



Faculty of Manufacturing Engineering



DESIGN AND ANALYSIS OF HOME AUTOMATION BASED ON RASPBERRY PI FOR SMART HOME AUTOMATION

Navindran A/L Nadarajoo

Master of Manufacturing Engineering (Manufacturing System Engineering)

2023

**DESIGN AND ANALYSIS OF HOME ASSISTANT BASED ON RASPBERRY
PI FOR SMART HOME AUTOMATION**

NAVINDRAN A/L NADARAJOO

**A thesis submitted
in fulfillment of the requirements for the degree of Master of Manufacturing
Engineering (Manufacturing System Engineering)**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I declare that this thesis entitled "Design and Analysis of Home Assistant Based on Raspberry Pi for Smart Home Automation" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :



Name :

DR. MOHD NAZMIN BIN MASLAM

Date :

21/9/2023

Pensyarah Kenan
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya
76100 Durian Tunggal, Melaka

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Manufacturing Engineering (Manufacturing System Engineering).

Signature


.....

Supervisor Name

DR. MOHD NAZMIN BIN MASLAN
.....
Pensyarah Kanon
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka
.....
Hang Tuah Jaya
76100 Durian Tunggal, Melaka

Date

..21/8/2023.....

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Manufacturing Engineering (Manufacturing System Engineering).

	Signature	:
	Supervisor Name	:
	Date	:

اونيورسيتي تيكنيكل مليسيا ملاك
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEDICATION

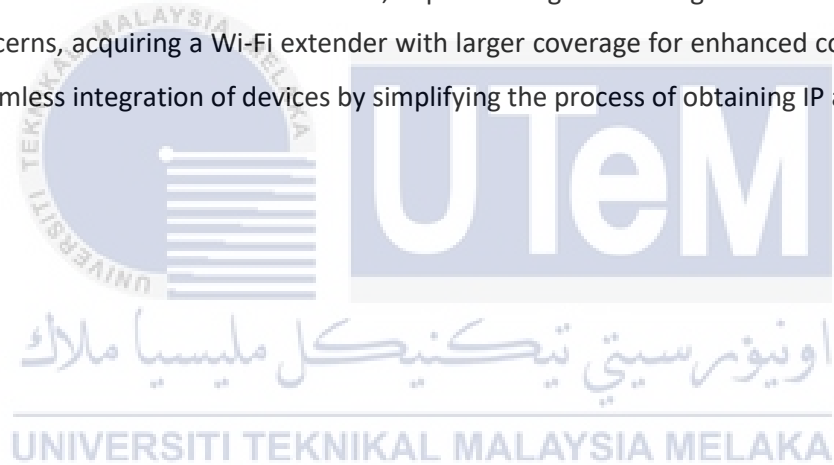
To my beloved wife Pakialakshmi who supported me morally and providing me the mental state to complete this project. I would like to thank my sister Anusooya Devi who made me who I am today and also thanking my mother Puvanesvary and father Nadarajoo who raised me well.



ABSTRACT

With the evolution of technology influencing every aspect of daily life, home automation has emerged as a popular option. Supported by the IoT, smart home technology integrates electronics and information technology to streamline everyday tasks and enhance convenience and efficiency. These internet-connected devices operate autonomously, meeting consumer preferences and demands, while providing numerous benefits to homeowners of all age groups, such as increased security, comfort, connectivity, and energy management. Home Assistant, an open-source program, is a prevalent choice among modern home automation systems. With a strong emphasis on local control and privacy, Home Assistant has garnered a significant user base. The platform can be integrated with Raspberry Pi using Hass.io, a managed operating system, offering additional capabilities for home energy management. This paper's primary objective is to utilize Home Assistant running on Raspberry Pi to create a home energy management system. The integration of Home Assistant with household appliances simplifies the process of understanding and optimizing energy usage in homes. By leveraging Home Assistant's capabilities and the Raspberry Pi's technology, this project aims to enhance energy management practices and empower users to make informed decisions about their energy consumption, promoting sustainable living and efficient resource utilization. Firstly, the project focuses on programming the appropriate script integration to efficiently handle household tasks through the Home Assistant system, effectively transforming it into a Home Automation Hub. Secondly, the project aims to develop a user-friendly Graphical User Interface (GUI) that provides centralized control over all installed smart devices in the home. The project aims to create a comprehensive and efficient home automation system using Home Assistant. The implementation of the project will contribute to enhancing smart home management, offering users enhanced control, security, comfort, energy efficiency, and connectivity, ultimately providing a seamless and intelligent living experience. Step-by-step phases of a process in a logical order, enhancing understanding through visually connected boxes and arrows. Initiating and implementation process was carried out by identifying the system integration

