NODEMCU BASED SMART HOME AUTOMATION SYSTEM USING SINRICPRO TECHNOLOGY

KAVINESH KUMAR A/L MANIRAJ

FACULTY OF COMPUTING AND INFORMATICS
UNIVERSITY MALAYSIA SABAH

2022

NODEMCU BASED SMART HOME AUTOMATION SYSTEM USING SINRICPRO TECHNOLOGY

KAVINESH KUMAR A/L MANIRAJ

THESIS SUBMITTED IN PARTIAL FULFILLMENT FOR THE DEGREE OF BACHELOR OF COMPUTER SCIENCE WITH HONOURS (NETWORK ENGINEERING)

FACULTY OF COMPUTING AND INFORMATICS

2021/2022

NAME : KAVINESH KUMAR A/L MANIRAJ

MATRIC NO. : BI18110064

TITLE : NODEMCU BASED SMART HOME AUTOMATION SYSTEM USING SINRICPRO TECHNOLOGY

DEGREE : DEGREE OF BACHELOR OF COMPUTER SCIENCE WITH HONOURS (NETWORK ENGINEERING)

DATE OF VIVA : 18TH JANUARY 2022

CERTIFIED BY;

1. **SUPERVISOR**
   MR. NORDIN SAAD SIGNATURE

DECLARATION

I hereby declare that this thesis, submitted to University Malaysia Sabah as partial fulfillment of the Bachelor of Electronic (Computer) Engineering requirements and has not been presented elsewhere. I have certified that the task discussed within is my work and is not photocopied from any respective research, excluding citations and quotations. Acknowledged research from online sources to obtain some knowledge regarding this project development cited, and the sources are mentioned.

11 January 2022

KAVINESH KUMAR A/L MANIRAJ
BI18110064

ACKNOWLEDGEMENT

I might want to accept this open door to offer my thanks and gratitude to my supervisor MR. NORDIN SAAD for his help and care in my advancement of this task. He has given rules and advice that were valuable to me. He was a truly mindful and commit speaker since he generally holds on to help at whatever point I deal with issue. In addition, I likewise need to recognize every one of the supervisors who will help and guide me out. They loaned me an assistance occasionally. Also, I might want to communicate earnest thanks and highest appreciation to my family for giving me backing, concern and consolation. Additionally, I moreover need to recognize my companions for their help. Ultimately, I wish to offer my respects furthermore, endowmentsto all of faculty who upheld me in any angle during the finishing of my undertaking.

KAVINESH KUMAR A/L MANIRAJ

01 JANUARY 2021

ABSTRACT

A smart home is a convenient house setting in which appliances and devices may be managed remotely using a mobile or other networked device from anywhere with an internet connection. A smart home's devices are connected via the internet, allowing the user to handle features such as home security, temperature, lighting, and a home theatre from afar. Now we'll focus on the most frequent question on whether this smart home automation is much more efficient compared to the traditional household activity. The answer is yes because Smart homes provide you more control over your energy consumption by automating things like temperature management and light switching and give you information on how you use energy, which can help you become more energy efficient and environmentally conscious. This also will be very beneficial for old and handicap people since they have difficulties in controlling home appliances where in the presences of automation system, they do to have to exert themselves. A smart home automation prototype has been proposed to carry out similar activities which will be able to ease our daily lives. The proposed project aims to control home appliances, monitor motion and temperature. As a microprocessor, the NodeMCU ESP8266 module will be used to gather information wirelessly. Prototyping techniques will also be used in the development of this project. The user will be asked to login into the system using SinricPro application and then will be able to see several switches and options on monitoring the stated factors. The real-time output will be displayed, and the values will be shown in the form of graph.

