POLITEKNIK
MALAYSIA
SULTAN ABDUL HALIM MU'ADZAM SHAH

POLITEKNIK SULTAN ABDUL HALIM MUA'DZAM SHAH

SMART SHOE RACK

CHPNG KHENG CHEN

(03DET22F1043)

ELECTRICAL ENGINEERING DEPARTMENT

SESSION 2: 2023/2024

POLITEKNIK SULTAN ABDUL HALIM MUA'DZAM SHAH

SMART SHOE RACK

CHONG KHENG CHEN
(03DET22F1043)

This final report is submitted to the Electrical Engineering Department in fulfilment of the requirements for the award of the Diploma in choose a program

ELECTRICAL ENGINEERING DEPARTMENT

SESSION 2: 2023/2024

DECLARATION OF PROJECT REPORT AND COPYRIGHT

AUTOMATED SHOE DRYER

1. I, **CHONG KHENG CHEN (03DET22F1043)** is final semester **Diploma in choose a program**, **Department of Electrical Engineering, Sultan Abdul Halim Mu'adzam Shah**, address **Bandar Darulaman, 06000 Jitra, Kedah Darulaman**

2. I declare that 'The project above' and the copyright contains in this report is original work/ design from me without taking or copying any intellectual property from other parties.

3. I agree to release the intellectual property 'The project' to the 'Polytechnics' for fulfil the requirements for awarding the Diploma in Choose an item. to me

Solemnly declared by;	)	
CHONG KHENG CHEN	)	…………………………………
(Identification Card No.:- 041104-02-0083)	)	**CHONG KHENG CHEN**
Before me,	)	
PUAN HUBSAH BT HUSSAIN	)	…………………………………
(As a project supervisor at (date): ……………	)	**PUAN HABSAH BT HUSSAIN**

ACKNOWLEDGEMENT

In preparing this project I have encountered and learnt so many new experiences. I would like to thank my supervisor, PUAN HABSAH BT HUSSAIN for his excellent advice, guidance and motivation. I am also very thankful to my classmate, friends and other people that contributed to my project. Without their contribution, I won't be able to finish my project on time.

Finally, I learnt a lot in Politeknik Sultan Abdul Halim Mu'adzam Shah, owe sincere and earnest thankfulness for the unforgettable and unique experience of my life. I am also very thankful to my family for their supports, especially throughout this period of my life and kept me going all the way through my study.

ABSTRAK

Rak Kasut Pintar, direka untuk merevolusikan pengurusan kasut di ruang tamu moden. Mengintegrasikan penderia dan sambungan IoT, penyelesaian inovatif ini mengautomasikan penyimpanan dan pengambilan kasut, menghapuskan pengendalian manual dan mengoptimumkan ruang. Pengguna boleh mengakses dan mengawal rak dari jauh melalui aplikasi telefon pintar, menerima pemberitahuan untuk item yang salah letak dan mendapat manfaat daripada analisis data untuk cerapan penggunaan. Rak Kasut Pintar menjanjikan bukan sahaja kemudahan dan kecekapan tetapi juga persekitaran yang bebas kekacauan, merangkumi pendekatan futuristik kepada penyelesaian penyimpanan yang disesuaikan dengan gaya hidup bandar kontemporari.

ABSTRACT

The Smart Shoe Rack, designed to revolutionize shoe management in modern living spaces. Integrating sensors, and IoT connectivity, this innovative solution automates shoe storage and retrieval, eliminating manual handling and optimizing space. Users can remotely access and control the rack via smartphone applications, receive notifications for misplaced items, and benefit from data analytics for usage insights. The Smart Shoe Rack promises not only convenience and efficiency but also a clutter-free environment, embodying a futuristic approach to storage solutions tailored to contemporary urban lifestyles.

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1 Introduction

When using shoe cabinets, since traditional shoe cabinets are limited in their type, more and more problems are exposed. Low-type shoe cabinets have limited storage space and the space between the top and ceiling cannot be reasonably used. Suspended ceiling shoe cabinets are not easy to put shoes because of the height. As the number of shoes becomes larger, it will be difficult for the user to sort them out. Since the capacity of the shoe cabinet will not be able to satisfy the demand for storing shoes, the phenomenon of random arrangement will occur, which will seriously affect the cleanliness of the interior and inner beauty, and even lead to safety accidents. In the context of intelligence and home automation, to solve the problems of traditional shoe cabinets and meet people's needs for shoe cabinets, smart shoe cabinets have become the best option. The design and use of smart shoe cabinets has a huge market potential. Currently, most of the smart shoe cabinets on the market are expensive and have many disadvantages. For example, they simply expanded the shoe case room and used an automatic switch to open and close the shoe case door based on a regular shoe cabinet. Also, their functionality is simple and single. They simply designed an ozone disinfection shoe cabinet and deodorization with car shoe polish because they found the closed cabinet would produce a strange smell and meld. However, their products are fundamentally not able to solve people's pressing problems.

In this project, the smartphone uses a button to select a pair of shoes and remove them. It can also monitor how much space is left in the shoe rack to store how many pairs of shoes and will retain the moisture of the space in the shoe rack. The device uses the engine as an elevator using a power of 220 / 240 AC to remove shoes from the shoe cabinet. When the barcode sensor detects the user's shoes, it will push the shoe into the elevator until the elevator lowers the shoe.

The system serves as an excellent product for the convenience of people. This project is one of the solutions to help people use the new high technology using IOT (Internet of Things), which means people can control using smartphones that need to be connected to the internet.

Therefore, people's requirements for smart shoe cabinets are becoming increasingly stringent, and they hope to use simple, smart and varied smart shoe cabinets.

1.2 Project Background

In the ever-growing shoe industry, studies on the use of smart shoe racks in shoe stores are becoming increasingly important. The use of smart technology in shoe racks not only enhances the customer purchasing experience by providing the convenience of finding the desired shoes, product information, and fast checkout, but also helps shoe stores to attract more customers and improve operational efficiency with automated inventory monitoring. By aligning these initiatives with current technological changes, the shoe industry can continue to compete in a competitive business environment while delivering added value to customers.

1.3 Problem Statement

Traditional shoe cabinets give rise to various limitations such as limited storage space, inefficient use of space, difficulties in sorting and sorting shoes, and potential hygiene and safety problems caused by the random arrangement of shoes.

Existing smart shoe cabinets on the market are expensive and often have limited functionality, such as simply automating the opening and closing of cabinet doors or providing basic shoe maintenance features. This solution fails to comprehensively address the diverse needs of consumers for a simple, smart and customizable shoe storage system.

Many traditional shoe cabinets do not have an effective organizational system, which leads to a cluttered display and the difficulty of finding a specific style, size or color of shoes. This inefficiency can prolong the shopping process and reduce the overall customer experience.

Falling Objects: Shoes arranged indiscriminately inside the cabinet may fall off when the seller's girl tries to pick them up, posing a risk of injury from falling objects.

Difficulties in Stock Management: The process of manually restoring and inventory management for traditional shoe cabinets can be time-consuming and error prone. Without an efficient stock monitoring mechanism, stores may experience out-of-stock or overstock situations, leading to loss of sales or excessive inventory costs.