for optimal script and operating system selection. Overall, the project effectively employed the Raspberry Pi 4 Model B as the central device to implement and evaluate the Home Assistant-based smart home automation system, offering energy-efficient and versatile control capabilities for enhancing home automation functionalities. Based on the surveyed data, approximately 68% of the respondents are aware of home automation, 25% of the participants have not heard of home assistant, while 18.8% are familiar with it, and an encouraging 56% express interest in implementing it in their homes in the future. Regarding security, all responded highly due its importance. Furthermore, it is evident that around 31% of respondents desire the implementation of all five elements of home automation in their homes, while approximately 25% prioritize either energy or security-related elements over others, highlighting their significance in their decision-making process. The necessary recommendations for improvement include making third-party coding scripts easily accessible for user convenience, implementing facial recognition for unlocking due to security concerns, acquiring a Wi-Fi extender with larger coverage for enhanced connectivity, and ensuring seamless integration of devices by simplifying the process of obtaining IP addresses.



ABSTRAK

Dengan evolusi teknologi yang mempengaruhi setiap aspek kehidupan seharian, automasi rumah telah muncul sebagai pilihan yang popular. Disokong oleh IoT, teknologi rumah pintar mengintegrasikan elektronik dan teknologi maklumat untuk menyelaraskan tugas harian dan meningkatkan kemudahan dan kecekapan. Peranti yang disambungkan ke Internet ini beroperasi secara autonomi, memenuhi pilihan dan permintaan pengguna, sambil memberikan banyak faedah kepada pemilik rumah semua kumpulan umur, seperti peningkatan keselamatan, keselesaan, ketersambungan dan pengurusan tenaga. Home Assistant, program sumber terbuka, merupakan pilihan yang lazim dalam kalangan sistem automasi rumah moden. Dengan penekanan yang kuat pada kawalan dan privasi setempat, Home Assistant telah memperoleh pangkalan pengguna yang ketara. Platform ini boleh disepadukan dengan Raspberry Pi menggunakan Hass.io, sistem pengendalian terurus, menawarkan keupayaan tambahan untuk pengurusan tenaga rumah. Objektif utama kertas ini adalah untuk menggunakan Pembantu Rumah yang dijalankan pada Raspberry Pi untuk mencipta sistem pengurusan tenaga rumah. Penyepaduan Pembantu Rumah dengan perkakas rumah memudahkan proses memahami dan mengoptimumkan penggunaan tenaga di rumah. Dengan memanfaatkan keupayaan Home Assistant dan teknologi Raspberry Pi, projek ini bertujuan untuk meningkatkan amalan pengurusan tenaga dan memperkasakan pengguna untuk membuat keputusan termaklum tentang penggunaan tenaga mereka, mempromosikan kehidupan yang mampan dan penggunaan sumber yang cekap. Pertama, projek ini memfokuskan pada pengaturcaraan penyepaduan skrip yang sesuai untuk mengendalikan tugas rumah dengan cekap melalui sistem Pembantu Rumah, dengan berkesan mengubahnya menjadi Hab Automasi Rumah. Kedua, projek ini bertujuan untuk membangunkan Antara Muka Pengguna Grafik (GUI) mesra pengguna yang menyediakan kawalan terpusat ke atas semua peranti pintar yang dipasang di rumah. Projek ini bertujuan untuk mencipta sistem

