Faculty of Electronic and Computer Technology and Engineering

DESIGN OF RAPID DRYING SHOES USING ESP32 CONTROLLER

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Bachelor of Computer Engineering Technology (Computer Systems) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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Date : 21.02.2024

DEDICATION

To my cherished family, your unwavering tolerance, support, and understanding have provided the bedrock for my educational journey. Your love has been a wellspring of strength, especially during challenging moments. To my dearest friends: Navigating the intricacies of thesis writing was made enjoyable by your friendship and shared humor. Your presence has illuminated the academic path, turning it into a collective journey. I extend heartfelt gratitude to my mother for her constant guidance and my father, who tirelessly works to provide for the family; their indomitable spirit propels me through every page, every discovery, and every triumph. This thesis stands as a testament to the love and wisdom they bestowed upon me. To my mentors and advisors, who imparted knowledge, introduced me to new perspectives, and consistently guided me through mistakes, I express sincere appreciation.

ABSTRACT

This project aims to address the problem of the lack of efficient and quick shoe drying solutions, especially during rainy weather conditions. Traditional drying methods are often cumbersome and ineffective, leading to discomfort for us. To overcome this challenge, the objective of this project is to design and develop a shoe drying system that combines a temperature and humidity sensor with an ESP32 microcontroller. The proposed method involves the use of sensors to accurately monitor and control the temperature and humidity levels inside the shoes. Therefore, this system aims to provide quick and efficient drying while ensuring the maintenance of shoe quality. The result is the creation of a compact and efficient shoe drying device that can effectively control temperature and humidity, facilitating quick and effective shoe drying. This solution improves user comfort and hygiene, offering a practical and systematic approach to shoe drying.

ABSTRAK

Projek ini bertujuan untuk menangani masalah kekurangan penyelesaian pengeringan kasut yang cekap dan cepat, terutamanya semasa keadaan cuaca hujan. Kaedah pengeringan tradisional sering menyusahkan dan tidak berkesan, membawa kepada ketidakselesaan bagi kita. Untuk mengatasi cabaran ini, objektif projek ini adalah untuk mereka bentuk dan membangunkan sistem pengeringan kasut yang menggabungkan sensor suhu dan kelembapan dengan mikropengawal ESP32. Kaedah yang dicadangkan melibatkan penggunaan sensor untuk memantau dan mengawal tahap suhu dan kelembapan di dalam kasut dengan tepat. Oleh itu, sistem ini bertujuan untuk menyediakan pengeringan yang cepat dan cekap di samping memastikan penyelenggaraan kualiti kasut. Hasil diperoleh ialah penciptaan peranti pengeringan kasut yang padat dan cekap yang boleh mengawal suhu dan kelembapan dengan berkesan, memudahkan pengeringan kasut yang cepat dan berkesan. Penyelesaian ini meningkatkan keselesaan dan kebersihan pengguna, menawarkan pendekatan yang praktikal dan sistematik untuk pengeringan kasut.

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First of all, I would like to thank my supervisor, and my co-supervisor, TS Nadzrie Bin Mohamood, Nurliyana Binti Abd Mutalib for their valuable guidance, words of wisdom and patience throughout this project.

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My deepest appreciation goes to my parents and family members for their love and prayers throughout my studies. Honourable mention also goes to my brother Muhammad Zazmi Bin Muhamad for all the motivation and understanding.

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CHAPTER 1

INTRODUCTION

1.1 Background

Difficulty, odor and bacterial or fungal growth can all be caused by damp or wet shoes. Traditional drying techniques often prove to be slow, ineffective, or dangerous. It was born out of a need for a quick and easy way to effectively dry shoes. This project uses an ESP32 microcontroller platform with temperature and humidity sensors to build a shoe drying system in an effort to solve this problem. This connection provides precise control and monitoring of the condition of the inner shoe, ensuring quick and efficient drying while maintaining the safety of the shoe. The adaptability of the ESP32 allows for further customization, including incorporating additional features such as timers or a user-friendly interface. This project aims to design an innovative shoe drying system that provides fast, effective and safe drying, improving overall shoe comfort and cleanliness. It does this by using temperature and humidity sensors. and adaptability.

1.2 Addressing Global Warming Through Weather Sensing Project

Malaysia experiences significant precipitation in the year, making rain a prominent climatic feature. The monsoon patterns, which are affected by the tropical climate, cause frequent and heavy rainfall in different parts of the world. Malaysia is more susceptible to rain because of its geographic location near the equator and wide coastline. The nation experiences a constant rainy season between October to March, which is occasionally accompanied by torrential rain. The extensive rainfall in Malaysia has a significant impact on the country's ecosystem and geography, necessitating effective infrastructure and readiness measures to reduce any potential negative consequences. As a result, temperature and humidity sensors are paired with ESP32 microcontrollers to measure the temperature and humidity of items.

1.3 Problem Statement

People have challenges as a result of the lack of an effective and speedy shoe drying solution, especially in wet weather. Traditional drying techniques are frequently laborious and ineffective, which causes discomfort. Therefore, a shoe drying system is required that can dry shoes fast and efficiently while guaranteeing that their quality is maintained.

1.4 Project Objective

This project's primary objective is to offer a methodical and practical approach for shoe drying systems. The following objectives are more precise:

a) To conduct a thorough literature review of Design Of Rapid Drying Shoes Using ESP32 Controller.

b) To design and develop a shoe dryer system that uses a temperature and humidity sensor along with an ESP32 NodeMCU microcontroller.

c) To incorporating elements of IoT automation and connectivity.

1.5 Scope of Project

The scope of the project is as follows:

a) To carry out a literature review on DHT22 sensor and moisture sensor.

b) Accurately monitor and control indoor temperature and humidity levels.

c) Accelerates drying while maintaining ideal temperature and humidity

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the examination and evaluation of past research that is relevant to the subject at hand are presented. The information and data acquired will be used as an additional source of information as the project is researched and modified to be more successful. To get a better understanding of the researches involved in the project, a few literature studies had been undertaken.

2.2 Understanding [Global/Current Issue] in the Literature

Climate change and extreme weather events are one of the most pressing global issues today, with significant implications for weather patterns and extreme weather events. Scientists and researchers have extensively studied the relationship between climate change and weather, highlighting the increasing frequency and intensity of extreme weather events due to climate change. As you can see, at the end of this year, there will definitely be areas in Malaysia flooded due to non-stop rain and there will be a situation of rain for a month. This results in all citizens facing difficulties in moving especially to go to work, school and so on. Therefore, this shoe dryer project plays an important role for shoe users on a daily basis.

2.3 Overview of Dryer Learning

The introduction of this study on drying black pepper emphasises the importance of the spice and the widespread usage of convective air heating tray dryers in processed businesses. The problem statement highlights how important it is to determine the ideal drying conditions in order to save energy use and enhance the quality of black pepper. Using an experimental apparatus built in-house, the process entails examining drying characteristics at various temperature and air velocities. Model coefficients are assessed when preexisting drying model are fitted to data from experiments. The logarithmic model, which offers the best fit with an overall RMSE of 0.0140, is the suggested analytical technique. It is recommended that future studies focus on further optimising drying conditions. The study concludes that the logarithmic model is a good fit for explaining the drying of black pepper, that ideal drying conditions can be found, and that careful parameter selection can result in significant energy savings [1].

This study looks into the possibility of using flash drying instead of traditional sun drying for coir pith, a large byproduct in areas that grow coconuts. The traditional sun-drying approach has drawbacks, including extended drying times and vulnerability to outside influences. A pilot-scale flashing dryer is used in the study to test several ranges of temperatures and gas velocities in order to evaluate drying effectiveness and product quality. The best temperature for flash drying, according to the results, is 140 °C. This achieves quality criteria that are similar to drying in the sun but takes much less time (12 minutes as opposed to 9 hours). The study highlights the effectiveness of flash drying as a workable solution to the coir pith business, providing faster drying and lower microbial counts, and it suggests further studies for scaling up this method [2].

This paper presents the application using solar power for drying while emphasising past customs and the drawbacks of conventional open-air drying techniques. It pinpoints issues including quality degradation and protracted drying times. The methodology section describes many methods of solar drying, such as box and greenhouse dryers, hybrid systems, open sun drying out, indirect solar being dried, and indirect solar drying. The conclusion highlights the advantages of solar energy while acknowledging its drawbacks. Future ideas suggest cost-effective enhancements including storage of heat and hybrid systems. Overall, despite existing challenges, the study highlights the promise of solar drying for improved quality, faster drying times, and sustainable practices [3].

Other than that, in order to optimise temperature control during fruit drying, the study suggests the FRIT approach, which makes use of a prototype air drying. The objective is to match the intended response with the chamber's temperature. The modification of controller parameters is improved by the PSO-based FRIT technique, according to experimental results. The method uses an embedded controllers system in hardware design along with a mathematical model. The results of experiments and simulations show that temperature management is effective. The potential of FRIT to optimise drying operations is emphasised in the conclusion. Subsequent research endeavours may concentrate on enhancing and improving control methodologies [4].

2.3.1 ESP32 Learning Algorithm

The usage of ESP32 controllers for data processing and measurement in embedded systems and the Internet of Things is examined in this article. It talks about the ESP32 chip's popularity and the Internet of Things' expansion. There are explanations of several development techniques, including MicroPython, Arduino Core, and the Espressif IoT

Framework. A variety of useful applications are shown, indicating that larger screens can display real-time data and graphics, while smaller ones are appropriate for status reporting. Platform recommendations depending on project complexity are summed up in the conclusion, and control strategy optimisation will be the focus of subsequent work [5].

