A Wearable Pulse Oximeter

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Introduction
The aim of this project is to design a wearable pulse oximeter which is capable of measuring the heart-rate and blood’s oxygen saturation. The project employs wearable electronics. The project consists of three main parts: 1) sensor design, which includes the optical transceiver used for transmitting and receiving light in the near-infrared range at two wavelengths; 2) the microcontroller, which receives and processes the analog signal from the optical receiver to display the heart rate and blood’s oxygen saturation ratio on an LCD display; and 3) mobile phone app which is used to real-time record data then send report information as message to another phone. The project has been successfully implemented and tested.

![Design structure block diagram](image)

**Figure1.** Design structure block diagram

Basic Principle
Oxygenated and deoxygenated hemoglobin have different absorption coefficients in the near infrared (NIR) range. Two LEDs will emit light at two different wavelengths. Photodetector converts the received light intensity to electrical signal. Oxygen saturation can then be calculated as:

\[ SaO_2 = \frac{HbO_2}{Hb + HbO_2} \times 100\% \]

Method
In the LED transmitter part, we choose two different light sources, which are 680nm and 940nm wavelength according to the operation principle. This transmitter is controlled by our microcontroller to be turned on and off. At the receiver, we used OPT101 as an integrated photodetector and transimpedance amplifier. After that, we applied a band-pass filter. The pass band of this filter is 0.8Hz-3Hz to get rid of other undesirable disturbance. Also the filer has a 37dB gain to amplify the signal. For easy calculation of microcontroller, we add a DC offset around 0.7V to the output signal. After analog signal processing, the signal connects to our microcontroller. Then we programmed this controller to apply the ADC and calculate our heart rate and oxygen saturation. A LCD screen is applied to our design for real time display. For communication with our mobile phone, we use a Bluetooth communication technology to build a bridge from microcontroller to our phone. In the end, we add a mobile phone app to record and display our data. Also, we add a function that people can text the measurement result to the doctor.

Conclusion and Results
Our design integrates successfully. People put finger into our device, the heart rate and oxygen saturation rate can be seen from our LCD display and the phone app works well.