INTRODUCTION

1.1 Research Background

Arrhythmia is a heart problem in which the heart has an irregular beat, rate, or rhythm. The anomalies in the heart that could be classified as arrhythmia are heart beating too fast, heart beating too slow, or heart beating in an irregular rhythm. Arrhythmia is classified according to the abnormalities. This includes Bradyarrhythmia, Supraventricular arrhythmia which includes atrial fibrillation, atrial flutter, paroxysmal supraventricular tachycardia (PSVT), and ventricular arrhythmia which includes ventricular tachycardia and Ventricular fibrillation. Arrhythmia could be caused by many different factors, such as damage from disease, injury, or genetics which may affect the heart tissue, its activity, or the electrical signals that control the heartbeat. People affected by arrhythmia often did not have any symptoms, but the report suggests that some of them feel an irregular heartbeat, faint, dizzy, or have difficulty breathing (Arrhythmia | NHLBI, NIH, 2020). According to the paper by Chugh et al., more and more people are affected by arrhythmia over time globally (2014). Ventricular fibrillation (VF), one of the common, life-threatening types of arrhythmia which contributes to significant morbidity and mortality (Krummen et al., 2016) will be the focus of the study.

Arrhythmia has many risk factors, such as age, environment, genetics/family history, lifestyle habits, other medical conditions, race, ethnicity, sex, and if a person has gone through surgery or not. There are many prevention strategies for people who are affected by arrhythmia, including arrhythmia trigger avoidance, defibrillator, lifestyle modification to improve heart health, and monitoring. Prevention strategies are designed to prevent sudden attacks of arrhythmia, as well as to manage sudden arrhythmia attacks. This makes screening for arrhythmia in high-risk individuals the most important step in arrhythmia prevention (Arrhythmia | NHLBI, NIH, 2020).

Screening for arrhythmia could be done in three different ways, which include an electrocardiogram (EKG or ECG) test, genetics test, and imaging test, but ECG is the main test for arrhythmia detection. To do ECG testing, the doctor may give their patients a portable ECG to be worn for several days to detect arrhythmia (Arrhythmia | NHLBI, NIH, 2020).

Ventricular Fibrillation is a type of arrhythmia where the ventricle chamber of the heart has an irregular pattern. Ventricular fibrillation has been considered as dangerous as the body will not receive enough blood due to the anomaly of the ventricle chamber of the heart. Ventricular fibrillation contributes to the majority of arrhythmia mortality and morbidity rate. Previous

studies have been conducted for the survival rate of patients who have been discharged from the hospital ranging from 3 to 33 percent, while the mortality rate of patients whose community did not have early access to defibrillation exceeds 90 to 95 percent (Bunch et al., 2003). Ventricular fibrillation comes after ventricular tachycardia, which many detection algorithms use to detect before ventricular fibrillation happens to the patient, have a wide QRS complex, and has no P wave (Vera, 2022).

Machine learning (ML) is a branch of Artificial intelligence (AI) that is focused on building a method for a machine to understand the nuance of data fed into the algorithm so that it may produce an algorithm or model that is able to classify, regress, or cluster data to then be used to predict the outcome of a task that produced the data or make decisions in a task. (Mitchell, 1997). The data that is fed to the algorithm, which is called training data, is usually preprocessed and formatted to fit what the machine learning algorithm expects it to be (Koza et al., 1996). Machine learning thrives in fields where it is difficult or impossible to develop the conventional algorithms counterpart due to the complexity of understanding the data (Hu et al., 2020) (LAWRENCE et al., 2016).

Deep learning is one of the branches of machine learning that focuses on artificial neural networks (ANN) with representation or feature learning. Artificial neural networks mimic how information is processed in a living being, that is using neurons that processed information and passed it down to other neurons, making it a network of neurons. Neural networks created artificially in a machine have distinguishable differences from that of a living being (Schulz & Behnke, 2012). Artificial neural networks currently tend to be fixed in function, while that of living tend to be dynamic in nature (Marblestone et al., 2016). One of the classes of deep learning is the convolutional neural network (CNN). Deep learning distinguishes itself from other artificial neural networks by the multiple layers of neural networks deep learning uses (LeCun et al., 2015), (Rampasek & Goldenberg, 2016).

The research gap for this research is the use of deep learning, specifically the use of convolutional neural networks using a one-dimensional convolutional layer to detect ventricular fibrillation. Currently, the best model to detect ventricular fibrillation is the study conducted by Qiao Li et al., which uses a support vector machine method (2014). This is currently the best in detecting ventricular fibrillation due to the performance of the model, and the tight time interval that the model needed to detect the presence of ventricular fibrillation in the data.

This research also comes from assisting LIRA MEDIKA hospital in the development of an IoT portable ECG, which has a limitation in gathering ECG data using a one-lead ECG system.

1.2 Scope of Research

The scope of the research is to create a method of ventricular fibrillation detection from an ECG signal

1.3 Objective/Aim

- Obtain and process ECG data of Normal and Ventricular Fibrillation patients to be used as training, validation, and testing data for the detection algorithm
- Develop a machine learning model that could detect ventricular fibrillation from an ECG signal
- Optimize the model to obtain an accurate model that is not underfit or overfit the training model