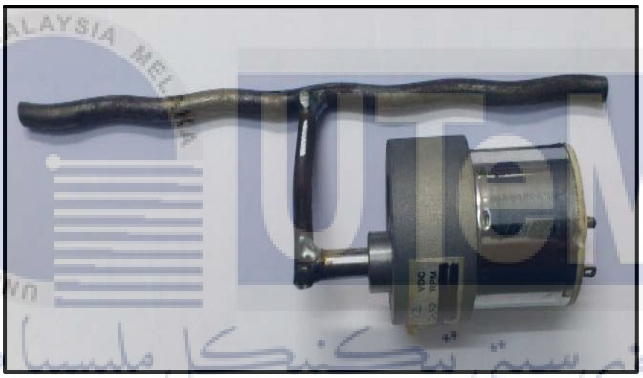

Figure 2.3 : DC Motor welded together with the shaft

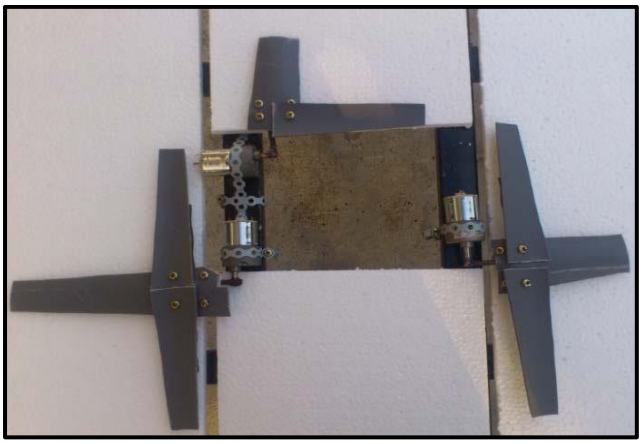

Figure 2.4 : Base for the DC Motor Placement

2.2.2.2 Servo Motor

A servo motor is used to control when the clothes are folded. A servo motor is a rotary actuator (motor) with a closed-loop (servo) feedback control mechanism that can be set up or modified to determine and maintain the angular direction of the motor output shaft. A servo motor is a system that includes a DC motor, gears, a control circuit, and a potentiometer. A series of gears attached to the DC engine shaft will slow down shaft rotation and increase servo motor torque while the resistance potentiometer shifts as the motor rotate as a determinant of servo shaft rotation. [4][5] Figure 2.5 shows a picture of servo motor.

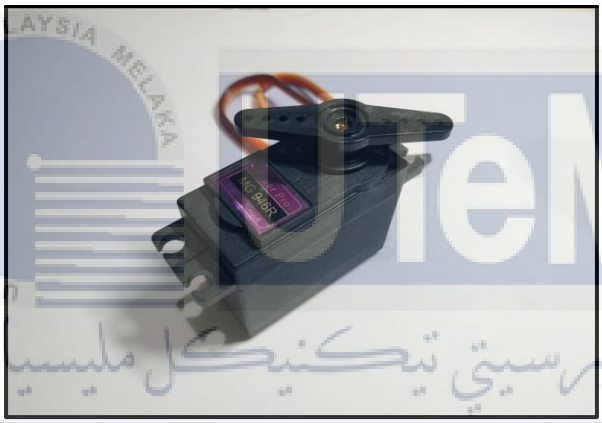

Figure 2.5 : Motor Servo

2.2.2.3 Stepper Motor

A stepper motor is a brushless direct current motor that divides a complete revolution into several equivalent stages. When a DC voltage is applied to the terminals of a brushed DC motor, it rotates continuously. A train of input pulses is converted into an increment in the shaft direction by the stepper motor. Each pulse rotates the shaft by a set amount. Figure 2.6 shows a basic stepper motor.

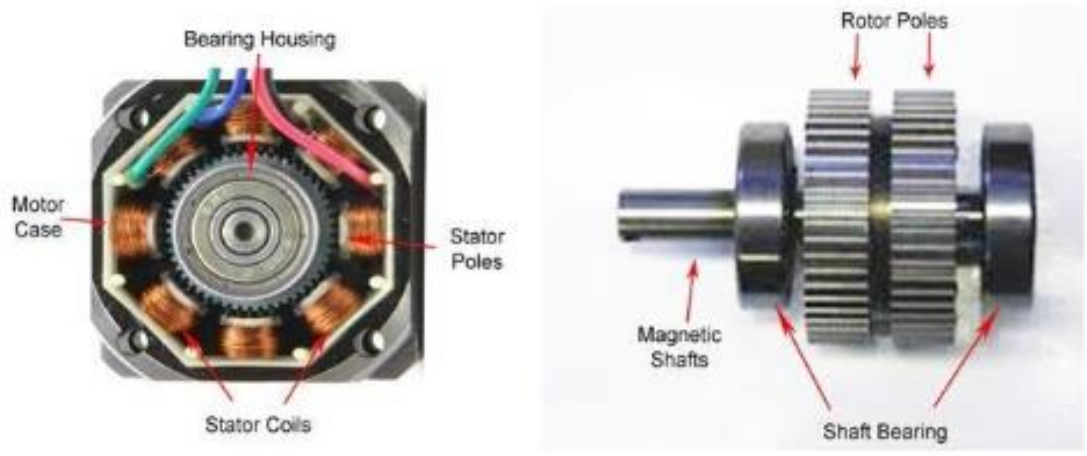

Figure 2.6 : Stepper Motor

Electromagnets are arranged around a central gear-shaped piece of iron in a stepper motor. An external drive circuit or a microcontroller powers the electromagnets. The gear is significantly offset from the next electromagnet as it is aligned to the first electromagnet. When the next electromagnet is turned on while the first is turned off, the gear rotates slightly to sync with the next one, and the process repeats. Each rotation is a process with an integer of steps that rotate completely. Each phase of a bipolar motor has a single winding. To reverse a magnetic pole, the current in a winding has to be reversed. The windings obtained are more efficient and effective than a similar-weight unipolar motor. This is because of the winding's physical space. The driver circuit is critical to the operation of a stepper motor. Increase the drive voltage to bypass the inductance and easily turn the windings. This contributes to the need to regulate or otherwise trigger the current with high voltage. [6]

2.2.3 Ultrasonic Sensor

Ultrasonic sensor, which is useful for locating the clothes that need to be folded. The ultrasonic sensor is a sensor that converts physical amounts into electricity and vice versa. The use of this sensor is based on the theory of sound wave reflection, which can be used to determine the presence (distance) of an object with a certain frequency. It is known as an ultrasound sensor because it uses ultrasound waves. Ultrasonic waves are sound waves of a frequency of 20,000 hertz. The ultrasonic sound can travel through solids, liquids, and gases. The reflectivity of ultrasonic sound on a solid's surface is almost identical to that of ultrasonic sound on a liquid's surface. The ultrasonic sound waves, on the other hand, will be absorbed by textiles and foam. [7] Figure 2.7 shows the ultrasonic sensor pins as well as how the ultrasonic sensor functions as both a receiver and a transmitter.

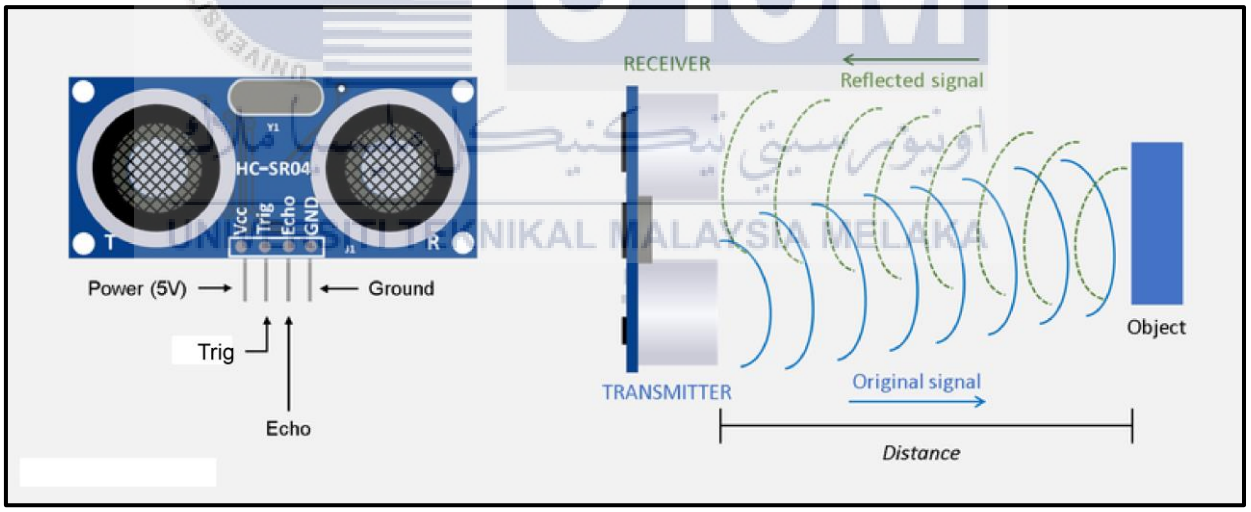

Figure 2.7 : Ultrasonic Sensor

2.2.4 Modul ESP8266

The ESP8266 is a built-in chip that was created for today's wired environment. This chip offers a complete and unified Wi-Fi networking solution, which can be used as an application provider or to separate all Wi-Fi networking functions to other application processors. The

ESP8266 has an onboard processor and storage capability, allowing the chip to be integrated with sensors or unique appliance applications via input-output pins with only a few lines of code. The high integrated on-chip level makes slim external circuits and all solutions, including the front-hand modules, are built for a narrow PCB region. It should be remembered that the ESP8266 module has a maximum operating voltage of 3.6V. The 3.3V pin on the Arduino connects the Vcc Wi-Fi module. If a voltage is obtained, the Wi-Fi module can light up red and sometimes blink blue. The ESP8266 wireless module is a low-cost Wi-Fi module with full TCP/IP support. AT-Command is used to configure this module. This module is further developed by several developers because of its low price, low power consumption, and small sized module. [8] As seen in the figure 2.8 shows a Modul ESP8266.

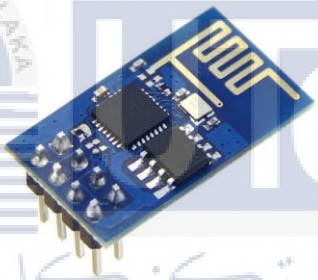

Figure 2.8 : Modul ESP8266

2.2.5 Bluetooth Module

A) Bluetooth Module HC-05 I

Figure 2.9 shows the Bluetooth module HC-05. AT COMMANDS are the only way to change the module's role (Master or Slave). Slave modules cannot initiate a Bluetooth connection with another Bluetooth device, but they can acknowledge existing connections. The Master module is used to establish a connection with other devices. The project may be used to substitute a serial port to make the connection between GPS, MCU, and PC for such a built-in project.[9]

Figure 2.9 : Bluetooth Module HC-05

B) Bluetooth Module HC-05 II

There are six pins on the Bluetooth module HC-05. The pins of the Bluetooth module are presented in Figure 2.10.[10]

i. KEY: This pin works by default in 9600 bps baud mode. If the rate of baud is 34800 bps, the command is modelled.

ii. RXD/TXD: TXD and RXD link the microcontroller with RXD and TXD pins. The TXD pin sends serial information to the Bluetooth module wirelessly. The Bluetooth module also transmits the RXD pin to the received data wirelessly.

iii. GND: The ground pin is connected to this pin.

iv. VCC: The 5V or 3.3V of the module connects this pin.

v. STATE: This pin determines whether or not the module is attached.

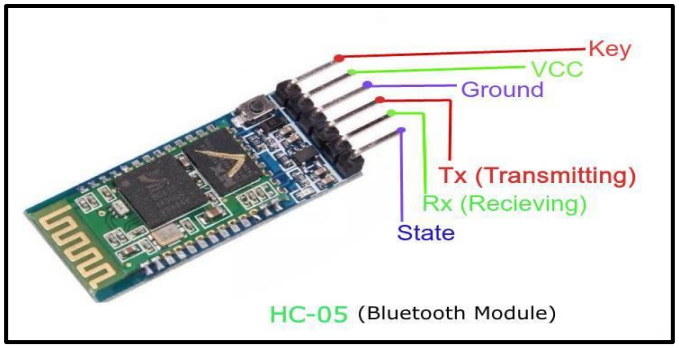

Figure 2.10 : Bluetooth Module HC-05

C) Bluetooth Module HC-05 III

When a push-button is pushed and released, it contacts for a brief period before returning to Normally Open (ON). Typically, this sort of switch has a set of locks attached to the connector, and the on type is used for the on the button. There is also a Normally Closed (NC) push button, which is usually used for the off button. [11] Figure 2.11 shows Bluetooth Module from tinkercad software.

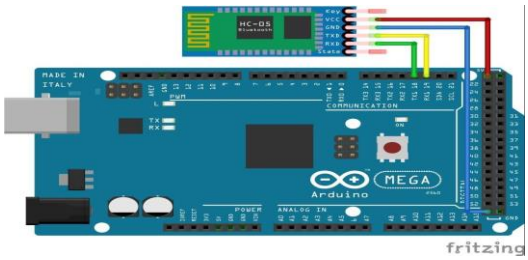

Figure 2.11 : Bluetooth Module from Tinkercad

2.2.6 I2C (Inter Integrated Circuit)

I2C is an abbreviation for Inter-Integrated Circuit (Inter-Integrated Circuit). I2C LCD is a serially operated LCD module that uses the I2C / IIC (Inter-Integrated Circuit) protocol or TWI (Two Wire Interface). Both the data line and the control line are operated in parallel by the LCD module. However, there are several pins in the parallel line on the controller side, so an I2C is necessary to save on using the PIN on the Arduino. I2C is supported by Arduino, and the I2C pin is located on pin A4 for serial data and A5 for serial clock. [12]

2.3 Software

2.3.1 Microcontroller

A microcontroller is a chip that works as an electronic circuit controller and can normally store programs in it. In general, it consists of a CPU (Central Processing Unit), memory, specific I/O, and an integrated support unit such as an Analog-to-Digital Converter (ADC). The key benefit of a microcontroller is that RAM and I/O equipment are available to support the board's size, which is very compact.

2.3.1.1 Arduino 1.8.5

Arduino is a software and hardware-based, open-source electronics platform. Arduino boards can read inputs and convert them to outputs. It can instruct the board by sending a set of instructions to the board's microcontroller. To be able to do this, it needs to use Arduino and the processing-based Arduino software (IDE).[13]

2.3.1.2 Arduino Uno

Figure 2.12 shows a picture of Arduino Uno. Arduino Uno is both hardware and software that enables anybody to prototype an electronic circuit based on a microcontroller rapidly and easily.

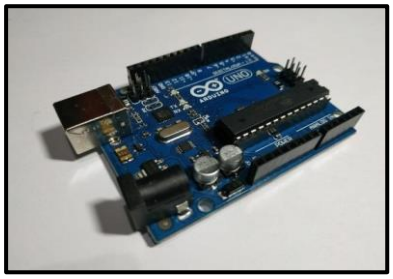

Figure 2.12 : Arduino Uno

The Arduino Uno board accepts input voltages ranging from 7 to 12 volts. The operating voltage is 5 volts. This board has 14 digital pins, 6 of which can function as PWM (Pulse Width Modulation) pins, allowing analog signals to be obtained on digital pins. This Arduino Uno has 6 analog pins as well. These six analog pins can be used as digital pins. Figure 2.13 shows the name of the pins on the Arduino Uno board.