automasi rumah yang komprehensif dan cekap menggunakan Home Assistant. Pelaksanaan projek itu akan menyumbang kepada meningkatkan pengurusan rumah pintar, menawarkan pengguna kawalan, keselamatan, keselesaan, kecekapan tenaga dan ketersambungan yang dipertingkatkan, akhirnya memberikan pengalaman hidup yang lancar dan pintar. Fasa langkah demi langkah proses dalam susunan logik, meningkatkan pemahaman melalui kotak dan anak panah yang disambungkan secara visual. Proses permulaan dan pelaksanaan telah dijalankan dengan mengenal pasti integrasi sistem untuk pemilihan skrip dan sistem pengendalian yang optimum. Secara keseluruhannya, projek itu secara berkesan menggunakan Raspberry Pi 4 Model B sebagai peranti pusat untuk melaksanakan dan menilai sistem automasi rumah pintar berasaskan Pembantu Rumah, menawarkan keupayaan kawalan cekap tenaga dan serba boleh untuk meningkatkan fungsi automasi rumah. Berdasarkan data yang dikaji, kira-kira 68% daripada responden mengetahui tentang automasi rumah, 25% daripada peserta tidak pernah mendengar tentang pembantu rumah, manakala 18.8% sudah biasa dengannya, dan 56% yang menggalakkan menyatakan minat untuk melaksanakannya dalam mereka. rumah pada masa hadapan. Mengenai keselamatan, semua memberi maklum balas yang tinggi kerana kepentingannya. Tambahan pula, adalah jelas bahawa kira-kira 31% daripada responden menginginkan pelaksanaan kesemua lima elemen automasi rumah di rumah mereka, manakala kira-kira 25% mengutamakan sama ada elemen berkaitan tenaga atau keselamatan berbanding yang lain, menonjolkan kepentingan mereka dalam membuat keputusan mereka. Cadangan yang diperlukan untuk penambahbaikan termasuk menjadikan skrip pengekodan pihak ketiga mudah diakses untuk kemudahan pengguna, melaksanakan pengecaman muka untuk membuka kunci kerana kebimbangan keselamatan, memperoleh pemanjang Wi-Fi dengan liputan yang lebih besar untuk sambungan yang dipertingkatkan dan memastikan penyepaduan peranti yang lancar dengan memudahkan proses mendapatkan alamat IP.

ACKNOWLEDGEMENTS

First and foremost, I want to thank the faculty and Professor IR. Dr. Hambali Bin Arep, Dean of the Faculty of Manufacturing Engineering, for giving me the chance to complete the project as part of the Master's degree requirement. I particularly value the advice and materials given to me by Dr. Mohd Nazmin bin Maslan for the project. I also want to convey my sincere appreciation to Dr. Mohd Nazmin bin Maslan, who oversaw my research. Many thanks to him for his tolerant direction, passionate support, and helpful critiques as we worked to finish this job. I am very grateful for his invaluable advice and the time he took to provide me with wise advice and helpful criticism to help me get the most out of my work. Additionally, I want to express my gratitude to all my friends for contributing their insightful thoughts and encouragement to the project's success. Their input is highly valued and helpful in enhancing the project's work. Last but not least, I would want to express my sincere gratitude to my family for their support, love, and encouragement during the endeavor. Their encouragement had turned into my driving force to do this task. As a result, I was able to overcome the difficulties and hurdles I encountered. In conclusion, I would want to thank a lot of individuals for their contributions to this project. I would like to take this opportunity to thank everyone for their comments and support.