To address this challenge, the project aims to design and develop smart shoe storage cabinets that automatically select, place, and arrange shoes in cabinets. The system uses a unified and expandable structure, allowing the user to customize the configuration according to the needs and available space. The goal is to provide solutions that maximize the storage capacity of shoes, optimize the use of space, improve user convenience, and maintain internal cleanliness and safety

1.4 Project Objective

The project aims to achieve the following goals:

1. Allows users to easily recover their shoes by providing a user-friendly interface through the App, which communicates with shoe cabinets to display real-time shoe storage information.

2. Create a shoe storage system featuring a unified and expandable structure, allowing users to customize and combine modules according to their specific needs and available space.

1.5 Project Scope

The Smart shoe storage systems are designed to facilitate the storage and retrieval of shoes. It consists of modular units that can be arranged according to the needs of the user. The system includes mechanisms for lifting and moving shoes, shelves for arranging them, and seats for convenience. The user can control the system through the mobile app, which provides information about shoe storage and weather conditions, as well as enabling functions such as shoe pickup and disinfection.

However, there are limits to consider, such as cost, space requirements and complexity. Moreover, the compatibility of the system with different types of shoes and the reliability of electronic components may vary. Ensuring the security and privacy of user data is also important. Overall, although the system offers convenience, it is important

1.6 Chapter Summary

Customer Experience Improvements: Smart shoe racks allow customers to find and access shoes more easily and quickly. This can improve the customer experience in the shoe store, allowing them to feel more comfortable and satisfied with the services provided. Increased Sales: With a more organized and easy-to-see arrangement, customers are more likely to find and buy the shoes they want. This can increase sales in shoe stores, providing economic benefits to businesses. Optimize Space: Smart shoe racks can better optimize the space in a shoe store. This can help store owners to use their space more efficiently, increasing capacity for storage and product exhibition. Innovation and Competitive Advantage: Through the implementation of smart shoe racks, shoe stores can demonstrate commitment to innovation and technology in their industry. This can help attract the attention of customers who appreciate such things and give them a competitive edge in the market. Marketing Analytics: Some smart shoe racks may be equipped with analytical technology that can collect data on customer favorites and behavior. This information can be used to streamline inventory, organize promotions, and improve marketing strategies. Time and Energy Reduction: With a smart shoe rack system, shoe store employees may have to spend less time managing shoe reorganization and repositioning. This can free up time and energy for other uses in the store or provide a more personalized service to customers. Inventory Accuracy: Using smart shoe rack technology, shoe store owners can manage inventory more efficiently and accurately. This helps to avoid the problem of overstocking or too little, saving costs and increasing customer satisfaction.

1.7 Definition of Term or Operation

Sensors: A device used to track the position and availability of shoes in a rack. Sensors can be vibration sensors, light sensors, or distance sensors. Processing Device: A computer or microcontroller responsible for processing data from sensors and controlling storage rack functions, such as opening and closing shelves. Stock Management Software: An application or software system that manages in-store shoe inventory. It can include functions such as stock calculation, production tracking, and automatic inventory syncing. User Interface: An interface that allows users, whether customers or store staff, to interact with storage shelves. The user interface can be a touchscreen display, a mobile app, or a voice interface. Shoe Detection System: A system that allows customers to use smartphones to find in-store shoes. It can involve a mobile app that displays the location of shoes in a shelf using tracking or tagging technology.

1.8 Expected Result

Improved Customer Experience: Smart shoe racks reduce shoe search time, increase customer comfort, and increase the likelihood of purchase. Increased safety: The use of smart shoe rack reduces the risk of falls or injury with an orderly and regular display of the shoes on the shelves. Inventory Management Optimal: Automatic identifiers enable more efficient inventory management with trend data and product popularity. Energy and Cost Savings: Smart shoe rack uses energy efficiently and reduces inventory waste costs. Installation and Usage Executability: Easy installation without interruption of daily operation, with an intuitive user interface for store staff.

1.9 Summary

Traditional shoe cabinets often have various disadvantages such as limited storage space, inefficient use of space, difficulties in the arrangement of shoes, and the hygienic and safety risks that may arise because of random arrangement of shoes. Existing smart shoe cabinets on the market are often expensive and poorly meet the needs of consumers.

The project aims to create smart shoe cabinets that have more spacious and comprehensive functionality. Using the latest technology, the system allows users to easily find, sort, and retrieve their shoes with the help of mobile applications. The cabinet consists of modular units that can be customized according to the needs and available space.

The advantages of using this smart shoe cabinet include improved customer experience in shoe stores, increased sales through more organized arrangement, space optimization, innovation in the industry, marketing analytics, reduced time and energy, and reduced inventory errors. Through this project, it is expected to increase customer satisfaction while increasing the efficiency of shoe store operations.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The smart shoe rack project aims to simplify the shoe storage experience in a shoe store by utilizing smart technology. It aims to overcome traditional problems such as inefficient organization, difficulty finding shoes, and manual inventory management.

By utilizing sensors to detect shoe position and availability, as well as using mobile apps for user interaction, the project enables customers to find and acquire shoes more quickly and easily. This not only improves customer satisfaction but also improves the efficiency of store operations.

Through automated inventory management and constant monitoring, store owners can optimize their shoe stock without having to spend excessive time on manual stock management. This helps reduce inventory wastage and increase the overall profitability of the store.

By simplifying the process of finding and acquiring shoes, as well as improving inventory management, the smart shoe rack project provides tangible benefits to shoe stores and their customers. It represents a step towards a more efficient, smart, and connected direction in the shoe industry.

.

2.2 Design of Smart Shoe Box Based on IOT

Feet are very important parts which support weight and hold the center of gravity, so that they make us be able to walk and move in a balanced way. The importance of managing feet has been emphasized enough to call feet the second heart.

However, it is difficult to manage them because the secretion of sweat is three times more than other parts of a body and there are few sebaceous glands, which makes it easily dry and rough. It is very important to manage footwear for foot care in respect of foot care. Nevertheless, it is neglected by many. Footwear should be worn to be out and is the optimum space for microorganisms due to sweat, dead skin cells, dust secreted from feet. Therefore, it is essential to manage footwear for foot care. Yet, it is not easy for people who live busy daily lives to invest their time in shoe care.

In this paper, we design the IOT (Internet of Things) shoe box which can be managed without investing time and effort. It is made to be able to keep footwear clean by judging temperature, humidity and the status of opening/closing of the door and operating UV lamp, halogen lamp and a cooling fan depending on the conditions through temperature/humidity sensor and ultrasonic sensor. Moreover, using the Bluetooth sensor, the conditions inside the shoe box can be checked and the devices can be controlled.

The products based on IOT technology enable more convenient lives with intelligent systems and their configurations come to be diverse depending on different situations and user's environment. In this study, the IOT shoe box has been implemented, which automatically judges and controls the conditions inside the shoe box based on an embedded system, including smartphone control. Using ultrasonic sensor and temperature-humidity sensor, the conditions inside the shoe box are judged and each device is automatically controlled. Furthermore, it can be controlled through a smartphone based on the Bluetooth sensor. By developing this study, furniture, such as wardrobes and drawers, is to be designed and studied as the next smart products with IOT technology.