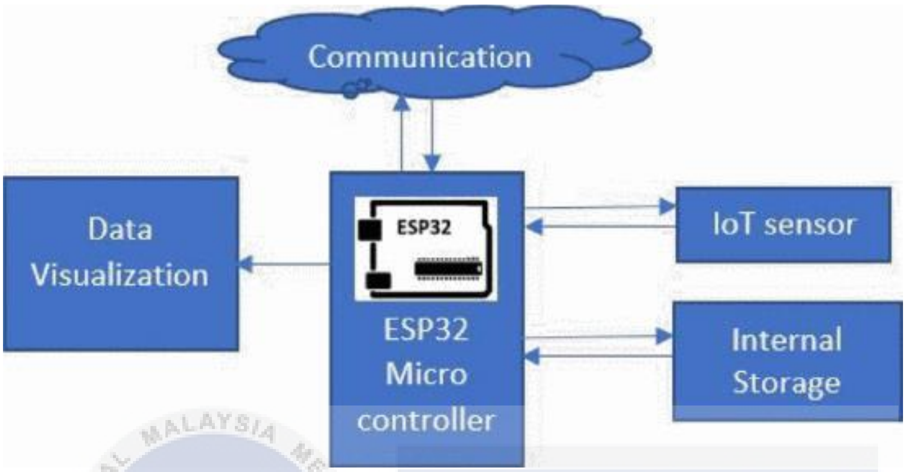

Figure 2.1 Block scheme of the embedded system [5]

Other project about Integration Of Lifting Pump Monitoring System Using ESP32 And Hostinger With Internet Of Things Based, This study focuses on improving the monitoring of a wastewater distribution system at Soekarno-Hatta Airport using an ESP32-based prototype. The existing system required manual on-site visits twice daily, prompting the need for real-time monitoring. The proposed solution involves a prototype that reads pump current and voltage, processes the data, and sends it to Hostinger web for display on Android. The study draws inspiration from similar IoT applications in wastewater management. The results show the prototype's effectiveness, with less than 5% difference from actual measurements. Future recommendations include adding a temperature sensor and exploring alternative web servers. In conclusion, the ESP32-based system provides real-time monitoring, enhancing operational efficiency at the airport [6].

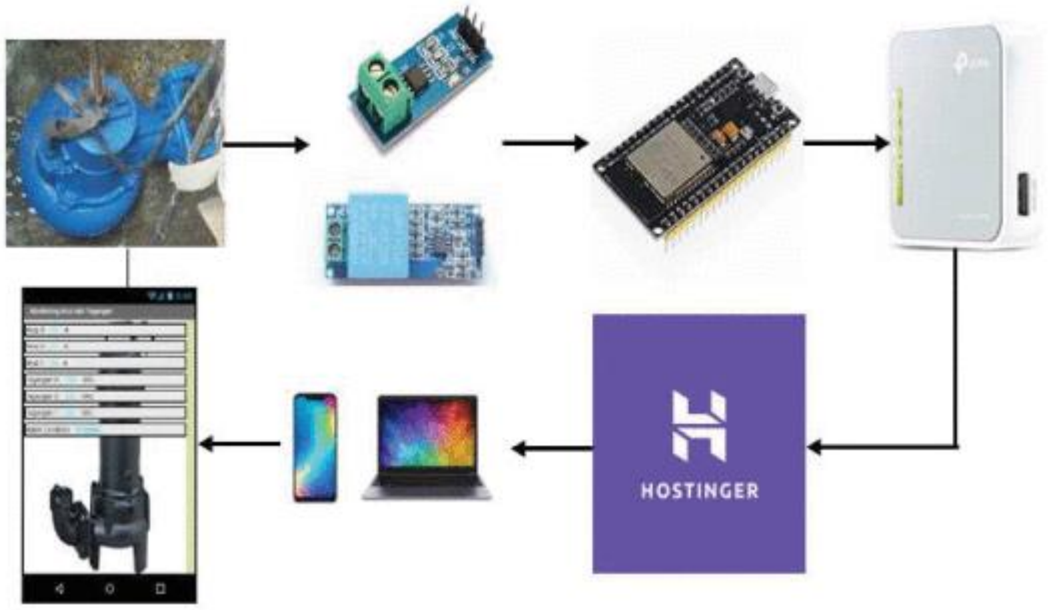

Figure 2.1.1 Block diagram design [6]

Efficiency and Performance Evaluation of an Early Fire Detector Device Using an ESP32 Wireless Sensor Network, The study addresses the deficiency of fire prevention measures in residential areas by introducing an ESP32-based wireless sensor network for early fire detection. Using ESP32 microcontrollers, the process entails building a system to collect fire data, such as temperature, humidity, pressure, and gas. Through a mobile application, a graphical user interface (GUI) transmits notifications and shows the data. To ensure precise identification, threshold values are validated using the ANOVA test. Future developments will include the addition of gas type detection, the ability to control fires, and the addition of more nodes to improve coverage. In summary, the system exhibits dependability in identifying and alerting authorities to fires, and suggestions for additional enhancements and uses are provided [7].

Figure 2.1.2 The PHOENIX: A wireless ESP32 mesh network for fire detection and monitoring system.[7]

2.4 DHT11 Learning Algorithm

Aiding Plant Growth Difference for Indoor Vertical Garden against Traditional Outdoor Vertical Garden Setup using DHT11 and Capacitive Soil Moisture Sensor, the study offers an automated lighting and watering system based on an ESP32 platform as a solution to common problems in indoor gardening. For particular plants, it contrasts indoor and outdoor vertically planting techniques. Hardware configuration, flowcharts, and conceptual frameworks are all part of the technique. Plant growth studies and sensor calibration show no appreciable variations from indoor and outdoor configurations. More plant kinds should be investigated, indoor growth treatments should be made, and watering should be improved [8].

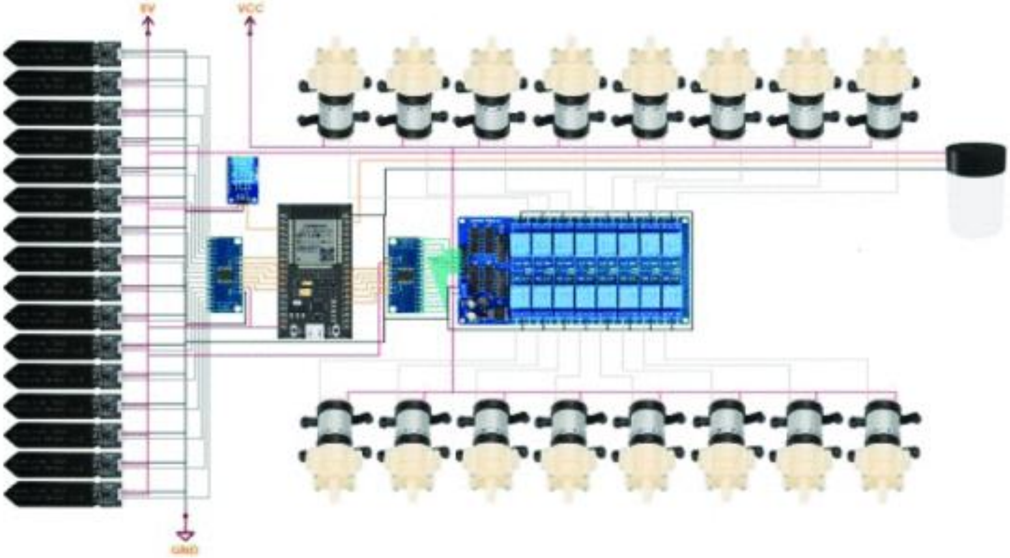

Figure 2.2 Circuit Diagram for Indoor Vertical Garden Prototype [8]

Other than that, Iot Based Smart Window using Sensor Dht11. The Smart City initiative in India is the subject of this study, which focuses on improving urban and rural infrastructures digitally. The suggested remedy is a Smart Window system that is Internet of Things (IoT) based and intended to track temperature levels in enclosed areas in real time. By utilising DHT11 sensors, the technology makes it possible for windows to operate automatically without human input, which promotes sustainability and energy savings. An explanation for the Internet of Things (IoT) offers itself, emphasising its use in automation, energy conservation, and gadget integration. An analysis of the current and suggested systems highlights the shift from manually operating windows to automatically operating windows based on temperature detection. Stepping motors, DHT11 temperature sensors, and Arduino are all necessary for the system to function. The conclusion highlights possible uses in orphanages, hospitals, and smart buildings and offers directions for further development [9].

2.5 Moisture Sensor Learning Algortihm

The project name Using a gamma-ray spectrometer for soil moisture monitoring: development of the the gamma Soil Moisture Sensor (gSMS) In order to measure soil moisture content, this work presents a novel gamma Soil Moisture Sensor (gSMS) that uses gamma-rays released by naturally occurring radionuclides in soil. The technique uses gamma-ray spectrometers (GRS) to measure radionuclide radiation emissions, and first findings imply relationships with soil moisture. The gSMS is placed in a potato field, and its spectral analysis plays a critical role in reducing noise caused by radon. Calculating the impacts of radon, comprehending the impact of measurement height, and calibrating sensors for a variety of soil types are among the challenges. The study highlights how gSMS may give agricultural areas spatially accurate information on soil moisture. Upcoming projects include improving calibration, tackling the effects of radon, and investigating UAV-based mapping for thorough soil moisture measurement [10].

