

ABSTRACT

This study aims to design a portable photoplethysmography (PPG)-based device for measuring oxygen saturation (SpO_2) and detecting hypoxia in real time. The device utilizes a MAX30102 sensor with Bluetooth Low Energy (BLE) connectivity, linked to an Android application. The application displays SpO_2 values, hypoxia status (Normal, Caution, Acute Hypoxia), PPG waveform graphs, and includes features for data recording and storage via Firebase.

Testing was conducted on 15 participants, yielding an average difference of 1.04% and an average relative error of 1.06% compared to a medical-grade oximeter—still within the sensor's tolerance range. Hypoxia simulation using the breath-holding technique also showed an average relative error of 1.10%. Signal filtering (High-Pass filter and cut-off) significantly improved the visualization quality of the PPG waveform.

The results demonstrate that the device is capable of providing accurate SpO_2 measurements and representative visualization of physiological signals. This tool shows potential as a practical early monitoring system for both healthcare professionals and general users in self-health monitoring.

Keywords: Photoplethysmography, pulse oximetry, SpO_2 , signal processing, hypoxia