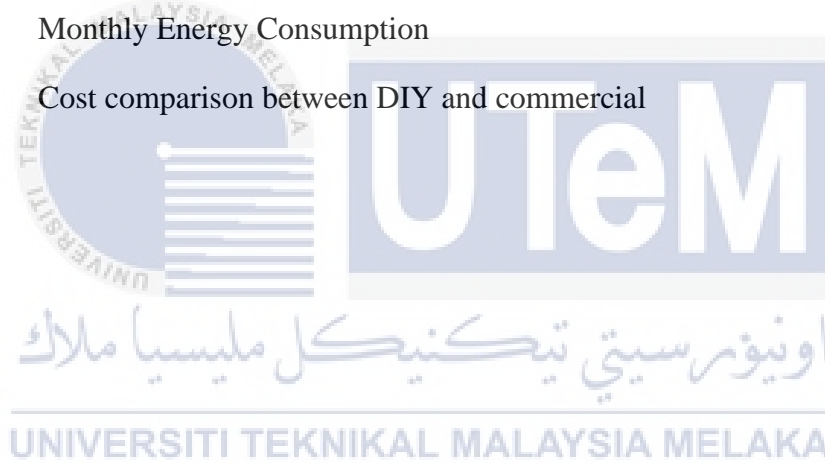
TABLE OF CONTENTS

	PAGE
DECLARATION	
DEDICATION	
ABSTRACT	i
ABSTRAK	iii
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vi
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS	xi
CHAPTER	
1. INTRODUCTION	1
1.0 Background of Study	1
1.1 Problem Statement	2
1.2 Objectives	4
1.3 Scopes	4
1.4 Significance of Study	5
1.5 Organization of Report	6
1.6 Summary	7
2. LITERATURE REVIEW	9
2.0 Introduction of Literature Review	9
2.1 Smart Home	9
2.1.1 Home Automation	8
2.1.2 Energy Monitoring	11
2.1.3 Home Security	12
2.2 Home Automation for Energy Efficient	13
2.2.1 Amazon Alexa	14
2.2.2 Smart Lighting	15
2.3 Home Assistant for Home Energy Management	17
2.3.1 Technology of Home Assistant	17
2.3.2 Implementation of Home Assistant with Smart Devices	19
2.4 Summary	21
3. METHODOLOGY	23
3.0 Project Overview	23
3.1 Project Planning	24
3.2 System Integration	25
3.2.1 Coding in Python for Script Integration	25
3.2.2 Linux Operating System	26
3.3 Planning and Execution	27
3.3.1 Hardware Implementation	27
3.3.1.1 Raspberry Pi 4 Model B	27
3.3.1.2 Amazon Alexa	30
3.3.1.3 Proximity Sensor	30
3.3.1.4 Sonoff RF Bridge	31
3.3.1.5 Sonoff Switch	32

3.3.2 Software Implementation	34
3.4 Analysis on Home Assistant	36
4. RESULT AND DISCUSSION	37
4.0 Configuration of the Hardware	37
4.1 Dashboard for Home Assistant	39
4.1.1 Lovelace Dashboard	40
4.1.1.1 Sonoff Devices	43
4.1.1.2 Sonoff Sensors	44
4.1.1.3 Shelly EM	45
4.1.2 Energy Dashboard	47
4.2 Connectivity implementation	51
4.3 Script Integration	52
4.3.1 Configuration.yaml	53
4.3.2 Automations.yaml	54
4.3.3 Secrets.yaml	59
4.3.4 Sensor.yaml	60
4.3.5 Utility_meter.yaml	62
4.3.6 Picture Elements Card Configuration	63
4.4 Demonstration of The Home Automation	66
4.5 Analysis of Home Assistant Accuracy on Monitoring Energy Consumption	68
4.5.1 Shelly 3EM	69
4.5.2 Smart Meter myTNB	70
4.5.3 Comparison Between the Consumption of Energy on Shelly 3EM and TNB	71
4.6 Price comparison between DIY vs Commercial	73
4.7 Home automation survey	76
5. CONCLUSION AND RECOMENDATION	79
5.0 Conclusion	79
5.1 Limitation and future recommendations	81
5.2 Sustainable design and development	83
5.3 Complexity	84
5.4 Lifelong learning and basic entrepreneurship	85
REFERENCES	86

LIST OF TABLES

TABLE	TITLE	PAGE
4.1	Daily Energy Consumption	71
4.2	Monthly Energy Consumption	72
4.3	Cost comparison between DIY and commercial	74