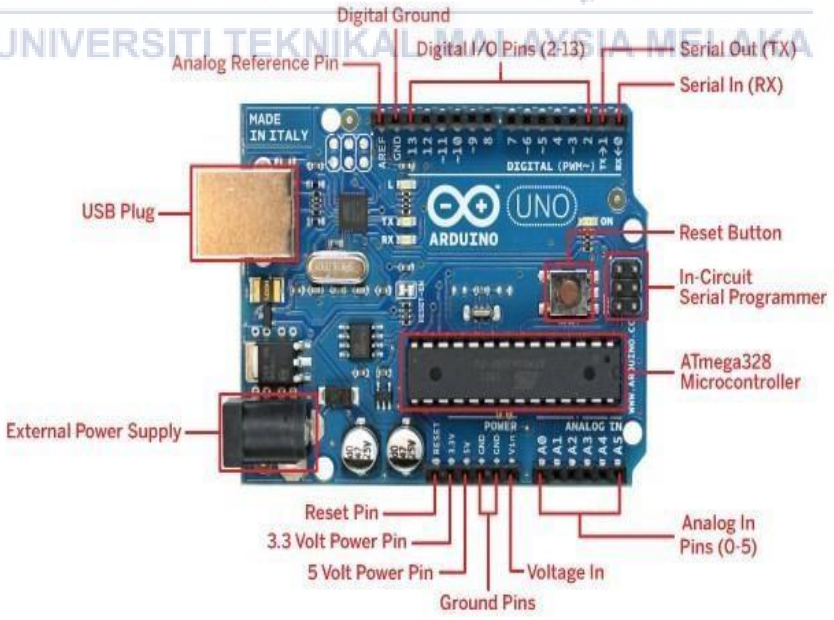

Figure 2.13 : The name of the pins on the Arduino Uno board

Especially for digital pins, only one mode, namely only as input or output, can be assigned to each pin. As input, it means that an external party determines the value on the pin and this value can be read in Arduino. As an output, it means that Arduino can control the value on the pin and that the value can be calculated using the digital write order. The pin mode is determined as an input or output from the pin mode.[5]

2.3.1.3 Arduino IDE

The Arduino implementation IDEA is used to monitor the machine, which is programmed in C. Arduino IDE is an open-source platform officially introduced by Arduino (Integrated Development Environment). Used in particular to edit, compose and upload codes to the computer Arduino. [14] A flow map is used to facilitate the development of the programmer. For example of the flow chart to development of the programme as seen in the figure 2.14. As seen in Figure 2.14, this flowchart shows which of the 3 modes to select after putting on the clothes. There are 3 folding modes. For modes 1, uses to fold shorts, pants, and others. Next, mode 2 is used to fold the towels and so on. Lastly, mode 3 can be used to fold shirts, T-shirts, and so on.

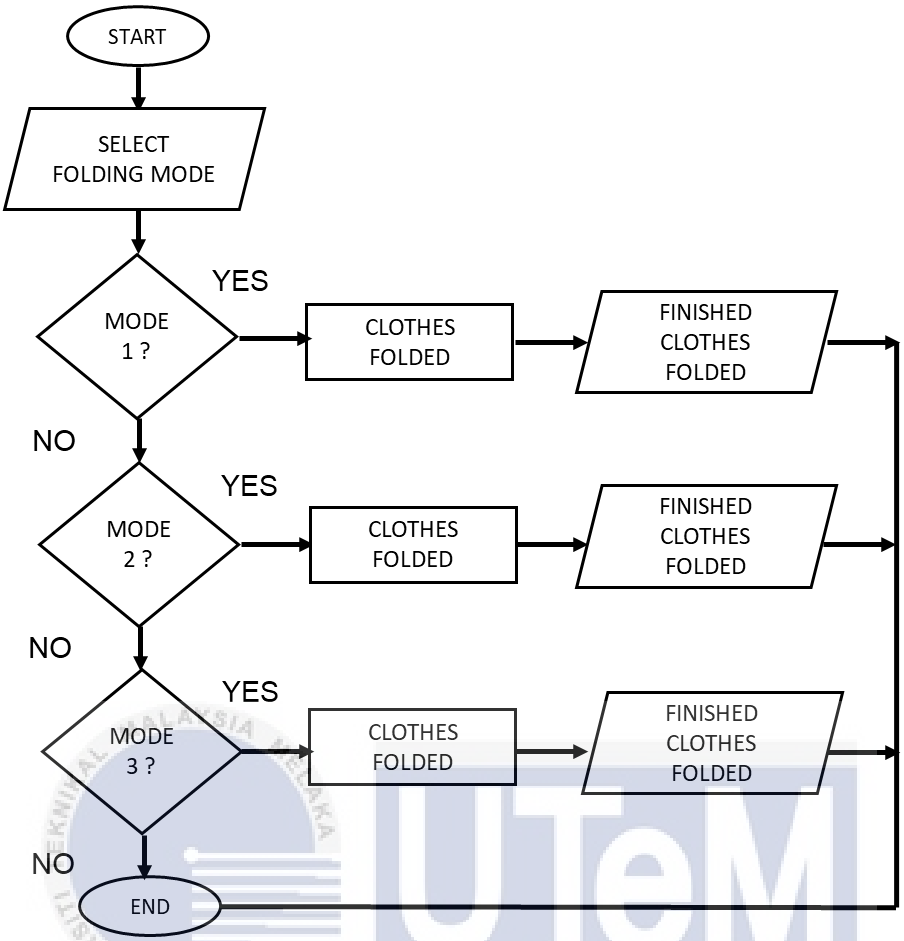

Figure 2.14 : Flow chart to development of the programme.

2.3.1.4 Arduino Uno R3

The Arduino Uno R3 is a microcontroller board with a removable ATmega328 AVR microcontroller in a dual-inline package (DIP) box. It has 20 optical input/output pins, six of which are PWM outputs and six of which are analog inputs. It can be programmed using the Arduino programming software, which is simple to use. The Arduino has a large group of supporters, making it a simple way to get started with embedded electronics. The R3 is Arduino Uno's third and most recent revision.[15] Figure 2.15 shows a picture of Arduino Uno R3.

Figure 2.15 : Arduino Uno R3

2.3.2 PLC (Programmable Logic Controller)

PLC (Programmable Logic Controller) is a device designed to replace conventional control systems. PLC (Programmable Logic Controllers) are devices that are intended to replace traditional control systems. General Motors (GM) developed the first PLC around 1968. The key intention was to replace the relay that was used to execute the control circuit. PLC means programmable logic controller literally. In other words, PLC is equipment system for controlling an equipment or other system that can be programmed as required by a logic circuit. PLC is like an easy-to-use electronic machine with different styles and difficulties.[16]

2.4 Proposed Model

The mechanism is created with the assistance of certain technologically advanced and error-free elements. The cloth folding mechanism was created with the help of wooden ply, aluminum holders, and hinges for the system's solid rigidity. The color selection mechanism uses a small robot to get the fabric down to the desired course, rendering the whole mechanism modern and technologically advanced.

A. Folding Mechanism

The folding system is made up of an Arduino UNO board and DC motors that are fixed on a wooden ply that serves as a base for the fabric to be folded. The mechanism must complete four steps to complete the overall folding of the cloth. The aluminum rods are attached to DC motors that rotate the flaps (wooden planks) in a clockwise or anticlockwise direction, as well as the final half fold in an upward direction. The DC motors mounted on the aluminum rods are linked to the Arduino Uno and programmed to perform the rotations used to perform the folds. [17] Block diagram of folding mechanism as shows in Figure 2.16.

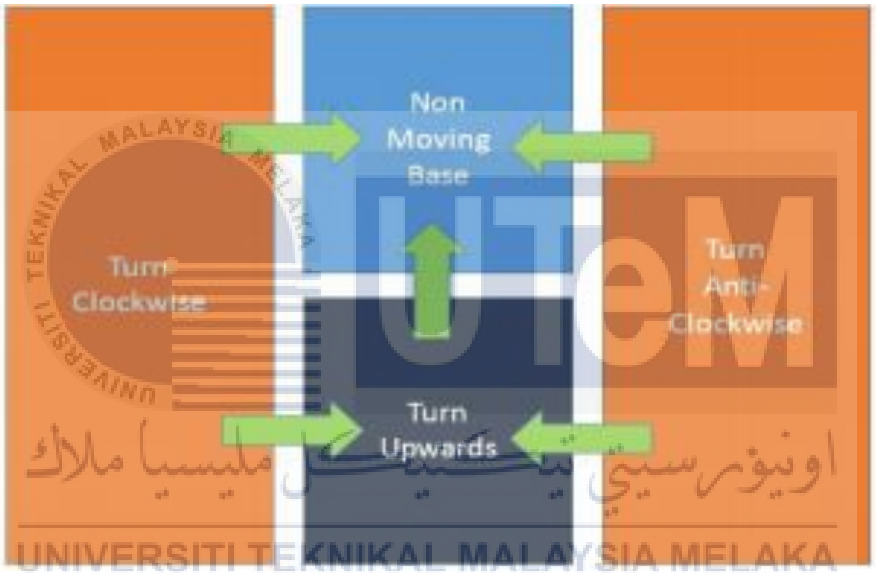

Figure 2.16 : Block Diagram of folding mechanism

2.5 Electrical Design

When designing an electrical system, several considerations must be considered, including the power supply source, the unit that will be used as a controller, device service driver architecture, developing the management device that will be used, a tool for creating schematic models, and flowchart design.[18]

2.6 Physical Design

The physical architecture will be based on a currently available folding frame. Divide the board into A, B, C, and D and create three custom hinges with an articulated rod between the boards. These rods will be connected to the servo rotation axes. When the servos spin, the rods rotate as well, flipping the boards. Photosensors will be installed on boards A and D to detect the presence of clothing. On the left side of board B, three ultrasonic sensors would be attached to detect any obstacles such as hands and fingertips. [19] Figure 2.17 shows an example of physical design:

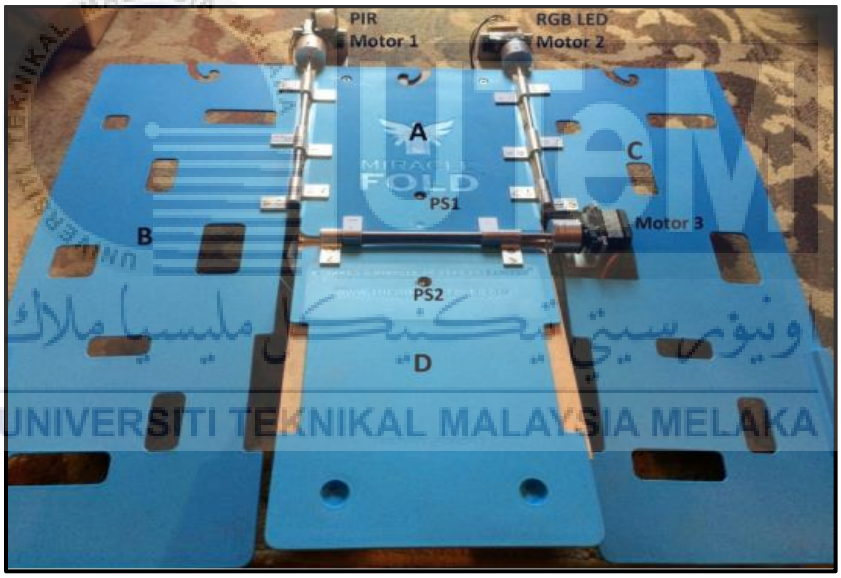

Figure 2.17 : Physical design of flip board

2.7 Evaluation of Existing Techniques

A. Traditional method

The traditional method for folding cloth is a hand-folding technique and it's very easy method. It's an old approach that predecessors have taken. Figure 2.18 shows how to folding T-shirt with traditional method. [20][21]

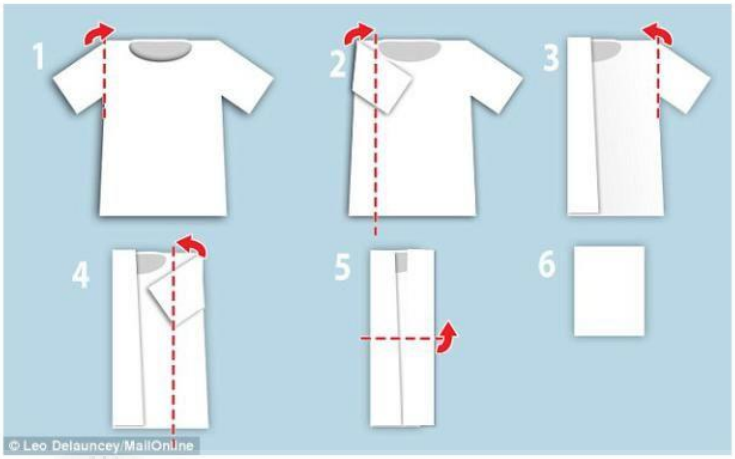

Figure 2.18 : T-shirt folding traditional method

B. Folding Board

Figure 2.19 shows a folding board which is a collapsible plastic board that allows users to fold clothes with their hands. This board is easy to use and maintain. [20]

Figure 2.19 : T-shirt folding board

C. Folding machine FX-23

In a short amount of time, this automated fabric folding machine can fold a big quantity of items. Furthermore, they are kept in a chamber beneath the folding frame. It is, however, an

industrial product that is not fit for use in a home. It is appropriate for industrial application.[20][22]

D. Foldimate

Foldimate is an autonomous robot that was developed in 2016 and will be available for pre-order in 2020. With its simple clipping operation, folding, packaging, and distribution process, the FoldiMate Folding Machine is robotic clothes folding machine that can easily handle most types of clothes, including suits, tops, and towels. After reviewing all of the existing techniques and mechanisms, developed a simple Bluetooth-controlled low-cost cloth folding machine that is easily affordable. Providing and self-containing a process for folding the board.[20][22] FoldiMate Folding Machine is a robotic clothes as seen in Figure 2.20.

Figure 2.20 : FoldiMate Folding Machine

2.8 Summary of Related Work

Table 2.1 : Summary of related work.

No.	Author	Title	Microcontroller	Monitoring System	Communication System	Function
1.	P. D. Raut, S. D. More	Automatic T-Shirt Ironing and Folding Machine	-Arduino	None	-Internet	-To introduce an easy and fully automatic t-shirt ironing & folding machine which will efficiently work and reduce the human effort.
2.	R. Cahyadi, S. Hardhienata	"Model Alat Pelipat Baju Portable berbasis Arduino Uno,"	-Arduino Uno	None	-Internet -Hardware programming	-The activity of folding clothes can be done automatically and the folding process is faster and tidy. -This model is made portable so that it can move places.

3.	N. Gomesh, I. Daut, V.	Photovoltaic powered T-Shirt Folding Machine	-AT89C51	None	-Internet	-powered by photovoltaic system. -To fold t-shirts merely by pressing a button.
4.	N. Silitonga, J. M. Hutapea, I. S.	Design and Simulation of Automatic Folders	-Arduino Uno -Ultrasonic sensors	LCD	-Internet	-Fold the clothes within a short namely short-sleeved shirt with a time of 4 seconds, ¾ sleeves with a time of 5 seconds and shorts with a time of 3 seconds.
5.	A. M. Nurkholis,	"F-Cloth Automatic Solusi Cerdas Melipat Pakaian Dengan Praktis Berbasis Arduino Uno."	-Arduino Uno	LCD	Internet	-To help in terms of folding clothes quickly and practically with the system work automatically.
6.	M.Periyasamy, M. Ramya, V. Maha Vishnu,	Automated Match Box base Folding	PIC16F877	None	Internet	-The productivity of company increases with less time consumtion.

