CHAPTER I
INTRODUCTION

1.1 Background

In 2016 the World Health Organization (WHO) noted that stroke was the second leading cause of death from non-communicable diseases [1]. In addition, in Indonesia, the Indonesian Ministry of Health's Basic Health Research (Riskesdas) results in 2018 showed that the prevalence of stroke based on diagnosis in the population aged over 15 years was 10.85 percent [2]. A blockage causes stroke in the flow of oxygen to the human brain, making the brain lack a oxygen.

Tools and techniques that can determine human brain activity are essential for knowing brain signals in stroke patients. At this time, Brain Computer Interface (BCI) is getting much attention from researchers because BCI is a system used to translate, manage and recognize human brain activity [3] [4]. Electroencephalography (EEG) is one type of BCI which is included in non-invasive because EEG uses external sensors to measure brain activity [5]. However, the EEG signal has a disadvantage: the lack of channel connection with other channels. Therefore the active area in the EEG signal of stroke patients is challenging to identify.

The EEG signal converted into an energy distribution image can clearly show which areas are currently active in the brain. Therefore, a method is needed to convert the EEG signal into an energy distribution image. However, there are many methods for converting an EEG signal into an energy distribution image, as has been done by previous studies such as Power Spectrum Density (PSD) [6] [7] [8]. PSD can be used for the characteristics of brain signals that have different properties. Therefore the PSD method can be used to analyze the pattern of the signal based on the strength of the spectrum possessed by a signal [8]. PSD is obtained from the frequency and time values of the signal, which has been transformed into a frequency domain with Fourier Transform. Fourier Transform can show the frequency content contained in a function because the signal is available in the form of time, but the important information in the signal is frequency.

One of main characteristic of EEG which is non-stationary, which means that the variable changes every time due to external factors and has a large number of channels. Channel selection is needed to select the best time and find relevant channels. It has several methods, one of which is spatial selection. Spatial selection

will find and select the best signal and channel session time through energy calculation. Spatial selection can reduce computational time on the system and reduce the unnecessary overfitting of channels. In this study, an analysis of the energy distribution image method, namely Power Spectrum Density, which was previously not selected for channel selection, has been carried out using channel selection. After getting the processed energy distribution image, feature extraction will be carried out using Gray Level Co-Occurrence Matrix (GLCM) as feature extraction. Feature selection is carried out using Genetic Algorithm, Multi-Information and Chi-Square to obtain optimal results and classification using Artificial Neural Networks Back Propagation (ANN BP).

1.2 Problem Identification

The identification of problems in this research are:

1. A method for converting EEG signals into energy distribution images with their characteristics.
2. Effect of energy distribution image when processed with image feature extraction.
3. Effect of feature selection on the energy distribution image.
4. Effect of channel selection on energy distribution image.

1.3 Objective

To simplify the description, this thesis assumes several points as follows:

1. This thesis design a system to convert the EEG signal into an energy distribution image using the Power Spectrum Density (PSD) method.
2. This thesis design an energy distribution image system as input, using GLCM feature extraction and ANN BP classification.
3. The optimization analysis of the BCI system uses feature selection with the Genetic Algorithm, Multi-Information, and Chi-Square methods.
4. The optimization analysis of the BCI system uses channel selection with the Spatial Selection method.
5. Measure and analyze the performance of the energy distribution image processing system after channel selection and before channel selection.

1.4 Scope of Work

The breadth of the scope of this thesis. Therefore, in this study, some scopes of the problem are given as follows:

1. The data used only use the EEG signal of stroke patients.
2. Data set was obtained from previous research, thus, data collection techniques is not discussed anymore.
3. The focus of the research is on (a) channel selection and (b) methods of converting EEG signals into energy distribution images.
4. Signal classification is not discussed in detail. Classification for validation on the system.

1.5 Research Methodology

In this thesis, several processes are carried out. Compare the stroke signal and the healthy signal to determine the difference in energy in the channel. Furthermore, a comparison of the EEG signal system with the energy distribution image will be carried out using the GLCM image feature method. After knowing the best results from the previous process, an energy distribution image test before and after channel selection. It would then compare GLCM with feature selection: GA, MI and CS to get a more optimal BCI system.

1.6 Stucture of Thesis

The rest of this thesis is organized as follows:

1. Chapter II: Basic Concept

   This chapter describes the basic concept of the brain computer interface, EEG signal, channel selection, power spectrum density, gray level co-occurence matrix, feature selection, and artifical neural network back propagation.

2. Chapter III: System Model and Proposed Framework

   This chapter discusses the system model of energy distribution image processing using channel selection and feature selection.

3. Chapter IV: Results and Validations

   This chapter shows the obtained result and discuss its validation

4. Chapter V: Conclusions

   This chapter concludes all the discussion and analysis of this thesis.