A Novel Multimodal Wearable Sensor System for Continuous Monitoring of Chronic Diseases

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One of the greatest challenges facing chronic disease management is the lack of a non-invasive continuous monitoring medical device that is compact and convenient enough to be worn daily by patients with conditions such as peripheral artery disease and diabetes. The purpose of this project is to tackle this challenge through developing a novel multimodal arm patch sensor system that combines multiple useful sensing modalities into a single system yet still meets the design goals of compactness, flexibility, low power consumption, and wireless operation. The sensor was developed based on these design goals to eliminate the high cost and complexity of collecting multiple signals individually. It features with three main innovations: utilizing a single highly-sensitive silicon photomultiplier to collect signals from both photoplethysmography (PPG) for heart rate monitoring and fluorescence lifetime (FLT) sensing for physiological data such as bloodstream glucose concentrations; transmitting data wirelessly via a Bluetooth® microcontroller to a mobile application for ease of monitoring; and assembling all components onto a flexible polyimide substrate to maximize comfort and mobility. The new sensor is compact (86 mm × 34 mm × 2 mm) and lightweight (< 3 g). It was validated using simulated input signals. The evaluation showed that it can simultaneously measure PPG and FLT with accurate readings and with low power consumption. This new sensor system demonstrates the feasibility of creating a compact, multimodal continuous monitoring medical device and represents a significant technological advancement in chronic disease monitoring.

Awards Won:
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