ABSTRACT

The heart plays a vital role in maintaining bodily functions by ensuring a continuous supply of oxygenated blood to vital organs. Cardiovascular disease remains the leading cause of death globally, with 19 million cases recorded in 2020. In response to this critical issue, this study aims to develop a cloud-based portable ECG device capable of detecting cardiac rhythm abnormalities such as sinus tachycardia and bradycardia in real time, with low cost and compact dimensions.

The device is built using a Wemos D1 Mini ESP32 microcontroller and an AD8232 sensor for ECG signal acquisition. Signal processing is performed directly on the microcontroller using the Pan-Tompkins algorithm, encompassing stages from filtering to RR interval detection. The processed data are transmitted via Bluetooth to an Android application, which displays the ECG waveform, RR interval values, heart rate, and rhythm classification. The data are also stored in Firebase and can be exported as a .csv file for further analysis.

The results show that the device has dimensions of 8.5 × 5 × 2.5 cm, a weight of 200 grams, and a total production cost of IDR 181,200, thus meeting portability and cost-efficiency criteria. In terms of accuracy, validation was conducted using two approaches: a Fluke PS400 simulator and direct testing on human subjects. Simulator testing showed 0% error rate in classifying sinus tachycardia and bradycardia conditions. Meanwhile, direct testing was conducted under two conditions: at rest and post-exercise to induce physiological sinus tachycardia. BPM validation against a pulse oximeter yielded error rates of 1.7% and 1.8%, while rhythm classification remained accurate with 0% error in both scenarios.

Keywords: AD8232 Sensor, Electrocardiogram (ECG), Pan-Tompkins Algorithm