LISTS OF FIGURES

FIGURE	TITLE	PAGE
3.1:	Flowchart of the Project	24
3.2:	Specification of Raspberry Pi	28
3.3:	Architecture Diagram of User Interaction with Raspberry Pi	29
3.4:	Amazon Echo Dot	30
3.5:	Sonoff Smart Motion Sensor	31
3.6:	Sonoff RF Bridge	32
3.7:	Sonoff Switch	33
3.8:	Wiring Diagram of the Sonoff Switch During The Implementation	33
4.1:	Hardware Setup	38
4.2:	Raspberry Pi connected to the Display	39
4.3:	Lovelace Dashboard used in Home Assistant	41
4.4:	Floor Plan and Smart Devices Location	42
4.5:	Vertical Stack Card of Sonoff Devices.	44
4.6:	Entity Card of Sonoff Wi-Fi Door Sensors.	45
4.7:	Entity Card of Shelly 3EM Switch.	46
4.8:	Entity Card of The Consumption and Cost.	46
4.9:	Entity Card of Total Energy.	47
4.10:	Daily Energy Usage from March 5 th , 2023, to March 11 th , 2023.	48
4.11:	Source Table Card within the week of March 5 th to 11 th , 2023.	49
4.12:	Monthly Energy Usage of March 2023.	50
4.13:	Source Table Card of Monthly Energy Usage in March.	51
4.14:	Wi-fi connection coverage with the house	52
4.15:	“Configuration.yaml” File.	54
4.16:	RF Bridge Automation.	55
4.17:	Notification of “Sonoff RF Receive”.	55

4.18: Script of “ON” for “Bathroom 3 Dry”.	57
4.19: Script of “ON” for “Bathroom 3 Wet”.	57
4.20: Script of “OFF” for “Bathroom 3 Dry”.	58
4.21: Script of “OFF” for “Bathroom 3 Wet”.	59
4.22: “Secrets.yaml” File.	60
4.23: “Sensor.yaml” File.	61
4.24: “Platform” of “Sensor.yaml” File.	62
4.25: “Utility_meter.yaml” File.	63
4.26: Picture Elements Card for Lights.	64
4.27: Picture Elements Card for Fan.	65
4.28: State of The Icon in “ON” State.	66
4.29: Motion sensor placed at the outdoor area.	66
4.30: Smartphone with NFC capability to scan and activate home lights.	67
4.31: Voice Control by Amazon Alexa.	68
4.32: Dashboard of Shelly 3EM.	69
4.33: Daily Consumption on Smart Meter myTNB.	71
4.34: Percentage of knowing about home automation	76
4.35: Familiar with the home automation systems	76
4.36: Effectiveness of providing Security	77
4.37: Ease of control	77
4.38: Primary reason for using home automation	78

LISTS OF ABBREVIATIONS

AI	-	Artificial Intelligence
API	-	Application Programming Interface
ASR	-	Automatic Speech Recognition
AWS	-	Amazon Web Service
BE	-	Basic Entrepreneurship
CCTV	-	Closed-circuit Television
CT	-	Current Transformer
DNS	-	Domain Name System
GPIO	-	General-purpose Input/Output
HASS	-	Home Assistant Operating System
HoG	-	Histogram of Gradient
IFTTT	-	If This Then That
IoT	-	Internet of Things
IP	-	Internet Protocol
kWh	-	Kilowatt Hour
LLL	-	Lifelong Learning
MQTT	-	Message Queue Telemetry Transport
NLU	-	Natural Language Understanding
PIR	-	Passive Infrared
SSL	-	Secure Socket Layer
SVM	-	Support Vector Machine
VPAs	-	Virtual Personal Assistants
VPN	-	Virtual Private Network

CHAPTER 1

INTRODUCTION

1.0 Background of Study

At the current century, with our technological advancement growing at a high pace, technology has significantly influence on our lives and is essential to living, working, and resting on a daily basis. People have seen how technology is helpful and advantageous in terms of enhancing and making life simpler and more convenient as it has developed. The advancement of technology has led to the development of artificial intelligence (AI) and the internet of things (IoT), as well as improvements and connections between human and machine technologies. For everyday tasks around the house that include the fusion of electronics and information technology, home automation is presently a well-known option. In general, home automation, also known as smart home technology, has been established in many homes today and is supported by the Internet of Things (IoT), which grows as contemporary electronic technology is increasingly used in daily living at home. The introduction of smart home technology makes living easier and connects smart devices like smartphones with smart home applications to enable remote management of house equipment. The smart home system may be managed successfully by following a few easy procedures, which include monitoring and controlling various home systems and equipment, such the air conditioner, lights, gate, and others. These internet-connected smart appliances and gadgets link to one another and run normally while automating operations to satisfy consumer demand and preference. Therefore, smart home technology is undoubtedly advantageous for a variety of parties, including

children, adults, and even seniors, as it enables the owners to achieve a secured home and control the home's comfort, safety, convenience, efficiency, and cost-saving features, as well as energy management.

