



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF NEURO IOT SMART HOME
CONTROLLER USING ARTIFICIAL INTELLIGENCE
NETWORK (AIN)**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

by

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DECLARATION

I hereby, declared this report entitled Development of neuro iot smart home controller using artificial intelligence network (ain) is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Computer Systems) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Tesis ini membentangkan perkembangan *neuro* dan IoT dalam mengawal peralatan rumah dengan cara yang pintar. Elektroensefalogram (*EEG*) adalah satu teknik yg berdasarkan rekod daripada aktiviti neural manusia dengan meletakkan elektrod pada kulit kepala manusia. *EEG* berdasarkan hubungan dan interaksi antara computer dan otak manusia (*BCI*). Fokus utama projek ini adalah untuk menjana isyarat kawalan yang boleh diaplikasikan dan digunakan sebagai arahan dalam mengawal sistem rumah pintar dengan cara yang mudah. Projek ini termasuk dalam pembinaan prototaip untuk sistem rumah rumah pintar yang membenarkan pengguna rumah mempunyai visualisasi ke arah sistem rumah pintar. Eksperimen ini dijalankan dengan bantuan perisian MATLAB, set kepala MindFlex , Bluetooth, NodeMCU dan Arduino. Eksperimen ini juga dijalankan apabila pengguna rumah melakukan kerlipan mata yang boleh menjana isyarat yang dikesan oleh pengesan *EEG* dan kemudiannya meghantar isyarat tersebut kepada peranti Arduino. Keputusan dan data analisis adalah berguna untuk dilaksanakan pada kerja-kerja akan datang dan membantu dalam meningkatkan kualiti hidup ke arah yang lebih baik disamping itu dapat meringankan kehidupan orang kurang upaya.

ABSTRACT

This thesis presents the development of neuro IoT smart home controller using Artificial Intelligence network with an EEG sensor. Electroencephalogram (EEG) is a based from the technique that acquiring of neural electrical activity of human by placing electrodes to human scalp. EEG-based Brain Computer Interface (BCI) for smart home is a technology system that allows direct communication and interaction between computer and human brain. The main objective of this project was to control a simple smart home system by generating signals that obtained from the home user command. This included a new development of an example prototype for smart home system whereas the home user can get visualized towards the smart home system. This project is conducted by using the collaboration from software and hardware part of MATLAB software, MindFlex Headset, Bluetooth, NodeMCU and Arduino. The experimental executed when the home user does the eye double blinking which which sensed by EEG sensor then send the understandable command to Arduino devices in order to manage and control a real-time feature of home appliances. The results and the analyzation of data is useful to be implemented in future works that can enhance the quality of life to a better way and ease the life of disabled people.

DEDICATION

To my beloved parents

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CHAPTER 1

INTRODUCTION

This chapter gives the main focuses on the project introduction, background, problem statement, objective, and project scope about this whole project. The development of Neuro Smart Home Controller using Artificial Intelligence will be explained more details in this chapter. Besides that, the purpose of this project will more be expresses in the problem statement. In addition, all the part that is associated to the theory of this project will be clarified as to shows the perception of this project.

1.1 Background

Smart homes have been researched for nearly a couple of decades. All those research highlight the interaction between environment that evolved among humans in various ways. They figure out the environmental conditions and act, react or adjust accordingly. Hence, such behaviour can automate various tasks that humans have to perform manually, and also provide home services and facilities. A smart home is a homelike whereas environment can be conduct by automatic control and ambient intelligence, which allow it to give respond to the behaviour of home residents and cater them with various facilities.

Home automation system is a system that take care the daily routines of a home such as controlling the room temperature, lighting and etc. that acts as traffic cop. It always watching the home on behalf of the users and making sensible decisions according to the house events occurs based on the user preferences and commanding the device/system to do what the users would like automatically. In fact, the empirical of home automation is growth rapidly as electronic technologies converge.

As an overview of this project, there will be a device which is the wearable EEG sensor on the head of a subject as it is to analyse the brain activity signal from the user. The data outcomes have been recorded. Then, the microcontroller will operate and execute as it sends the data to the database through the IoT system. The microcontroller reacts as a controlling system to receive and transmit the data from the sensor to the database.

1.2 Problem Statement

People nowadays tend to leave their house without switching off the home appliances such as fans and lights due to hectic life style. This careless behaviour does not only result in wastage but also bring potential danger to the home. This problem issue could be solved by applying this project system that use electroencephalogram biosensor which is portable device in controlling home appliances. Hence, this also help people that lack of capability to control house appliances since this device require no physical activities. Based on the above problems, smart home controller is needed to keep the wastage and danger to the very minimum. Applying the proposed system, wastage of electricity due to careless will be reduced. So, a more comfortable and relaxing living environment will also be made applicable by the system. Instead, within more facilities and home appliances that added, it becomes assured to have convenient and easy methods to control also operate these appliances.