2.3 Smart Shoe Storage Controlled by One-Chip Computer

Traditional shoe cabinets often fall short in addressing modern storage needs, leading to issues like limited space, difficulty in organization, and compromised hygiene. Low-type cabinets offer limited storage, while suspended ceiling cabinets pose usability challenges. As shoe collections grow, disorganization becomes a common problem, resulting in clutter and potential safety hazards. Recognizing these shortcomings, the emergence of intelligent shoe cabinets presents a promising solution, leveraging automation and smart technology to optimize storage and enhance convenience. However, existing smart cabinets often come with high price tags and limited functionalities, failing to meet the diverse and evolving demands of users. Consequently, there is a growing demand for affordable, versatile, and truly intelligent shoe storage solutions that effectively address these pressing challenges.

Current smart shoe cabinets fall short of meeting ideal expectations, lacking automation in shoe storage and retrieval. This design addresses these shortcomings by automating the entire process from organizing to retrieving shoes, effectively utilizing vertical space and simplifying shoe storage. Its user-friendly operation enhances home comfort and tackles shoe clutter efficiently, aligning with contemporary social needs. Featuring a unique mechanical design requiring minimal energy consumption and a precise control system, it offers heightened intelligence and improved user experience. Compared to existing models, it boasts advantages such as compact size, affordability, ease of use, and seamless integration, making it suitable for widespread adoption in various households, thereby enhancing quality of life and fostering smart home environments. Its versatility positions it with significant potential for broad application.

2.4 A Study on the Perceived Marketability of ShoeVid-19 as an Effective Disinfecting

Amidst the COVID-19 pandemic, heightened concerns regarding virus transmission via surfaces, including shoes, have necessitated innovative solutions. Introducing Shoevid-19, a shoe rack designed to address these concerns by incorporating UV disinfection technology. In response to the surge in demand for disinfection equipment worldwide, especially in medical facilities, Shoevid-19 aims to provide a convenient and effective way to disinfect shoes, thereby enhancing safety and peace of mind for users. This product aligns with the growing emphasis on health and hygiene, offering a practical solution to mitigate the risk of virus transmission within households.

In response to the ongoing COVID-19 pandemic, the development of ShoeVid-19, a shoe rack equipped with UV light and deodorizer, emerges as a timely global innovation. Given the heightened awareness of virus transmission via surfaces like shoes, this product offers an effective solution to disinfect viruses and bacteria, including the potentially deadly COVID-19 virus. The study, validated by 251 Filipino respondents and analyzed using the SEM model, demonstrates high acceptance and marketability among consumers. The SEM model indicates strong positive correlations between various factors, such as perceived usefulness and ease of use, affirming the product's effectiveness and appeal to end-users. With its innovative features and positive reception, ShoeVid-19 has the potential to make a significant impact in the global market, contributing to efforts to combat the COVID-19 crisis and enhance public health and safety.

2.5 Artificial Intelligence Shoe Cabinet Using Deep Learning for Smart Home

Smart home technology has transformed residential living, introducing a range of appliances and furniture like smart boilers, refrigerators, and beds [1–5]. Recognizing the potential for enhancing convenience, a shoe rack integrated with IoT technology has been designed, leveraging components such as Raspberry Pi for functionalities like shoe list management, automatic storage, and personalized shoe recommendations [6–9]. The automatic storage feature utilizes pressure sensors and motors controlled by

Raspberry Pi to move shoes to vacant slots when placed on an x-y floater. Shoe recommendations are provided through a mobile app, where users input their clothing types and destination, with the system suggesting the most suitable shoes based on stored inventory and user preferences. To enable shoe recommendation, a deep learning model employing a Convolutional Neural Network (CNN) layer categorizes shoe types from images captured by a camera on the smart shoe rack, while colours are classified using the OpenCV image processing library. This real-time data is accessible via the mobile app, facilitating informed footwear choices for users.

This paper presents the implementation of a smart shoe rack featuring automatic storage, shoe type classification, and shoe recommendation functionalities. Utilizing Raspberry Pi, pressure sensors, and an x-y floater, embedded programming techniques were employed to control the system. Deep Learning techniques, specifically Convolutional Neural Networks (CNN), were utilized for shoe type classification, with efforts focused on improving accuracy through learning from various shoe images. While acknowledging the model's imperfections, this endeavour served as an opportunity to enhance understanding of Deep Learning. The paper highlights the potential for expanding the capabilities of home IoT systems through innovative applications such as smart shoe racks.

2.6 Research on intelligent integrated shoe cabinets.

In view of the current prevalence of the door entrance and entrance shoes at random drop problem, designed a smart access integrated shoe cabinet, mainly used for home storage, automatic finishing and family life casually dropped shoes, can bring convenience to life. The device is mainly divided into storage module and shoe rack module two separate modules, can achieve automatic access shoes through intelligent control, and according to the size of the household and the needs of the household shoe cabinet, the storage module and drive module for adaptive adjustment and modular work design, to achieve the effect of making full use of effective space, especially conducive to the use of existing highrise housing space

2.7 Summary

This formula focuses on the integration and synthesis of information from reference materials covering the field of development of smart shoe racks in shoe stores. With reference to a thorough review of literature, this formulation provides an overall view of existing knowledge in this domain.

The articles examined highlight developments in technology identification, inventory management, user-computer interaction, and the design of smart shoe rack systems. With this survey in mind, this formulation reflects an in-depth understanding of the key issues, challenges, and potentials associated with smart shoe rack projects.

This formulation not only lays out the need for a more efficient and effective shoe racking system, but also emphasizes the importance of using smart technologies such as RFID, IoT, and human-computer interaction in the context of shoe storage. It also outlines a comparison and analysis of the different approaches that have been taken in the development of automated shoe racking systems.

By embracing views from multiple reference sources, this formulation provides a solid foundation for the development of smart shoe rack projects aimed at enhancing customer experience, optimizing store operations, and providing added value to the shoe industry.

CHAPTER 3
METHODOLOGY

3.1 Introduction

In this chapter of the methodology, we will discuss the approaches used in the realization of the smart shoe rack project. It will include steps taken from initial planning to project implementation. This study will focus on the aspects of design, software development, technology integration, testing, and overall evaluation of the suitability of the project with the objectives set. Covering key aspects of each phase of development, this chapter will provide clear guidance on the development process of smart shoe storage systems.

3.2 Project Design and Overview

Initial Design:

- Identification of user needs and project objectives.
- Preparation of technical and functional specifications.
- Discussion sessions with designers, developers, and users to understand the needs and expectations.

System Design:

- Intuitive and functional user interface design.
- Construction of storyboards, wireframes, and prototypes.
- Compilation of software specifications and hard devices.

Software Development:

- Arduino esp32
- Development of system prototypes and integration of software components.

Integration and Testing:

- Integration of software components and hard devices.
- Implement system-wide testing to ensure reliability and performance.

Implementation and Assessment:

- Implementation of the system in the real environment of the shoe store.
- Data collection and assessment of system performance based on user experience.