ABSTRAK

SISTEM AUTOMASI RUMAH PINTAR BERASASKAN NODEMCU MENGGUNAKAN TEKNOLOGI SINRICPRO

Rumah pintar ialah tetapan rumah yang selesa di mana peralatan dan peranti boleh diurus dari jauh menggunakan peranti mudah alih atau rangkaian lain dari mana-mana sahaja dengan sambungan internet. Peranti rumah pintar disambungkan melalui Internet, membolehkan pengguna mengendalikan ciri seperti keselamatan rumah, suhu, pencahayaan dan teater rumah dari jauh. Sekarang kita akan menumpukan pada soalan yang paling kerap sama ada automasi rumah pintar ini jauh lebih cekap berbanding dengan aktiviti isi rumah tradisional. Jawapannya ya kerana Rumah Pintar memberikan anda lebih kawalan ke atas penggunaan tenaga anda dengan mengautomasikan perkara seperti pengurusan suhu dan pensuisan lampu dan memberi anda maklumat tentang cara anda menggunakan tenaga, yang boleh membantu anda menjadi lebih cekap tenaga dan mementingkan alam sekitar. Ini juga akan memberi manfaat kepada orang tua dan orang kurang upaya kerana mereka menghadapi kesukaran dalam mengawal peralatan rumah di mana dengan adanya sistem automasi, mereka perlu berusaha sendiri. Prototaip automasi rumah pintar telah dicadangkan untuk menjalankan aktiviti serupa yang akan dapat memudahkan kehidupan seharian kita. Projek yang dicadangkan bertujuan untuk mengawal peralatan rumah, memantau pergerakan dan suhu. Sebagai mikropemproses, modul NodeMCU ESP8266 akan digunakan untuk mengumpul maklumat secara wayarles. Teknik prototaip juga akan digunakan dalam pembangunan projek ini. Pengguna akan diminta untuk log masuk ke dalam sistem menggunakan aplikasi SinricPro dan kemudian akan dapat melihat beberapa suis dan pilihan untuk memantau faktor yang dinyatakan. Output masa nyata akan dipaparkan, dan nilai akan ditunjukkan dalam bentuk graf.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In the year 2011, Timo Pakkala and Elena created an app called Casambi. Nokia Research Center previously developed an app that allows users to control light with their hands. BLE, or Bluetooth Low Energy, was employed to create this clever lighting control approach. This BLE was a new leading-edge at the time, which began in 2006 at Nokia and was the key to creating connections in gadgets, giving the pioneers the concept that smartphones and wireless technology may alter how we interact with the things around us. The story of smart lighting control system starts in 1884 with the invention of the advanced light switch, continues in 1959 with the design of the dimmer switch, continues in 1989 with the growth of Bluetooth from previous short-link radio technology, continues in 1992 with the invention of blue LED by Shuji Nakamura as a kickstarting for the digital lighting rebellion, and concludes in 1998 with the creation of the internet of things. The term "internet of things" was coined in 1999 by Procter and Gamble's utilization RFID in the supply chain, supported by Nokia's revolutionary Wibree communication technology, which later developed Bluetooth Low Energy, and the revolution continued till now. This scenario prompted the development of more intelligent lighting management systems daily. We could convert our Home into a Smart Home by using some sensors. These sensors will work as the eyes and ears of our Home. Like as a human,there must also be a brain to look after the data received by the sensors, here this brain is NodeMCU Micro-Controller.

NodeMCU is an IEEE based specification of high-level Communication protocol which is suited for creating Personal Area Network. This network will connect all the sensor devices and the micro-controller and relay devices. The benefit of utilizing NodeMCU is that it deals with low power and have sufficient measure of network range. We can likewise screen and control the system distantly from any areas. This security system required for Empty Homes, Banks, Industries and some more. Assume there is nobody in the house or bank and somebody accompanied terrible goals and attempt to temper the lock or attempt to break the entryway at that point then this system will automatically came in action and will send a SOS message to Admin whom can monitor this system to take immediate move to that area to take further action, sensors will start to detect movement of a person standing inside home and send these will send a notification to the owner and will wait for the response of the owner and then work accordingly. Smart Home could also be called "Smart Automation System".

The scenario insists on highly efficient and effective usage of any form of power in Living room, Hall, classrooms, colleges, and schools where more energy is used and wasted. Commonly, most students leave the classrooms without turning off the electric appliances such as lights, fans, and air conditioners, where unnecessary energy wastage occurs. In this research, the focus is on controlling lights. Much investigation has been performed on lighting systems where automated lighting systems by using sensors, by using NodeMcu component, Bluetooth module and Wi-Fi. In this research, the project design will provide better illuminance for occupants by obtaining surrounding motion detection using motion sensors and ON/OFF the lights using a NodeMcu and Mobile App module.

