**JABATAN KEJURUTERAAN ELEKTRIK**

# INVESTIGATION REPORT: PROJECT 1

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| **DIPLOMA** | **: ELECTRICAL ENGINEERING** |
| **ACADEMIC SESSION** | **: SESI2 2021/2022** |
| **TITLE** | **: SMART SHOE RACK** |
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# INVESTIGATION REPORT

## 1.1 INTRODUCTION

During using shoe cabinets, because of traditional shoe cabinets are limited in their types, more and more problems are exposed. The low-type shoe cabinets have limited storage space and the space between its top and the ceiling cannot be used reasonably. The suspended ceiling shoe cabinets are not easy to put shoes due to the height. When the number of shoes becomes larger, it will be difficult for users to sort out them. Because the capacity of the shoe cabinet cannot meet the demand for storing shoes, the phenomenon of random stacking will occur, which will seriously affect indoor hygiene and indoor beauty, even lead to safety accidents. In the context of home intelligence and automation, to solve the problems of traditional shoe cabinets and meet people's needs for shoe cabinets, intelligent shoe cabinets have become the best choice. The design and use of smart shoe cabinets has a huge potential market. At present, most smart shoe cabinets on the market are expensive and have many drawbacks. For example, they just expand the room of shoe cases and use the automatic switch to open and close the door of shoe cases based on the normal shoe cabinets. Also, their function is simple and single. They just design the ozone disinfection and deodorization shoe cabinets with automobile shoeshine because they find that sealed cabinets will result in peculiar smell and Mold. However, their products cannot fundamentally solve people's urgent problems.

In this project, a smartphone uses buttons 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 maintain the humidity of the space in the shoe rack. This device uses an engine as a lift using 220 / 240 AC power to take the shoes out of the shoe cabinet. When the barcode sensor detects the user's shoes, it will push the shoes to the lift until the lift sends the shoes down.

This system work as an excellent product to ease the people. This project is one of the solutions to help people using a new high technology which is using IOT (Internet of Things), which means people can control using a smartphone that needs to connect with the internet.

Therefore, people's requirements for smart shoe cabinets are becoming more and more strict, and they hope to use convenient, intelligent and diversified smart shoe cabinets.

## 1.2 Problem Statement

The traditional shoe cabinet poses various limitations such as limited storage space, inefficient use of space, difficulty in sorting and organizing shoes, and potential hygiene and safety issues due to random stacking of shoes.

Existing smart shoe cabinets in the market are expensive and often have limited functionality, such as merely automating the opening and closing of cabinet doors or providing basic shoe maintenance features. These solutions fail to comprehensively address the diverse needs of users for convenient, intelligent, and adaptable shoe storage systems.

Many traditional shoe cabinets lack effective organization systems, leading to cluttered displays and difficulty in finding specific shoe styles, sizes, or colours. This inefficiency can prolong the shopping process and diminish the overall customer experience.

Falling Objects: Shoes stacked haphazardly within the cabinet may fall out when sell girl attempt to retrieve them, posing a risk of injury from falling objects.

Difficulty in Stock Management: Manual restocking and inventory management processes for traditional shoe cabinets can be time-consuming and prone to errors. Without efficient stock monitoring mechanisms, shops may experience stockouts or overstock situations, leading to lost sales or excess inventory costs.

To tackle these challenges, the project aims to design and develop a smart shoe storage cabinet that automatically picks, places, and organizes shoes within the cabinet. The system utilizes a unitized and expandable structure, allowing users to customize the configuration according to their needs and available space. The goal is to provide a solution that maximizes shoe storage capacity, optimizes space utilization, enhances convenience for users, and maintains indoor hygiene and safety.

### 1.3 Project Objectives

This project aims to accomplish the following goals:

1. Enable users to easily retrieve their shoes by providing a user-friendly interface through an App, which communicates with the shoe cabinet to display real-time shoe storage information.
2. Create a shoe storage system that features a unitized and expandable structure, allowing users to customize and combine modules according to their specific needs and available space.

### 1.4 Scope of the Project and Constraints

The smart shoe storage system is designed to make storing and retrieving shoes easier and more efficient. It consists of modular units that can be arranged according to users' needs. The system includes a mechanism for lifting and moving shoes, a rack for organizing them, and a seat for convenience. Users can control the system through a mobile app, which provides information on shoe storage and weather conditions, and allows for functions like shoe retrieval and disinfection.