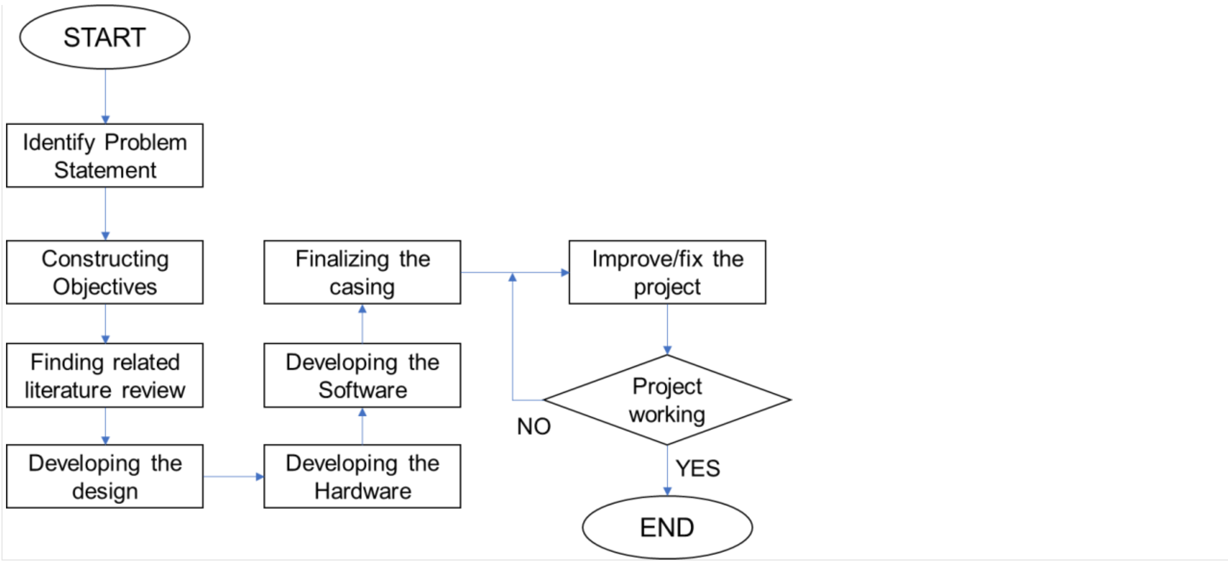


Figure 3.1 Process flow of the project

3.2.1Block Diagram of The Project

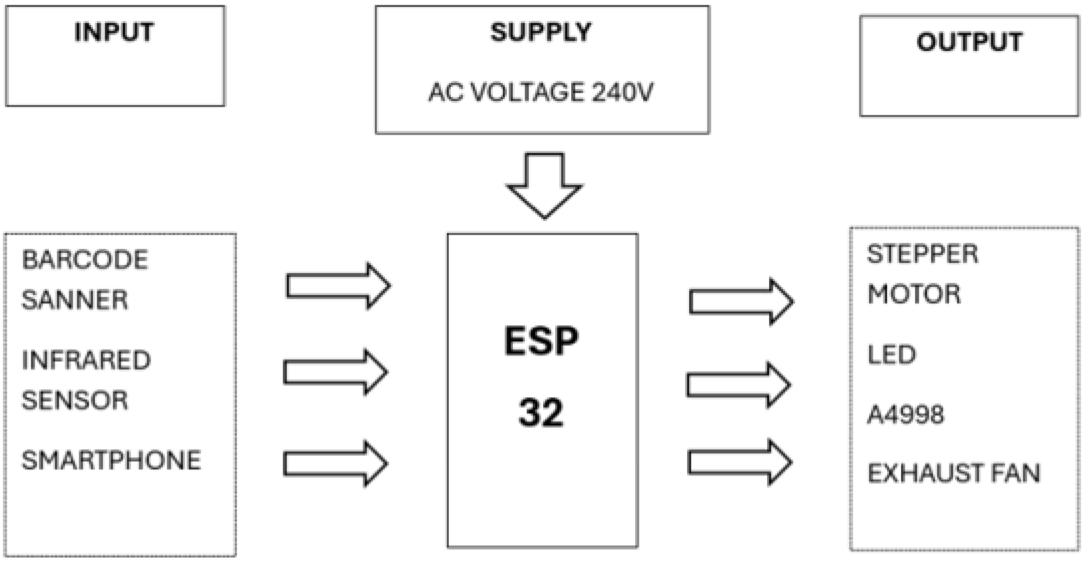


Figure 3.3 Block Diagram of the module

3.2.2Project flow chart

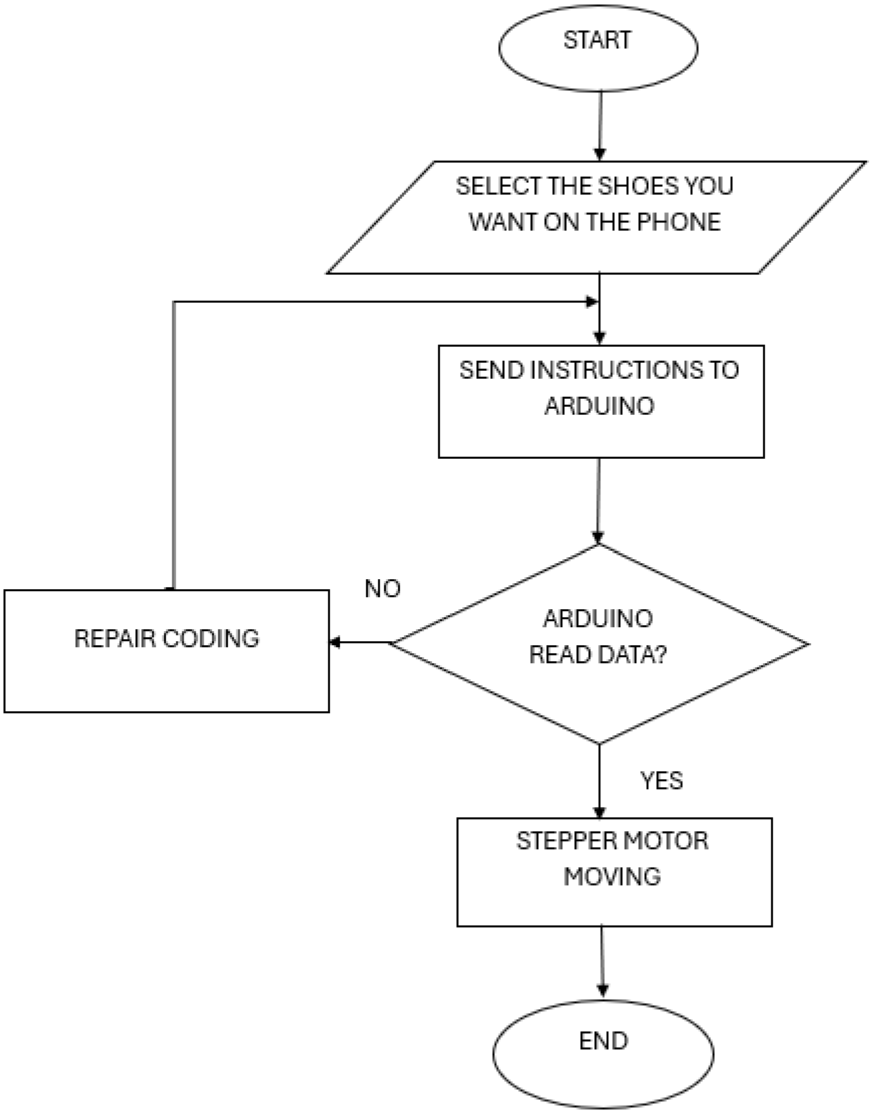


Figure 3.4:Flow chart of the modele

3.2.3Project Description

3.2.3 : Data Analysis Methods

Data Collection:

- System performance data such as response time, shoe storage capacity, and power consumption are measured during laboratory experiments and tests.
- Application usage data or user interface to determine usage patterns by customers.

