A pulse oximeter is a non-invasive device capable of monitoring the blood’s oxygen saturation. It has been widely used in the medical, fitness and clinical care worlds. A low-cost wearable oximeter can significantly expand its applicability. The aim of this project is to design and build a low-cost wearable pulse oximeter, using wearable electronics. The system consists of three main parts: 1) the sensor, consisting of the optical transmitter and receiver for emitting the light and receiving it; 2) the microcontroller, which receives and processes the signal to display the heart rate and blood’s oxygen saturation on an LCD display in real time; and 3) mobile phone app which is designed to receive data wirelessly, real-time display and send the information as text to another phone.

**Principles of Operation**

- 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: \( \text{SO}_2 = \frac{\text{Hb}_O_2}{\text{Hb} + \text{Hb}_O_2} \times 100\% \)

The hardware part of the project consists of:

1. Optical Transmitter: Two LEDs (680 nm, 940 nm) (Size: 0.827” × 0.827”)
2. Optical Receiver: Photodetector + Transimpedance Amplifier + Filter (Size: 1.772” × 0.984”)
3. Wearable Microcontroller (Size: 1.299” × 0.709”)
4. Wearable Bluetooth (Size: 1.376” × 0.590”)
5. Display (Size: 1.574” × 1.411”)

Programmed included three parts:

I) Programmed the microcontroller to process the data from the receiver and calculate heart rate and oxygen saturation

II) Developed a phone app to record and store data for offline analysis

III) Made the connection between the Bluetooth and the Phone App

**Final Result**

- Portable and Wearable
  1. Low Cost
  2. Real-Time display of heart-rate and \( \text{SO}_2 \)
  3. Phone App receives data wirelessly and is used for real-time display data then sends information as text message.

Our design will have applications in:

1. Clinical applications
2. Neonatal and Elderly Care
3. Exercise and Fitness

![Design-Hardware](Design-Hardware)

- Design Goal
- Programming included three parts:
  - Implemented the microcontroller to process the data from the receiver and calculate heart rate and oxygen saturation
  - Developed a phone app to record and store data for offline analysis
  - Made the connection between the Bluetooth and the Phone App

- Measurement and Integration

**Final Result**

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![Measurement and Integration](Measurement and Integration)

- References

[1] Young-Dong Lee, Sang-Joong Jung, Yong-Su Seo and Wan-Young Chung “Measurement of Motion Activity during Ambulatory Using Pulse Oximeter and Triaxial Accelerometer”