UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF NEURO EPILEPSY RECOGNITION SYSTEM USING ARTIFICIAL NEURAL NETWORK (ANN)

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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Tajuk: Development of Neuro Epilepsy Recognition System using Artificial Neural Network (ANN)

Sesi Pengajian: 2019

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I hereby, declared this report entitled Development of Neuro Epilepsy Recognition System using Artificial Neural Network (ANN) is the results of my own research except as cited in references.

Signature: ……

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Date:

APPROVAL

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

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ABSTRAK

Pada masa ini, kira-kira 65 juta orang di seluruh dunia mempunyai epilepsi. Epilepsi adalah penyakit neurologi yang memberi kesan kepada manusia dari semua peringkat umur dan punca penyakit ini adalah disebabkan kerana aktiviti tidak normal di dalam otak. Penyakit ini telah dicirikan oleh pergerakan yang tidak terkawal dan kehilangan kesedaran dan konvulsi yang boleh menyebabkan kecederaan serius. Hasilnya, kajian ini telah membangunkan sistem pengecaman epilepsi neuro menggunakan rangkaian neural buatan (ANN). Rangkaian neural buatan (ANN) digunakan dalam pembelajaran mesin sebagai salah satu alat utama dan ia adalah sistem yang diinspirasi daripada otak yang bertujuan untuk meniru cara manusia berfikir. Kajian ini menggunakan rangkaian pengenalan corak yang merupakan salah satu teknik rangkaian neural umpan balik dan mencadangkan kaedah pengecaman epilepsi yang akan dilaksanakan menggunakan perisian MATLAB. Tambahan pula, kajian ini juga menggunakan isyarat elektroensefalogram (EEG) untuk mendiagnosis dan mengakses aktiviti otak dan gangguan dengan menggunakan data yang ditetapkan dari Universiti Bonn yang digunakan secara meluas dalam kebanyakan kajian mengenai pengecaman epilepsy. Isyarat EEG juga boleh didapati dengan menggunakan sensor EEG NeuroSky MindLink. Sensor ini digunakan untuk memperoleh isyarat EEG data luaran untuk menguji dalam rangkaian saraf. Keputusannya menunjukkan sistem ini berjaya dilaksanakan dengan mendapat 75.8% untuk ketetapan keseluruhannya dengan latihan, pengesahan dan ujian masing-masing mendapat 76.3%, 70.7% dan 78.7%.

ABSTRACT

Currently, about 65 million of people around the world have epilepsy. Epilepsy is neurological disease that affects people of all ages and the cause of this disease is because of abnormal activity in the brain. This disease has been characterized by the uncontrollable movement and loss of consciousness and convulsions that can lead to serious injuries. As the result, this study has developed a neuro epilepsy recognition system using artificial neural network (ANN). Artificial Neural Network (ANN) are used in machine learning as one of the main tools and it is brain-inspired systems which are meant to replicate the way human being think. This study uses pattern recognition network which is it is one of feedforward neural network techniques and proposes epilepsy recognition method that will be implemented using MATLAB software. In addition, this study also used electroencephalogram (EEG) signal in order to diagnosis and accessing brain activity and disorder by using the dataset from University of Bonn which is widely used in the most of research regarding to epilepsy. EEG signal are also can be obtained by using NeuroSky MindLink EEG sensor. This sensor is used to acquire external data EEG signal to test in neural network. As a result, this system was successful implemented with 75.8% for overall accuracy with training, validation and testing respectively get 76.3%, 70.7% and 78.7%.

DEDICATION

This thesis is dedicated to my parents M.Saleh bin M.Taib and Teh Hawa binti Mohd Yusoff, my siblings, my friends for their unconditionally support to complete this final year project and my supervisor and lecturer, Encik Khairul Azha bin A Aziz and Encik Ahmad Fauzan bin Kadmin for the guidance and encouragement.

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LIST OF ABBREVIATIONS

ANN	- Artificial Neural Network
EEG	- Electroencephalography
MATLAB	- Matrix Laboratory
ROC	- Receiver Operating Characteristics
GPS	- Global Position System
CC	- Cloud Computing
MCC	- Mobile Cloud Computing
IoT	- Internet of Thing
WD	- Wearable Device
HR	- Heart Rate
ESDT	- Epileptic Seizure Detection Tag
MiWi	- Microchip Wireless Networking
MEMS	- Micro-Electromechanical System
NI	- National Instruments
GSM	- Global System for Mobile communication
PIC	- Peripheral Interface Controller
KEIL	- Knowledge Engineering Integration Laboratory
SQ	- Structured Query
SDK	- Software Development Kit
APP	- Application
SMS	- Short Message Service
I/O	- Input or Output