						- It reduces the large amount of labor cost and also decreases stress to wokers.
7.	J. Susilo, A. Febriani,	Car Parking Distance Controller Using Ultrasonic Sensors Based On Arduino Uno	-Arduino Uno -Arduino MP3 Shield -Sensor Ultrasonic HC-SR04	None	-BlackBox	-To make the car sensors it easy for car drivers to park the car.
8.	Amirah, Salman	"Rancang Bangun Alat Pelipat Pakaian Bebasis Android,"	-Arduino Uno	-Smartphone -Raspberry Pi	-Android -Ios -Wireless Wi-fi	- To help increases the results of laundry efforts with a faster work process.
9.	Ilham Saputra, E. Naf,	"Rancang Bangun Alat Pelipat Baju Sebagai Media Pembelajaran Bagi	-Arduino Mega	-LCD	-Android -Bluetooth HC-05	- A system designed to work well and can be used as a learning medium for

		Anak-Anak Via Smartphone”				children in the process of folding clothes.
10.	Basuki Rahmat	“Rancang Bangun Alat Pelipat Baju Menggunakan Pegas Sebagai Mekanisme Penggerak Manual”	-Spring Drive	-Autodesk Inventor Profesional (AIP)	-Internet	-To be able to design and make a clothes folding device with manual drive, foldable clothing size manual mechanism folding device is expected to fold clothes with a faster time.
11.	B. Vinitha, S. Amritha, M. Sinduja	Cloth Folding Machine	-Arduino -ATMega8	None	-User interface LED	-To fold up cloth by just pressing a switch. -The purpose design of a cloth folding machine is a household appliance.
12.	E. Hariyanti, G. Tambunan,	“Alat Pelipat Pakaian Otomatis Dengan Tiga Mode Pelipatan Berbasis Mikrokontroler,”	-Arduino Uno	None	-LCD	- Has 3 mode folding -Reduce the time less than 10 seconds.

13.	Izan , Ziemah, Wani	Mechanical Engineering Department 1201	-Arduino Uno R3	-LCD	-Arduino software (IDE) -Autodesk Inventor	-Be a helpful hand to the working women and also it saves energy, time and money.
14.	B. R. M. Iqbal Nur Fahmi , Wahyudi,	"perancangan dan pembuatan alat pelipat baju dengan pengontrol sistem elektro pneumatik dan plc untuk industri konveksi"	-PLC	None	-Autodesk Inventor Professional 2013 -CXProgrammer -FluidSIM Pneumatic	-Use basic technologies to create clothing folding aids -Reduce the amount of time.
15.	S. Shah, R. Pillai, U. Mahajan	Automatic Cloth Folding and Color Based Sorting Mechanism	-Arduino Uno -Ultrasonic Sensor	None	-Internet	-To build a product with a lower maintenance cost and easy replacement of any part.

16.	Y. Irawan, R. Wahyuni	Folding Clothes Tool Using Arduino Uno Microcontroller And Gear Servo	-Arduino Uno -UltraSonic Sensor	None	-Hardware Programming -Arduino IDE	-Folding clothes to be more efficient in time and energy.
17.	Xudong Li, Anran Su,	Automatic Cloth Folding Machine	-ATMEGA 328P -Ultrasonic sensosr	-LCD	-LED User Inteface	-Be able to detect the clothes automatically and fold them in a neat way. -Low cost folding machine
18.	M. S. Ahsan, S. Das	Android App based Bluetooth controlled Low-cost Cloth Folding Machine	-ATmega328	-Smartphones	-MIT app -Bluetooth	-It is predicted that by utilizing this machine cloth folding time can be reduced to a great extent compared to the traditional method.
19.	B. Shetye, P. Randive	Automatic T-Shirt Folding Machine	-PIC16F877	-LCD	-Internet	-To fold t-shirt by just pressing a switch.

						-To helpful hand to the working women's. - Detect the t-shirt and fold.
20.	S. Divya, I. K. S. David	Automatic T-Shirt Folding	-Arduino Uno	Internet	-PLC software	-To replace the damaged components which can be easily available in the market.
21.	Singh, Vinod Kumar Sahu, Abhishek Beg	Speed Direction Control of DC Motor through Bluetooth HC-05 Using Arduino	Arduino Nano BT-AT mega 328	-LCD display	Bluetooth Module	- The design and implementation of a low-cost, durable, resilient, and secure Bluetooth-enabled DC motor are available. The connection between the controller and the Arduino Nano is wireless, a person may work on Bluetooth devices. This board may be used to drive the DC motor due to its inexpensive cost.

22.	Debnath, Banashree Dey	Smart Switching System Using Bluetooth Technology	Microcontoller AT tiny 2313	-Bulb	Relay Module	The Bluetooth-based domestic automation system largely uses information technology to decrease human labour.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Here are going to explain all the steps about the research methodology that be used to establish of this project. In other words, this chapter will provide a complete explanation of the approach being used to successfully execute and run this project. According to Figure 3.1, there are various methodologies from this field that have mostly been published in journals for others to benefit from and improve in future research.

3.2 Project Overview

At the beginning of the planning project of the Development of Microcontroller Based Clothes Folding System, the supervisor assisted me in getting to starting the project. It begins with deciding on the project's architecture, which may range from manually folding clothes to automatically folding clothes.

This project is divided into two parts, which are software and hardware. In terms of hardware, it focuses on the Arduino Uno microcontroller. The IR sensor was detecting the touching of clothes when put on the boards and sensors were triggering the Arduino. The Blynk App application on a smartphone has an interface that will display all notifications and functions. For the software part, Arduino software (IDE) will be used for coding development. If there is any problem that occurs, troubleshooting on hardware and software will be implemented on the system until the system works properly. Figure 3.1 shows the flow chart of the methodology.

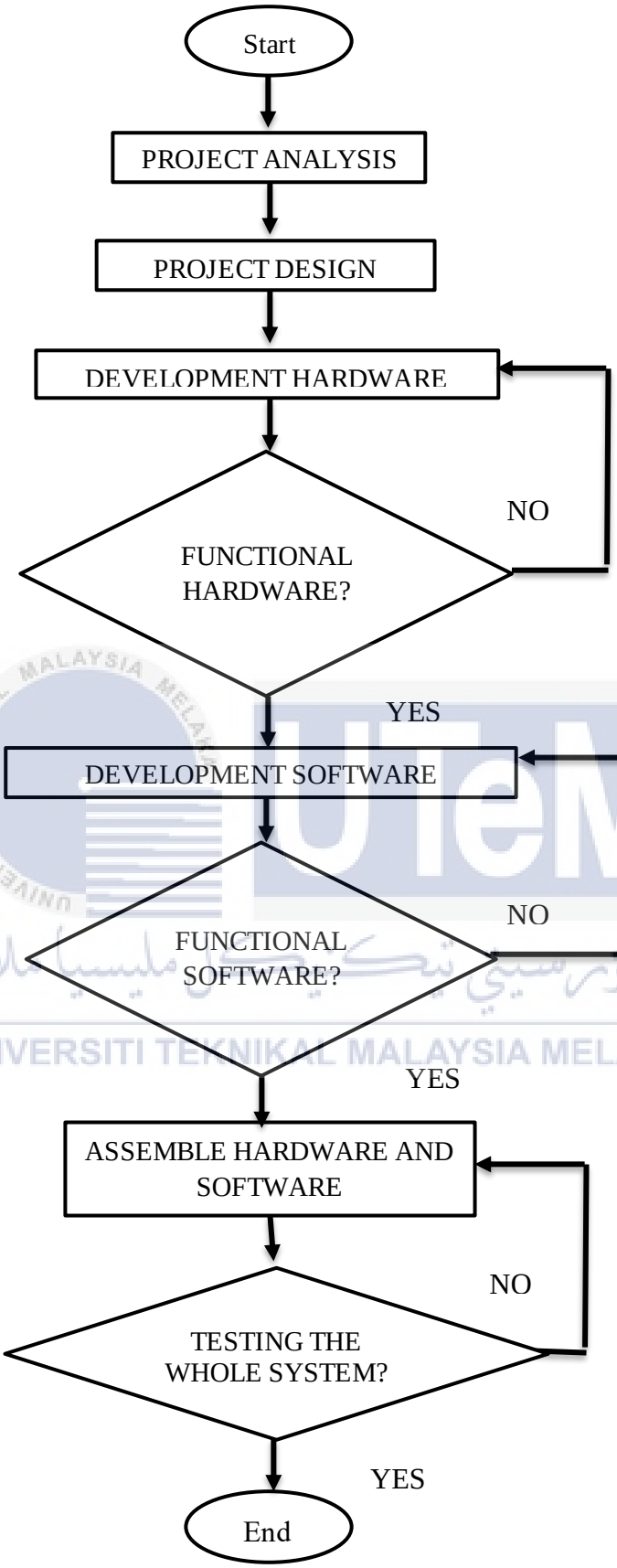

Figure 3.1: Methodology flowchart

3.2.1 Flow Chart

The flowchart of how the systems work in this project is shown in Figure 3.2. Before beginning the process of this project, it is necessary to turn on the power supply. The process of this project will start once the IR sensor detects a piece of clothing. Then it can move on to the next step of the project, which is to start folding the clothes. Motor servos are suitable components to be used for folding a board. This project can also count the number of folded clothes. Then, the amount will be displayed on the mobile phone using the Blynk application.

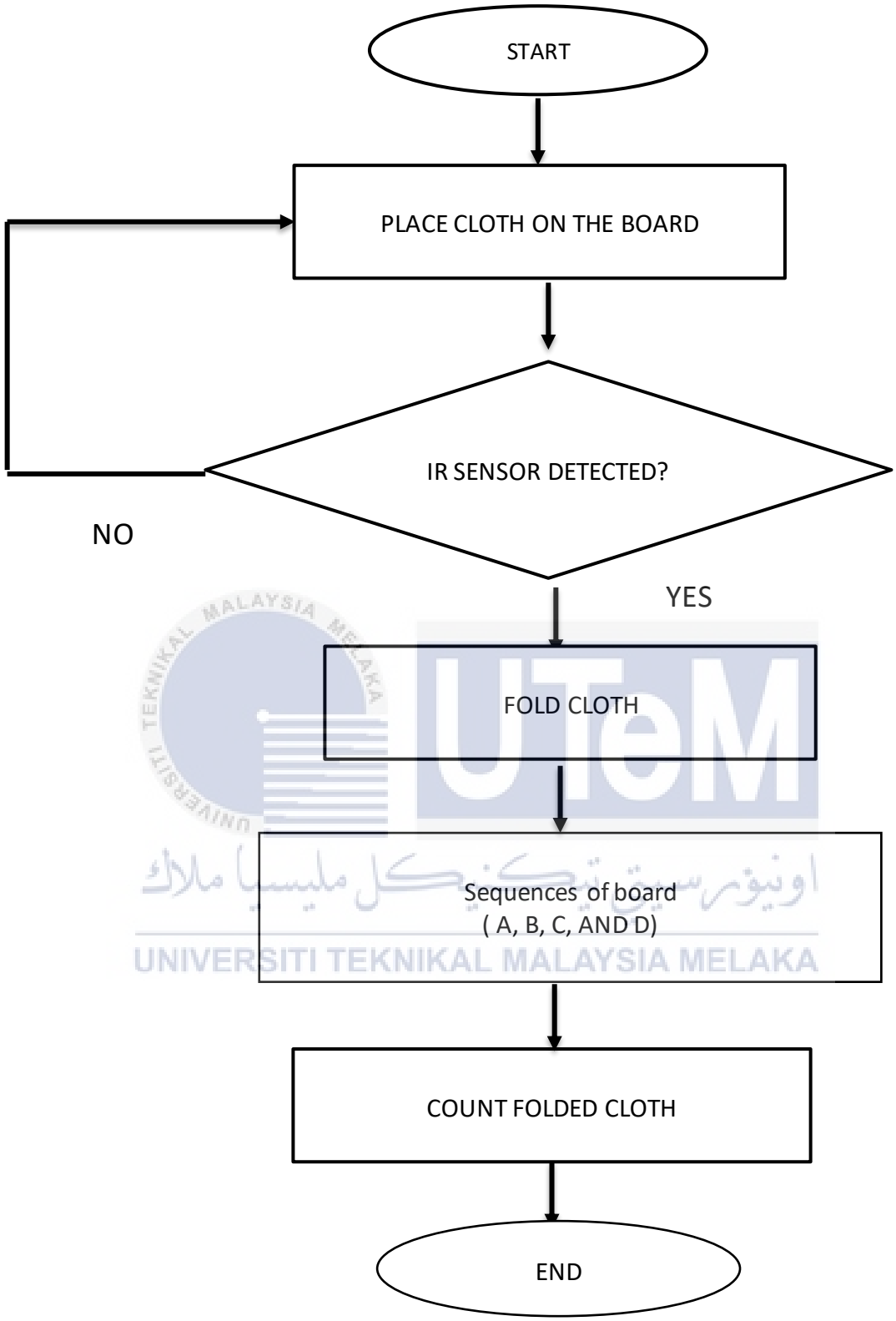

Figure 3.2 : The flow chart of folding clothes machines

3.2.2 The Block Diagram

In Figure 3.3, the general flow of the system is shown in the block diagram. Arduino is the main device of the system that will be controlling others what to do. There is one sensor used in this project which is an IR sensor while ESP8266 Wi-Fi Module will be functioning as a wireless communication that is connected from mobile smartphone to folding clothes machine.

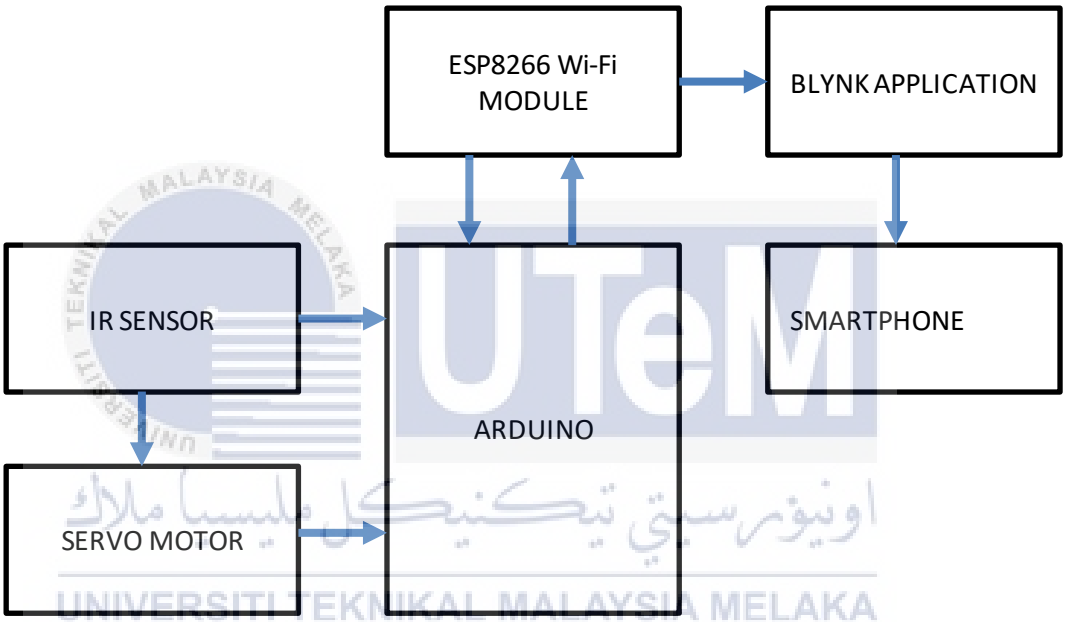

Figure 3.3 : General of Block Diagram

First of all, when the IR sensor detects the clothes on the board, it automatically sends the signal to the Arduino Uno to process the data. Hence, the Arduino Uno will send a signal to the servo motor to fold the clothes. An IR sensor acts to detect the clothes on the board, and it helps to count down the number of folded clothes after finishing the folding. The display of the amount will be displayed on the smartphone, which has been connected with an ESP8266 Wi-Fi Module. The ESP8266 Wi-Fi Module has been communicating with

the Blynk Application. The Blynk application that has been installed on the smartphone will be able to control and monitor every single project.