Data Organization:

- The data obtained are compiled in a format suitable for advanced analysis. This may involve arranging data in the form of tables or graphs for easy understanding.

Data Analysis:

- Using statistical techniques such as averages, ranges, and distributions to analyse system performance data and application usage.
- Create graphs to visualize data, such as line graphs to show system performance over time or bar graphs to compare performance between system variations.
- Perform comparative analysis between system variations or performance measurements before and after implementation to assess improvements or changes that occur.

Interpretation and Conclusion:

- Based on the results of the analysis, assess the effectiveness of the system and performance of use.
- Provide conclusions about the results of the analysis and suggest improvements or further steps to be taken.

User	Date	Start Time	Time's up	Number of Shoes Loaded
User A	January 10, 2024	8:00 a.m.	8:30 a.m.	15
User B	January 11, 2024	10:00 a.m.	11:00 a.m.	12
User C	January 12, 2024	9:30 a.m.	10:00 a.m.	18

3.3 List of components

3.3.1 ESP 32

NodeMCU is a Microcontroller board that comes together with Wi-Fi Module which is suitable for IOT (Internet of Things) project. It includes firmware which runs on the ESP8226 wifi and the hardware which based on the ESP-12 Module. The ESP8226 is a low-cost wifi chip, and it contains integrated Transmission Control Protocol/Internet Protocol (TCP/IP) that allowed any Microcontroller to access a wifi network. The Nodemcu shown in Figure 3.4.

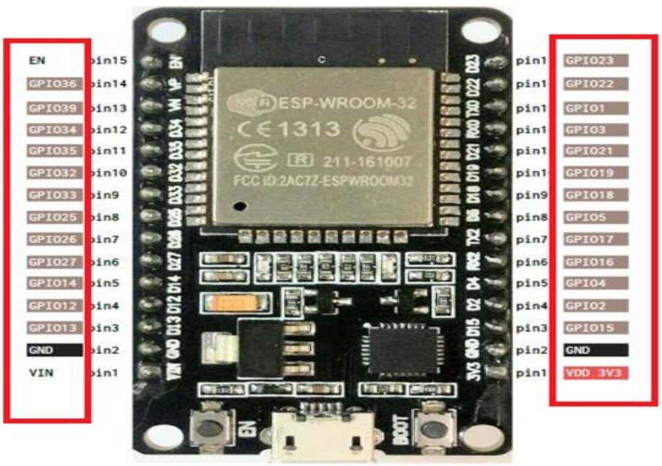


Figure 3.4: ESP 32

Figure 3.5 below shows the pin mapping of NodeMCU. There are a few precautions need to be sensitive to during the pin installation. NODE MCU ESP-12E dev board should be connected to 5V (Vin) using micro USB connector directly to the computer or using a power bank. The I/O pins of ESP8226 using input/output max 3.3V only.

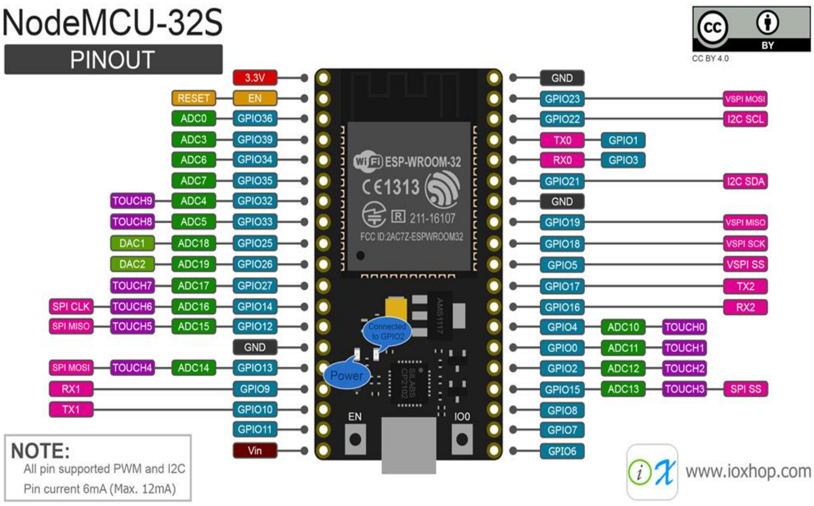


Figure 3.5: ESP 32 Pin Layout

3.3.2 IR PROXIMITY SENSOR

This Infrared Proximity detector could be a utile infrared detector which might use for obstacle sensing, colour detection, fire detection, line sensing and encode detector. The detector provides a digital as an output. The IR Proximity sensor was shown in Figure 3.6.

Figure 3.6: IR Proximity Sensor

The detector outputs (+5V) at the digital output once some object is placed ahead of the detector and a logic zero(0V), once there is no object ahead of the detector. This sensor is directly connected to NodeMCU to give information.

Infrared detectors unit extremely vulnerable to close lightweight and therefore, the IR detector on this detector is fitly lined to scale back result of close lightweight on the sensor. The detector incorporates a most vary of around 40- 50 cm inside and around 15-20 cm outdoors.

Features of the IR Proximity sensor are:

i. Operating Voltage: DC 5V
ii. Proximity Sensing
iii. Gesture Detection
iv. Operating Range: 4-8in
v. I2C Interface

The IR Proximity sensor pin details:

i. VCC: Power
ii. GND: Ground
iii. OUT: Digital

3.3.3 A4988 Stepper Motor Driver Module

The A4988 stepper motor driver carrier is a breakout board for Allegro's A4988 microstepping bipolar stepper motor driver. The driver features adjustable current limiting, overcurrent and over-temperature protection, and five different micro-step resolutions (down to 1/16-step). It operates from 8~35V and can deliver up to approximately 1A per phase without a heat sink or forced air flow (it is rated for 2A per coil with sufficient additional cooling).

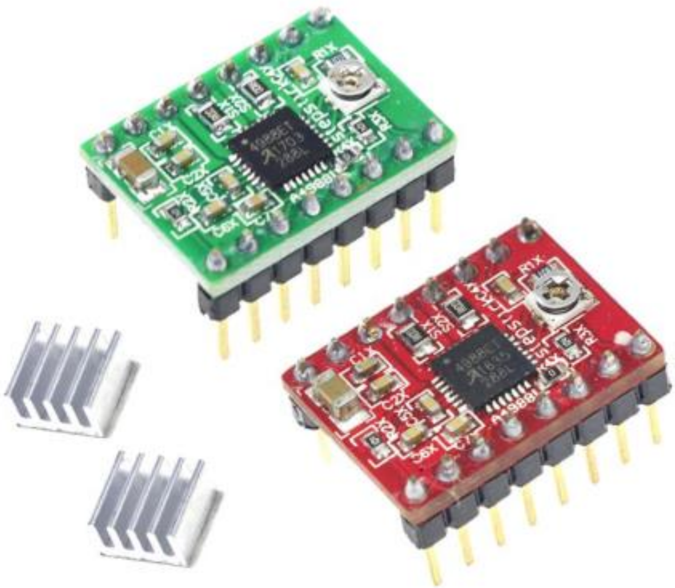


Figure 3.7: A4988

Brief Data:

- Minimum operating voltage: 8V.
- Maximum operating voltage: 35V.
- Continuous current per phase: 1A.
- Maximum current per phase: 2A (with heatsink).
- Minimum logic voltage: 3V.
- Maximum logic voltage: 5.5V
- Micro-step Resolutions: 1, 1/2, 1/4, 1/8, 1/16.
- Size: 0.6″ × 0.8″.
- Weight: 1.3g

Functional Diagram:

3.3.4 Stepper motor

NEMA 17 is a **hybrid stepping motor** with a 1.8° step angle (200 steps/revolution). Each phase draws 1.2 A at 4 V, allowing for a holding torque of 3.2 kg-cm. NEMA 17 Stepper motor is generally used in Printers, CNC machines and Laser Cutters.