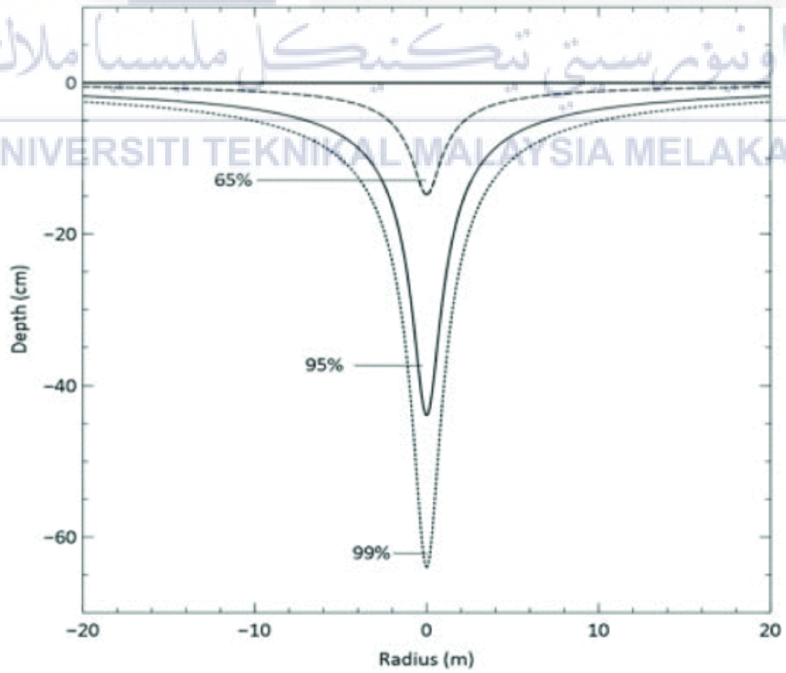

Figure 2.3 Cross sections of the ground showing the origin of the radiation that gives 65%, 95% and 99% of the intensity (gamma energy 2.62 MeV, [10]

The study focuses on satellite from NASA's SMAP and ESA's SMOS, that are able to measure the top 5 cm of soil in particular locations, in order to solve shortcomings in current worldwide soil moisture measurement techniques. In order to get around this, the researchers investigate the possibility of measuring soil moisture in densely vegetated areas down to a depth of up to 10 cm using P-band radiometers. They compare P-band and L-band observations with surface soil moisture measurements using an aerial experiment conducted over an irrigated farm in Tasmania. According to the findings, P-band provides better accuracy in locations with greater vegetation. The work highlights the potential for improved accuracy and suggests more research on P-band for worldwide soil moisture detection from space [11].

2.6 Firebase Learning Algorithm

This study examines how Firebase databases are used in mobile applications, highlighting the importance of these databases for large enterprises. The paper discusses the difficulties in developing mobile apps and emphasises the requirement for efficient and safe solutions. It explores the features of Firebase, including as integration with other services and real-time data processing. In addition to discussing the advantages of Firebase over conventional databases and demonstrating its quicker data processing performance, the article offers step-by-step instructions for connect to Firebase in Android Studio. After conducting performance tests and comparing Firebase and MySQL for CRUD operations, the researchers came to the conclusion that Firebase works more responsively. The study ends by highlighting Firebase's applicability for mobile apps and outlining potential directions for further investigation and optimisation techniques [12].

The technique that this research introduces enables patients to be continuously monitored outside of hospitals, thereby addressing the global challenge of cardiovascular disease. The solution combines Google Firebase for storage in the cloud and an Android app called "Healthy" that is paired with a hardware device via Bluetooth. In the event of an irregular heartbeat, the app alerts physicians and patients and shows real-time ECG data. The system is intended to be both economical and effective. Suggestions for future enhancements are made, and in general, the system works well for delivering prompt assistance and possibly lowering hospitalisation expenses [13].

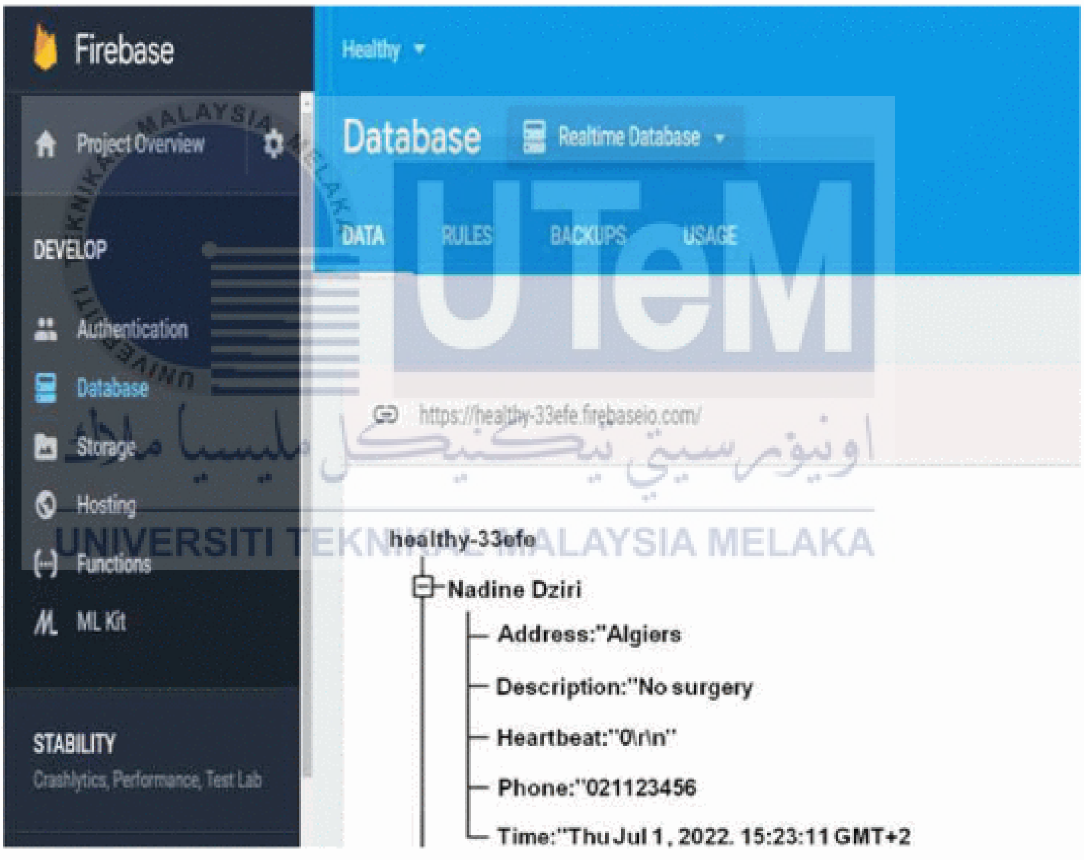

Figure 2.4 User info provided by Firebase Cloud system [13]

2.7 Heating Fan Learning Algorithm

In an effort to lessen labor-intensive charcoal fanning, this study investigates the use of waste heat from grilled stoves to produce energy for a self-rotating fan. The study examines the effects of temperature and configurations use a thermoelectric module and discovers that water aids in temperature stabilization. According to the experiments, the module's dual parallel arrangement generates the most power, suggesting that grilling may be an energy-efficient process. Future innovations for integrated technology in remote places and portable grills are suggested by the study. The study concludes by highlighting the possibility of generating electricity in grilled stoves using waste heat, providing a practical and economical alternative [14].

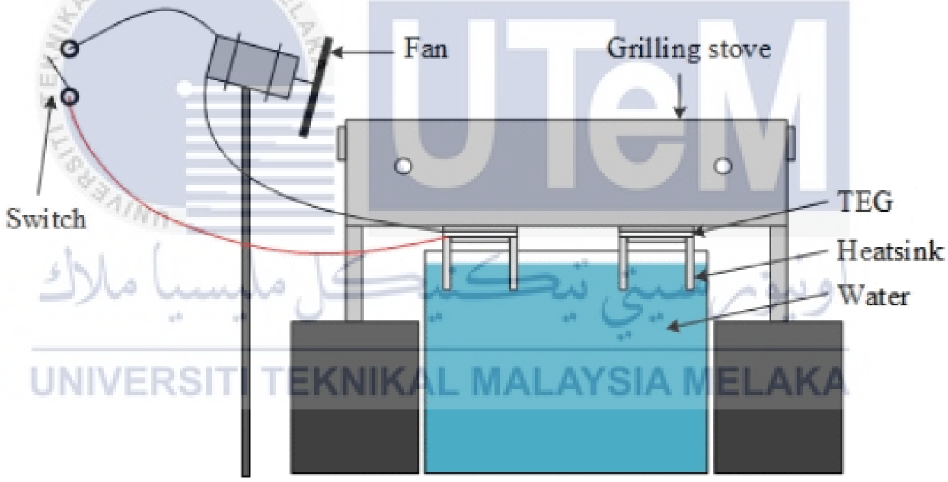

Figure 2.5 Performance test schemes of the self-rotating fan system from the grilling stove waste heat. [14]

This work investigates the use of a vibrating piezoelectric fan to improve transfer of heat in an isothermal slots channel. A dimensionless frequency (Sr) and amplitude (A) ranges with different Prandtl values are the main topics of interest. Piezoelectric fan vibration greatly enhances heat transfer on downstream walls, according to numerical models. It is discovered that the advantages are Prandtl number sensitive, with a critical amplitude of 0.1. The study highlights the need for more advancements and offers possible uses in electronic cooling. In conclusion, enhancing heat transfer in channel flows may be possible by utilizing a piezoelectric fan as a vortex generator [15].

2.8 Relay Learning Algorithm

The problem of higher currents of faults in power distribution systems as a result of scattered generation and rising power demand is addressed in this paper. The authors point out possible issues with the operation of over-current relays (OCRs), a typical protective device, but the main focus is on employing superconducting fault current limiters (SFCLs) as a remedy. They suggest an OCR that takes into account the voltage component in order to deal with SFCL-related OCR trip delays. A power distribution system incorporating SFCL and OCR is modelled using simulation tools, demonstrating better coordination. In order to improve protective coordination in power systems with SFCLs, the report recommends more research. In conclusion, sustaining protection coordination in power distribution systems using SFCLs appears to be a promising use case for the OCR utilising the voltage component [16].

2.9 Applications Mobile Learning Algorithm

In order to help osteoporotic patients avoid additional fractures, the study presents a brand-new smartphone software called Fracture Liaison Service (FLS). By utilising Internet of Things (IoT) sensors for safety monitoring and fall prediction in smart wheelchairs, it solves the problem of the absence of a worldwide mobile FLS. The process entails building the FLS app in phases for risk assessment, education, and fracture treatment. The smart wheelchairs' pressure sensors are part of the safety monitoring system. The study indicates possible commercialization by demonstrating successful development and testing for usability. In the future, the app will be improved, AI algorithms will be implemented, and an intelligent personalised FLS will be investigated. The contribution to fracture prevention worldwide and the possibilities for an intelligent health care system are emphasised in the conclusion [17].