Generally, house owners use most features of the system whereas others users have only limited access to the system. There are few existing problems in handling home appliances such as the house owner realizes that he/she forgot to turn the living room light off or in a situation when the user leaves the houses and goes to holiday then the user uses system to activate all the security features, be sure that all windows and doors are closed, lights are turned off. Then, the designing of this project system able to help house user to

monitor their house appliances and get to know their current state of house either light is on or off. Indeed, house user can control and monitor their home without presence in the house so it may be anywhere or anytime to make their house automated.

1.3 Project Objective

Based from the problem statement that stated above, here the objectives that should be taken as to obtain the goal of this project. The objectives are:

1. To develop a smart home controller using electroencephalogram brain sensor.
2. To monitor the current state of the house appliances through smartphone
3. To visualize electroencephalogram brain sensor data through IoT platform.

1.4 Scope of Project

Smart Home controller is a project that introduces the development of home automation control by using biosensor. First and foremost, this project is using NodeMCU microcontroller just like in Figure 1.1 as it is used to control any application. This microcontroller function to receive data from the biosensor and transfer data to the web view platform. Then, it also used to process data such as converting the signal from binary to a digital signal. This “brain” react exactly the same as Arduino microcontroller. Furthermore, there is an advance biosensor technology called electroencephalogram(EEG). The name for this brain sensor is called Mind Link sensor which consist of reference sensor to detect human brain sensor and there is ground node that attached to the forehead of the user. Mind Link sensor already have its own Bluetooth module that have been confugured to act as master device. So, for this project it needs another one HC-05 bluetooth module that will act

as slave device to receive command from the sensor. The captured signal from the human brain can be visualized through a software called brainwave visualizer. This software display all the exist signal like attention, meditation, alpha, beta, theta, and gamma. It reacts as the sensor to observe brain signal activity wave data from the subject. As for the web-view platform, the application u sed are ThingSpeak. ThingSpeak is used as the platform to display the recorded data. IoT system is used in transferring all the data from the microcontroller to the web-view platform. The outcomes data that analyzed in ThinkSpeak then used as the data to create a monitoring system. This monitoring system purposely to monitor and control whenever the home user wants to switch on/off home appliances. In this project, the hardware involves is NodeMCU, Bluetooth module, relay channel, fan and light.

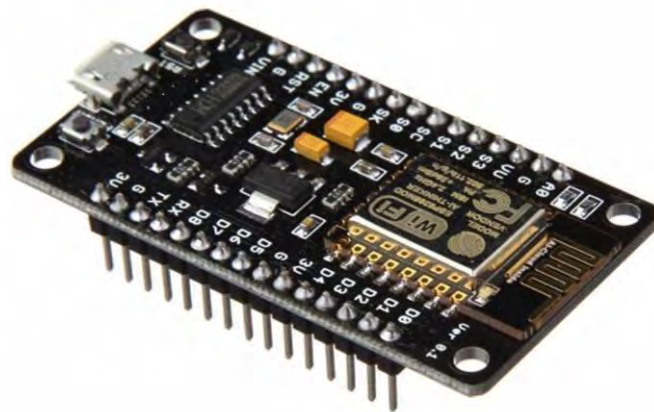


Figure 1.1: NodeMCU ESP8266

1.5 Project Methodology

This project will be a successful project as it follows the correct method and procedures. The methodology ensures the project is done within the required time and smoothly executes as the outcomes are observed.

Construction of this project is to illustrate the idea and the definition of this project and their purpose why this project is chosen. The process or method of this project includes the Flowchart figures, microcontroller setup and EEG biosensor device setup.

The project flowchart shows the overview project method to complete the project with a successful achievement. It shows the workflow or process and showing the steps. The flowchart also shows the selection of software and hardware that used in this project after doing analysis about all the microcontroller. Then, it also expresses the configuration of the hardware and software. The methodology is purposely to make the development of the project is well successful with a systematically and smoothly method.

Besides that, the proposed method is where the part to assemble the required step and procedure to achieve for every complete progress. The proposed method will describe the measurement that had to be characterized. Hence, it will express the analyzation and test that need to be done to ensure there is no error occur.