1.2 Problem Background

Most of the people forget to switch off the lights and other appliances after people leave the hall, living room or house. This is one of most common lighting problems in the house. This scenario increases the amount of energy used. Even if no one in the hall or room, the entire set of fans, lights, and air conditioners will be activated sometimes. This usual method of turning on lights using switches creates not only inconvenience for people, but also wastes time.

The reason for this assertion is that the project is unable to be implemented globally due to the high cost of installation, infrastructure, and complicated control systems needed to monitor the lighting. Furthermore, many research and lighting project involved around the world and have yet to be fully implemented. As a result, a low-budget project should innovate to provide better illuminance to occupants to create a conducive home environment.

1.2.1 Problem Statement

Problems and issues that faced by people in ordinary life at home is needed to assist in these areas:

i. Old and the handicapped client dealt with issue to physically get to control of light and fan rather than automation process.
ii. The condition and safety of the home is obscure when the user is away from the home for certain days.
iii. The complexity of installing and high-cost configuration of previous home automation system leads to not receive much demand and attention.
iv. Develop a system that can decrease the misuse of power, saves human energy, and makes human existence simpler.

1.3 Project Aim

This project aims to produce a Smart Home System for houses with low-cost and low energy consumption. This system will use one switch to turn on and off all the lights together with light sensors, collecting the surrounding motions to automatically off the lights accordingly using motion sensor module. Moreover, a mobile application via Wi-fi will control the lights independently as per the users' preferences.

1.4 Research Objective

The main objective of this project is to develop an energy-saving lighting management system, which is a Smart Home Automation system, while also offering better illuminance to the occupants. The followings must be performed to achieve this goal.

i. To study and understand the requirements for Smart Home System.

ii. To design and develop the Smart Home System based on NodeMCU, SinricPro Technology.

iii. To implement and test the performance of the proposed NodeMCU based Home Automation system.

1.5 Project Scope

The NodeMCU which is a component under Arduino is being used as the core microcontroller in this project. Based on previous Smart Home System control research, I've observed that the researchers have been unable to build a flawless and efficient system. This problem is caused by a variety of causes, one of which being the scope of this project. The following are the project's scope(s):

i. The system will be developed solely for home use.

ii. The system will be built on a low-cost budget that is within reach.

iii. This system can detect the surroundings movement and automatically ON/OFF lights using motion sensor (PIR Sensor).

iv. The system can send a notification to user when there's a movement detected at home when user is away from home, which determines by motion sensor.

v. The system can be controlled manually through a mobile application via wi-fi connection.

1.6 Project Timeline

Table 1.1 Gantt Chart of Planning the Development

Milestone		Semester 2 - 2020/2021(FYP 1)													
		WEEK1	WEEK2	WEEK3	WEEK4	WEEK5	WEEK6	WEEK7	WEEK8	WEEK9	WEEK10	WEEK11	WEEK12	WEEK13	WEEK14
	Identify the problem														
	Identify the Objectives of the project														
	Conduct the literature review related to the project														
	Conduct the requirement gathering														

1.6.1 Organization of the Project Development

Introduction, literature review, methodology, testing and results, and conclusion are now the five chapters of this research. The next chapters provide most of the information necessary to demonstrate how the progress of the work. The next chapters provide most of the information necessary to demonstrate how the progress of the work.

The project's introduction is presented in Chapter 1. The background of studies, the research problem statements, the investigation's objectives, and the project's scope are all included in this chapter.

The literature review is covered in Chapter 2. This chapter will go through some of the previous research that has been done on the project's issue. This chapter aids in the development of project ideas and guidelines.

Methodology is covered in Chapter 3. The techniques used to build the Smart Home Automation System for houses design are discussed in this chapter. This chapter also includes the project's components, relevant theories, and thorough illustrations on how to create the project. This chapter will also outline the project's flow.

The results and discussion will be Chapter 4. The results acquired will be explained in this chapter, and the analysis procedure will be carried out here. The final prototype's comprehensive design as well as simulations will be given here.