SVD - Singular Value Decomposition

IDE - Integrated Development Environment

PLX-DAQ - Parallax Data Acquisition tool

TP - True Positive

TN - True Negative

FP - False Positive

FN - False Negative

DWT - Discrete Wavelet Transform

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter was describing the introduction to the project that consists of background of the project, problem statement, the objective, scope of the project and thesis organization. The development of neuro epilepsy recognition system using artificial neural network (ANN) was briefly explain in more detail in this paper including the method used to complete the project. In this chapter also describes how idea of the project was developed, why this project should take place in community and what problem that needs to be solved. It also includes the reason why this project needs to implement and explain the current situation and its problem. The objective of this project was stated will solve problem statement that is declared on this chapter. Understanding on the overall description of the project can be gain through this chapter.

1.2 Project Background

Brain is the important organs of the human body that serves as the center of the nervous system which is located in the head. So that, the brain can cause many disorder such as epilepsy. Epilepsy is one of the most common disorder of central nervous system or also called as neurological disease that affects people of all ages and this disease caused by abnormal activity in the brain. About 65 million of people around the world have epilepsy. The main reason of this disorder still remain unknown but the cause of this disorder maybe because of genetic influence, stroke, traumatic brain injury

or brain infections. Seizure patient are categorized when the seizure happen more than two in a lifespan of a person.

The effect of the epileptic seizures can impact the quality of life for patients and his or her family and even can lead to death. It also shows the symptoms such as the uncontrollable movement and loss of consciousness and convulsions that can lead to serious injuries. This symptom is depending on the type of the seizure. In the most cases, the epilepsy patients have the same symptoms if seizure that they occur is in the same type. The quality life of the patient able to improve if there is a system that able to predict of epilepsy seizure at an early stage which also will increase the effect of medication and many patient able to treat accordingly. Figure 1.1 below display the epilepsy brain states.

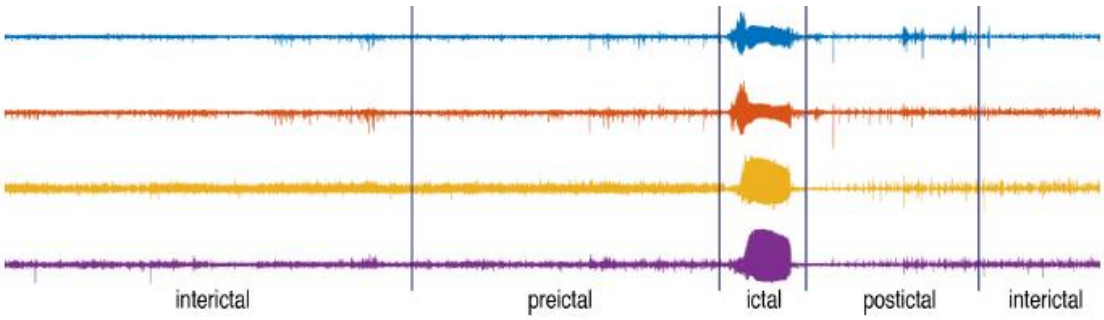

Figure 1.1: The epilepsy brain states

The main target of this project is the result neural network using EEG dataset from University of Bonn will be compared with real-time brainwave data. This project used electroencephalography or EEG signals for diagnosis of epilepsy that able to capturing the changes in neuronal activity that happen during epilepsy seizures.

Recently, analysis of EEG signal has been used with the goal of predict epilepsy seizures in order to reduce or eliminate the risks associated with it. EEG also used to confirms if it detect the presence of abnormal activity and record the data in order to identify the properties of the seizure. Figures 1.2 below illustrate the EEG signal during pre-seizure and seizure activity.