However, there are limitations to consider, such as cost, space requirements, and complexity. Additionally, the system's compatibility with different shoe types and reliability of electronic components may vary. Ensuring security and privacy of user data is also important. Overall, while the system offers convenience, it's important to consider its limitations during use.

### 1.5 Literature Review

| NO | TITLE/AUTHOR | OBJECTIVE | METHOD | RESULT |
|---|---|---|---|---|
| 1 | ➢ Design of Smart Shoe Box Based on IOT<br>➢ (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 |

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| | | | | 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<br>➢ 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<br>➢ 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<br>➢ Jingfeng Xu et al 2021 | Users can easily take off their shoes after returning home, and by the shoe cabinet organized to the corresponding position, easy to save effort, and achieved a beautiful effect. When you need to wear shoes when | The device consists of three main parts: skeleton structure, motion module, and control module. The skeleton structure features a space-saving tilt design for the shoe plate, optimizing | 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 |

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| | | 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. | 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. | 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<br><br>➢ 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. |

## 1.6 Project Analysis

### 1.6.1 Cost Estimation

This project involves the cost of purchasing components and materials throughout its implementation. Components involving cost are hardware ESP32,3D Printer guide rail sets, Infrared Module - IR Obstacle Avoidance Sensor, barcode scanner, stepper motor, A4988. All these components are purchased through online purchase methods to make it easier as well as save on costs.

The overall gross budget estimate for the implementation of this project is RM 412.06 and other expenses are RM 50 as shown in Table 1. The project's cost is also in line with one of the key features of a good project developer that is low cost but has a high-quality project.

**Table 1: List of Components and Materials**

| 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** |

## 1.6.2 Project Duration

| 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 | | | | | | | | | | | | | | |

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|---|---|
| Plan | |
| Actual | |

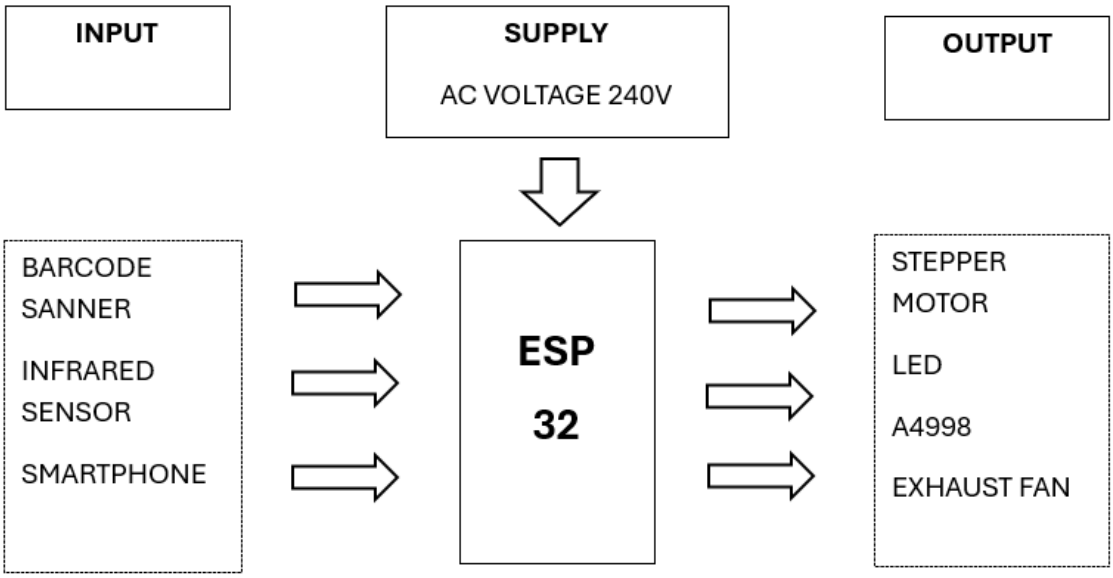
### 1.6.3Project Usability

This project involves the development of a smart shoe rack equipped with sensors and connectivity features to enhance user convenience and organization. The smart shoe rack is designed to monitor various parameters such as shoe placement. By leveraging IoT technology, it provides real-time data on the status of shoes stored within the rack. .The primary focus of this project is to streamline the shoe management process for shop holds, particularly  with busy schedules or limited storage space.