This paper examines Progressive Web Applications (PWAs) is a more rapid and economical alternative to native applications for testing mobile-based solutions. Native app development via conventional methods requires a lot of resources, especially for startups. Benefits of the suggested PWA methodology include less updates, easy development, cross-platform interoperability, and easier A/B testing. Using a case study including a PWA prototype for a the college's digital Identity Card Portal, the paper demonstrates these benefits. It highlights how PWAs are more easily developed and support multiple platforms than native and websites. Future research will include non-LEAN approaches, scaling tactics, raising startup awareness, and creating process metrics. PWAs, in summary, seem to be a useful tool for entrepreneurs, allowing for effective and inexpensive idea iteration [18].

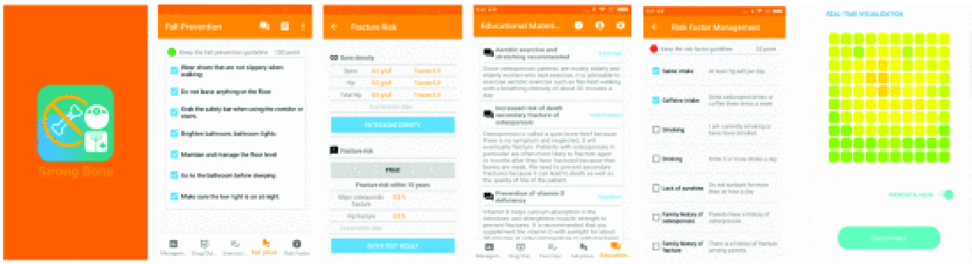

Figure 2.6 Screenshot of Fracture Liaison Service (FLS) application and Safety Monitoring real-time signal from the IoT sensor [17]

2.10 Table of related work

Name	Year	Platform	Purpose	Advantage	Disadvantage
Virantha, Ishan; Wijewardane, Anusha	2021	Dryer Learning	To look into and improve the black pepper drying process using a tray dryer of the convective kind. In order to reduce overall drying energy consumption and improve the taste of black pepper, the study attempts to determine the ideal drying temperature and high air velocity. After running tests at various temperatures and air speeds and fitting the results to drying models, the researchers came to the conclusion that the logarithmic approach best accounted for the drying process.	When compared to open sun drying, the usage of convective heated air tray dryers implies increased efficiency. A more regulated and consistent drying process can be obtained with artificial dryers.	Convection air heating tray dryers are common, however they may require more initial setup money than open sun drying techniques. For small-scale farmers with limited resources, this could be a challenge.
Fernando, J. A.K.M. Amarasinghe, A. D.U.S. Jayarathna, W. A.R. Narayana, M.	2019	Dryer Learning	To investigate and analyse flash drying as a substitute for sun drying coir pith, with the goal of comparing the quality parameters and drying effectiveness of the dried item to those attained by conventional sun drying.	Coir pith can be dried in as little as 12 minutes using flash drying, as opposed to 9.1 hours using sun drying. This faster processing speed might be a significant benefit in terms of effectiveness and quickness.	Flash drying is a quicker drying method, it usually calls for greater temperatures and gas velocity. Particularly in terms of energy sustainability, the higher energy input needed for these conditions can be viewed as a drawback and result in higher operating costs.

Name	Year	Platform	Purpose	Advantage	Disadvantage
Moitra, Mohini	2022	Dryer Learning	Talk about how solar drying techniques have advanced, surpassing the limitations of earlier open systems that were vulnerable to weather and insect damage. It investigates enhanced solar dryers to accomplish quicker, more effective, and more hygienic drying procedures for a range of uses, including drying crops, fruit, carpets, bricks, and agricultural products.	Since solar energy is a clean and renewable energy source, using it for drying has several benefits. It promotes environmental sustainability by lowering reliance on non-renewable resources.	The efficiency of solar dryness is highly reliant on meteorological factors, specifically sunlight. The drying process can be greatly impacted by cloudy days or bad weather, which might make it less dependable and possibly slower than other drying techniques.
Ruangurai, Piyanun Silawatchananai, Chaiyaporn Howimanporn, Suppachai	2020	Dryer Learning	This research presents a novel approach to temperature management during fruit drying: Fictitious Reference Iterative Tuning (FRIT). Maintaining a temperature within the drying chamber that corresponds with the intended response is the aim. Using an initial air dryer as a test bench, the study's experimental findings show that optimising controller parameters with the PSO-based FRIT method is more effective.	To better regulate the temperature within the fruit dryer chamber so that it almost exactly corresponds to the intended reaction.	The efficiency of solar dryness is highly reliant on meteorological factors, specifically sunlight. The drying process can be greatly impacted by cloudy days or bad weather, which might make it less dependable and possibly slower than other drying techniques.

Name	Year	Platform	Purpose	Advantage	Disadvantage
Babiuch, Marek Foltynek, Petr Smutny, Pavel	2019	ESP32 Learning Algorithm	This experiences with the creation of ESP32 microcontroller applications and offers a thorough analysis of the potential for developing data processing and measurement applications on this platform. Microcontrollers typically establish connections with IoT modules along with other intelligent sensors, transferring data to higher-level systems.	The ability of the ESP32 microcontrollers to interface with a variety of internet of things and smart sensors is emphasized, demonstrating how well they can be integrated into systems for applications involving data processing and measurement.	Sensors and IoT modules can occasionally be complicated, requiring technological know-how.
Budiyanto, Setiyo Silalahi, Lukman Medriavin Silaban, Freddy Artadima Simanjuntak, Imelda Uli Vistalina Rochendi, Agus Dendi Darusalam, Ucuk	2021	ESP32 Learning Algorithm	To solve the lifting pump monitoring system's inefficiency, which necessitates twice-daily on-site visits. In order to improve accessibility and information retrieval efficiency, the research proposes and implements a prototype for an immediate time flow measurement and voltage monitoring device utilising an ESP32. This will enable remote monitoring using web hosting and Android.	The voltage and current of the pump are available in real time with the suggested monitoring system. This makes it possible to identify problems or anomalies quickly, which facilitates effective management and immediate intervention.	The system relies on internet access as it transmits data to hosting web for Android display. Any interruptions to internet access might have an impact on the real-time monitoring features and cause important information to be delayed.

Name	Year	Platform	Purpose	Advantage	Disadvantage
Garcia, Celina Francine I. Ibarra, Joseph Bryan G.	2023	ESP32 Learning Algorithm	ESP32 wireless sensor network will be used to create an early detection device that will collect data on fire the location, temperatures, pressure, humidity, and gas concentration. The goal is to offer a graphically interfaced, reasonably priced, dependable, and effective fire detector that enables users to log and track the environment in real-time via a mobile application.	Early Identification and Extensive Surveillance.	Delay in notification.
Kagalingan, Ruby Jon M. Tolentino, Bernard Piolo M. Balbin, Jessie Jaye R.	2022	DHT11 Learning Algorithm	To describe and illustrate the potential use of an ESP32 module boards and a variety of sensors in a vertical garden control system as a means of addressing the issues associated with indoor farming. The system's goals are to increase plant development efficiency and get around the drawbacks of indoor environments lacking in sunlight.	Effective Indoor Horticulture	The ESP32 module, sensors, and automatic irrigation are only a few examples of the technologies that make the system work.

Name	Year	Platform	Purpose	Advantage	Disadvantage
Margret Sharmila, F. Suryaganesh, P. Abishek, M. Benny, Ullas	2019	DHT11 Learning Algorithm	To showcase the implementation of an Internet of Things-based solution for effective and automated window operating in support of India's Smart City aim. Real-time temperature monitoring in enclosed spaces is the major goal, with the goal of preserving ideal temperatures and achieving automated window functions.	By enabling automated temperature adjustments for keeping a comfortable level, this may lessen demand for artificial cooling or heating and increase energy efficiency.	Any malfunctions or loss of connectivity could affect the system's capacity to track and regulate the temperature, which could cause disruptions to its intelligent functioning.
Van Der Veeke, Steven Koomans, Ronald Limburg, Han	2020	Moisture Sensor Learning Algorithm	To present and explain the gamma Soil Moisture Sensor (gSMS), a revolutionary soil moisture sensor that measures soil moisture content by using gamma-rays released by the soil. The sensor's working principle, reliance on naturally occurring radionuclides, and the requirement for spectrum analysis to weed out extraneous elements like air radon concentrations are all covered in the text.	Innovative Approach to Measurement	Radon Sensitivity in the Atmosphere

Name	Year	Platform	Purpose	Advantage	Disadvantage
Madaminov, Uktam A. Allaberganova, Muyassar R.	2023	Moisture Sensor Learning Algorithm	Will thoroughly examine and talk about using Firebase's database in mobile apps, with an emphasis on big businesses. The paper attempts to address a number of topics, such as how the system interfaces with mobile applications, how best to utilise Firebase's specific libraries, real-world application problems, safety considerations, and operational techniques.	Effective data management is made possible by the usage of Firebase databases in mobile applications.	Internet access is necessary for Firebase to synchronise data in real time.
Meziane, Nacera Bouzid, Merouane Meziane, Dalila	2023	Firebase Learning Algorithm	Presents a method for keeping an eye on patients with cardiovascular disease utilising Cloud Firebase and an Android app. It makes it possible to remotely monitor ECG data and instantly alert medical professionals about irregular heartbeats. Through Bluetooth communication, the hardware and app gather and show ECG data continually. The application is easy to use and alerts the physician and patient to any irregularities, demonstrating its potential for effective remote health monitoring.	Remote cardiovascular monitoring makes it possible to track ECG data in real-time, identify irregular heartbeats right away, and promptly notify doctors so that they can take appropriate action.	The system's Cloud Firebase and Bluetooth connectivity. The effectiveness of the system for remotely monitoring may be jeopardised in circumstances in which there are technical difficulties, network challenges, or constraints on the capabilities of the smartphone.