Chapter 5 is the thesis's final chapter. This chapter brings the project to a close and summarizes the knowledge gained throughout it. This chapter will include suggestions for future upgrades that can be adop

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Some reviews of past research done by other researchers related to the project will be reviewed in this chapter. The research focused on smart home system for a given area. Articles and journals were gathered for this study to establish the methods and hardware that were used to complete the project. This chapter also goes over the techniques and components that can be used in the Smart Home Automation System for home design

2.2 Past Research Review

This page to go over the existing study that has been conducted on Lighting Control in the Classroom. Reviewing earlier research is necessary to gain a deeper knowledge of the matter and applying the knowledge throughout the project. To apply as a guideline for this project, earlier research articles were compared, and conclusions have been drawn. The research project is split into lighting control strategies. The techniques that have Been classified in this chapter are:

i. Movement detection using sensor for security
ii. Analyzing data occupancy
iii. Sensors
iv. IoT
v. Wi-fi

2.2.1 Movement detection using sensor for security

Pema Chodon and Devi Maya Adhikari (2016) presented a method for controlling PIR sensor at a low cost by detecting movement of person or any living things. A PIR-based security system is proposed, which minimizes the recording system's energy consumption and memory space. The PIR sensor detects differences in infrared radiation from warm-blooded motion within its detection range. The energies caused by the change in infrared radiation were multiplied and used to turn on the camera and lighting system through relay. When the camera is turned on, software was developed and installed in the computer to collect and record the video. The lighting system and the camera are activated when an intruder reaches the detection range of the PIR sensor.

The need for a security system is becoming increasingly relevant as the amount of crime and robberies has risen. A surveillance system that always observes the area and reacts quickly to attacks is needed. Ultrasonic detectors, CCTV, microwave sensors, photoelectric sensors, laser systems, as well as other surveillance systems are accessible on the market for both indoor and outdoor purposes. However, one either both solutions have disadvantages such as expense, greater voltage energy consumption, greater recording system data storage consumption, and complex circuitry, among many others. A low-cost sensor possessing the ability to identify intruders as they reach the sensor's detectability and provide an output can also be used to overcome these issues. This output can be used for signal analysis or to operate other devices such as security devices, lighting systems, recording devices, and other related systems. This can at the very least minimize power usage, as some components are only engaged when intruders are spotted inside the sensor's monitoring range. The active infrared sensor is a minimal, low-power, and lengthy sensor.

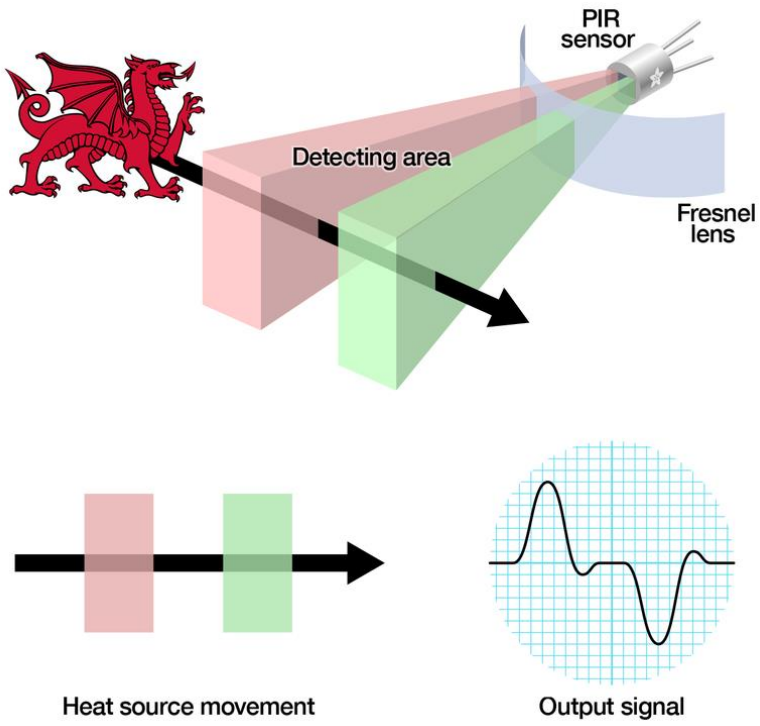

Figure 2.1: How Motion sensor works

Source: (Tony DiCola et al., 2014)