3.3 Methodology for Hardware

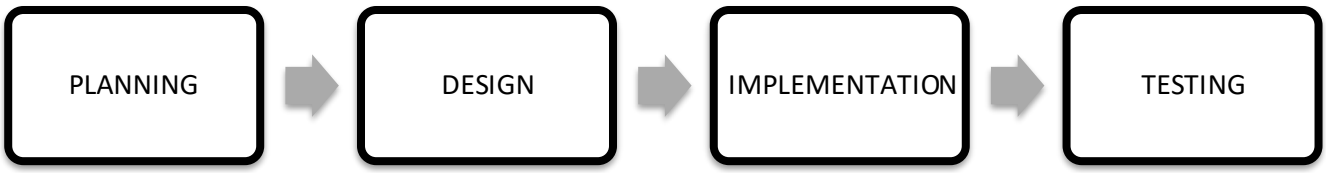

Figure 3.4 : Methodology for Hardware

Figure 3.4 above shows the list of process methodology for making the hardware for this project. The hardware system only focuses on the circuit of the folding machine and it will be installed with a ESP8266 Wi-Fi Module and Arduino to analyses the signal. After a built, tested and reworked until it achieves the objectives of developing and representing finalized products. This model was chosen since it needs a quick response phase to determine whether the prototype truly works or doesn't. Otherwise, it will take a long time to figure it out.

3.3.1 Planning

At this stage, the understanding of why the project should be implemented and, in addition, deciding the importance of a good framework will determine how the project should be well-prepared. The careful observations of this stage will prompt the next stage, which is the outline. The related sources for this project are consistent with the outline of this project that has been shown. The software and hardware used in this project were

planned from the start, including the IR sensor, ESP8266 Wi-Fi Module, Arduino Uno, and Smartphone. While the software used IDE Arduino software.

3.3.2 Design

At the beginning of the development of hardware, the first thing that needs to be done is the configuration of each piece of equipment before making the connection between the ESP8266 Wi-Fi Module and the Arduino Uno application for assembly purposes. When the hardware was designed, they needed to make sure the mechanism of the project folding machine would not be affected by the sensitivity of the sensors. As a precaution to make the system work properly, a method of calibration will be used.

3.3.3 Implementation

A prototype is built based on the reports from the outline stage and the requirement report from the planning stage and the necessary archive from the planning stage. The implementation phase, however, must deal with issues such as performance, quality of development, and troubleshooting.

3.3.4 Testing

It involved overall activities and general resources required methods and processes to be used to test the prototype to complete the testing stage. The project has to test the system roughly together with the application if something goes wrong and needs to recheck the problem until it succeeds.

3.4 Drawing Design and Prototype

This architecture is made up of four parts. All parts on the board are folded when it's detected by an IR sensor. It has four parts, which are A, B, C, and D. Part A, B, C, and D are rotated 180 degrees. Figure 3.5 shows the initial planning of the drawing design. Figure 3.6 shows a prototype for a folding clothes machine.

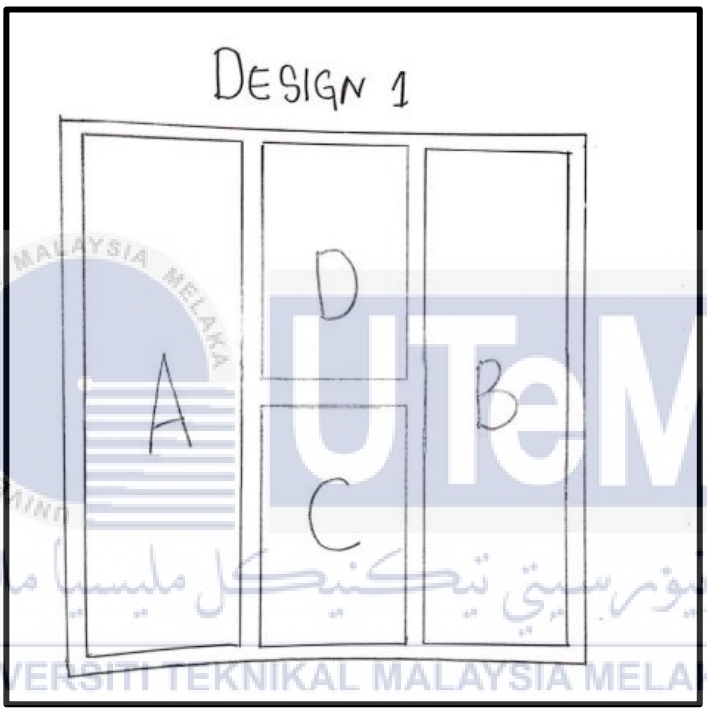

Figure 3.5 : Drawing design of folding clothes machines

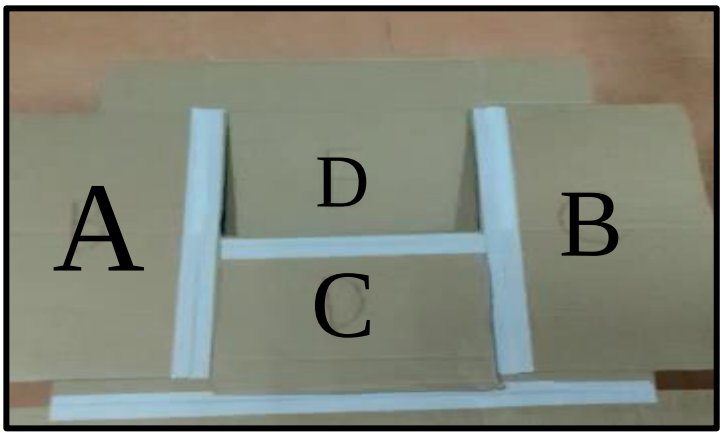

Figure 3.6 : Prototype of folding clothes machines

3.5 Design using Tinkercad Application

This design is made in the form of a plan, with four parts on the board as a Figure 3.7. Here are several views of the design as well and dimension for each part. Among the views in this design are the top view in Figure 3.8, right view as in Figure 3.9, left view as in Figure 3.10, back view as in Figure 3.11, front view as in Figure 3.12 and the view from inside the body machine.