Name	Year	Platform	Purpose	Advantage	Disadvantage
Sagita, Diang	2020	Firebase Learning Algorithm	To investigate the possibility of producing energy for a self-rotating fans system by using waste heat from a traditional grilled burner. The experiment focuses on using thermoelectric modules to transform thermal energy into electrical energy with the goal of improving power generation efficiency and configuration optimisation.	Demonstrates how to efficiently convert the surplus heat produced during grilling into energy.	Incorporates a number of treatments and configurations, including different thermoelectric module arrangements and the use of water in the heatsink.
Qiu, Yunlong Wu, Changju	2018	Heating Fan Learning Algorithm	To conduct a numerical investigation on the enhancement of heat transfer in an isothermal slot channels resulting from the shedding of vortices by a vibrating piezoelectric fans. The purpose of the study is to investigate how heat transfer performance is impacted by dimensional the frequency, dimensionless amplitude, and Prandtl number.	Piezoelectric fan vibrations greatly enhance heat transfer in the channel, providing superior cooling for walls downstream.	Fan vibration's ability to improve heat transmission is greatly dependent on the characteristics of the fluid, especially the Prandtl number.

Name	Year	Platform	Purpose	Advantage	Disadvantage
Madaminov, Uktam A. Allaberganova, Muyassar R.	2023	Heating Fan Learning Algorithm	Must carefully investigate how Firebase databases are used in mobile applications, particularly in large enterprises. It emphasises best practices and specialised libraries while focusing on connecting systems and mobile apps. Additionally, the study sets Firebase apart from other databases, covers security concerns, talks about real-world application challenges, and shows how useful Firebase is for teaching mobile technology courses.	For large organisations, effective data management is made possible by the usage of Firebase databases in mobile applications.	Any database system is vulnerable to security threats, even though Firebase is generally safe. Possible system vulnerabilities that could raise security issues could exist, depending on how the system is implemented and configured.
Sagita, Diang	2020	Relay Learning Algorithm	To produce power from waste heat to a grill in order to increase the energy efficiency of grilling. Its main objectives are to test a thermoelectric module, investigate different configurations, and look at how water impacts temperature stability.	Uses the waste heat from a traditional grilled burner to create electricity, which is an inventive method.	Involves a number of steps and several thermoelectric designs, with the usage of water in a cooling among them.

Name	Year	Platform	Purpose	Advantage	Disadvantage
Virantha, Ishan Wijewardane, Anusha	2021	Application Learning Algorithm	To maximise the drying of black pepper by employing a tray dryer of the convective type. Finding the optimal drying temperature and hot air velocity is the main goal in order to reduce the overall energy consumption during the drying process and improve the quality of the black pepper.	Enhancing the black pepper's quality and offering a more successful and efficient drying procedure.	The implementation difficult, particularly for individuals without specialised knowledge in the area, which can restrict access to the ideal drying conditions.

Table 2.1 Summary of literature review

2.11 Summary

In this chapter, it's describe the resources from the search as well as project examples. It also introduces how to use components and understand the flow of projects that have been produced in the past year. Test results also help to visualize project progress. With search results, it is understandable and pleasant to make methodology easily. A research project that explores related previous studies can show understanding to create a project and identify the components used. This study provides valuable insights and practical solutions for accurate humidity measurement, measuring temperature, appropriate types of heaters and much more.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will outline the structure's primary flow as it lifts the suggested project. 'Design of Rapid Drying Shoes Using ESP32 Controller' project is being offered to assist those who struggle with hard-to-dry shoes. This study is based on specific phases of work that are done correctly and successfully in accordance with the goals. This application device needs to be developed in order to meet the project's objectives. This prototype was created using the hardware and software indicated as being utilized for this project.

3.2 Block Diagram

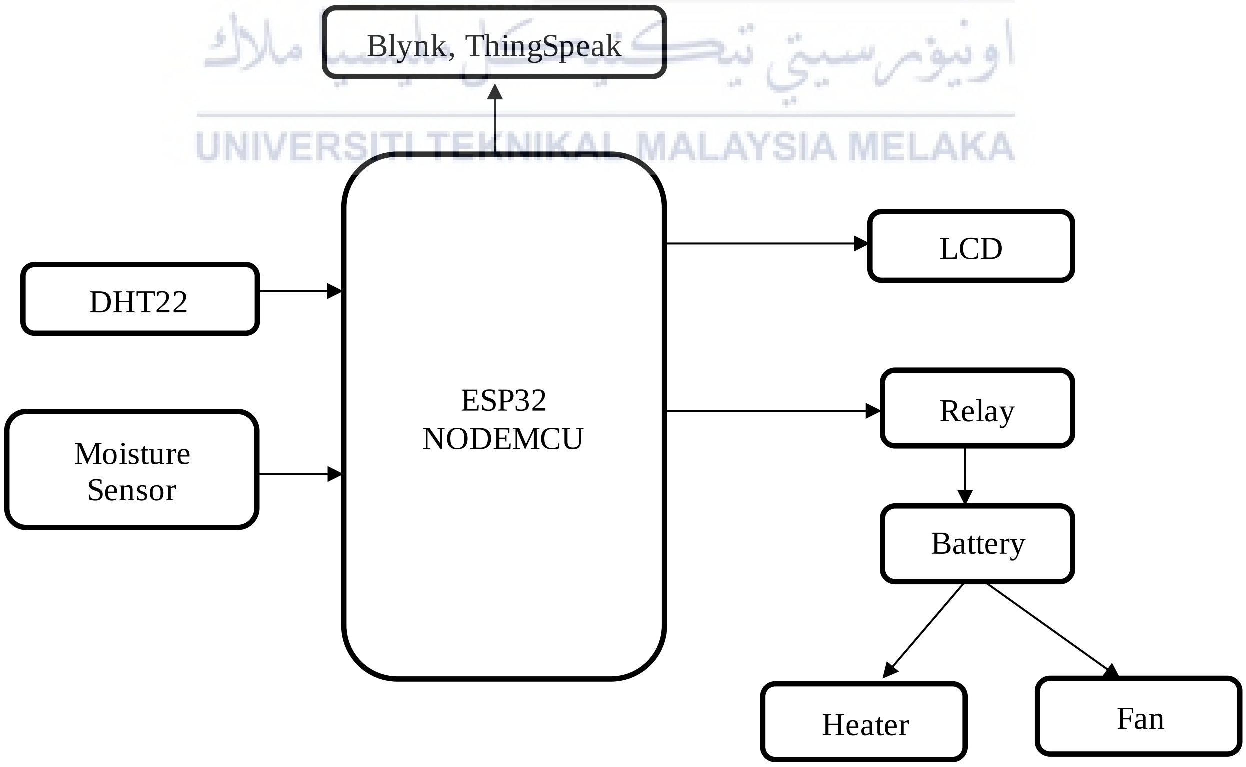

Figure 3.1 Block Diagram

3.2.1 Experimental setup

A DHT22 sensor for humidity and temperature measurement, a moisture sensor for detecting shoe moisture, a relay module for controlling a fan and heater, a battery with 12 volts for power, and connection with the Bling! app for controlling the device remotely and ThingSpeak for data logging comprise the test setup for designing rapid-drying shoes using an ESP32 controller. Both sensors are connected to the ESP32, and the heater and fan are controlled by the relay module to ensure effective drying. Users may modify drying parameters with ease thanks to the Bling! app, which enables remote monitoring and control. The ThingSpeak platform also records moisture, humidity, and temperature data analysis.

3.2.1.1 Equipment

A DHT22 sensor, a moisture sensor, a relay, a 12V battery, an LCD, an ESP32 NODEMCU, a fan, and a heating element are among the tools used for this project. The DHT22 sensor starts this equipment's operating flow by measuring the humidity and temperature. The moisture sensor then measures the amount of moisture within the shoes, and the LCD shows both sets of data. For effective drying, the relay activates the fan and heating when certain thresholds are reached. All acquired data is recorded and visualised via the Blynk application, which allows for remote control and monitoring in order to improve user accessibility. Furthermore, ThingSpeak is included for thorough data logging, which enables users to assess and enhance the drying process for increased effectiveness.

3.2.2 ESP32 NODEMCU

Based on the the ESP32 device chipset, the ESP32 NodeMCU is a flexible and potent microcontroller board. Its dual-core processor, built-in Wi-Fi and Bluetooth, and other features make it perfect for a wide range of Internet of Things (IoT) applications. With its versatile devices GPIO (General Purpose Input/Output) ports, and analog-to-digital converter, the ESP32 NodeMCU is suitable for a wide range of electronic projects. A large developer community can utilise it as it is able to written with the Arduino IDE. featuring a small form size, affordability, and a wide range of functions.

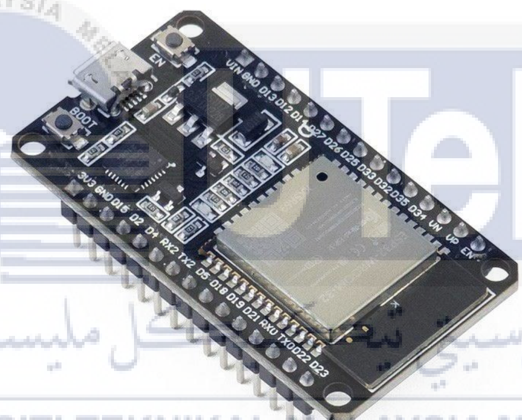

Figure 3.2 ESP32 NODEMCU [18]

3.2.3 Moisture Sensor

One type of sensor used to determine the volumetric content of water in the soil is the soil moisture sensor. As the soil moisture straight gravimetric dimension needs to be removed, dried, as well as sample weighting. These sensors measure the volumetric water content indirectly using the electrical resistance, neutron interaction, dielectric constant, and other soil laws as well as replacement of the moisture content. It is necessary to calibrate the link between the observed parameters and soil moisture since it can change based on the environment, including the kind of soil, temperature, and electrical conductivity.

