

CHAPTER 1: INTRODUCTIONS

1.1. Background

Cardiovascular diseases (CVD) are one of the most common diseases in human history, responsible for 17.9 million deaths annually from people of different ages (Cardiovascular Diseases, 2019). One common CVD is arrhythmia, a condition in which a patient's heart is beating irregularly (Tse, 2016). Irregularities of heartbeat may include beating too fast, known as Bradycardia, beating too slow, known as tachycardia, and irregular heartbeat, such as fibrillations (Trappe, 2018). Arrhythmias are caused by an improper impulse formation from the natural pacemaker or the HIS-Purkinje fibers and due to re-entries, a phenomenon in which the impulse of the heart travels in a loop within the heart instead of terminating after the intended route has been traversed (Waks & Josephson, 2014). Arrhythmias may be asymptomatic and are not directly responsible for fatalities; however, arrhythmias are a clear sign of problems in the heart that may result in much more severe diseases in the future as the heart gets weaker (Obeyesekere et al., 2012). As such, detection of arrhythmia allows for early preemptive measures to prepare a patient for future CVD that may arise due to their arrhythmia.

Long QT syndrome (LQTS) is a type of arrhythmia that may occur in a patient. LQTS is a CVD defined by the elongated time interval between the start of the QRS complex to the end of the end of the T-wave, known as the QT interval, as shown in figure 1 ("2015 ESC Guidelines for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death," 2015). Extension of the QT interval causes reduced heart rate or tachycardia, which reduces a patient's capacity to do strenuous activities such as aerobic exercises, and may result in fainting, seizures, and even sudden death (Goldenberg et al., 2008). Early detection may improve the living conditions of people with the disease.

Electrocardiogram (ECG) is a common tool used to diagnose different CVDs such as arrhythmias by recording the heart beat of patients into a graph (Feather et al., 2020). Sometimes referred to as EKG (elektrokardiogramm) in order to avoid confusion with EEG (electroencephalography) due to the similar pronunciation. People at risk of CVD such as LQTS may utilize personal ECG in order to monitor their heart beat. Different types of personal use ECGs are available in the market. The most common model is using a smartwatch's ECG function. The data of the heart beat collected by the smartwatch is transmitted to the phone through Bluetooth. Smartwatch's ECG, however, is too imprecise to be used for diagnosing different types of arrhythmias. Another common form of ECG is the personal use ECG using the 6 lead system on the torso. The Six leads gives a better reading and the 6 leads can be hidden under clothing. However, a patient with little background knowledge regarding ECGs might not be able to comprehend the ECG graph, and therefore, can not diagnose and get treatment when they need to. As such, a program should be made to detect abnormalities in their ECG graph.

Another simple algorithm that is produced recently using python and MATLAB is based on the research of Tiwari *et al*, 2021. The researchers use a threshold method to identify the Q-point and the T-wave end to calculate the QT interval. However, Their research may be flawed as the QT interval is calculated from the start of the Q-wave, at the P-Q junction to the end of the T-wave. This research aims to create a basic algorithm to locate the P-Q junction and the end of the T-wave to the find the QT interval

1.2. Aim of research

To construct an algorithm to detect LQTS using Python by finding the Qt interval

1.3. Significance of research

An algorithm can be used for remote and automatic diagnosis of patients which can lead to quick response to CVD