POLITEKNIK SULTAN ABDUL HALIM MUA'DZAM SHAH

SMART SHOE RACK

CHONG KHENG CHEN

(03DET22F1043)

ELECTRICAL ENGINEERING DEPARTMENT

SESSION 2: 2023/2024

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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

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(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

Abstrak adalah bahagian yang penting dalam sesuatu laporan. Ia sebagai informasi ringkas mengenai isi laporan secara keseluruhan. Selain itu ia merupakan gambaran secara menyeluruh mengenai aktiviti dalam menghasilkan projek. Abstrak ditulis dalam satu perenggan sahaja. Di dalam abstrak perlu dinyatakan secara ringkas kaedah yang digunakan dan juga rumusan keputusan yang diperolehi. Abstrak hendaklah ditulis dalam Bahasa Melayu dan ditulis dalam satu perenggan sahaja. Penulisan Abstrak selalunya ditulis setelah projek selesai.

ABSTRACT

Abstract is an important part of a report. This is a brief summary of the content of the whole report. In addition, it provides a comprehensive overview of the activities involved in producing projects. The abstract is written in one paragraph only. In the abstract, it is necessary to state the summary of method and the conclusions of the project. Students are expected to finish writing the abstract after finishing the project.

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LIST OF ABBREVIATIONS

GA	-	Genetic Algorithm
OP	-	Operational Amplifier
DC	-	Direct Current
AC	-	Alternating Current
V	-	Volt
GPS	-	Global Positioning System

LIST OF SYMBOLS

D, d	-	Diameter
r	-	Radius
v	-	Velocity
l_n	-	Line length
R	-	Distance

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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

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 to consider its limitations during use.

1.6 Project Significance

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 favourites and behaviour. 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.

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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 Literature Review Topic 1

NO	TITLE/AUTHOR	OBJECTIVE	METHOD	RESULT
1	➢ Design of Smart Shoe Box Based on IOT ➢ (Dae-Jea Cho Dept. Of Multimedia Engineering)	In this paper, to design the IOT (Internet of Things) shoe box which can be managed without investing time and effort.	The shoe box is designed, which can judge the conditions and automatically operate the devices through temperature-humidity sensor and ultrasonic sensor based on an embedded system. and controls the sensors using the smartphone.	All the values accepted via ultrasonic sensor and temperature-humidity sensor can be checked on a smart phone through the Bluetooth sensor. It is possible to check whether each device is operating. What is more, the devices inside the shoe box can be controlled by

				a smart phone. By using the application on a smart phone, the conditions inside the shoe box can be checked according to the value of each sensor in real time and the devices can be controlled.
2	➢ Smart Shoe Storage Controlled by One-Chip Computer ➢ Yuxi Liu et al 2021 IOP Conf. Ser.:	It has the functions of organizing and storing shoes that can be widely used in various families to improve the quality of family life and build a smart home. Therefore, the design has broad Application prospects.	The mobile phone uses the App to communicate with the operator and obtains weather-related information and real-time shoe cabinet storage information on the wireless network to facilitate the selection of a suitable shoe.	This design realizes the work automatically from putting, organizing and taking out shoes. Above all, it makes easier for the storage of shoes and effectively take advantage of the upper space. It is convenient to operate and can enhance the comfort of home life, and effectively solve the problem of messy shoes.
3	➢ Artificial Intelligence Shoe Cabinet Using Deep Learning for Smart Home ➢ Jun-Ho Huh and Kyungryong Seo	Shoe rack is the first furniture to encounter when a person enters home and its though if IoT is added to the shoe rack, it can be of great convenience to people as a component of smart home such as smart boiler and smart refrigerator.	With Raspberry Pi, pressure sensor and x-y floater were controlled to have and experience of embedded programming. And it attempted to classify shoes by using the Deep Learning.	The shoe rack is implemented that provides automatic storage, shoe. type classification and shoe recommendation
4	➢ Research on intelligent integrated shoe cabinets	Users can easily take off their shoes after returning home, and by the shoe cabinet	The device consists of three main parts: skeleton structure, motion	The device is mainly divided into storage module and shoe rack module two

	➢ Jingfeng Xu et al 2021	organized to the corresponding position, easy to save effort, and achieved a beautiful effect. When you need to wear shoes when you go out, you can choose the shoes you want to wear at a glance, so as to avoid the difficulty of choosing because of the shoe mess.	module, and control module. The skeleton structure features a space-saving tilt design for the shoe plate, optimizing storage. The shoe plate design ensures efficient transportation. The seat section is connected to the door for user convenience. The drive module handles the lifting and panning of shoes, while the control system ensures precise positioning during transportation.	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.
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	The objective of the product that we have thought of is for people to be safe from the virus and remove their feeling of being uneasy with their shoes.	There searchers aim to take part in the innovation of Shoevid-19.it is a shoe rack that functions not only as shoe storage but could also disinfect the shoes from bacteria and viruses.	Hence, this means that the innovations presented by the product, especially the addition of the deodorizer did not only make its function better but also marketable to the end-users. Furthermore, all indicators used for the factors of the model were all positively significant, particularly intention to use, attitude toward use, perceived use fulness, and

				perceived ease of use.