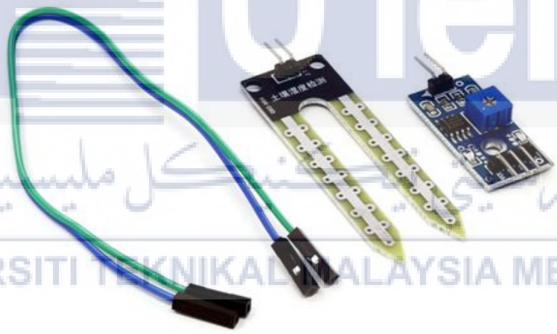

Figure 3.3 Moisture sensor. [19]

3.2.4 Humidity and Temperature Sensor (DHT22)

Temperature and humidity sensors are electronic devices that measure, detect and report both ambient temperature and humidity at low cost. the ratio of the optimum quantity of moisture at a given air temperature to the total amount of moisture. One of the most important tools to track and determine temperature and humidity to a specific place, especially in a data center or server room, has been widely used in consumer, industrial, biomedical or environmental applications. This type of sensor uses a Negative Temperature Ratio Thermistor to measure temperature, which results in a decrease in resistance value as the temperature increases. These sensors are usually made of ceramic polymers or semiconductors to obtain better resistance values also for small temperature changes. The DHT22 has a temperature range of 0 to 50 degrees Celsius for an accuracy of 2 degrees. This sensor has a humidity range of 20 to 80% with an accuracy of 5%. This sensor has a sampling rate of 1Hz, meaning one reading per second. The DHT22 is also a small device with an operating range of 3 to 5 volts. 2.5mA is the maximum current that can be used to measure.

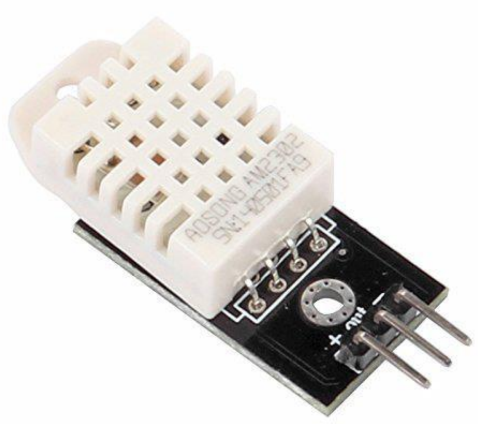

Figure 3.4 DHT22. [20]

3.2.5 Relay

Relays are electrically powered switches that operate by processing electrical signals from other sources to open and close circuits. Some individuals may associate the term "relay" with team sports such as racing where competitors pass batons back and forth to finish the race. Similar to this, "relays" built into electrical items receive electrical signals and send them to additional equipment by turning switches on and off. Relays are electronic control devices commonly used in automatic control circuits. They have two systems: the control system (also known as the input loop) and the controlled system (also known as the output loop). In reality, it is an "automatic switch" that controls a larger current with a smaller current. Relays function as circuit automatic balancing, safety protection and switching circuits.

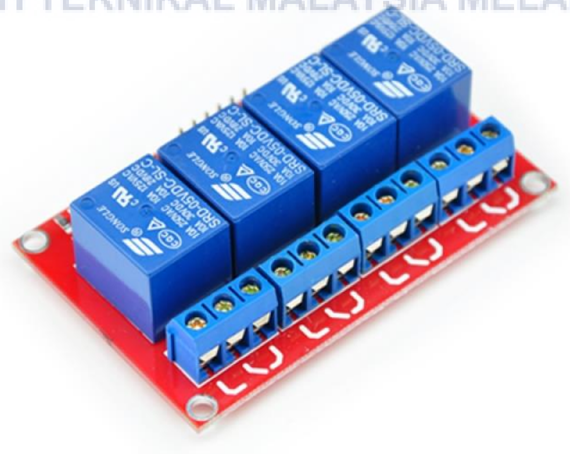

Figure 3.5 Relay. [21]

3.2.6 Fan 12V

An electrical device intended for cooling reasons, a DC fan, more precisely a 12V DC fan, runs in direct current (DC) electricity at the voltage of 12 volts. Common uses for these fans include a wide range of electrical and electronic equipment, such as computers, electronics, automobiles, and more. When energised, the 12V DC fan's rotor and stator, which include blades, create airflow that helps dissipate heat and keep the connected equipment working at the ideal temperature. The voltage needed to power the fan is indicated by the 12V standard, and it is imperative that users match this voltage requirement to guarantee good operation and avoid damaging the fan motor.

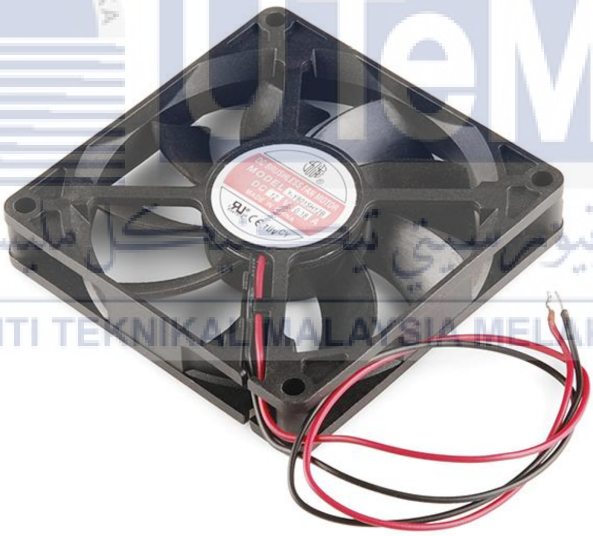

Figure 3.6 Fan 12V. [22]

3.2.7 Heater

Adopting PTC ceramic heating element and aluminium tube, low heat resistance, high heat transmission efficiency. This device is an energy-efficient electric heater that maintains a steady temperature automatically. This PTC ceramic the air heaters includes an automatic energy conservation feature. Excellent performance, simple to install and maintain. 50W of strong aluminium are utilised, with a 12V AC/DC voltage source.

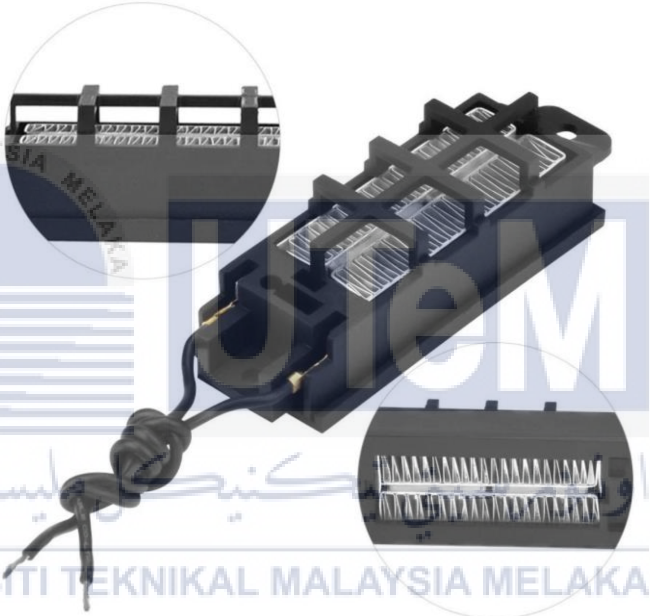

Figure 3.7 Heater. [23]

3.2.8 Battery 12V

A recharged energy storage device with an initial voltage of 12 volts is referred to as a 12-volt battery. Numerous applications, including as automobiles marine, solar energy systems, and other electrical equipment, frequently use these batteries. The 12-volt designation refers to the average output voltage of the battery when it is in operation; between cycles of charge and discharge, there may be modest variations. The electrical power required to run the numerous onboard electronics is supplied by the 12V battery. 12V batteries are also utilised as power storage devices for devices like solar panels and wind turbines in off-grid and renewable power systems.

Figure 3.8 Battery 12V. [24]

3.2.9 Blynk IoT Application

Users are able to monitor and control their shoe drying process remotely by implementing the Blynk IoT application. Custom mobile interfaces with features like real-time drying status information, customisable drying parameters, and notifications are made possible using the Blynk platform. In the case of quick-dry shoes, this flawless integration not only guarantees effective drying through precise management but also shows how IoT technology can be combined with useful, everyday solutions.

3.2.10 ThingSpeak website

This system is improved by the interface with the Thingspeak website, which makes monitoring in real time and data visualisation possible. The moisture data is sent to Thingspeak via the ESP32's Wi-Fi capability, giving consumers information about the drying process. This not only keeps the shoes from getting too moist, but it also lets users monitor and manage the drying process remotely via the Thingspeak platform, making it a smooth connected experience for those looking for cutting-edge technical solutions in footwear development.

