I. INTRODUCTION

In 1887, a British physiologist, Augustus D. Waller demonstrated the electromotive movement within the heart during heartbeats. This process was done through the use of 5 brine moisturized zinc covered in chamois leather electrodes attached to the back and front of the chest. The electrodes are connected to a Lipmann capillary electrometer which contains mercury. The beat of the heart will create a small movement in the mercury which will be projected simultaneously with the electrometer. This projection shows the presence of electrical activity before each heartbeat (Waller, 1887). This device became the first ECG device ever developed. In 1895, a Dutch physiologist, Dr. William Einthoven improved Waller's design through mathematical corrections to adjust the inertia of the capillary. This adjustment allows observation of the PQRST curve which is found in the result of modern ECGs (Einthoven, 1895). Further adjustment was made in 1901 through the use of string galvanometers and numerous state-of-the-art electrical and mechanical technologies available at the time, which resulted in the first clinical ECG due to the high sensitivity of the apparatus (Burnett, 1985). Another notable adjustment is reducing the electrodes used from 5 to 3, which resulted in Einthoven's triangle. The triangle aids in placing leads correctly to prevent errors in ECG readings (Einthoven et al., 1950). The ECG have been used in 1909 by Sir Thomas Lewis in concluding that Delirium Cordis is a result of atrial fibrillation (Lewis, 1909) and by 1930 had been used in the differentiation of cardiac and non-cardiac diseases (Levine, 1930). However it is found that some areas are undetectable, thus additional modifications were made by Frank N. Wilson in 1934 through the development of Wilson's central terminal (Wilson et al., 1934) which was used by Emanuel Goldberger to create unipolar leads (Goldberger, 1942). These inventions allow for more detailed readings and the establishment of the 12-lead ECG. Since then, ECG has been a crucial initial screening method for CVD. It allows the plotting of the heart's cardiac conduction system to measure its frequency and amplitude. From these data, a standard deviation can be made to diagnose certain diseases. The apparatus has also been used to monitor rhythm changes of the heart due to drugs in preparation for surgery or drug development. However use of the apparatus is often robust and complicated with the doctors, nurses, and technicians to operate the ECG (Sattar & Chhabra, 2021). Additionally, delayed response to these heart diseases could lead to mortality. Therefore there is currently a need for a device capable of constant ECG monitoring of patients suspected of cardiac diseases without hindering their daily activity.

Arrhythmia is one type of CVD characterized by an abnormality in the heartbeat frequency. Based on these abnormal frequencies, arrhythmia is further classified into several subcategories. This study is focused on AFIB. AFib was estimated to be prevalent at 37,574 cases worldwide and has caused death in 0.287 cases in 2017. This number was predicted to increase to 62,510 cases worldwide with 0.427 death by 2050. In addition, this disease occurs most frequently in the elderly aged 60-64, with an incidence of 0.526 million new cases by 2017 (Lippi et al., 2020). AFib is indicated by 3 discrepancies. These include fast/irregular heart rate, weakening/absence of p wave, and irregularly irregular ventricular response (Ahmed & Zhu, 2020). These discrepancies are detectable through lead 2 of the ECG, however as some diseases mimic the ECG reading of atrial fibrillation, V1 is often used to ascertain the diagnosis. V1 allows the detection of fine or coarse F waves, which further determines the severity of the disease (Pourafkari et al., 2018). However as

most portable ECG uses lead 2, signals from V1 detection will not be implemented in this study. In addition, p wave detection and interpretation are not conducted due to the complexity of the detection algorithm. Thus, this research aimed toward developing AFib detection and indicator algorithm through average R-R interval and R-R interval amount difference between 2 timeframes in Python.