Abstract

The utilization of non-invasive, contactless methods to detect physiological parameters such as oxygen saturation (SpO2) and respiration rate has the potential to significantly improve healthcare delivery. This dissertation suggests a new system that utilizes photoplethysmography (PPG) signals extracted from facial and fingertip video recordings. These video recordings are captured using a standard smartphone. The system accomplishes real-time, contactless health monitoring without the necessity of specialized medical equipment by employing advanced image processing and signal analysis techniques. This method addresses critical health challenges, particularly for vulnerable populations, by facilitating continuous monitoring in resource-constrained environments.

The development of a context-aware mobile application that is capable of collecting high-quality PPG signals, mitigating motion artifacts, and improving signal-to-noise ratio (SNR) is a critical focus of this research. This application is designed to assure the accurate detection of SpO2 and respiration rate. These physiological parameters are indispensable for the surveillance of respiratory health, as hypoxia-related cognitive impairments and Chronic Obstructive Pulmonary Disease (COPD) are both characterized by reduced oxygen saturation. The utility of this system is further enhanced by its integration with an Electronic Medical Record (EMR) platform, which allows caregivers and healthcare providers to monitor patient health over time and make data-driven decisions.

The proposed system in this dissertation is especially beneficial for children with cognitive disabilities, as their health may be more susceptible to respiratory fluctuations. The system supports the early detection of health issues and enables timely interventions by facilitating remote monitoring of SpO2 and respiration rate. This work emphasizes the potential of low-cost, broadly accessible health technologies to enhance health outcomes in underserved communities. Validation of the system, particularly its oxygen saturation detection, was conducted in real-world scenarios. This also contributes to enhanced patient care and equitable healthcare access by providing a scalable, non-invasive solution for continuous health monitoring.