3.3 Flowchart Project

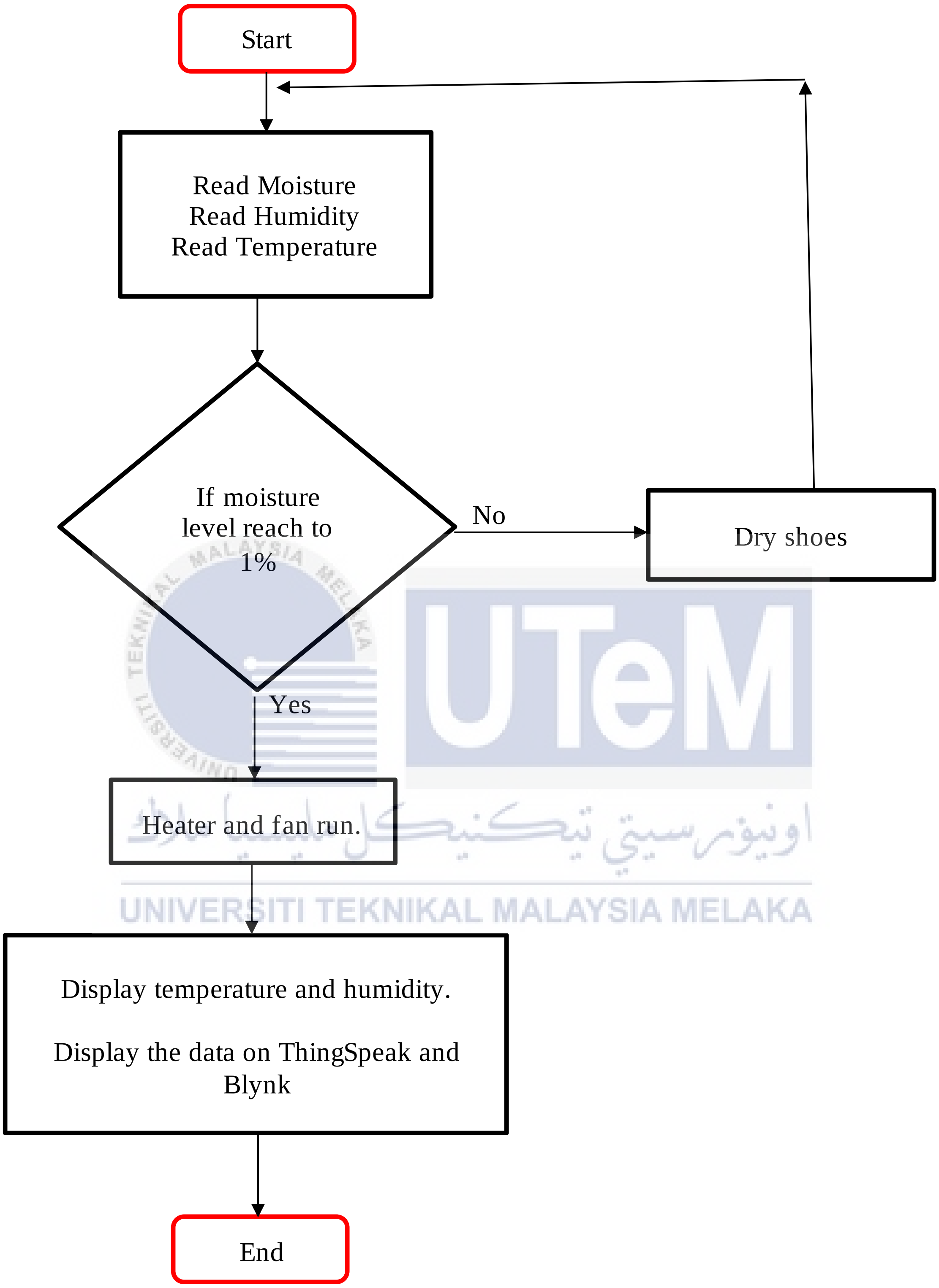

Figure 3.9 Flowchart for Project

3.4 Summary

More important actions have been taken in this chapter, where a comprehensive shoe drying system has been developed, integrating key components to monitor and manage the drying process effectively. The system includes the ESP32 microcontroller board, a temperature and humidity sensor, a moisture sensor, a relay, and a fan/heater. Acting as the brain of the system, the ESP32 receives input from the sensors and orchestrates the output devices accordingly. The moisture sensor gauges the moisture content, while the temperature and humidity sensors assess the shoe's internal atmosphere. Leveraging the capabilities of Blynk apps and ThingSpeak, the ESP32 communicates real-time data to the Thingspeak website, allowing users to remotely monitor and control the drying process through the Blynk application. The ESP32, following a predefined flowchart, determines whether to activate the heating element via the relay based on the sensor readings. The fan/blower enhances air circulation, expediting the drying process. This interconnected system, utilizing Blynk and ThingSpeak, harmonizes the components for a controlled and efficient shoe drying experience.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The project "Design of Rapid Drying Shoes Hanger using ESP32 Microcontroller" is shown in this chapter, showing the result of unifying the components and prototype of the project using plywood and pallet wood. This chapter also shows the analysis and results using ThingSpeak and Blynk IoT based on the output from the DHT22 and moisture sensor. This experiment shows how shoe dryers can maintain ideal drying conditions without overheating or drying out through intensive testing and analysis. The presentation emphasized the value of accurate temperature and humidity readings for efficient drying and the advantages of the ESP32 as a reliable and customizable platform.

4.2 Hardware Setup

This image at figure 4.1, the LCD showing the message "Shoes are ready to be used" when the switch is turned ON. This visual indication assists the user in quickly verifying that all systems are operational and ready for use. For figure 4.2, This illustrates the placement of the fan and heater inside the wooden box. This design ensures optimal use of the 12V battery capacity, allowing the fan to effectively remove hot air. Next, the shoes are positioned within the wooden box, the moisture sensor is strategically attached to the shoe to measure its moisture level, triggering the automatic activation of the fan and heater. Meanwhile, the DHT22 sensor reads the humidity and temperature levels in the surrounding environment. The temperature and humidity readings reflect the current environmental conditions; however, these values may fluctuate when the fan and heater are activated. The introduction of hot air can elevate the temperature and increase humidity. Additionally, the moisture sensor registers a reading of 0 when the shoe is dry, while a value above 0 suggests the likelihood of dampness or wetness on the top surface of the shoe.

Figure 4.1 Shoes dryer startting ON

Figure 4.2 Fan and heater position inside box.

Figure 4.3 The position of the shoes is in the drying box.

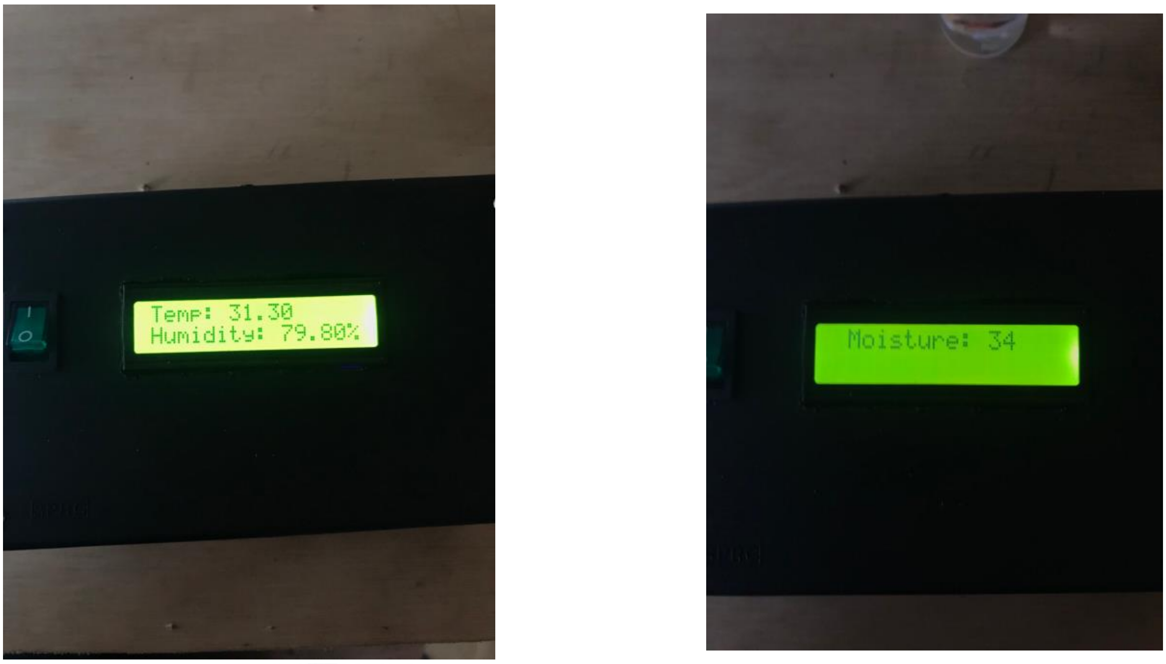

Figure 4.4 LCD show reading temperature, humidity and moisture.

4.3 Software Setup

This code establishes the connection between the hardware setup and ThingSpeak as well as the Blynk IoT app. The code requires the input of specific ID and API parameters for proper configuration. As figure 4.6, this situation is depicted while the shoe dryer is in operation. The readings from both Blynk and ThingSpeak align with the information displayed on the LCD. These readings dynamically adjust based on the humidity and moisture levels of the shoes inserted into the project, providing real-time updates on the drying progress.


```
// channel id : 2401019
//channel api key : GDMWLRPB69CJPHBW

#define BLYNK_TEMPLATE_ID "TMPL6owItM_FV"
#define BLYNK_TEMPLATE_NAME "Dryer Shoes"
#define BLYNK_AUTH_TOKEN "ba1vFFzJBsJfbqZD_TnK9ZgEJuM--ggI"
```

```
const char* WIFI_NAME = "Zkwn";
const char* WIFI_PASSWORD = "12345678";
const int myChannelNumber =2401019 ;
const char* myApiKey = "GDMWLRPB69CJPHBW";
const char* server = "api.thingspeak.com";
```

