Chapter 4
Machine Learning-Based Application for Long-Term Electrocardiogram Analysis

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ABSTRACT

Electrocardiogram (ECG) analyses can only be performed by health professionals whose demand for care is often greater than the availability. In this context, this work consists of the development of an application capable of processing long-lasting ECG signals to assist health professionals in making decisions. The application has an interactive interface that allows view the entire ECG signal in a single image generated by all overlapping cardiac cycles. The proposed application still has email communication between users with the objective of facilitating patient

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follow-up. The application was tested on three different ECG signals, one artificial and two real. The first signal was an artificial signal generated in software Matlab. The second ECG signal has normal sinus rhythm, available in the MIT-BIH normal sinus rhythm database. The third ECG sign diagnosed with arrhythmia can be found in the MIT-BIH arrhythmia database. The results obtained by the proposed method can be used to support decision-making in clinical practice.

INTRODUCTION

The heart is an organ that has cells with its own rhythm, capable of generating action potentials of which are recorded by the ECG, that is, the ECG is an exam that registers the variation of the electrical potentials of the cardiac muscle and is composed of the P wave that corresponds to the depolarization of the atria, the QRS complex that corresponds to the depolarization of the ventricles, and the T wave that records the repolarization of the ventricles (Hall, 2015).

Changes in heart rate patterns provide a sensitive and anticipated indicator of an individual's health compromises. High heart rate and signal good adaptation, characterizing a healthy individual with efficient autonomic mechanisms. On the other hand, low heart rate and often an indicator abnormal or insufficient adaptation, which may indicate the presence of physiological malfunction in the individual, needing further investigations in order to find a specific diagnosis. This additional investigation can be performed based on the morphology of the cardiac cycles, deformations in the waves of the ECG signal, may be an indication of cardiovascular diseases.

Data released by the World Health Organization (WHO) indicate that 17.3 million people die each year worldwide victims of cardiovascular diseases, and 80% of these deaths are registered in low and middle income countries (World Health Organization, 2004). The number of deaths in the world is forecast to rise from 16.7 million in 2002 to 23.3 million deaths in 2030, which will put heart disease in a group responsible for 70% of all deaths in the world in 2030 (Mathers & Loncar, 2006). In this context, this work proposes the development of an application that can assist in making decisions medical decision, processing long-lasting ECG signals.

For the development of an application that analyzes signals long-term ECG, we propose a generalization of the method presented in our previous study, Queiroz et al. (2019). Here we will present a method to segment the P waves, QRS complex and T wave of the ECG signal and not just the cardiac cycle as previously proposed. In addition, a graphic interface was created, for the direct use of the health professional. The purpose of the graphical interface is assist in monitoring long-term ECG signals reducing the analysis of the long-term ECG signal in a single image to be