The PIR sensor component contains two slots, which are each constructed of a unique IR-sensitive substance. Since the lens deployed here never does anything, we will see that the two slots can 'see' out past that same range. When the sensor is switched off, two modules detect the same level of IR, which may be the ambient amount produced by the room, walls, or even outside. When the hot body exits the area, the device senses a negative temperature coefficient change, enabling the sensor to generate a low output change. These pulses of change are what are detected. To improve noise, temperature, and humidity immunity, the IR device is installed in a sealed metal storage container. The sensing element is surrounded by a window consisting of IR-transmissive material (usually coated silicon and it is easily obtainable). The two equal sensors are installed behind the window.

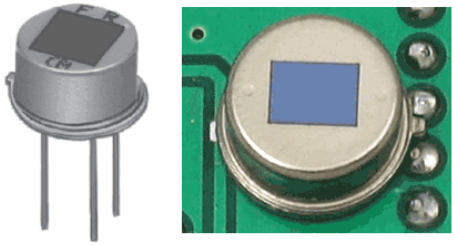

Figure 2.2: Image of IR Sensor

Source: (Lady ada, 2015)

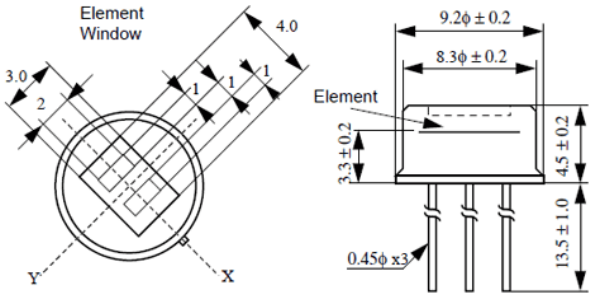

Figure 2.3: Two pieces of sensing Material

Source: (Lady ada, 2015)

PIR Types of sensors are generic, only with significant distinction being cost and sensitivity. The sights are where most of the true magic occurs. The Sensing element and electronics are fixed and cost a few dollars; therefore, this is a great manufacturing strategy. The lens is simple and users to quickly modify the depth, frequency, and detecting pattern. The lens is basically a piece of glass in the diagram above, but that meant the sensing area seems to be just 2 rectangular. Typically, we might prefer a significantly larger image region. The lens is basically a piece of glass in the diagram above, but that meant the sensing area seems to be just 2 rectangular. Typically, we might prefer a significantly larger image region.

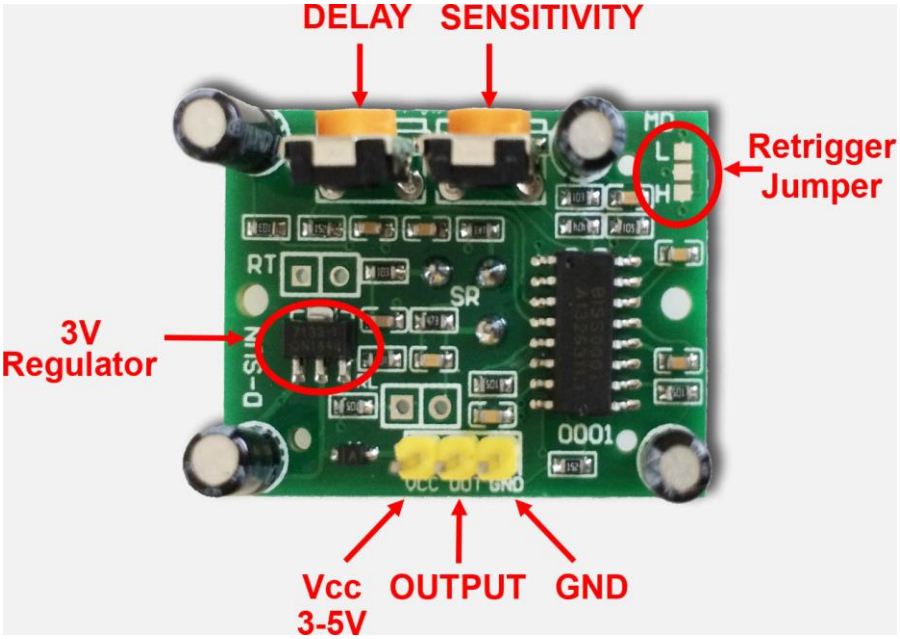

Figure 2.4: Importance of PIR

Source: (Hans Luijten, 2015)