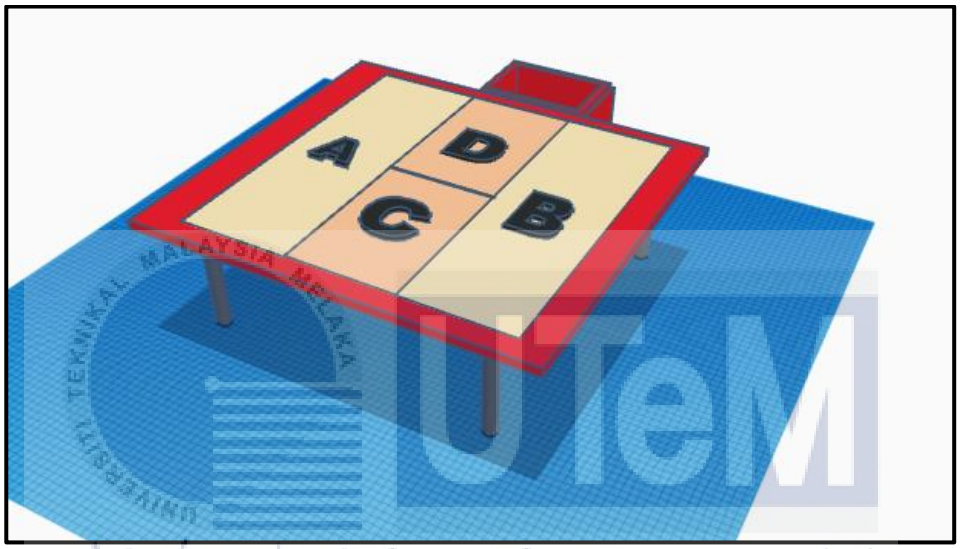

Figure 3.7 : The whole design view

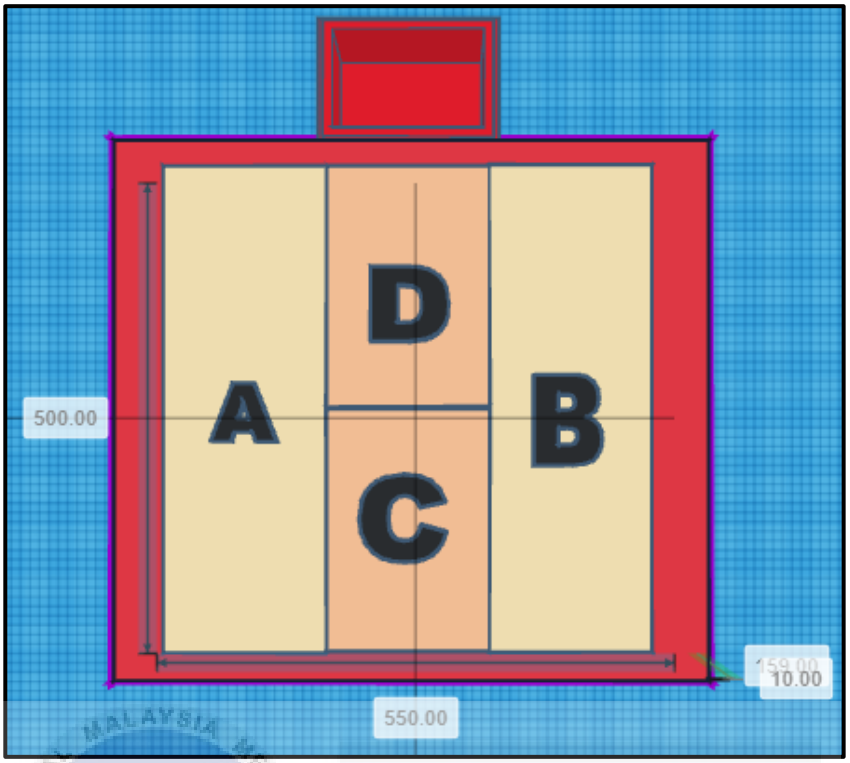

Figure 3.8 : Top View

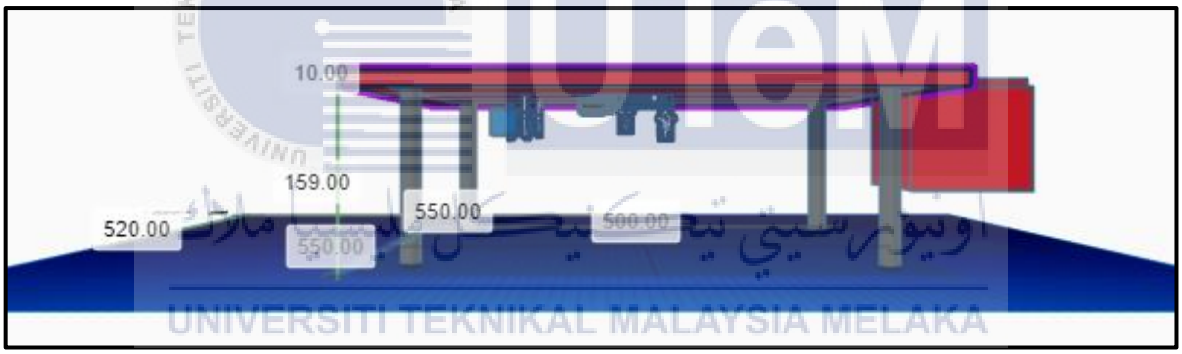

Figure 3.9 : Right view

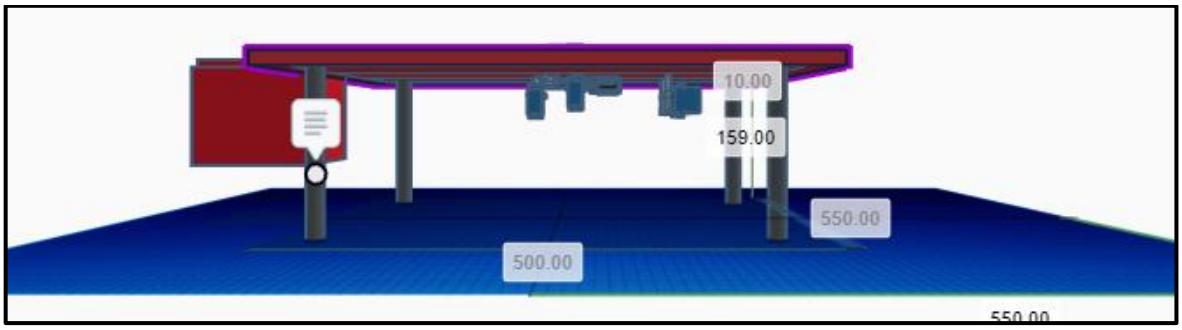

Figure 3.10 : Left view

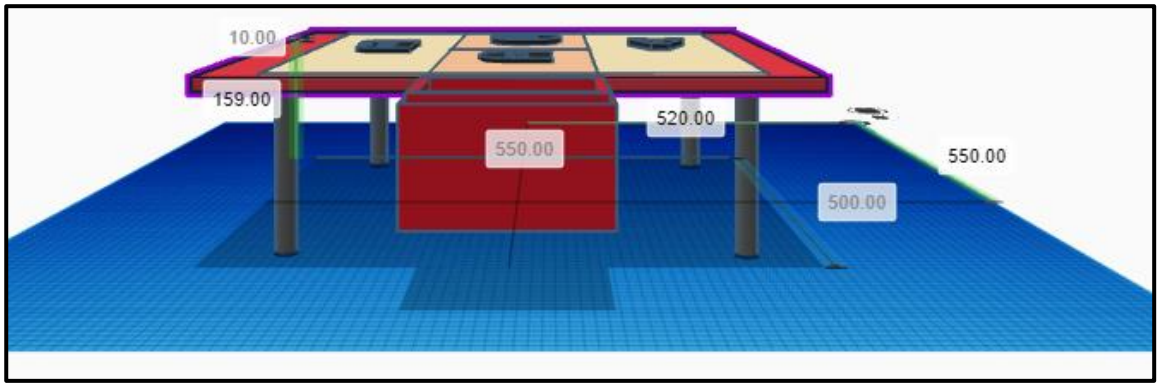

Figure 3.11 : Back view

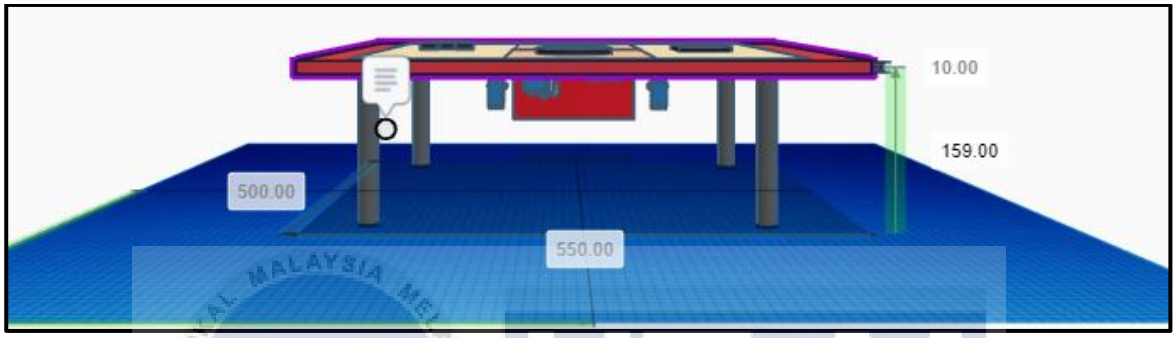

Figure 3.12 : Front view

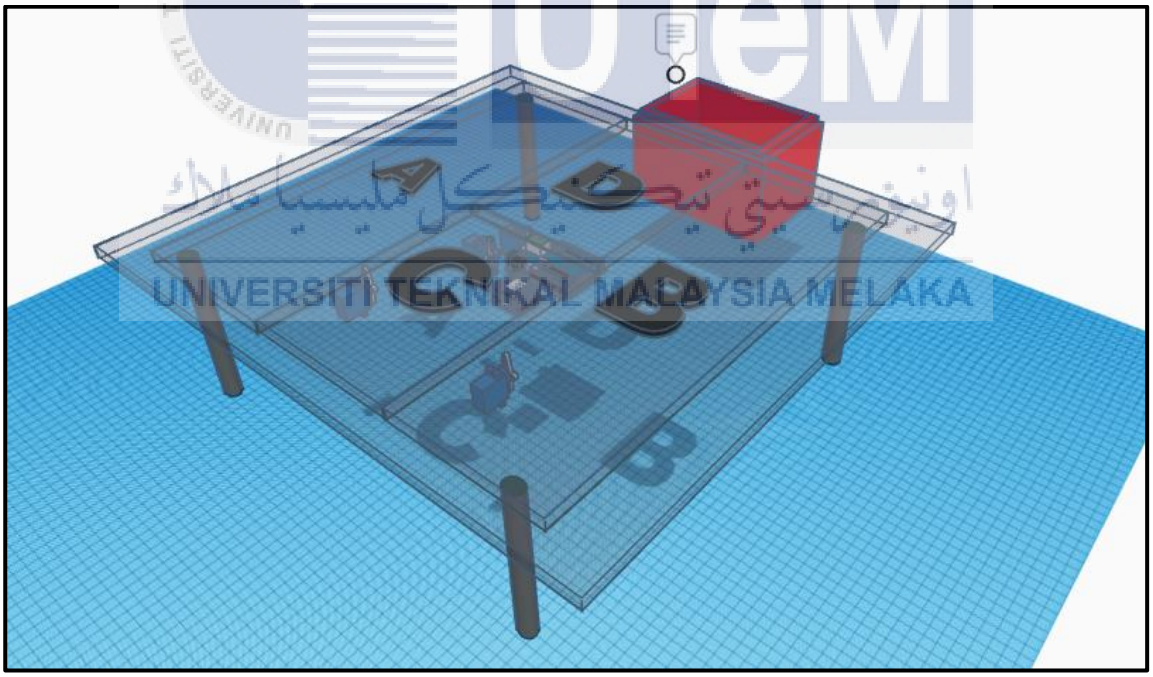

Figure 3.13 : View inside body machine

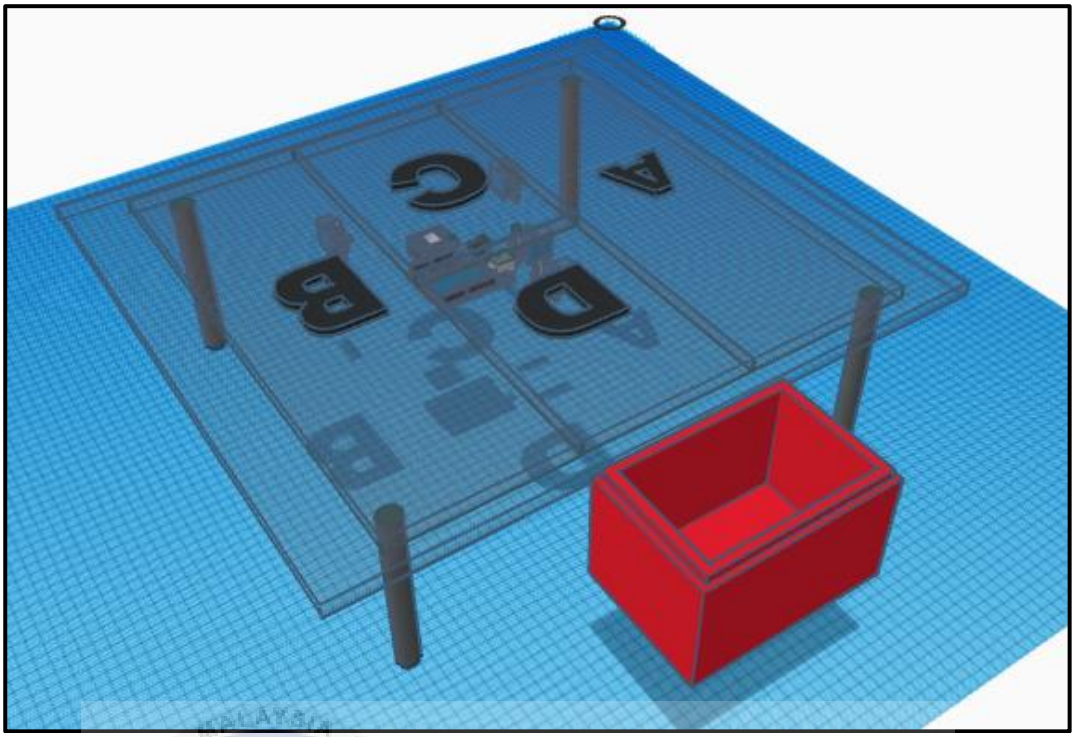

Figure 3.14 : Storage Box view

Figure 3.13 above shows a view from inside body machine. The main function of the storage box is to store the clothes after finishing folding them as shown in figure 3.14.

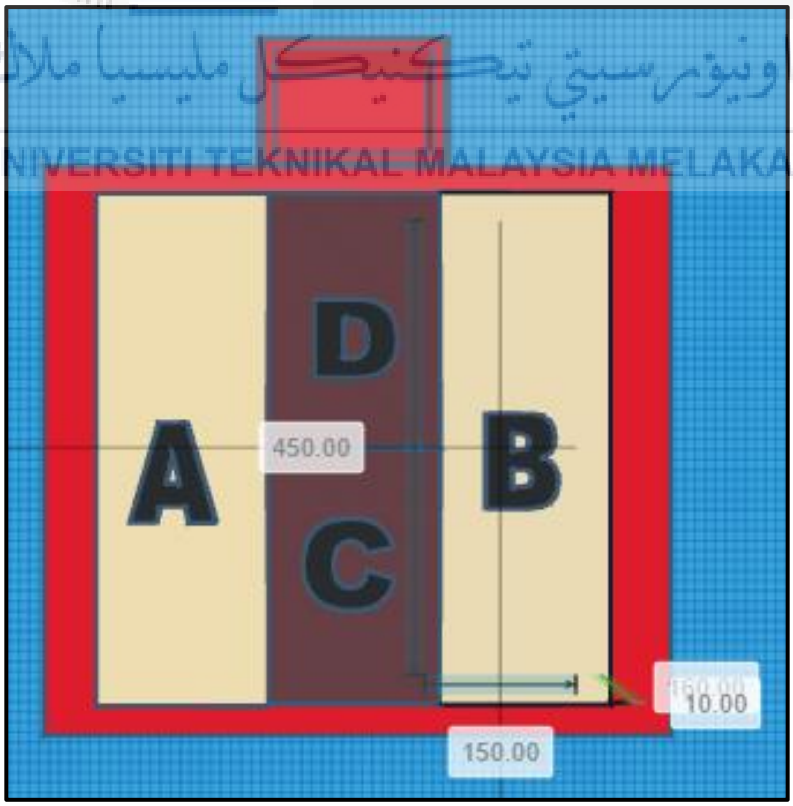

Figure 3.15 : The parts of board I

As seen the figure 3.15 shows the parts of the board for A and B. The dimensions of boards A and B are all the same. It's just a different position on the board. The rotating direction for the folding board of parts A and B is 135° flip up.

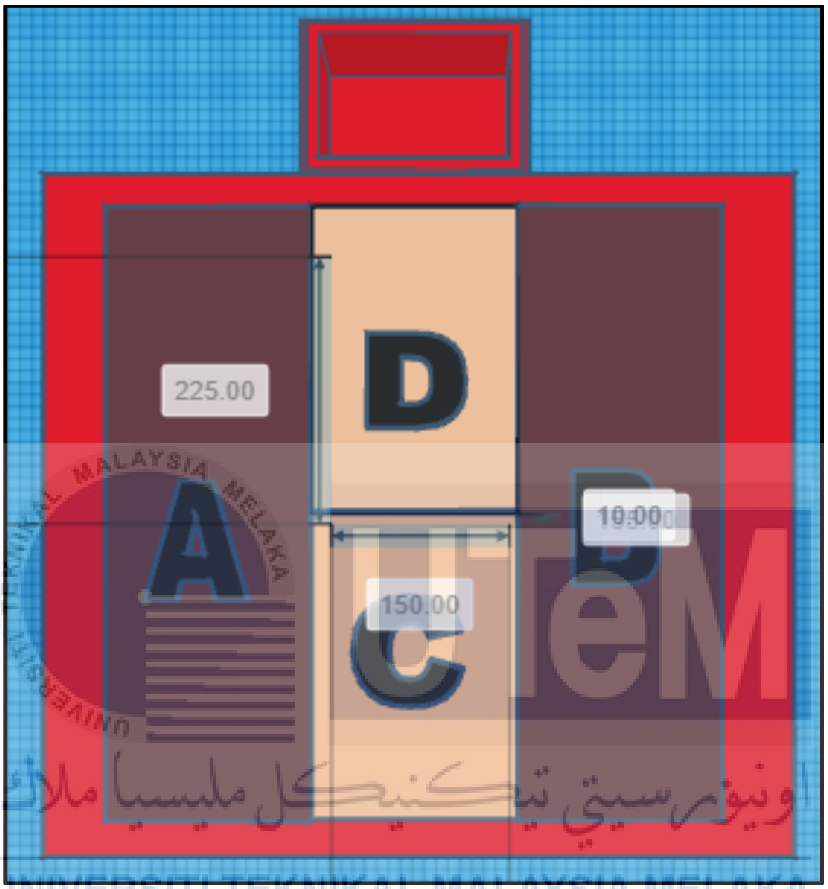

Figure 3.16 : The parts of board II

Figure 3.16 shows a parts of board II. The dimensions of boards C and D are all the same. The rotating direction for the folding board of parts C is 135° flip up, and for parts E is flip up 135° directly to storage box.

3.6 Clothes Folding Design

The prototype for this project uses PVC pipes and casing wiring to support the board for folding clothes. Figure 3.17 shows types of PVC pipes and casing wiring. Figure 3.18 and Figure 3.19 shows a design of prototype after cutting the PVC.

Figure 3.17 : PVC of Pipes and Casing Wiring

Figure 3.18 : Design of prototype

Figure 3.19 : Design of prototype when apply a board

3.7 Hardware Development

3.7.1 Arduino Uno Board

The system had to be automated, so a microcontroller, the Arduino Uno, was chosen. In addition, an Arduino is an applicable board that can save power utilization. It has all that anyone could need for a port to associate all information that is planned with interfaces. Moreover, the most important thing for Arduino is that writing computer code is an easy and simple way to understand it and emerges among others. According to Figure 3.20, it shows the schematic graph of the Arduino board.

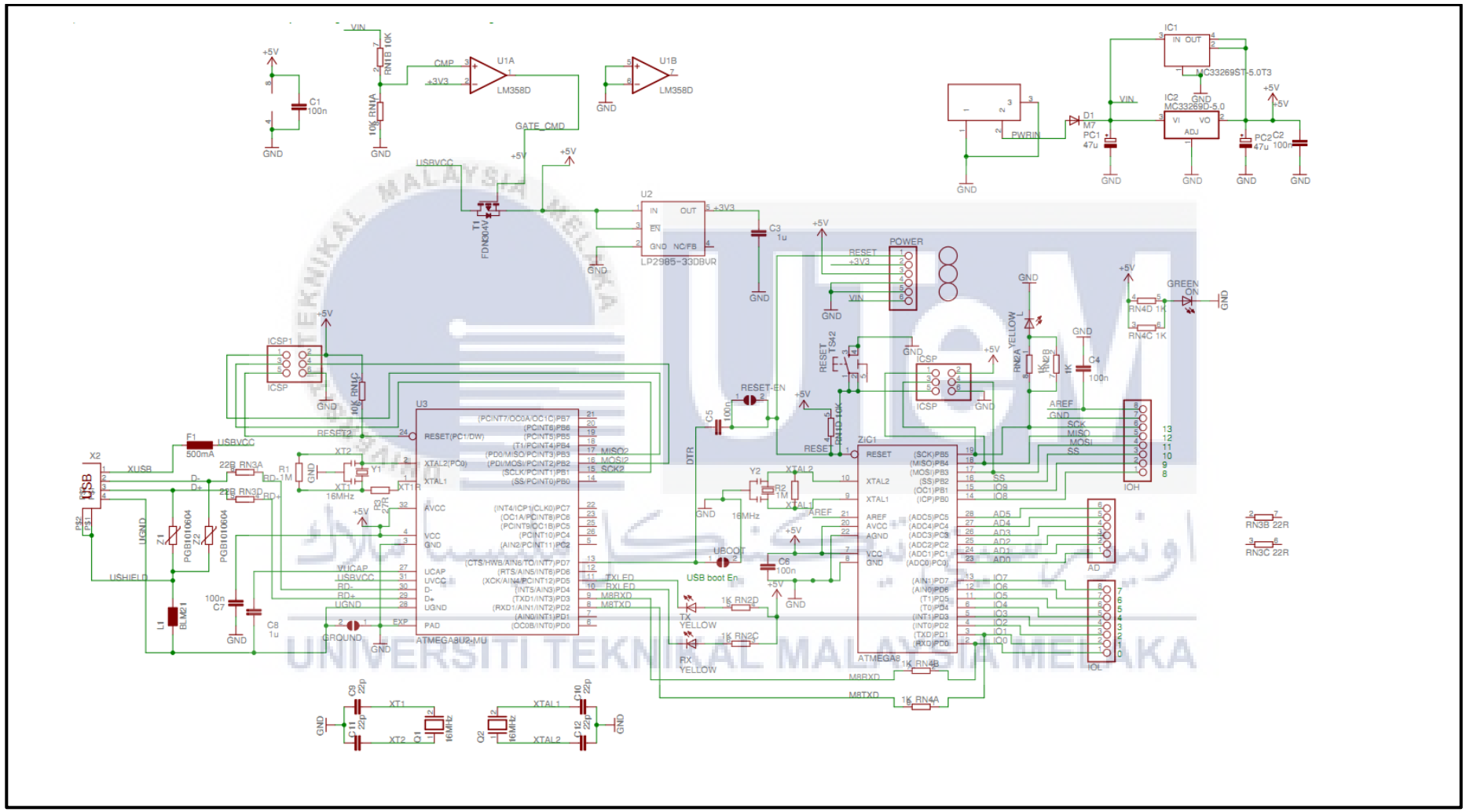

Figure 3.20 : Arduino Uno Schematic diagram.