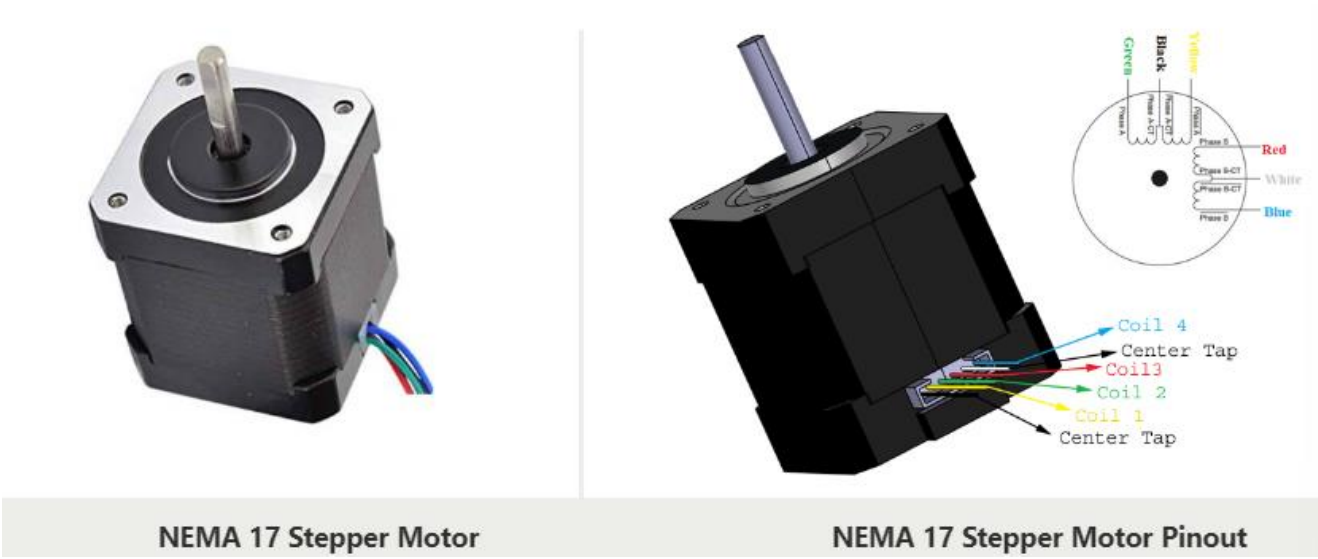


Figure 3.8: UV Light

NEMA 17 Stepper Motor Technical Specifications

- Rated Voltage: 12V DC
- Current: 1.2A at 4V
- Step Angle: 1.8 deg.

- No. of Phases: 4
- Motor Length: 1.54 inches
- 4-wire, 8 inch lead
- 200 steps per revolution, 1.8 degrees
- Operating Temperature: -10 to 40 °C
- Unipolar Holding Torque: 22.2 oz-in

Stepper Motor Applications

- CNC machines
- Precise control machines
- 3D printer/prototyping machines (e.g. RepRap)
- Laser cutters
- Pick and place machines

3.4 Circuit Operation

In the modified smart shoe rack design, the circuit's primary function shifts to controlling the stepper motor responsible for moving shoes into the rack. The microcontroller, like Arduino or ESP8266/ESP32, governs the stepper motor's operation based on input signals. When activated by the user or triggered by a sensor (such as a button press or motion sensor indicating the presence of shoes), the microcontroller commands the stepper motor to rotate, guiding the shoe holder mechanism to receive the shoes. Once the shoes are in place, the microcontroller halts the stepper motor's motion. Integration with the Blynk application allows users to initiate the shoe placement process remotely and receive notifications once the task is completed. This revised design streamlines shoe organization and retrieval while maintaining user control and convenience through smart automation and connectivity.

