A PPG Simulation Device

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Introduction

Aktiia SA of Neuchâtel, CH has created a wearable PPG blood pressure monitoring system. For optimization of their optical sensor, a PPG simulator is required for ex-vivo testing. There are few PPG test systems on the market, and none meet all the design requirements specified by Aktiia SA [1]. Basic features must include elimination of ambient and LED light interference, raw signal playback, and adjustment of physiological parameters, including AC and DC values. It was therefore the aim of this project to create a calibration device which includes the above design parameters for initial testing and further development for *Aktiia SA*.

Materials and Methods

A PCB was designed incorporating an analog front-end (AFE) for photo-diode signal aquisition and a 16-bit variable current digital to analog converter (DAC) for finite LED control.

Fig. 1 Final PPG simulator design used for testing with Aktiia's sensor.

LED signal playback was accomplished using a microcontroller timer to drive DAC current output in a precise manner. The hardware was designed to fit within a 3D-printed housing for elimination of ambient light interference with a sealed sensor interface for elimination of sensor light interference. A graphical user interface (GUI) was developed for AC and DC adjustments as well as data acquisition.

Results

PPG signal playback was accomplished at a frequency of 200 Hz with the ability for dynamic AC and DC adjustment using single and multi-channel DAC control. A perfusion index of 1% was achieved using 11 bits of resolution to minimize total current output.

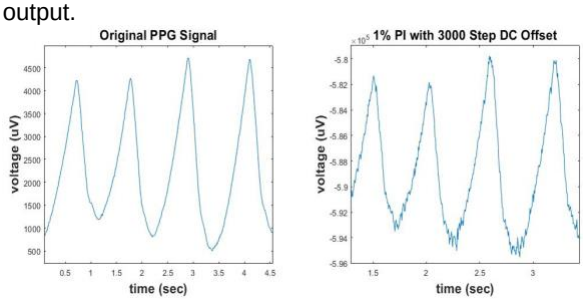

Fig. 2 Original PPG signal and signal recorded by Aktiia's optical sensor played back from the PPG simulator's LED.

Discussion

Design requirements were met allowing for adjustable PPG signal recreation. Minimizing light detected by Aktiia's optical sensor either through lowering the maximum DAC current output, or refraction are two possible ways of further optimization of the device. Furthermore, electrical noise at the DAC output must also be investigated.

References

[1] *HRS200 - Products*. Test Solutions for Medical Device Manufacturers – WHALETEQ Co., LTD. Retrieved August 28, 2022.

Comments

This project was completed through collaboration of the Bern University of Applied Sciences, Institute for Human Centered Engineering, Sensoric Laboratory with *Aktiia SA,* of Neuchâtel.