One of the open-source programs used by modern home automation systems is called Home Assistant. According to Baat (2021), Home Assistant has a sizable user base with the intention of prioritizing local control and privacy in the home automation system. Hass.io, a managed operating system, will be launched to utilize Home Assistant, a Python scripting tool, with Raspberry Pi. Additionally, users of Home Assistant who access it via a smartphone app or website may link it to Amazon Alexa. A house might become clever in how it runs thanks to home automation. Home Assistant does, however, provide an add-on help for home energy management considering the environmental problem that the world is now experiencing the climate catastrophe. Installing Home Assistant, which could be a better platform in this situation, can help with energy management in homes. The integration of Home Assistant with household appliances might make it simpler for individuals to comprehend the energy use in a home with a few straightforward actions.

The overall goal of this project is to use Home Assistant, a program that runs on the Raspberry Pi, to develop and build a home energy management system. Users might measure and manage their home's energy consumption accurately and efficiently thanks to the technology that is already accessible.

1.1 Problem Statement

The adoption of home automation technology has seen significant growth in recent years, offering homeowners enhanced convenience, energy efficiency, and security. However, the commercialized home automation solutions available in the market often come with exorbitant costs and require regular maintenance, making them inaccessible for a large segment

of the population. This financial barrier poses a considerable challenge for homeowners who seek to modernize their living spaces and enjoy the benefits of smart home automation.

High upfront costs associated with purchasing commercial home automation systems, including smart devices, hubs, and installation fees, deter many potential users from investing in these technologies.

To address these challenges, DIY platforms like Home Assistant have emerged as more accessible and affordable alternatives. Leveraging technologies such as Raspberry Pi, Home Assistant provides a flexible, open-source solution that empowers users to build their own customized smart home ecosystems. The modularity and expandability of DIY platforms allow homeowners to start with a basic setup and gradually integrate additional devices and functionalities over time, based on their budgets and requirements.

With the rising interest in sustainable living and energy-efficient solutions, the affordability of DIY platforms like Home Assistant encourages more individuals to adopt smart home automation without incurring significant financial strain. Furthermore, the DIY approach fosters a sense of ownership and satisfaction among users who actively participate in building and maintaining their smart homes.

Many European nations had a notable decline in energy output during this time. Many European nations now generate their energy mostly via the use of gas, nuclear power, and coal; only a small number have considerably transitioned to renewable energy sources. Malaysia also sees this type of behavior. When the epidemic first began, carbon emissions in the atmosphere decreased, allowing the light to shine straight on photovoltaic panels, increasing solar energy production. According to residential building energy study, Malaysia's overall electricity usage rose from 42% prior to the pandemic to 50% during the whole lockdown period. A participant in research conducted in New York claimed that during the COVID-19 lockdown, their consumption of power starts later in the morning and is consistent throughout

the rest of the day. Only a small number of participants claimed to have used less electricity before the epidemic, whereas a large majority claimed to have used more.

However, it is still impossible to check and keep an eye on how much energy each gadget is using. As a result, the project's implementation can track and manage daily residential energy usage. In short, the motives are driving the execution of this project. This implementation will examine Home Assistant's Raspberry Pi-based implementation in addition to enhancing home energy management.

1.2 Objectives

The project has numerous goals, including the following:

- a) To program the appropriate script integration for the household tasks that the Home Assistant introduces as a Home Automation Hub.
- b) To create a user-friendly GUI (Graphical User Interface) that can have control over all the devices installed in the home to be controlled in a single device.
- c) To analyze the functionality of the installed Home Assistant for safety and security, comfort, control, energy efficient and connectivity

1.3 Scopes

This project looks at how to use Home Assistant to develop and deploy a home energy management system by integrating it with a few household appliances. In order to complete the assignment and achieve the project's goals, the home energy management is developed in a fashion that makes use of the Raspberry Pi. As a result, this initiative emphasizes:

- a) Analyze the daily chores that have been completed in a home and conduct research on the energy usage of various home activities that include the energy consumption of the gadgets at home. The energy used in other sectors, such as commerce, industry, and

transportation, is not included.