3.4.1 Schematic circuit

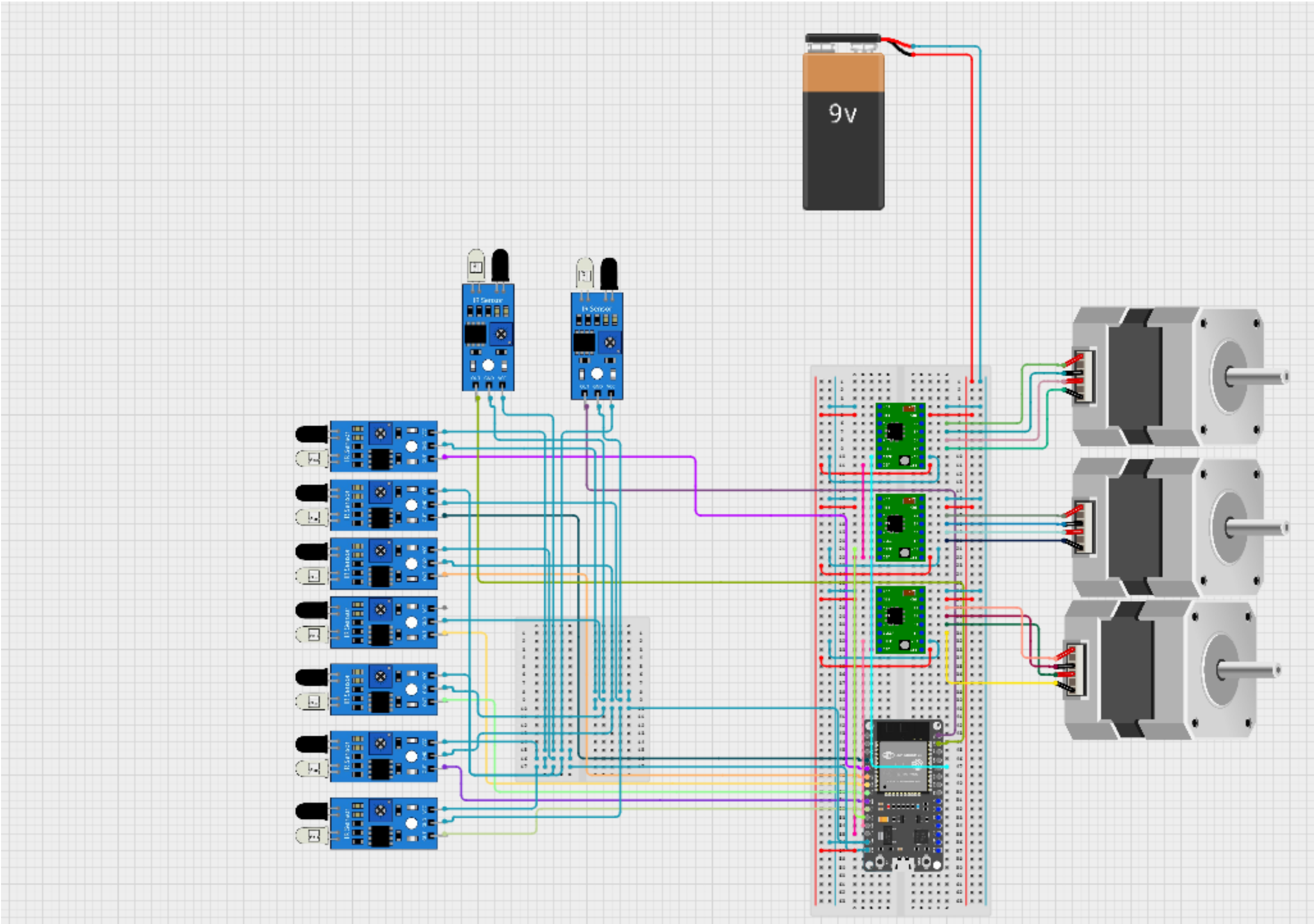


Figure 3.10: Circuit Diagram

3.4.2 Blynk Application

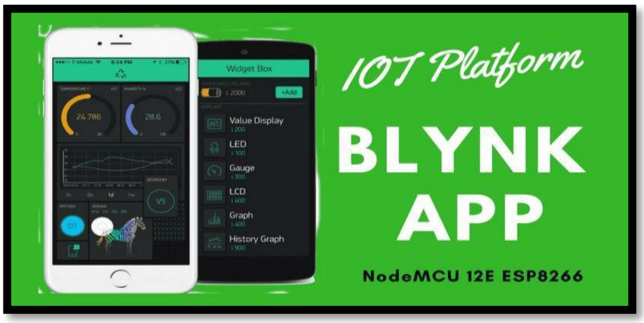


Figure 3.11: Blynk Application

Figure 33.15 shows that Blynk is a smartphone application that allows creating an interface for controlling and monitoring a project. Blynk app is free to download for Android and iOS. Blynk uses an interface of drag and drop widgets. Blynk also can work over the internet, Bluetooth and USB.

To run the Blynk application, they will use an Internet platform. To connect a Blynk server and pair it with the smartphone, Blynk libraries should write in the sketch (coding section). It is simple easy because we can get it from the internet. The architecture, as shown in figure 3.16 below:

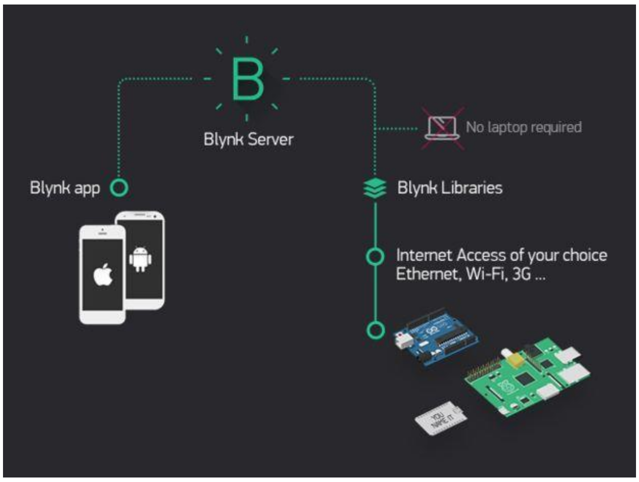


Figure 3.12: Blynk Architecture

3.5 Project Duration

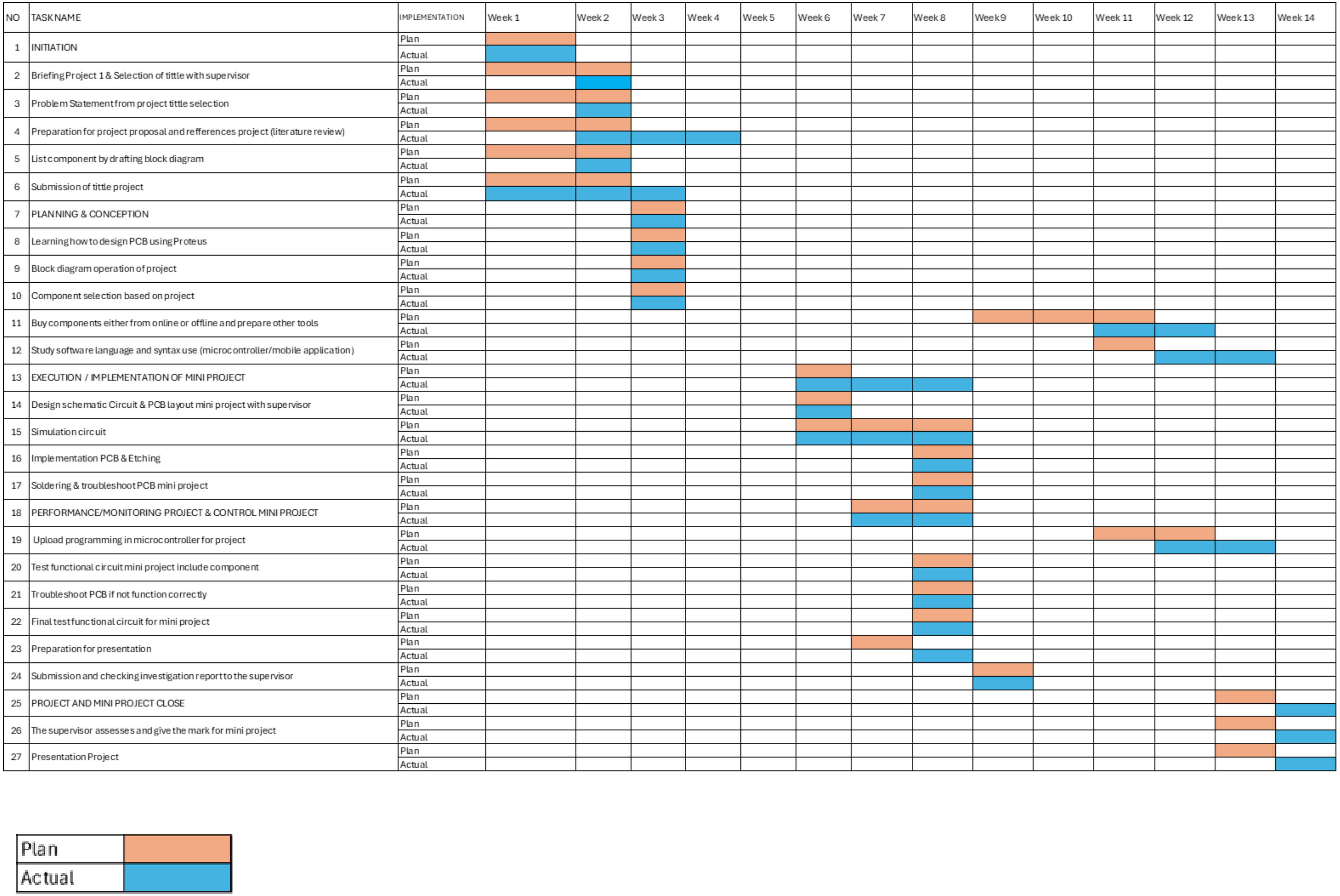


Figure 3.2 Project GantChart

3.6 Project Costing List

No.	Component and materials	The unit price	Quantity	Total
1	ESP32	RM 20.14	1	RM 20.14
2	3D printer guide rail sets	RM 105	1	RM 105
3	Infrared Module - IR Obstacle Avoidance Sensor	RM 1.48	9	RM 13.32
4	Barcode scanner	RM 66.60	1	RM 66.60
5	Stepper motor	RM 37	3	RM 111
6	A4988	RM 4	3	RM 12
7	Board	RM 20	1	RM 20
8	Exhaust fan	Rm 14	1	Rm 14
9	Other materials	RM50	-	RM50
	Total :			**RM 412.06**
	List of other costing			
1	Transportation			
2	Postage			
3	Craft Work			
4	Internet			
5	Application			
	Total :			**RM50.00**
			Overall total	**RM 462.06**