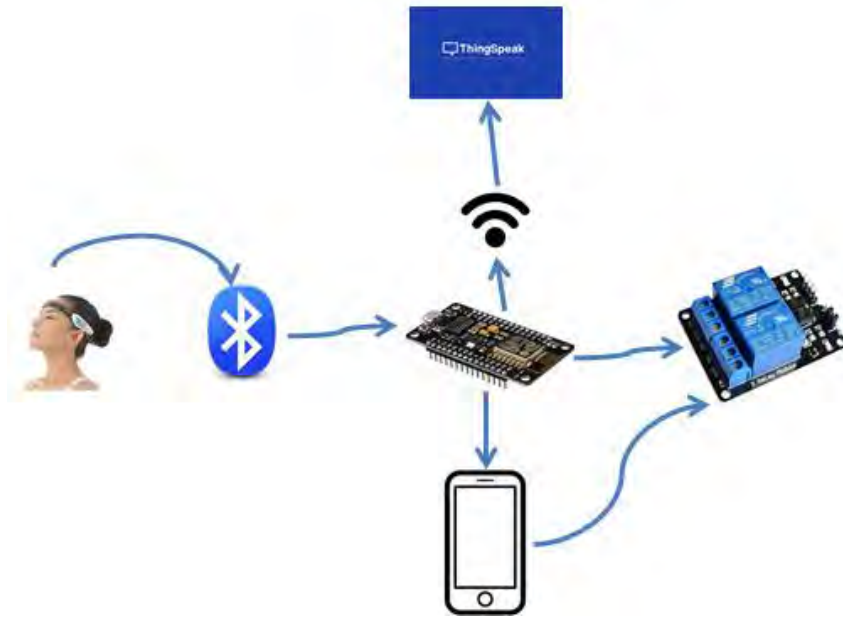


Figure 1.2: Illustration diagram project

The Figure 1.2 above displays the illustrative diagram of the project of what really happens and how the hardware and components are correlated. The figure also shows the input and output system of the project. The EEG device transmits the brainwave signal into the NodeMCU. The microcontroller then processing the signal received by converting to the desired signal form and transfer to IoT platform (ThingSpeak) for a data visualization. The smartphone is functional to control the home appliances wirelessly.

1.6 Thesis Structure

1) Chapter 1:

In this chapter, it introduces the brief idea of the project. It focused on the project background, the detail in objectives, the problem statement, project scope, and methodology of the project.

2) Chapter 2:

In this chapter, it discusses the background of the project. The concept, theory, and characteristic of component and hardware that cover in this project are included in this chapter. This chapter also covers the definition of the term used. The observation is done in this chapter by making a research from the previous available project to apply in the project.

3) Chapter 3:

In this chapter, it discusses methodology. The methodology is where the chapter discusses step and procedure on how to complete the project. Also, it includes the schedule and detailed reports of studies and accordance with objective achievement. Detail development of the project is also discussed in this chapter.

4) Chapter 4:

In this chapter, it is the result and discussion of the project. All the simulation recorded data, and data analysis is discussed and attach in detail. The hypothesis, discussion, and conclusion of this project are included in this chapter. Those parts are based on comparison and elaboration to the outlined objectives.

5) Chapter 5:

In this chapter, it consists of embellishment about conclusion and recommendation for the future project. Also, this chapter concluded about what the project has done and followed by a recommendation on how to enhance the performance of the system that refer to the expected results.

CHAPTER 2

LITERATURE REVIEW

This chapter gives the review on terms and information that related with Development of Neuro Iot Smart Home Controller using Artificial Intelligence Network (AIN), this conclude neuro based signal, smart home, EEG smart home, ThinkSpeak and Internet of Things (IoT).

2.1 Introduction

Smart home controller using Artificial Intelligence Network is a device to assist people who are often shift from one place to another for their business purpose, personal work, travelling, etc. So, with this kind of people situations, that's a reason why we need an intellectual home system makes with a network so that it can monitor component in a home. By building a system in the home, we will control the home things virtually which means we need not present physically at home. Truly, Artificial Intelligence Network plays an important role in this modern world nowadays as it perform well of human activities and provide better solution for almost all automatic systems. In fact, applying artificial intelligence means home master can easily control the home appliances without a touch of button and leads to save electricity.

2.2 Neuro based EEG

In general, electroencephalogram (EEG) is a technique that widely used as non-invasive method for monitoring the brain. Basically, EEG is refer to place metal electrodes on the scalp which is to measure the small potentials that occur outside of the head due to neuronal action within the brain. In fact, it is unlikely with other sensing methods since it can

monitor the brain with the easiest way, plus over a long period of time, and with a high time resolution for transient events and capturing rare events. Indeed, EEG is used for monitoring the heart, but applied to human head. The process is briefly explained when brain activity is conducted by the passing of electrical impulses along neurones and postsynaptic responses as neurones communicate with one another (Alexander J.Casson et al.,2018).



Figure 2.1 : Conventional EEG

Figure 2.1 illustrated a user with a head cap on which has holes to hold a number electrodes next to the scalp with each electrode has a long wire which allows it to be connected to recording instrumentation.

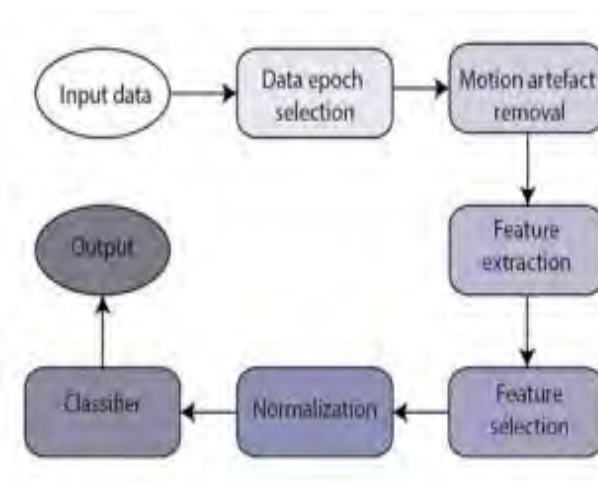


Figure 2.2 : Basic EEG Signal