

ABSTRACT

This research aims to design and evaluate a wearable device based on photoplethysmography (PPG) for monitoring the user's heart rate. The system integrates an analog front-end circuit consisting of an INA333 instrumentation amplifier, a second-order Bessel high-pass filter, a second-order Butterworth low-pass filter, a Twin-T active notch filter, and a non-inverting amplifier. The entire analog chain is designed to operate optimally within a frequency range of 0.34 Hz to 4.98 Hz, which aligns with the physiological characteristics of PPG signals.

Frequency response tests of the system revealed a bandpass characteristic with maximum gain around 3 Hz. The notch filter also proved effective in suppressing 50 Hz power line interference.

The wearable device was tested in three different body positions: standing, sitting, and lying down. Heart rate measurements obtained from the device were compared to a standard reference device, showing low average error percentages of 0.82% (standing), 0.82% (sitting), and 0.62% (lying down). These results indicate that the device delivers accurate and consistent real-time heart rate monitoring. In conclusion, the designed and tested system is feasible for use as a wearable device for biomedical signal acquisition, particularly in health monitoring applications based on PPG.

Keywords: photoplethysmography, wearable, heart rate, analog filter.