1 INTRODUCTION

This chapter discusses the reasons for choosing the topic of atrial fibrillation detection on electrocardiogram (ECG) records and the problems that exist in this topic. This chapter also discusses the theoretical framework, conceptual framework, objective, hypothesis, scope and elimination, and the last part is the importance of the study.

1.1 Background

The heart is one of the human's vital organs. It is responsible for pumping blood to the lungs to pick up oxygen and pump oxygen-containing blood throughout the body. This cycle runs continuously 24 hours a day in the form of heart rate. So, it is important to always maintain a healthy heart, including being aware of the symptoms of heart problems such as arrhythmia.

Arrhythmia is a heart rate disorder. Individuals experiencing arrhythmias may perceive their heart rhythm as either too rapid, too slow, or irregular. Among the various types of arrhythmias, Atrial Fibrillation (AF) is characterized by a speedy and irregular heartbeat. AF arises from an interruption of the electrical signal in the atria, which causes the atria to vibrate (fibrillation), and consequently, not function normally. At this rate, the blood is gathered in the atria and can cause formation of blood clots that can block blood vessels [1]. This blockage can lead to a stroke if it occurs in brain blood vessels. AF also may lead to heart failure [2]. Unfortunately, AF can occur without causing symptoms [3], and the sufferer does not realize it. To anticipate the presence of heart disease, it is necessary to do an examination or early detection of AF.

Cardiac examinations are usually done using an ECG in the hospital and the doctor will analyze the results. Doing examinations at the hospital is certainly not practical because it requires a long-time process, especially if the examination carried out is a heart rate detection for anticipatory purposes. For this purpose, it is necessary to use a home-based monitoring AF detection method. Currently, many researchers have proposed methods for detecting AF automatically. There are characteristic features that are usually used in AF detection methods. These characteristic features can be obtained through feature extraction from ECG signals. The feature often used by researchers is the duration of the R peak interval (RR-interval) [4] [5] [6]. Other features such as the absence of P wave [7], or ECG morphology [8] also can be used in AF detection methods. Besides the characteristic features above, many other characteristic features can be extracted, which can help to detect AF better.

In the AF detection method, there are generally three stages that must be carried out, pre-processing, feature extraction, and classification. Initially, the noise in the raw signal is cleaned in the pre-processing stage. Then, at the feature extraction stage, the signal features are identified. These features will be used at the classification stage to determine whether the signal includes AF or not. The feature extraction stage is one of the most important stages because the final accuracy value in AF detection depends on the feature extraction process carried out.

Understanding the condition of the heart which is a vital organ in the body is very important, especially in preventing stroke due to AF. It is necessary to monitor the heart condition by using a home-based AF detection method. To produce accurate detection,

proper features for detecting AF are needed. Therefore, this research proposes a feature extraction method using ECG dynamic features on multi-channel ECG for AF detection.

1.2 Statement of the Problem

The selection of characteristic features used in the AF detection method greatly influences the success of detection, therefore the problems that can be formulated are:

1. How to study the dynamic-based AF features to get the proper features to detect AF.
2. How to design ensemble learning based on developed features.
3. How to analyze the performance of AF detection.

1.3 Theoretical Framework

AF is a common heart rhythm disorder characterized by irregular heartbeats caused by the presence of fibrillation waves [5]. AF can manifest as an acute or chronic condition, with sudden paroxysmal episodes that can last for varying durations. Although these episodes can end spontaneously, AF tends to recur and eventually become persistent. [9].

Based on the AF heart rate characteristics above, this research tries to obtain characteristic features that represent the absence of P waves or the appearance of fibrillation waves.

1.4 Conceptual Framework

Many characteristic features can be obtained from dynamic ECG recordings. Other than RR-interval and QRS-width, more features such as P wave duration, QRST wave duration, and T wave duration [10]. The use of these features greatly influences the success of detection. therefore, it is important to select which features need to be used in the AF detection method.

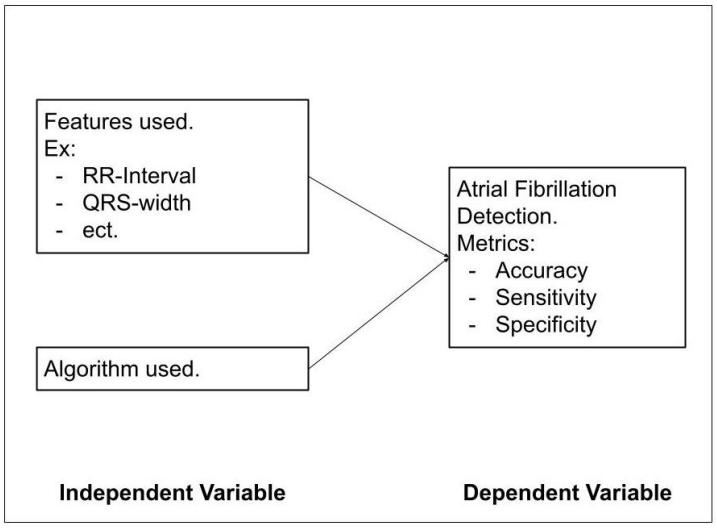

Figure 1.1 Conceptual framework.

Using different algorithms in the method will produce different accuracy values [11]. Other than the characteristic features, the suitability of the algorithm used with the method chosen in the AF detection method also influences the detection results.

Figure 1.1 illustrates the relationship between characteristic features and algorithms on detection results.

1.5 Objective

From the problems that have been formulated, the objectives of this research are:

1. To conduct a study of the dynamic-based AF features to get the proper features to detect AF.
2. To design ensemble learning based on developed features.
3. To analyze the performance of AF detection.

1.6 Hypothesis

From the objectives that have been formulated, the hypotheses in this research are:

1. The occurrence of AF is characterized by the disappearance of the P wave and the appearance of the f-wave in the ECG signal [5]. Not only the RR-interval and heart rate features, but the fibrillation signals around the P wave can also be used as a feature, especially as an indication of the appearance of the f-wave.
2. The designed ensemble learning based on developed features produces a strong model.
3. Using proper features will produce accuracy, sensitivity, and specification values of more than 90%.

1.7 Scope and Delimitation

This research selects features to be used in AF detection using specific ECG recordings, with lead I, lead II, or lead III with a duration of 1 minute. Also, this research only classifies two types of heart rate, normal and AF.

1.8 Importance of the Study

AF is the most common arrhythmia disease. Currently, AF diagnosis relies on the presence of several common symptoms, including breathing problems, chest discomfort, or an irregular heartbeat, and the identification through the characteristics seen on the ECG. Detecting AF in its early stages, when it is still in the initial event can be challenging and prone to inaccuracies because in some cases, there may not be any symptoms associated with the occurrence of AF [3]. As a result, most cases of early-stage and easily treatable AF are not diagnosed on time and develop into chronic complications. The automatic detection of AF for the purpose of early diagnosis and prevention of complications is of utmost importance. [12].