- b) Use Home Assistant to evaluate the effectiveness of energy use before designing and implementing an energy management system in the homes.
- c) To construct this project, use the Raspberry Pi's microcomputer technology. Home Assistant's technology was created to communicate with a few home appliances and regulate the environment.
- d) Integrate and configure the home appliances in the Home Assistant via supported virtual assistant includes Amazon Alexa, Sonoff Switches, and Shelly 3EM.
- e) Optimize the coding in implementation stage to communicate with the appliances and modify based on the rule set.

1.4 Significance of Study

The adoption of home automation technology has the potential to enhance the quality of life for both users and present families. Home automation systems have been used to study energy management technologies and expertise. The users may be able to obtain certain possible advantages.

As a result of the study's conclusion, consumers should consider how to use the idea of home automation to increase household energy efficiency and achieve sustainable energy. The users' need for energy in their homes when the temperature changes has been considerably impacted by climate change. Climate change might thus lead to significant rises in power costs and a significant rise in the need for cooling, leading to the adoption of air conditioning. Automation technology has the potential to make homes more energy efficient, which would benefit the environment by lowering greenhouse gas emissions from household appliances. This would be possible if household energy was properly controlled and managed.

One of the most significant benefits of implementing home automation technology is

giving customers a way to track their energy use and plan it based on demand as they use the technology in their everyday lives. One of the ways to save money and increase energy efficiency is to use Home Assistant. With only a swipe on their smartphones, consumers can automate equipment to do regular household tasks wherever they are. Therefore, by addressing the deployment of smart home solutions, home automation might be more cost-effective to run and help in saving money on energy bills over time.

The improvement of quality of life with practical and user-friendly smart gadgets in homes is another important aspect. From their smartphone, users may operate any devices or appliances in the home that are connected to a shared network. For instance, a programmable smart thermostat is useful because it can learn a user's preferred temperature and schedule, then propose the most energy-efficient settings as the day goes on, providing a user more precise control over the environment in their house. To prevent energy waste, the lights may also be set to switch to the proper illumination setting automatically when a room is entered or exited. Consequently, the adoption of home automation systems will enhance their quality of life.

Finally, the dashboard of apps like Home Assistant allows users to comprehend their energy use as well as the energy usage per hour and the sources of energy utilized at home. It suggests that consumers may plan their home energy use based on the graph during the time, particularly when there are travel limitations and individuals are urged to stay at home. Thus, for improved home energy management, users might integrate Home Assistant to plan their energy consumption on household equipment like lights, fans, and air conditioners. In the end, automating household appliances and gadgets will improve efficiency and transform lifestyle into one that is more convenient and fun.

1.5 Organization of Report

Regarding the entire project, there are a total of five chapters in the report, each of

which offers in-depth details about how the project was carried out. Following is how the report is organized:

- A. The study's history, problem description, project objectives, project scope, and significance are all covered in Chapter 1's introduction. The specifics of the project's implementation for home energy management, as well as the properties of the product and component used in the project's implementation, are explained in the project's background. To fully understand the condition faced during specific household activities, the issues with the home automation system are analyzed. This is followed by the project goals that must be met within a predetermined project scope. This leads to a brief introduction of the study's relevance. The report concludes with a succinct summary of the chapter for this project.
- B. Chapter Two provides a survey of the literature on the connected issue. This chapter examines related work as well as fundamental theory and information that will be used as references in finishing the project. This is followed by evaluations on the deployment of Home Assistant for home energy management and control of smart devices in homes. Finally, prior research on various home automation systems has been summarized.
- C. The third chapter describes the approach used to complete the project. This chapter delves into the implementation of the home automation system and the appropriate script used in this project. Throughout the research, this chapter will offer a comprehensive summary of the procedure.
- D. The fourth chapter contains the system's outcomes, covering its development and implementation stages throughout the integration. There will also be a discussion of the system's outcomes and general performance.
- E. Chapter Five concludes the full chapter of research. This chapter finishes the overview and evaluation of the project's implementation and achievement. This chapter will also feature recommendations for the project's future development and enhancement.