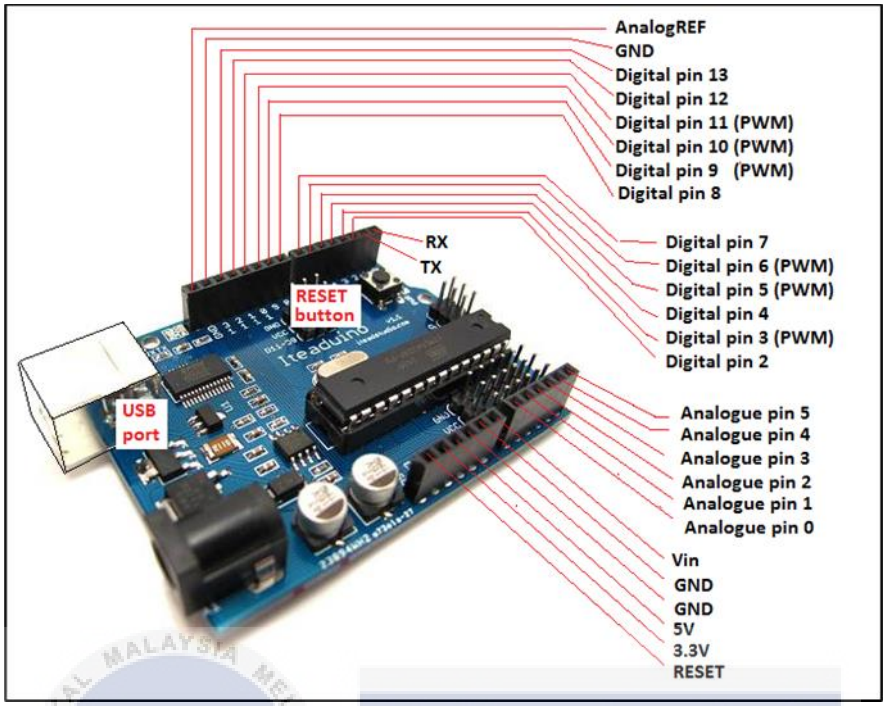

Figure 3.21 : Pin mapping on Arduino Board

Figure 3.21 above shows that the mapping of every pin at Arduino Uno board. This Arduino has provided 28 pins and every single pin had its function. An Arduino Uno has advantages such as simply connect to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. In addition, the flexibility of Arduino makes the community of uses grows day by day. This is because the Arduino software is free, the hardware board is pretty cheap, and both software and hardware are easy to learn.

3.7.2 ESP8266 NodeMCU Module Wi-Fi

The ESP8266 is a designed module component for today's internet-connected environment. This module provides a detailed and unified Wi-Fi network solution that may be used as an application provider or to isolate all Wi-Fi network functionalities from other processors. The ESP8266 offers on-board processing and storage capabilities, allowing the module to be easily coupled with sensors or specific device applications through input-output

pins. This module's high level of integration allows for a minimal external circuit, and all options, including front-side modules, are designed to fit on a small PCB. The ESP8266 module requires a maximum voltage of 3.6V to operate. The Arduino's Vcc WiFi module is attached to a 3.3V pin. When the Wi-Fi module receives voltage, it will become blue. The figure 3.22 shows a picture of ESP8266 NodeMCU Module Wi-Fi.

Figure 3.22 : The ESP8266 NodeMCU Module Wi-Fi

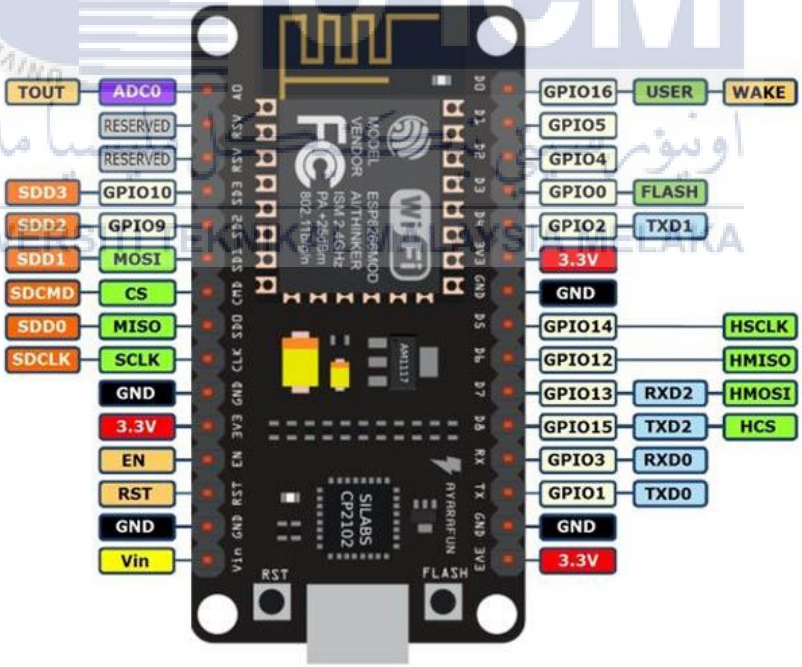

Figure 3.23 : Pin mapping on ESP8266 NodeMCU Module Wi-Fi

Figure 3.23 above shows that the mapping of every pin at ESP8266 NodeMCU Module Wi-Fi. This ESP8266 NodeMCU Module Wi-Fi has provided 30 pins and ever single pin had its function. The ESP8266 wireless module is a low-cost Wi-Fi module that supports complete TCP/IP functionality. AT-Command is used to configure this module. Many developers are interested in participating in the development of this module again because of its inexpensive price, low power consumption, and small module dimensions.

From the Figure 3.24 shows that the connection between NodeMCU ESP8266 to the light bulb. This connection will control On/OFF the light bulb using their own I/O pin. Furthermore, there is an advanced API for hardware IO that can drastically decrease the amount of redundant effort associated with setting and controlling hardware. So that, the user can code like Arduino. Table 3.1 shows a the list of feature NodeMCU ESP8266 Wi-Fi Module.

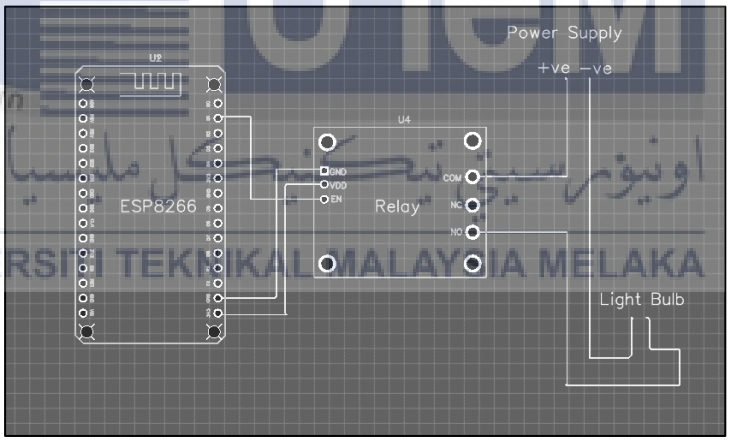

Figure 3.24 : The application of NodeMCU ESP8266

FEATURES
- Open-source - Programmable - Low Cost - Wi-Fi enabled - Speed up IoT application developing process - Lowest cost Wi-Fi - Input Voltage (3.3V-5V)

Table 3.1 : The list of feature NodeMCU ESP8266

3.7.3 Infrared Sensor (IR Sensor)

An infrared sensor is a piece of equipment that senses the changes in the environment. It works by absorbing or locating infrared radiation. Besides that, it could also detect the variation of heat changes due to object movement.

In real life, the use of infrared technology is also quite widespread. It is also not only used in the industry. The signals sent from a remote control, for example, are analyzed by an infrared detector in air conditioners. Passive for motion detection systems, infrared sensors are often utilized in security alarms and automatic lighting applications, whereas LDR sensors are employed for outdoor lighting systems. Infrared sensors provide several advantages, including low power consumption, simple electronics, and portability. An infrared sensor is represented in Figure 3.25. (IR sensor).

Figure 3.25 : An Infrared Sensor (IR Sensor)

The IR (Infrared) sensor is used in the system. To detect the object or obstacle and identify if the clothes are present or not. This IR sensor offers simple, user-friendly, and fast obstacle detection via infrared reflection. When the IR sensor detects the clothes, it will output logic "LOW" at the output pin and the green LED will light up to indicate the detection. This IR sensor supports power inputs of 5V or 3.3V. The IR will provide a signal to the Arduino Uno, which will give the signal to the motor. After this, the folding process of the system will begin.

Figure 3.26 : Pin mapping on IR sensor

Figure 3.26 above shows every pin on the IR sensor. As mentioned above, this IR sensor supports 5V or 3.3V and 1A only for each IR sensor. Setting up an IR sensor connection to the Arduino is easier. Figure 3.27 shows that the connection between VCC and GND pin is broken. The sensor has only one output pin that should be connected to one

of the digital pins of the Arduino. In this case, it's connected to pin 2. This sensor has two main parts: an IR transmitter and an IR receiver. When the transmitter transmits their infrared waves, whereas the receiver's work is to receive these waves. The IR receiver frequently sends digital data in the form of 0s or 1s to the Vout pin of the sensor. For example, if the IR sensor detects a reflected wave from that object and it is received by the receiver, The IR sensor gives 0 in this condition.

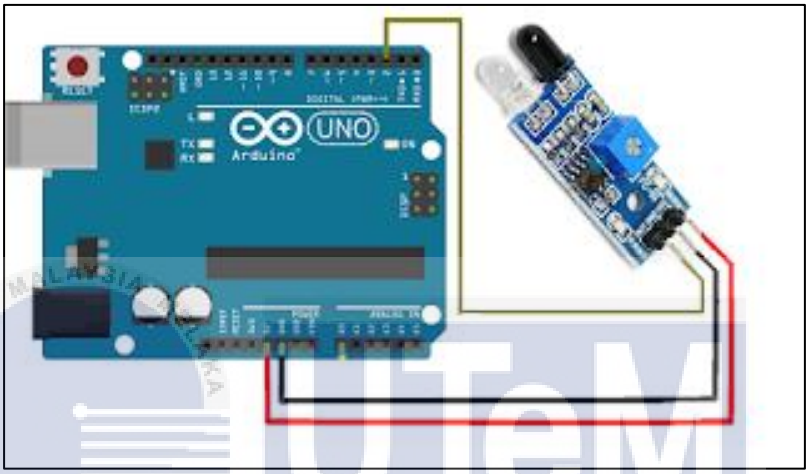

Figure 3.27 : IR sensor connection with Arduino

3.7.4 Motor Servo

The servo motor provides the accurate control of angular or linear location, speed, and acceleration of the rotatory action / linear actuator. A relevant motor is attached to a position feedback sensor in this system. It also demands a powerful controller, which is often a separate module designed specifically for servo motors. Servo motors are utilized in a variety of applications, including robotics, CNC machines, and automated manufacturing. A servo motor is a closed-loop servo mechanism that uses position feedback to control its speed and ultimate position. The sensor is connected to the motor, which rotates 1800 times to determine the distance range surrounding the sensor. To rotate in both clockwise and

anticlockwise directions, the motor is controlled and interfaced with an Arduino microcontroller. Figure 3.28 and Figure 3.29 shows a servo motor with internal diagram.

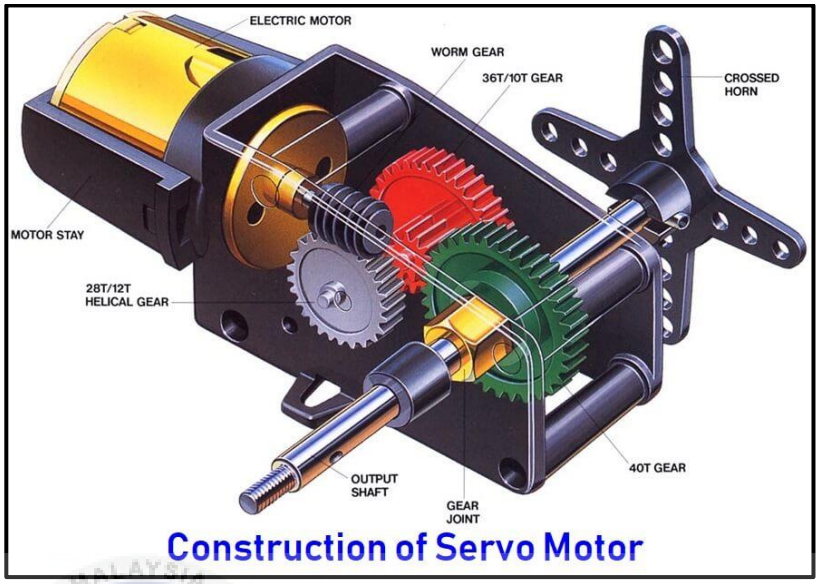

Figure 3.28 : Servo motor with internal diagram

Figure 3.29 : The servo motor

3.8 Software Requirement

3.8.1 Arduino IDE

The IDE (Integrated Development Environment) is a software that enables code editing, compiling and debugging to be better and supported. The Java Platform runs the Arduino IDE. So, this Arduino IDE has built-in functions and commands that are customized to run on the Arduino dev board, although they work on the Java platform. Thus, the Arduino IDE is used to edit, compile, debug and then burn the code into the Arduino dev board. The Arduino IDE interface shows like Figure 3.30 and Figure 3.31.

Figure 3.30 : Arduino IDE interface

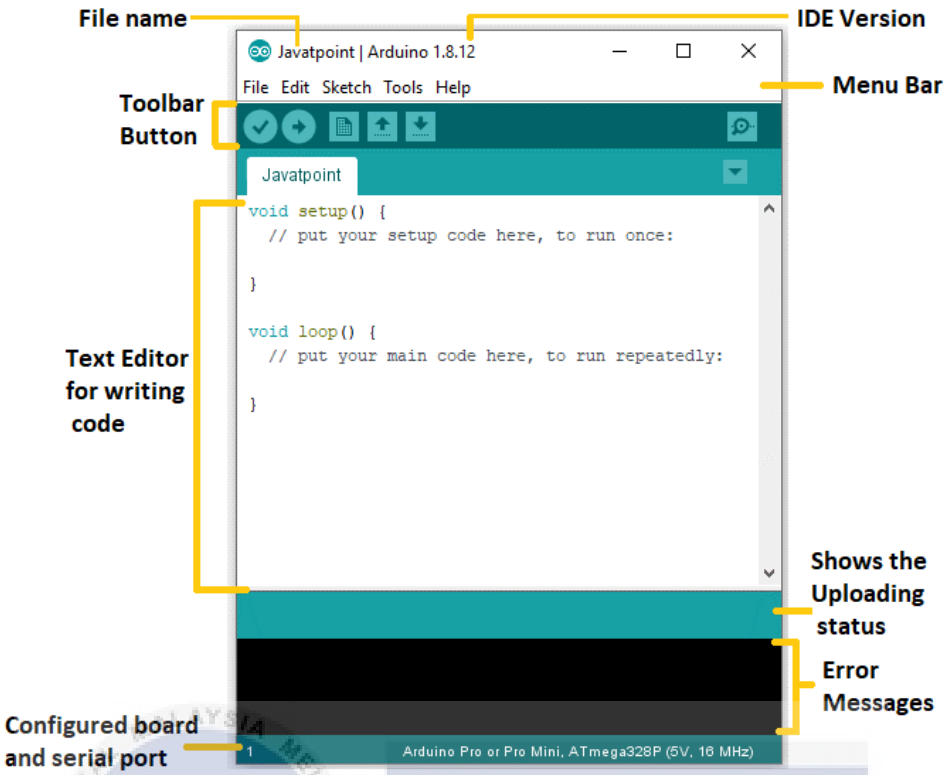

Figure 3.31 : Interface of Arduino IDE

3.8.2 Autodesk Tinkercad

Tinkercad by Autodesk as seen in the Figure 3.32 is a modelling programme that allows users to create 3-dimensional goods and even achieve their creative dreams. Typically, this approach creates a solid object by drawing a 2D profile and then extruding and lofting it. Because it is user-friendly and has more functionality, Autodesk Tinkercad is a good choice for designing the prototype of the folding clothing machine. Figure 3.33 shows the whole design view. It's made from Autodesk Tinkercad.