2.3 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

Project Production Methods/Procedures/Techniques
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.

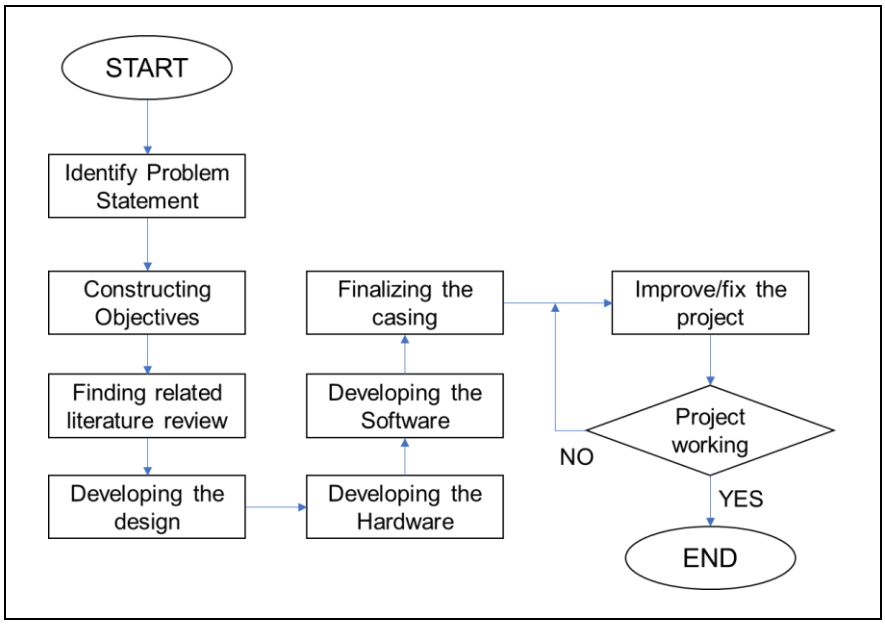

Figure 3.1 Process flow of the project

You may include the gant chart of your planning to show how you manage your project. This could show your Project management skill, whether you can manage the project accordingly or not. Figure 3.2 shows the project gantchart. For the proposal, you may prepare only up to planning because you did not finish the project yet. But for final report, you may include the real expectation and implementation of your planning. Please put the gantchart or any figure/tables if needed in landscape.

NO	TASK NAME	IMPLEMENTATION	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
1	INITIATION	Plan														
		Actual														
2	Briefing Project 1 & Selection of tittle with supervisor	Plan														
		Actual														
3	Problem Statement from project tittle selection	Plan														
		Actual														
4	Preparation for project proposal and refferences project (literature review)	Plan														
		Actual														
5	List component by drafting block diagram	Plan														
		Actual														
6	Submission of tittle project	Plan														
		Actual														
7	PLANNING & CONCEPTION	Plan														
		Actual														
8	Learning how to design PCB using Proteus	Plan														
		Actual														
9	Block diagram operation of project	Plan														
		Actual														
10	Component selection based on project	Plan														
		Actual														
11	Buy components either from online or offline and prepare other tools	Plan														
		Actual														
12	Study software language and syntax use (microcontroller/mobile application)	Plan														
		Actual														
13	EXECUTION / IMPLEMENTATION OF MINI PROJECT	Plan														
		Actual														
14	Design schematic Circuit & PCB layout mini project with supervisor	Plan														
		Actual														
15	Simulation circuit	Plan														
		Actual														
16	Implementation PCB & Etching	Plan														
		Actual														
17	Soldering & troubleshoot PCB mini project	Plan														
		Actual														
18	PERFORMANCE/MONITORING PROJECT & CONTROL MINI PROJECT	Plan														
		Actual														
19	Upload programming in microcontroller for project	Plan														
		Actual														
20	Test functional circuit mini project include component	Plan														
		Actual														
21	Troubleshoot PCB if not function correctly	Plan														
		Actual														
22	Final test functional circuit for mini project	Plan														
		Actual														
23	Preparation for presentation	Plan														
		Actual														
24	Submission and checking investigation report to the supervisor	Plan														
		Actual														
25	PROJECT AND MINI PROJECT CLOSE	Plan														
		Actual														
26	The supervisor assesses and give the mark for mini project	Plan														
		Actual														
27	Presentation Project	Plan														
		Actual														

