

Portable System for the Acquisition and Processing of Electrocardiographic Signals to Obtain Different Metrics of Heart Rate Variability

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Abstract : Heart rate variability (HRV) is defined as the temporary variation between heartbeats or RR intervals (distance between R waves in an electrocardiographic signal). This distance is currently a recognized biomarker. With the analysis of the distance, it is possible to assess the sympathetic and parasympathetic nervous systems. These systems are responsible for the regulation of the cardiac muscle. The analysis allows health specialists and researchers to diagnose various pathologies based on this variation. For the acquisition and analysis of HRV taken from a cardiac electrical signal, electronic equipment and analysis software that work independently are currently used. This complicates and delays the process of interpretation and diagnosis. With this delay, the health condition of patients can be put at greater risk. This can lead to an untimely treatment. This document presents a single portable device capable of acquiring electrocardiographic signals and calculating a total of 19 HRV metrics. This reduces the time required, resulting in a timelier intervention. The device has an electrocardiographic signal acquisition card attached to a microcontroller capable of transmitting the cardiac signal wirelessly to a mobile device. In addition, a mobile application was designed to analyze the cardiac waveform. The device calculates the RR and different metrics. The application allows a user to visualize in real-time the cardiac signal and the 19 metrics. The information is exported to a cloud database for remote analysis. The study was performed under controlled conditions in the simulated hospital of the Universidad de la Sabana, Colombia. A total of 60 signals were acquired and analyzed. The device was compared against two reference systems. The results show a strong level of correlation ($r > 0.95$, $p < 0.05$) between the 19 metrics compared. Therefore, the use of the portable system evaluated in clinical scenarios controlled by medical specialists and researchers is recommended for the evaluation of the condition of the cardiac system.

Keywords : biological signal análisis, heart rate variability (HRV), HRV metrics, mobile app, portable device.

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