Figure 3.32 : Autodesk Tinkercad software

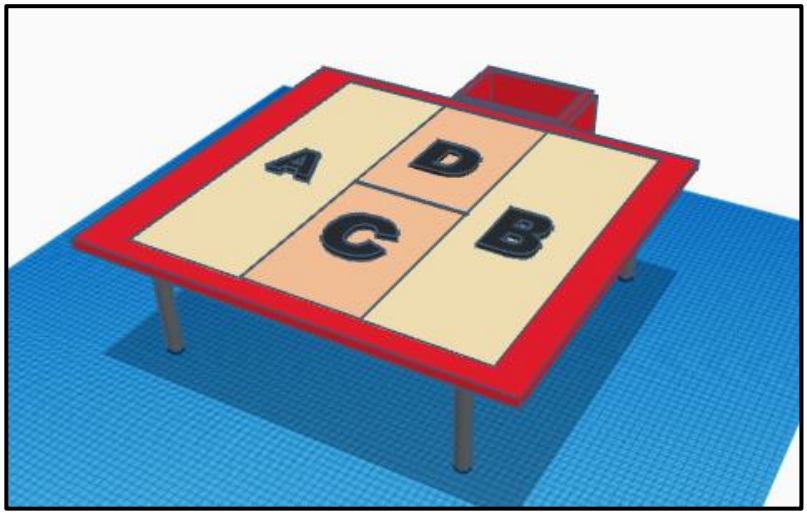

Figure 3.33 : The whole design view.

3.8.3 Proteus

Proteus is software for simulating components and attracting the desired circuit. It is used to check the code written for the microcontroller quickly. Proteus has a large component list and there are many libraries available for more components to be included. Using this software makes it a circuit simulation, so it's pretty easy to design and add a library package. This project will also use this software to create and test electronic circuits because, by adding a package, Arduino-based simulations are also possible. Figure 3.34 shows a example of circuit design using Proteus software.

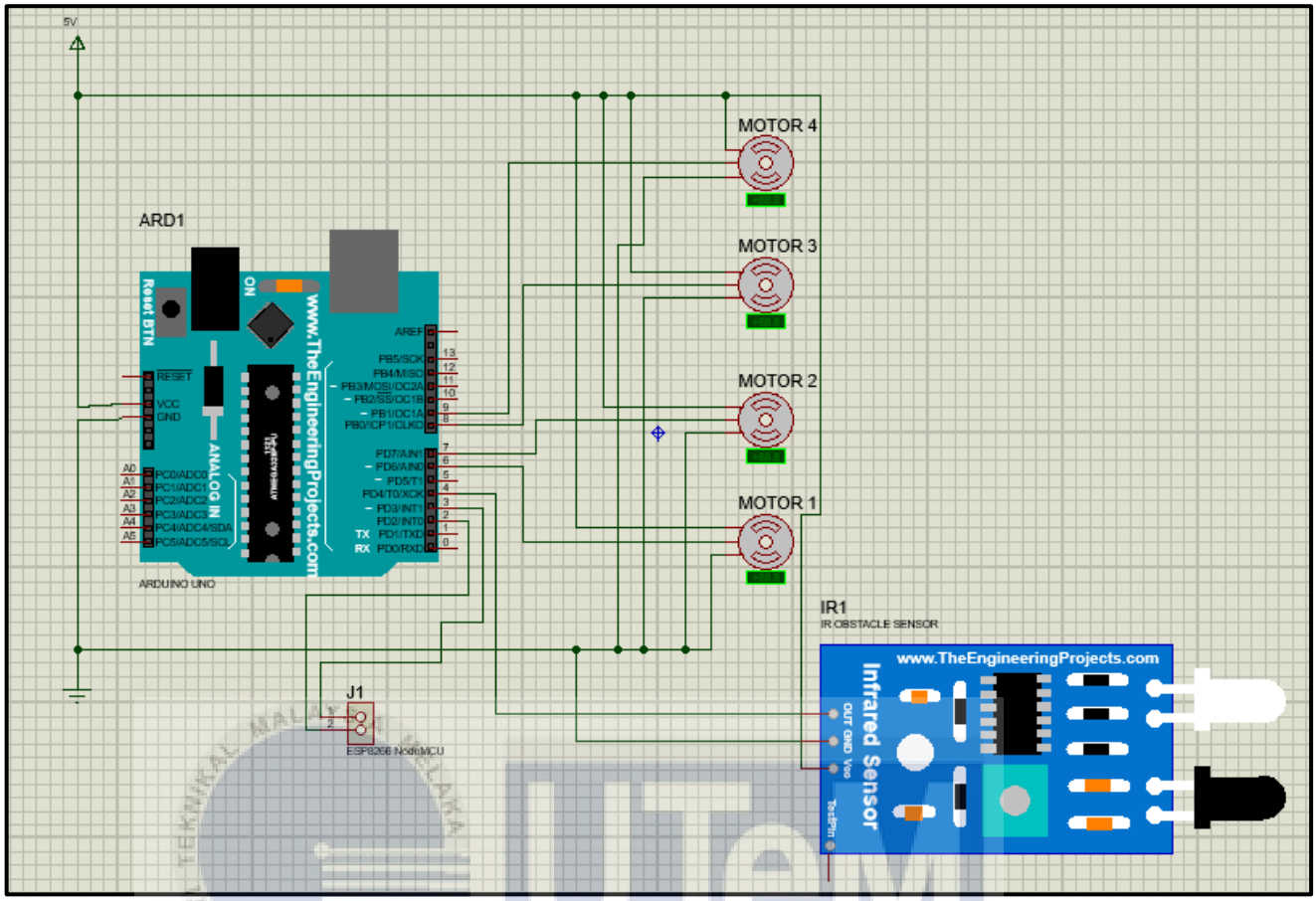

Figure 3.34 : Circuit design using Proteus software

3.8.4 Blynk IoT Application

Blynk was created with the Internet of Things (IoT). It can remotely manage hardware, display sensor data, store data, visualize it, and do a lot more. Many applications and software have been developed to support IoT for widespread use in recent years. Blynk is the only software that offers a new platform for easily designing interfaces for controlling and monitoring hardware projects on iOS and Android smartphones. If it already has the Blynk programme, it can create a project dashboard and arrange buttons, sliders, graphs, and other widgets on the screen. The widgets can be used to switch on and off pins as well as display data from sensors.

Whatever the project is, there are plenty of tutorials to make the hardware part quite easy, but it's still challenging to build the software interface. Blynk is ideal for interfacing with simple projects. As seen in Figure 3.35, it's shown how a connection of Blynk. Figure 3.36 shows some of the layouts on the Blynk Application.

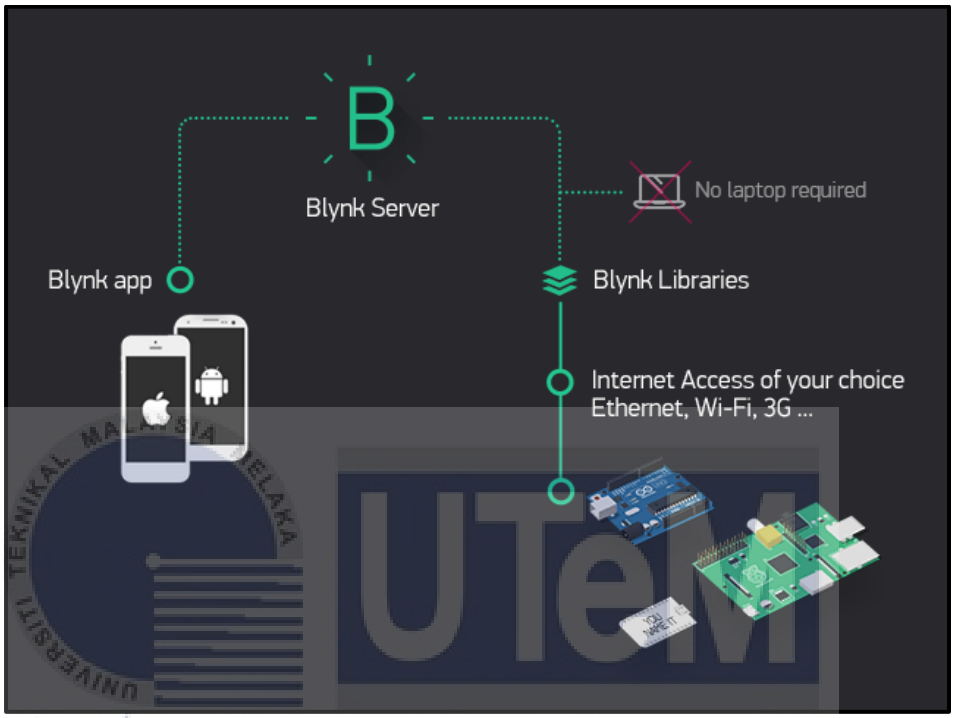

Figure 3.35 : Blynk Connection

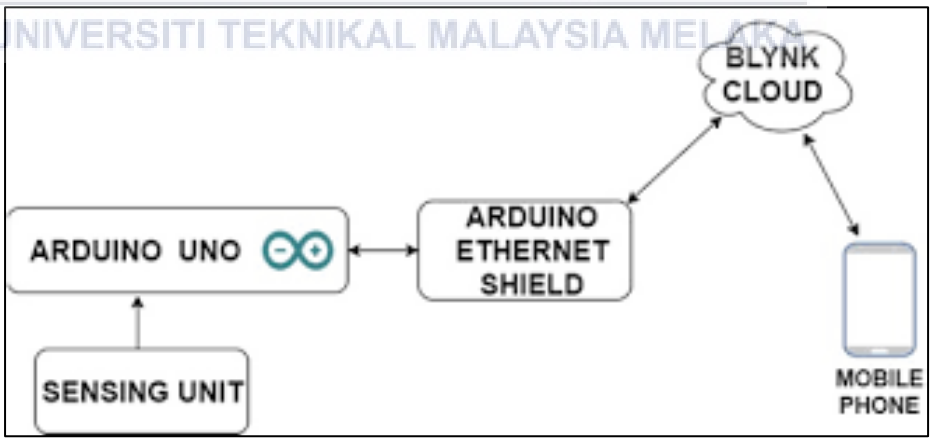

Figure 3.36 : Block Diagram of Blynk

Based on Figure 3.36, this block diagram generally shows about the IoT of a system. In addition, everything processing by Arduino will be sent to the internet module and will keep the data into the cloud that connected between smartphone and cloud. The smartphone

that gets access to the cloud will easy to communicate and monitor the system at the Arduino.

Table 3.2 shows a advantage and disadvantages of Blynk application.

Advantage	**Disadvantage**
Easy and simple	Lack of documentation for some device
Many feature	Can't make own widget
There is no need for any additional hardware	Not made to implement complex projects
Active community	

Table 3.2 : Advantage and Disadvantage of Blynk

3.9 Gantt Chart

Table 3.3 : Project Gantt Chart BDP 1

PROJECT ACTIVITIES	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEE K 7	WEE K 8	WEE K 9	WEE K 10	WEE K 11	WEE K 12	WEE K 13	WEE K 14	WEE K 15	WEE K 16
BDP Briefing									M							S
Meeting with Supervisor									I							T
Distribution of project titles									D							U
PSM1 Rubrics Explaination									B							D
Project Planning									R							Y
Proposal Preparation									E							
Abstract									A							W
Literature Review									K							E
Design Project																E
Flowchart									S							K
Prototype Design									E							
Create layout using MIT app inventor									M							
Design the circuit									E							
Simulation the circuit									S							
Contract actual circuit									T							
Performance Analysis									E							
Thesis preparation									R							

Table 3.4 : Project Gantt Chart BDP 2

PROJECT ACTIVITIES	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14	WEEK 15	WEEK 16
BDP 2 Briefing									S							S
Meeting with Supervisor									E							T
Identify Hardware and Software									M							U
Method of component									B							D
Design of prototype									R							Y
Project Development									E							
Finalize the project design									A							W
Chapter 3 : Methodology									K							E
Chapter 4 : Analysis																E
Chapter 5 : Conclusion and Recommendations																K
Submission Final Report																
Presentation																

3.10 Summary

In this chapter, an IoT development of a microcontroller-based clothes folding system will be built using Arduino UNO based on previously discussed methods and processes. This project's main operating system is the Arduino UNO. The project's block diagram and flowchart were created. The Arduino IDE programming languages are used to run the hardware, thus both hardware and software development are linked. The IoT development of a microcontroller-based clothing folding system that can display information on sensors will be the outcome of this project.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

In this chapter, data obtained from a combination of software and hardware development as well as system operations and functions will be recorded. This chapter shows how the system works and communicates using the microcontroller and internet module ESP8266 ESP8266 Module Wi-Fi that will monitor the counting a clothes folding via the user's smartphone.

4.2 Electronic Design

For the result of electronic design, the simulation circuit in Figure 4.0 has been made first by using the software Proteus. Then, hard wiring on the hardware module will be done after the simulation circuit runs perfectly.

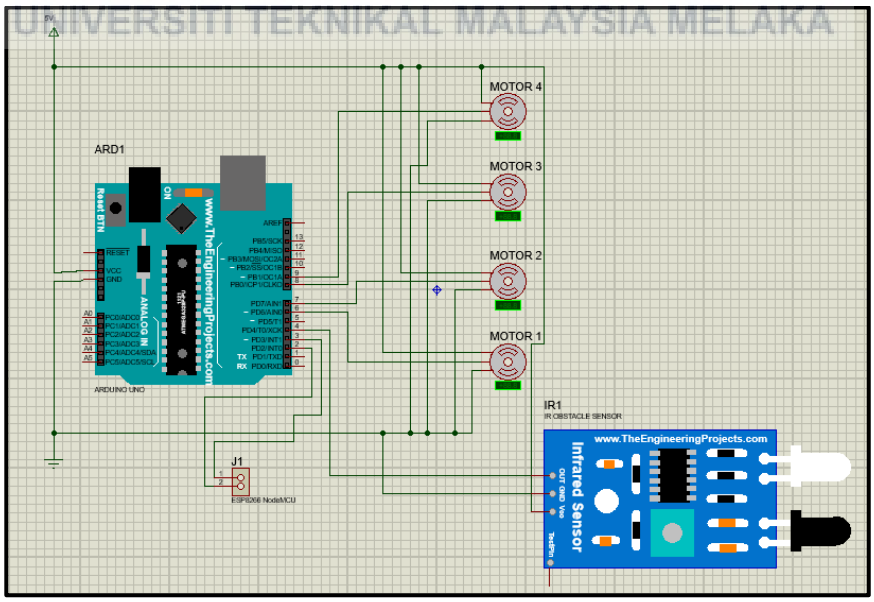

Figure 4.0 : Simulation Circuit

The complete circuit board shown in Figure 4.1 has been made and applied to the prototype board. For this folding clothes project, this circuit works to control all electronic components.