Figure 3.2 Project GantChart

3.2.1 Block Diagram of The Project

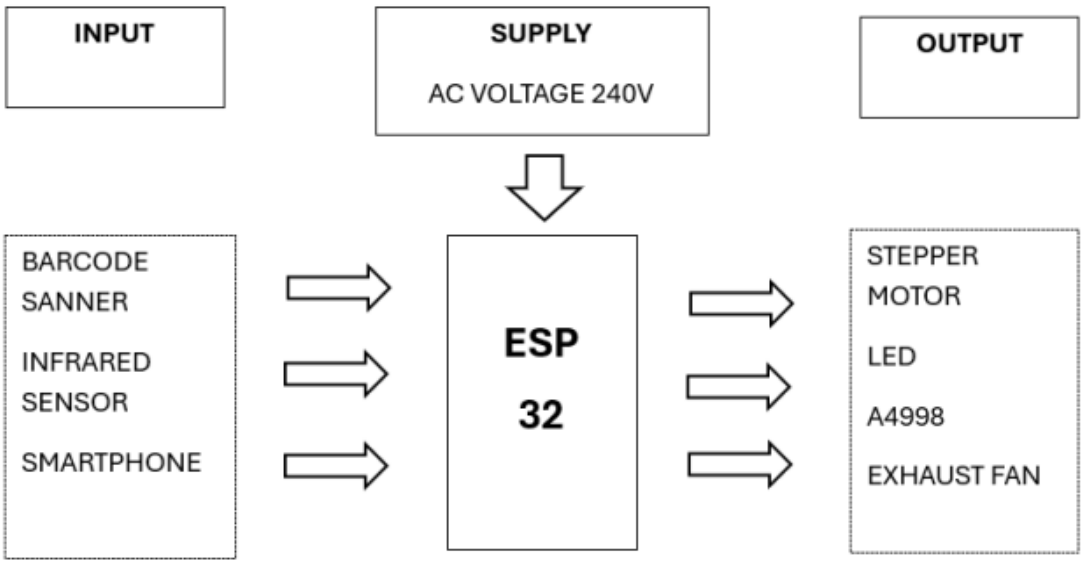

Figure 3.3 Block Diagram of the module

3.2.2 Project Flow Chart

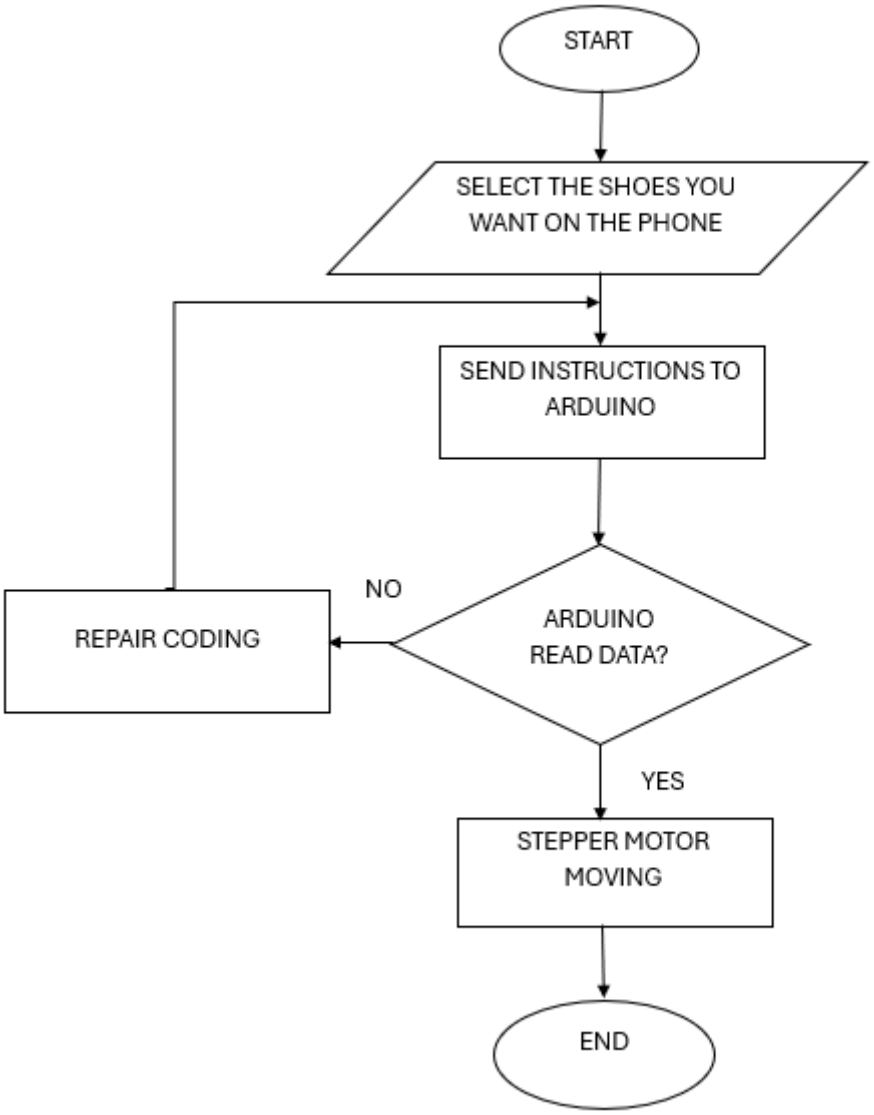

Figure 3.4 Flow chart of the module/system

3.2.3 Project 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 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.

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Ye-Rin Jeong Dept. Of Multimedia Engineering Andong National University Andong City, Rep. of KOREA difls8137@daum.net
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APPENDICES