## 1.7Evaluate Feasibility

### 1.7.1Technical Resources

The smart shoe rack project utilizes an ESP32 DEVKITV1 microcontroller unit (MCU) as its core processing unit, enabling dual-core operation and 32-bit architecture for efficient handling of multiple tasks. Integrated with 3D printer guide rail sets, it ensures smooth and precise movement of shelves. Infrared Sensor is a place sensor,thus it can detect where have the vacancy.  A barcode scanner enables seamless identification and inventory management of stored items. Stepper motors, controlled by A4988 drivers, govern the rack's shelf movement, ensuring precise positioning. Technical resources include datasheets and integration guides for each component, aiding in assembly, wiring, and programming for seamless functionality of the smart shoe rack




### 1.7.2Financal Resources

Financial resources for this project are self-financed with some basic components and materials sourced at the project laboratory. The other components and materials will order by using Shopee. Based on the cost projection it is estimated at RM500. The development cost is still feasible with the duration of 4 months with only RM125 per month. It is feasible and achievable based on the investigation.

## **1.8** Conclusion and Recommendations

### **1.8.1** Conclusion

The current implementation of shoe cabinets in smart shoe shops falls short of ideal expectations. However, this innovative design surpasses existing models by automating shoe storage, organization, and retrieval processes. It optimizes shoe storage, effectively utilizing vertical space while simplifying operation for enhanced comfort. By addressing the perennial issue of messy shoes, it aligns perfectly with contemporary societal needs, delivering tangible results. Its unique mechanical mechanism facilitates effortless actions with minimal energy consumption. The precision of its control system showcases advanced intelligence, elevating user experience. Unlike other intelligent shoe cabinets, this device boasts a compact size, affordability, intuitive operation, and seamless integration. Its shoe organizing and storage capabilities can enhance quality of life across various settings, fostering smart environments. Consequently, this design holds immense promise for widespread adoption and application.

### 1.8.2 Conclusion

The current implementation of shoe cabinets in smart shoe shops falls short of ideal expectations. However, this innovative design surpasses existing models by automating shoe storage, organization, and retrieval processes. It optimizes shoe storage, effectively utilizing vertical space while simplifying operation for enhanced comfort. By addressing the perennial issue of messy shoes, it aligns perfectly with contemporary societal needs, delivering tangible results. Its unique mechanical mechanism facilitates effortless actions with minimal energy consumption. The precision of its control system showcases advanced intelligence, elevating user experience. Unlike other intelligent shoe cabinets, this device boasts a compact size, affordability, intuitive operation, and seamless integration. Its shoe organizing and storage capabilities can enhance quality of life across various settings, fostering smart environments. Consequently, this design holds immense promise for widespread adoption and application.

### 1.8.2 Recommendation

When selecting a smart shoe rack, prioritize features that enhance efficiency, such as automation for shoe retrieval and organization, space-maximizing designs, and user-friendly controls. Ensure compatibility with your existing smart home setup and prioritize durability and security features like locking mechanisms. Look for customization options to accommodate various types of footwear and consider energy efficiency to minimize power consumption. By focusing on these factors, you can find a smart shoe rack that seamlessly integrates into your lifestyle while optimizing storage and convenience.

### 1.8.3 Benefit to Organization /Society/Nation/Others

Implementing smart shoe racks in shoe shops offers a myriad of benefits that extend beyond mere convenience. By optimizing organization and display, these racks streamline the customer shopping experience, fostering increased satisfaction and loyalty. Moreover, their space-efficient designs enable shops to maximize the utilization of floor space, potentially leading to higher sales volumes and improved profitability. Furthermore, the integration of data analytics features provides valuable insights into customer preferences and buying patterns, empowering businesses to make informed decisions regarding inventory management and marketing strategies. Additionally, the adoption of eco-friendly technologies within smart shoe racks aligns with sustainability goals, reducing environmental impact and appealing to socially responsible consumers. Ultimately, the adoption of smart shoe racks not only enhances operational efficiency and competitiveness but also contributes positively to societal well-being and environmental conservation efforts.

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