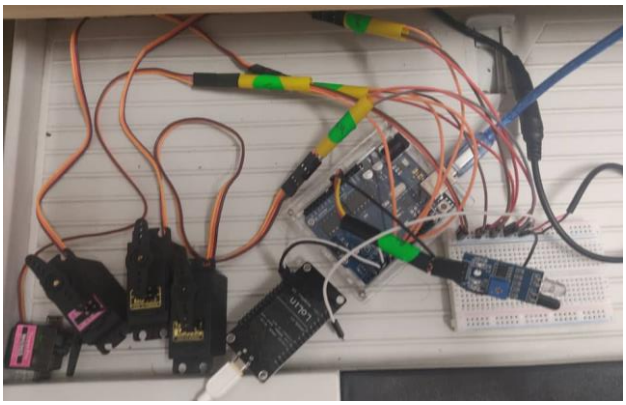

Figure 4.1 : Wiring circuit on electronic part

The figure 4.1 above show that one sensor of Infrared (IR) sensor and four servo motor that connected to Arduino Uno. This sensor represent one of project have one sensor which is Infrared (IR) sensor. Besides, the ESP8266 NodeMCU Module Wi-Fi of port Rx and Tx will connected to pin 2 and 3 of Arduino Uno.

4.3 Testing Result

4.3.1 Software Result

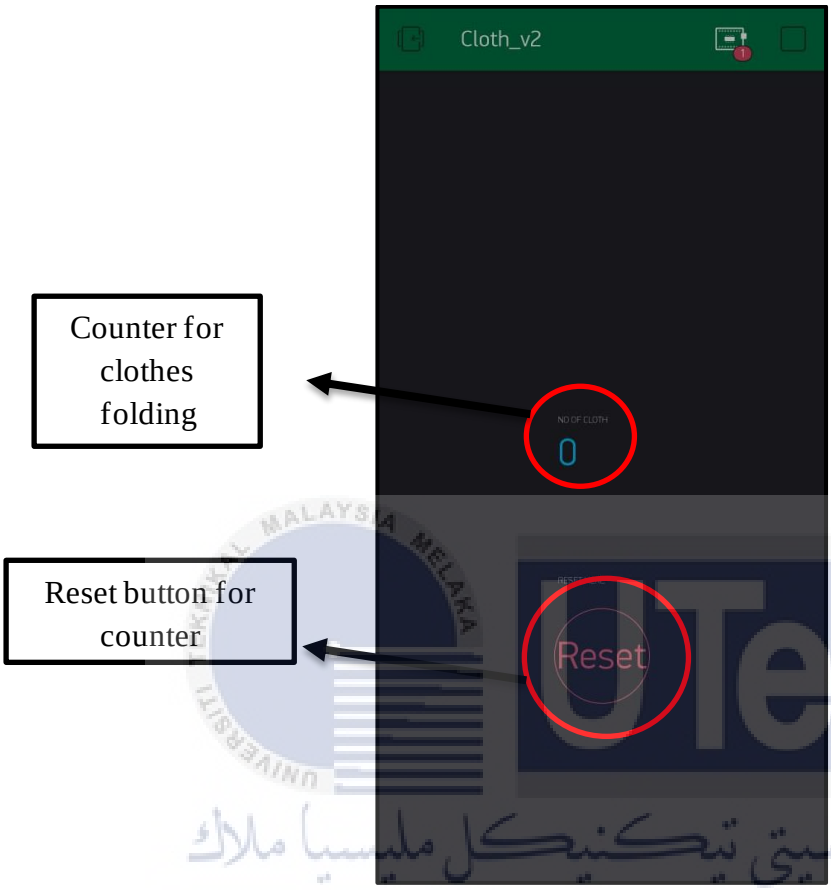

Figure 4.2 : Blynk Interface

This result is shown for the Blynk interface on the smartphone user in Figure 4.2 above. In the first box is a counter. This counter is to count every piece of clothing after finished folding. The second box is the reset button for the counter. The purpose of this reset is to reset the button for the counter to 0. The user must reset the counter in the Blynk application if they want to start counting the folded clothes from 0.

4.4 Analysis

4.4.1 Result and Analysis

Types Of Motor Servo	Declare
FS5115M 	0
MG90S 	1
Time Delay	
10s	0
15s	1
Power Supply	
12V 1A 	0
5V 3A 	1

Table 4.0 : Declaration for analysis

RUN	Types Of Motor Servo	Time Delay	Power Supply	Summary	Output	Pass / Fail
Run 1	0	0	0	It can be run but not for all motor servos because the current doesn't support all motor servos.		X
Run 2	0	0	1	It can run smoothly. All motor servos can run, and the speed for folding the board is also suitable.		✓
Run 3	0	1	0	Motor servo can be run with this analysis but not for power supply. 12V 1A can't support 4 motor servos and 1 IR sensor. Time delay can function like usual, but it's untidy to fold clothes.		X
Run 4	0	1	1	It's almost the same result as 001. A power supply suitable for all components, such as a 4-motor servo and an IR sensor. The motor servo can also be set to support +-13 kg. But the speed of the time delay is not very appropriate. It's because when the board		✓

				moves slowly, the clothes get untidy.		
Run 5	1	0	0	Using this servo motor and power supply is not suitable because this motor servo can't support folding up the board and the current is not enough to support all motor servos.		X
Run 6	1	0	1	This analysis can run all motor servos but is not suitable for folding clothes. This motor servo just supports -1 kg. When putting the clothes on the board, the motor servo can't support folding the board.		X
Run 7	1	1	0	This analysis can't be used for this project. It's because the motor servo, time delay, and power supply are not suitable for folding clothes.		X
Run 8	1	1	1	This also has almost the same result as 101. It can support all motor servos and IR sensors. But this motor servo is unable to fold up a board. It's just support -1kg.		X

Pass Fail

Table 4.1 : The result of analysis

4.4.2 Discussion of analysis

In conclusion, from this analysis, just two can be used, which are run 2 and run 4. Run2 uses the type of motor servo FS5115M. The time delay is 10 s and the power supply is 5V 3A. While run 4 uses the type of motor servo FS5115M, the time delay is 15 s and the power supply is 5V 3A. The difference between both these analyses is the time delay, which is 10 s and 15 s. I would prefer run 2. It is because the lower value of the time delay (10s), it achieve higher tidiness of the cloth folding output. When slowly extending the time delay, the clothes will be untidy when folded.

4.5 Summary

As a summary of this chapter, the methods implemented in this project are crucial and important to completing the project. The materials and components used in the project created a lightweight and strong product, making this project very convenient for everyone because the design of clothes folding machines is simple. The aim was to make it easy to handle, operate, and understand in use. The aim was to make it easy to handle, operate, and understand in use. In this chapter, we also show the results of the testing of coding programmes, the result of testing on the IR sensor when detecting the clothes, and the result of testing on the Blynk application to display the output of the counter when folding clothes.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter will outline the conclusion and recommendation for the project as a whole and discuss a few recommendations and suggestions for improving the project for future development related to this project.

5.2 Conclusion

Development of a Microcontroller Based Clothes Folding System is an innovation project designed to meet the requirements of IR 4.0.The Fourth Industrial Revolution (IR 4.0) is expected to change how we live, work, and communicate; it is also likely to change the things we value and the way we value them in the future. This clothes folding system has been developed by using wireless technology, which is an internet module using an ESP8266 NodeMCU Wi-Fi Module. This device is very useful and easy to use in daily life to promote human life.

In a nutshell, this project has been successfully achieved its objectives. The understanding of interface and cloud between the ESP8266 NodeMCU Wi-Fi Module, Arduino Uno and Blynk Application was study before implementation of IoT based Clothes Folding System. Beside, this project was successfully designed and develops using Arduino Uno as a main controller. The notification can be triggered to user when the IR sensor detected the clothes on the board. Therefore, the ESP8266 NodeMCU Wi-Fi Module is a good function as required as a medium to inform the user how much clothes they finished folding. The interface of the Blynk application the communicate between ESP8266

NodeMCU Wi-F Module and Arduino Uno also successful and display the monitoring of counter the clothes after finished folding.

5.3 Recommendation

Even though this project is a successful design and development, improvements can be made to solve the various constraints and make this system more efficient. There are several limitations that can be further improved on this project. The system can be improved by solving the problem in terms of material prototypes. The problem is that the material prototype is untidy and unstable. It's because the only material utilised is PVC pipe, which is light and soft. It was unable to smoothly and properly accommodate the prototype's position. This problem can be improved by using wood or iron to make a prototype of this project more stable and proper.

Next is the servo motor. The servo motor has the disadvantage of being inexpensive and easily damaged. It's because the motor servo can be overlapped when trying a few times uploading the code to see the function of the motor servo. This motor servo also sometimes can't support the weight of the board and clothes even though it's already using a metal servo motor. So, this problem can be improved by using an expensive motor servo, which is the FS5115M motor servo. The estimated price for this motor servo is RM55. It can accommodate weights in the range of 14 kg to 15 kg.

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APPENDICES

Appendix A

Appendix 1 : Coding for Arduino Uno

arduino_-_Shortcut.lnk

```
#include <SoftwareSerial.h>
#include <Servo.h>

SoftwareSerial NodeMCU (10, 11);
Servo myservo1;  // create servo object to control a servo
Servo myservo2;
Servo myservo3;
Servo myservo4;

int pos = 0;
int counting = 0;
int counting2 = 0;
int counting3 = 0;
int status_sensor = 0;

int sdata1 = 0; // sensor1 data
int sdata2 = 0; // sensor2 data
int sdata3 = 0; // sensor3 data
String cdata; // complete data, consisting of sensors values

unsigned long previousMillis = 0;
unsigned long currentMillis;
const unsigned long period = 500;
void setup()
{
  pinMode(13, OUTPUT);
  pinMode(4, INPUT);
  Serial.begin(9600);
  NodeMCU.begin(9600);
```

```
  Serial.begin(9600);
  NodeMCU.begin(9600);
  myservo1.attach(6);
  myservo2.attach(7);
  myservo3.attach(8);
  myservo4.attach(9);
  myservo1.writeMicroseconds(1000);  // set servo to mid-point
  myservo2.writeMicroseconds(1000);
  myservo3.writeMicroseconds(1000);
  myservo4.writeMicroseconds(1000);
  Serial.println("CLOTH TEST");       // print some text in Serial Monitor
  Serial.println("with Arduino UNO R3");
}
void loop() {
  currentMillis = millis();
  Send_data();
  bool readsensor = digitalRead(4);
  //Serial.println("========== ");
  //Serial.print("SENSOR : ");
  //Serial.println(readsensor);
  Serial.print("NO BAJU : ");
  Serial.println(counting);
  //delay(500);

  if (digitalRead(4) == LOW) {
    if (status_sensor == 1) {
      //delay(1000);
      digitalWrite(13, HIGH);
```

```
      digitalWrite(13, HIGH);
      for (pos = 45; pos <= 210; pos += 1)
      {
        myservo1.write(pos);
        //Serial.println("motor 1");
        delay(5);
      }
      for (pos = 210; pos >= 45; pos -= 1) {
        myservo1.write(pos);
        delay(1);
      }
      delay(500);
      //================================
      for (pos = 45; pos <= 210; pos += 1)
      { // goes from 0 degrees to 180 degrees
        myservo2.write(pos);
        //Serial.println("motor 2");
        delay(5);
      }
      for (pos = 210; pos >= 45; pos -= 1) {
        myservo2.write(pos);
        delay(1);
      }
      delay(500);
      //================================
      for (pos = 45; pos <= 210; pos += 1)
      { // goes from 0 degrees to 180 degrees
        myservo3.write(pos);
```

```
      }
      for (pos = 210; pos >= 45; pos -= 1) {
        myservo3.write(pos);
        delay(1);
      }
      delay(500);
      //================================
      for (pos = 45; pos <= 210; pos += 1)
      { // goes from 0 degrees to 180 degrees
        myservo4.write(pos);
        //Serial.println("motor 4");
        delay(5);
      }
      for (pos = 210; pos >= 45; pos -= 1)
      {
        myservo4.write(pos);
        delay(1);
      }
      //delay(500);
      //================================
      counting++;
      NodeMCU.print(counting);
      NodeMCU.println("\n");
      status_sensor = 0;
    }
  }
  else{
    digitalWrite(13, LOW);
```

```
      NodeMCU.print(counting);
      NodeMCU.println("\n");
      status_sensor = 0;
    }
  }
  else{
    digitalWrite(13, LOW);
    pos == 0;
    status_sensor = 1;
    delay(100);
  }
}

void Send_data() {
  if ((currentMillis - previousMillis >= period)) {
    sdata1 = counting;
    sdata2 = counting2;
    sdata3 = counting3;
    cdata = cdata + sdata1 + "," + sdata2 + "," + sdata3;

    Serial.print("Send TO ESP : ");
    Serial.println(cdata);
    NodeMCU.println(cdata);
    delay(1000); // 100 milli seconds
    cdata = "";
    previousMillis = previousMillis + period;
  }
}
```

Appendix 2 : Coding for ESP8266 NodeMCU

NodeMCU_blynk_25112021

```
#define BLYNK_PRINT Serial
#include <SoftwareSerial.h>
#include <BlynkSimpleEsp8266.h>
#include <ESP8266WiFi.h>
BlynkTimer timer;

//================= CONNECT TO WIFI ================

char auth[] = "0IlcKy7saw8TNEOu0lsMovOPnmyOeDXM";
char ssid[] = "Azaiman";
char pass[] = "AliahAiman";
int rpm = 0, a;
int numcount1 = 0;
int numcount1_ = 0;
int numcountminus = 0;
int numcount2 = 0;
int numcount3 = 0;

String myString; // complete message from arduino, which consistors of snesors data
char rdata; // received charactors

BLYNK_WRITE(V0) {
  a = param.asInt();
  numcountminus = numcount1;
  Serial.print("No Button :");
  Serial.println(a);
}

void setup() {
```

```
void setup() {
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
}

void loop() {
  Blynk.run();
  timer.run();

  if (Serial.available() > 0 ) {
    rdata = Serial.read();
    myString = myString + rdata;

    if ( rdata == '\n') {
      String l = getValue(myString, ',', 0);
      String m = getValue(myString, ',', 1);
      String n = getValue(myString, ',', 2);

      numcount1 = l.toInt();
      numcount2 = m.toInt();
      numcount3 = n.toInt();
      myString = "";
    }
  }
  numcount1_ = numcount1 - numcountminus ;
  if (numcount1_ >= 0) {
    Serial.print("counting = ");
    Serial.println(numcount1_);
```

```
      numcount1 = l.toInt();
      numcount2 = m.toInt();
      numcount3 = n.toInt();
      myString = "";
    }
  }
  numcount1_ = numcount1 - numcountminus ;
  if (numcount1_ >= 0) {
    Serial.print("counting = ");
    Serial.println(numcount1_);
    Blynk.virtualWrite(V1, numcount1_);
  }
}

String getValue(String data, char separator, int index) {
  int found = 0;
  int strIndex[] = { 0, -1 };
  int maxIndex = data.length() - 1;

  for (int i = 0; i <= maxIndex && found <= index; i++) {
    if (data.charAt(i) == separator || i == maxIndex) {
      found++;
      strIndex[0] = strIndex[1] + 1;
      strIndex[1] = (i == maxIndex) ? i + 1 : i;
    }
  }
  return found > index ? data.substring(strIndex[0], strIndex[1]) : "";
}
```