Figure 4.5 Coding from Arduino IDE

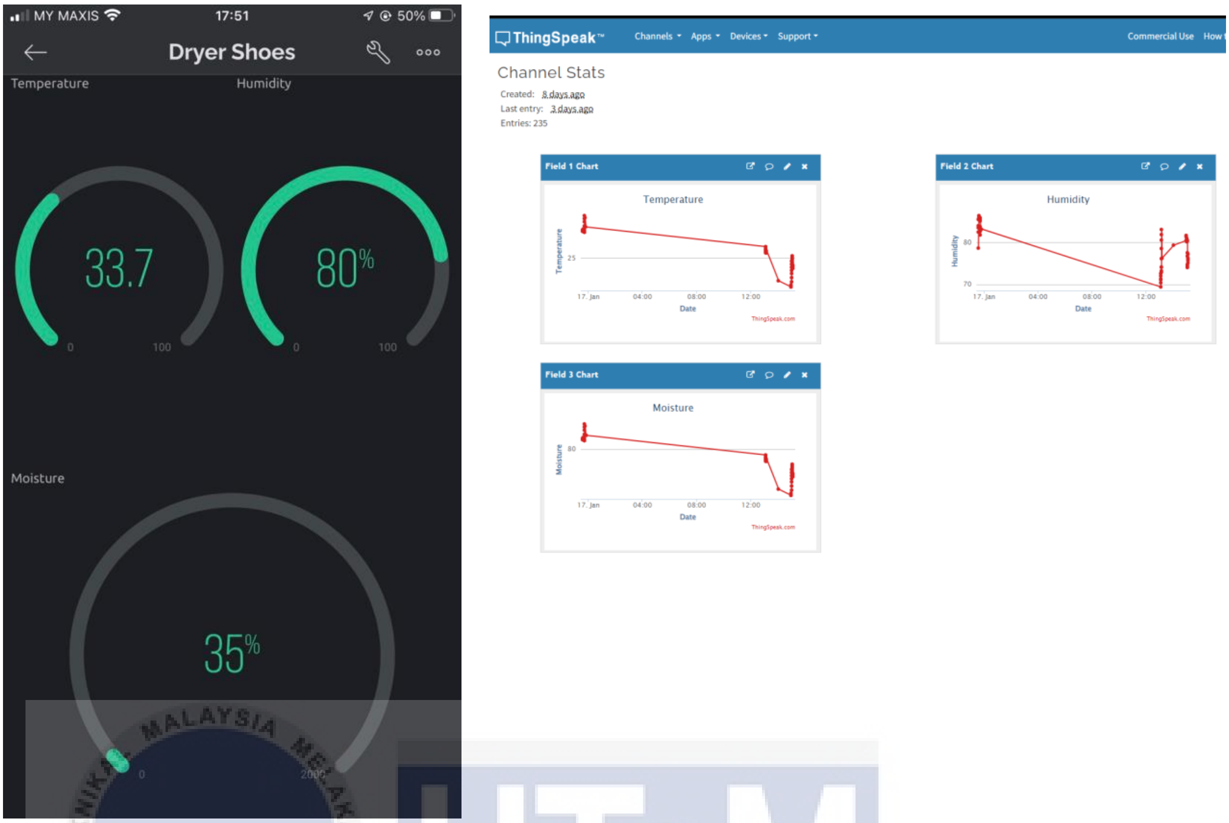

Figure 4.6 Display from Blynk IoT app and ThingSpeak website.

4.4 Data Collection and Analysis

Tables 4.1 and 4.2 present the analysis results obtained for two scenarios: wet shoes and damp shoes. The drying process typically takes 30 to 40 minutes, depending on factors such as the type and thickness of the shoe. Accordingly, Figure 4.3 illustrates the analysis for wet shoes, while Figure 4.4 represents the analysis for half-wet shoes.

Table 4.1 Result process with wet shoe.

Min	Moisture	Temperature	Humidity	Shoe wetness condition
1	35	33.7	83	Wet
3	29	35.8	82	Moist and wet
6	20	38	79	Moist
10	16	41	67	Moist
15	12	43	64	Moist
25	5	44	46	Moist
34	1	44	31	Dry and moist

Table 4.2 Result process with moist shoe.

Min	Moisture	Temperature	Humidity	Shoe wetness condition
1	22	34	80	Moist and wet
3	20	37	78	Moist
6	17	38	76	Moist
10	14	41	67	Moist
15	10	42.5	62	Moist
25	3	43.7	40	Moist
34	1	44	33	Dry and moist

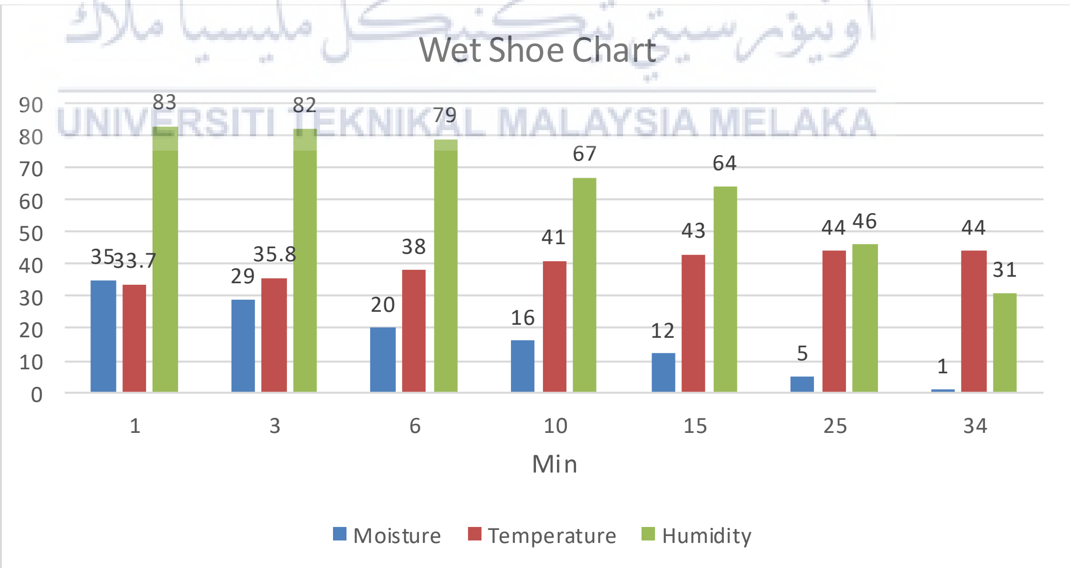

Figure 4.7 Graph for wet shoe.

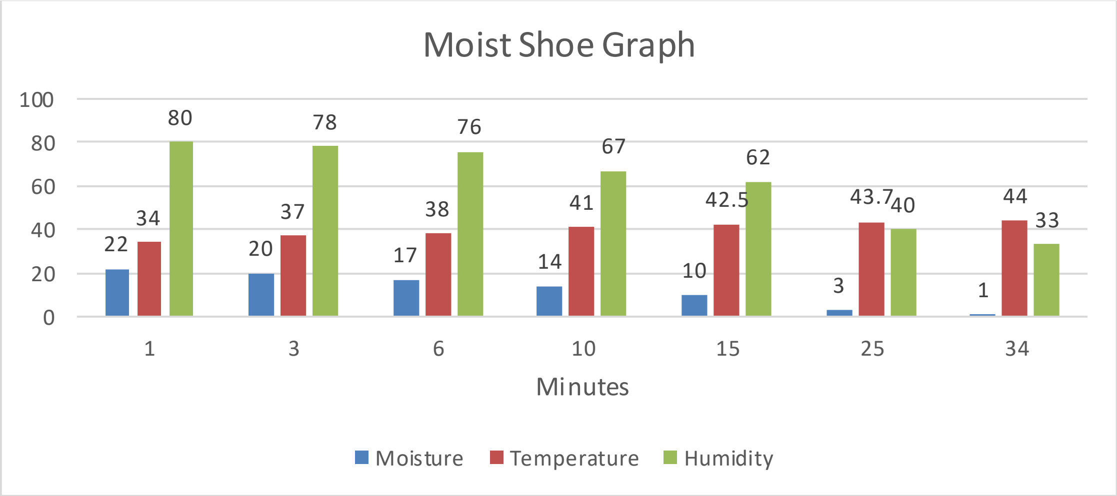

Figure 4.8 Graph for moist shoe.

4.5 Summary

The case study "Design of Rapid Drying Shoes Hanger using ESP32 Controller" presented in this chapter illustrates how to measure the moisture content of shoes using a humidity sensor and DHT22. Using the correct moisture sensor on the shoe produces a result between 0 and 1. If the moisture content of the shoe is within that reading, the heating system will be turned on based on that data. The output will then be presented on an LCD for easy viewing and will be displayed live on ThingSpeak as well as Blynk IoT. The use and effectiveness of shoe dryers have been proven with this early discovery. This can lay the foundation for additional development and advancements in technology.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, the "Design Of Rapid Drying Shoes Hanger using ESP32 Controller" project aims to offer a systematic and useful approach to shoe drying systems. The first objective that was successfully achieved was to conduct a comprehensive literature review on the Design of Fast Drying Shoe Hangers Using ESP32 Controllers. In addition, the search results can be learned a lot to create and design an ESP32 microcontroller-based shoe drying system that includes temperature and humidity sensors. The second goal achieved is to create an effective small device that can monitor and control the temperature and humidity levels inside the shoes. The goal of this project is to maintain the quality of shoes and make it easier for users to dry shoes even in rainy weather. This creative approach improves user comfort and hygiene while offering a reliable and practical way to dry shoes quickly.

5.2 Future Works

Certainly, here are potential future works or areas for further development in the design of Rapid Drying Shoes using the ESP32 Controller:

i) Investigate cutting-edge sensor technologies to enhance the precision and effectiveness of the shoes' moisture detection system. Examine more accurate sensors that can identify particular fabrics or materials.

ii) Utilise machine learning techniques to examine past drying data. This can assist in forecasting the best drying durations depending on several factors, including material kinds, beginning moisture content, and outside humidity levels.

iii) Look at methods to reduce the drying system's energy usage. This could entail using energy-saving parts, dynamically modifying the settings for the heater and fans based on data collected in real time, or looking into alternate energy sources.

iv) Permit customers to create customized drying profiles according to the kind of shoes or fabrics they are using. This could involve adjusting the drying temperatures, times, and fan speeds to suit the needs of the user or particular types of footwear.

v) Include methods for user feedback in the programme to learn about user happiness, areas for improvement, and problems that users have run across. The design may be improved in the future using this data.

vi) By putting reliable encryption protocols and security mechanisms in place to safeguard user data and guarantee system integrity, you may improve the security of the Internet of Things connection.

vii) Work on improving the drying system's physical layout to make it more user-friendly and aesthetically pleasing in the hopes of promoting broader usage.

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