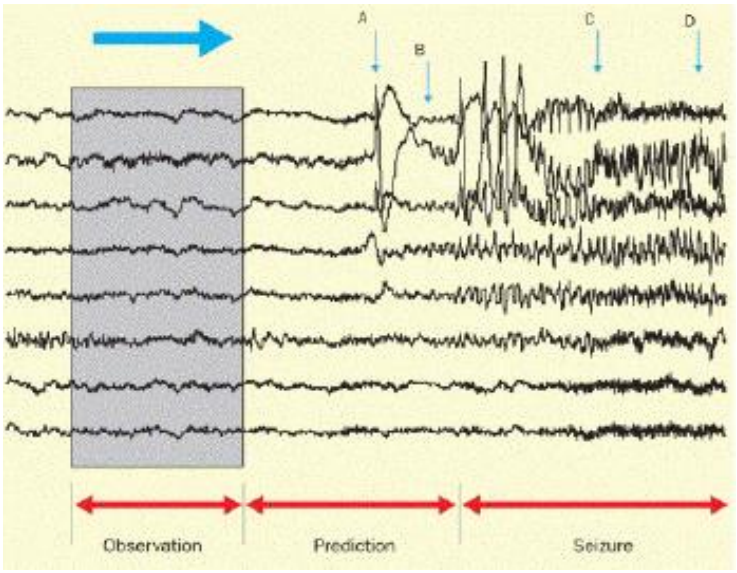

Figure 1.2: EEG signal during pre-seizure and seizure activity

This project also use artificial neural network. Artificial neural network are used in machine learning as one of the main tools and it is brain-inspired systems which are meant to replicate the way human being think. This network consists of input and output layers and in the most cases, it also have hidden layer which is consists of units that converts the input into something that can be used by the output layer. It also excellent tools to identify patterns that are far too complicated or numerous to be understood by a human programmer. This project also used EEG sensor to obtained real-time brainwave data from EEG signal.

1.3 Problem Statement

Nowadays, epilepsy seizures which reoccur at random times able to disrupt the patient cognitive and emotional state such as the ability to work and drive, social and economic situation. If there is a system able to recognize data between healthy person and epilepsy patient, the researcher able to rearrange the data and put in the correct set or classes. This system has been need for an efficient and accurate recognition of epilepsy.

Currently, neuro-physiologists or trained neuro-clinicians experienced only visual inspected with EEG recordings for epilepsy recognition system. It will hinder the diagnosis procedure and also the EEG recording process required several hours or more. An expert is required to analyse the entire length of EEG recordings to detect epileptic activity. The patient will tire because they have to wait several hours. Figure 1.3 shows the EEG recordings are mixed of electrical activities of different brain parts.

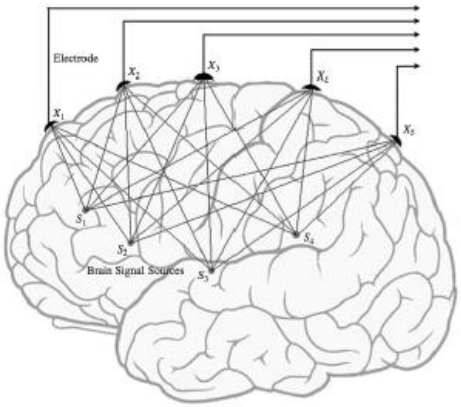

Figure 1.3: EEG recording are mixed of electrical activities of different brain parts

Besides that, they need a system because of both huge amount and expanded use of long-term EEG records for effective neurological disease assessment and treatment,

including epilepsy. It would also narrow the ability of the expert to misread the data and fail to make a proper decision

1.4 Project Objectives

The objective has been stated in order to overcome the problem stated in the problem statement and to attain the purpose of this project. The key objectives are:

a) To developed a neuro epilepsy recognition system using Artificial Neural Network (ANN) by using MATLAB.
b) To analyse the system whether it can recognize between healthy person and epilepsy patients successfully using an EEG dataset from University of Bonn.
c) To compare real-time brainwave data from EEG sensor using Artificial Neural Network (ANN) that had been trained using EEG dataset from University of Bonn.

1.5 Scope of Project

The scope of this project is implementing a neuro epilepsy recognition system using artificial neural network (ANN) by recognize between normal person and epilepsy patient. Besides that, this project used Matrix Laboratory (MATLAB) as the main software to develop the artificial neural network system. This system will recognise whether each of set from dataset of University of Bonn that contain of EEG signal is belong to normal person or epilepsy patient and will produce the result based on its accuracy, sensitivity or specificity. Furthermore, this project will also analyse from the confusion matrix. In addition, this project can analyse the comparison between real-time

brainwave data from EEG sensor using Artificial Neural Network (ANN) and training data by using EEG dataset from University of Bonn.

1.6 Project Methodology

Project methodology indicates that this project will be successful if it follows the correct method and procedures. This methodology was done to ensure the project finished within the required time given and smoothly executes while the outcomes are being observed.

The development of this project is based on the idea and the definition of the project and the purpose why this project is chosen. The process or method of this project includes the flow chart. The flow chart shows the steps by steps to do in completing the project with a successful achievement. It also purposely to ensure the development of the project is successful with a systematically and smoothly method. In this methodology also will describe the measurement that had to be done in order to test to ensure there is no error occurs.

1.7 Thesis Organization

In the thesis organization, the structure of the report for this project consists of five chapters that are shown below:

Chapter 1: Introduction

Describe the introduction to the project that consists of five subtopic include project background, problem statement, and project objective, scope of project and thesis organization.