3.7 Chapter Summary

Chapter 3 covers the analysis of this project which is the production and evaluation of the performance of the smart shoe rack system. Project implementation involves several steps such as initial planning, system design, software and hard device development, integration, and testing, as well as implementation and evaluation. System performance data and user feedback are carefully collected, compiled, and analysed using statistical methods and data visualization. The choice of study/project method is selected with strong justification, emphasizing its suitability and effectiveness in achieving project objectives as well as meeting the needs of consumers. By providing this comprehensive analysis, chapter 3 presents a solid foundation for understanding and evaluating the entire project without introducing new elements that will be detailed in the next section.

REFERENCES

1. Smart Shoe Storage Controlled by One-Chip Computer**Yuxi Liu[1], Tianshuo Zang[2], Bingzhou Xu[2], Xinyi Wu[2] and Yizhen Qian[2]**

https://iopscience.iop.org/article/10.1088/1755-1315/632/3/032004/pdf

2.Design of Smart Shoe Box Based on IOT
Dae-Jea Cho Dept. Of Multimedia Engineering Andong National University Andong City, Rep. of KOREA djcho@andong.ac.kr
Ye-Rin Jeong Dept. Of Multimedia Engineering Andong National University Andong City, Rep. of KOREA difls8137@daum.net
https://www.researchgate.net/publication/318737768_Design_of_smart_shoe_box_based_on_IOT

3. Research on intelligent integrated shoe cabinets To cite this article: Jingfeng Xu et al 2021 J. Phys.: Conf. Ser. 1865 032047
https://iopscience.iop.org/article/10.1088/1742-6596/1865/3/032047/pdf

4. Artificial Intelligence Shoe Cabinet Using Deep Learning for Smart Home Jun-Ho Huh and Kyungryong Seo
https://www.researchgate.net/publication/329262894_Artificial_Intelligence_Shoe_Cabinet_Using_Deep_Learning_for_Smart_Home_MUEFutureTech_2018

5. A Study on the Perceived Marketability of ShoeVid-19 as an Effective Disinfecting Shoe Rack Bruce Martin F. Pante1 , Mikhaella Aerielle B. Dizon2 , Recca Angelli F. Fernandez2 , Aimah Lane O. Micarsos2 , Emari Nazarene Angelica D. Zoleta3 , Michael N. Young
https://ieeexplore.ieee.org/document/9436704

6. ESP32 Series

https://www.espressif.com/sites/default/files/documentation/esp32_datasheet_en.pdf

7.Stepper motor

https://pages.pbclinear.com/rs/909-BFY-775/images/Data-Sheet-Stepper-Motor-Support.pdf

8. Smart Home using Blynk App Based On IOT M. Jaya lakshmi[1] , C.Sadia Sameen[2] , D.Maneesha[3] , G.Dharani[4] , K.Farhat Mubeena

Dean,Department of ECE

Department of ECE, Ravindra College of Engineering for Women, Kurnool,Andhra Pradesh,India.

https://www.researchgate.net/publication/369926992_Smart_Home_using_Blynk_App_Based_On_IOT

9. Arduino Lesson 16. Stepper Motors

https://cdn-learn.adafruit.com/downloads/pdf/adafruit-arduino-lesson-16-stepper-motors.pdf

10. al A4988 Stepper Motor Driver Module

https://www.handsontec.com/dataspecs/module/A4988.pdf

REFERENCES

APPENDICES

A4988 Stepper Motor Driver

SKU: DRV1000

Brief Data:

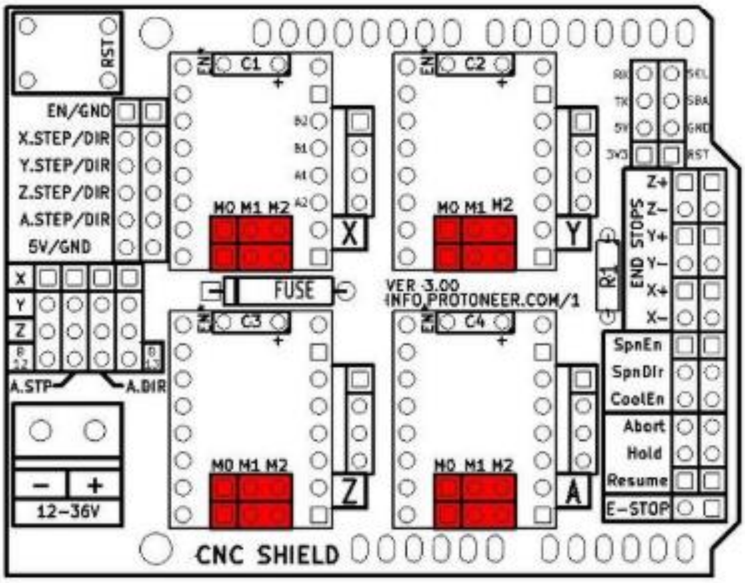
- Minimum operating voltage: 8V.
- Maximum operating voltage: 35V.
- Continuous current per phase: 1A.
- Maximum current per phase: 2A (with heatsink).
- Minimum logic voltage: 3V.
- Maximum logic voltage: 5.5V
- Micro-step Resolutions: 1, 1/2, 1/4, 1/8, 1/16.
- Size: 0.6″ × 0.8″ .
- Weight: 1.3g

Brief Data:

- GRBL 0.9 compatible. (Open source firmware that runs on an Arduino UNO that turns G-code commands into stepper signals)
- 4-Axis support (X, Y, Z , A-Can duplicate X,Y,Z or do a full 4th axis with custom firmware using pins D12 and D13)
- 2 x End stops for each axis (6 in total)
- Coolant enable
- Uses removable A4988 compatible stepper drivers. (A4988, DRV8825 and others)(Not Included)
- Jumpers to set the Micro-Stepping for the stepper drivers. (Some drivers like the DRV8825 can do up to 1/32 micro-stepping)
- Compact design.
- Stepper Motors can be connected with 4-pin Molex connectors or soldered in place.
- Runs on 12-36VDC. (At the moment only the DRV8825 drivers can handle up to 36V so please consider the operation voltage when powering the board.)

1. Configuring Micro Stepping for Each Axis

Each axis has 3 jumpers that can be set to configure the micro stepping for the A4988 plug-in driver board.



Micro-stepping jumper location, before inserting A4988.

3. Hooking Up the Stepper Motor to CNC Shield

Connect steppers motor to CNC Shield board as the below block diagram. of the CNC Shield connected to 3-stepper motor: