Optimization of Reflectance-Mode Pulse Oximeter Sensors

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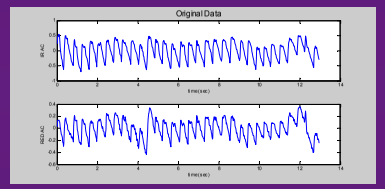
Pulse oximeters provide physiological information such as heart rate and blood oxygen saturation. These devices acquire measurements using red and infrared light that passes through the patients skin and underlying tissue. Pulse oximeter sensors can either be transmission-mode, where light passes completely through the tissue and is collected on an opposing skin surface, or reflection-mode, where light is reflected back towards the sensor and collected in the same region as the incident light. Reflectance-mode sensors offer more measurement-site flexibility since they are only mounted on one side of the skin. However, these sensors are at a disadvantage since they collect only a fraction of the light reflected from tissue, which is primarily forward scattering. Increasing the reliability and quality of reflectance-mode signals will make these sensors a more attractive alternative to traditional transmission-mode designs.

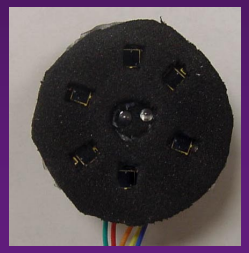
Previous Design

- One photodiode collects reflected red and infrared signals, resulting in poor efficiency and a smaller signal-to-noise ratio.
- Hard plastic material does not conform to most skin surfaces.
- More ambient light noise due to holes in plastic and inability to mold to a curved surface.

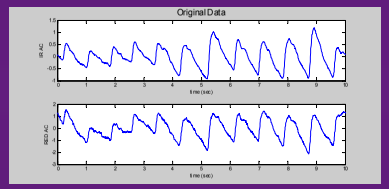


- Signal-to-noise ratio is highly dependent on sensor movement.
- Signal is often difficult to obtain, requiring several attempts to collect viable data.

Optimized Design

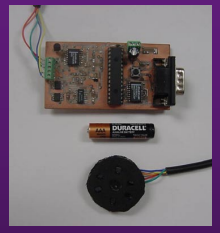


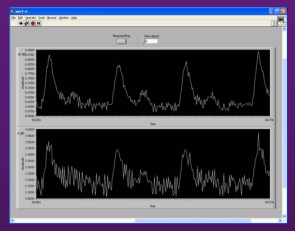
- Multiple photodiodes collect more of the reflected light, forming a radial pattern around the source(s).
- Pliable material allows the sensor to conform to the measurement site.
- Less susceptible to ambient noise due to opaque material and flexible design.



- Output signal exhibits greater signal-to-noise ratio.
- Signal is also more reliable than with the previous design; less effort is required to collect viable data.

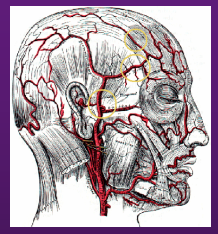
Pulse Oximeter Sensor





- Small, Lightweight components are unimposing to the wearer.
- Provides time-domain plethysmograms that can be used to calculate different physiological parameters.

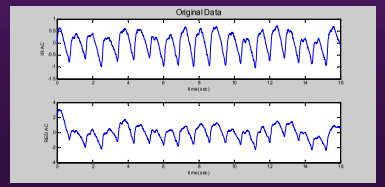
Measurement Site Comparison



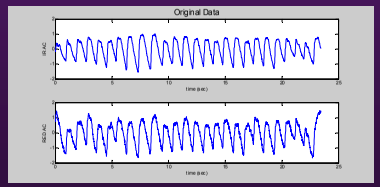
Viable and Unobtrusive Measuring Sites

- Middle temporal artery (in front of ear)
- Frontal branch (along hair line)
- Wrist

Finger



Middle Temporal Artery



- Measurements from sites on the head are similar to those collected from sites on the finger.
- Head-mounted sensors have also proven to be less obtrusive since they do not impede movement or use of the hands.

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