2.2.2 Analyzing Data of Occupancy

Sung and Hur (2020) proposed a method for managing light as a lifelog-based Systems when it comes. This study intends to gather information regarding a user's features in order to build a suitable lighting atmosphere. Lifelong was being used to design the lighting, which was categorized into three: mood info, user behavior, and geographic factors. Instant message data captured unique features, work data obtained by tracking activity, area of it, and environment evidence collected by getting temperature records. Temperature sensors, environmental quality detectors, PIR sensors, an ambient light sensor, an IoT webcam, Gateways, and a Zigbee switches were used to capture lifelog data. Digital multiplex (DMX) signal control is used to tune the LEDs. Deep learning, internet, demo space, wireless internet Area network, and Zigbee have all been introduced more by researchers. Figure 2.5 illustrates the processes that occur in lifelog-based lighting control. The deep learning platform is used to establish relationships in the data gathered and to undertake configuration optimization.

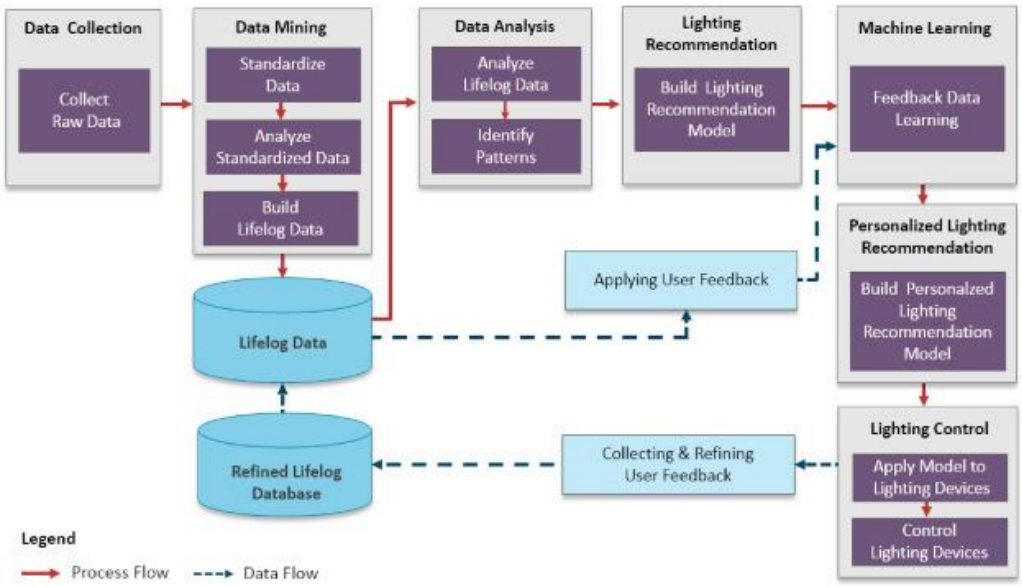

Figure 2.5: Process of Smart Lightning based on lifelogging

Source: (Cho et al.,2020)

Smart lighting based on dynamic illumination and shades control systems was given by Gunay, O'Brien, Beausoleil-Morrison, and Gilani (2017). The purpose of an adapted and adaptable system is to ensure lighting depending on the interests of the users. By collecting concurrent sun radiation, ceiling brightness, and occupant data, this application is evaluated on office buildings and a lab with a freestanding network. A technique was designed to deploy this system, which predicts the users' ideal level of illumination based on their power bulb ON and shades closing activities. After getting information well about interests of the users, the indicated a greater function as a decision factor that determines when to dim the lights and raise the shades. The illumination and curtains control system were examined, and the results shown in figure 2.6. It was essential to use recurrent prediction. The advanced analytical skills of actuators are insufficient to execute batch multiple linear regression.