NOVEL PULSE RATE SENSOR

Overview

Halare, LLC is a start-up company formed in 2010 that focuses on making medical devices for home and hospital use. This product is a medical therapy device used by patients with asthma to teach and control their breathing patterns. This is done through the use of a headset that audibly instructs the user on breathing while simultaneously taking measurements to monitor their breathing along with their heart rate and blood oxygen level. A heart rate monitor must be incorporated onto a headset that will be worn for prolonged periods of time. The heart rate monitor must not require extensive pressure to work.

Objectives

Halare Inc. would like our project team to complete the following objectives:

- Submit a detailed research paper on existing technology and innovative methods to monitor heart rates.
- Design an inexpensive prototype in the vicinity of the ear that can output a visible heart rate signal without being invasive.
- Build a working prototype of the design for proof of concept.

Approach and Outcomes

- The project team’s first step was to obtain an understanding of all the different types of devices used to monitor a person’s heart rate. Research was divided into three main categories: biology, current technologies, and new technologies.

- After researching the methods used to monitor a person’s heart rate, the team compared and contrasted each method to choose a cost-effective method.

- The team agreed unanimously to use photoplethysmography, or PPG, to monitor a person’s heart rate. PPG requires relatively low-cost components and is non-invasive so it can be integrated onto Halare’s headset.

- The team then researched various components. Tradeoffs between accuracy and cost were needed to choose proper parts.

- The team decided to use low power, rail-to-rail op-amps to reduce power consumption, an infrared LED, and a sensitive photodiode designed to detect infrared light. The design circuit consisted of an amplifying and filtering circuit, which took the noisy input signal of a person’s heart rate and was able to output a clean signal.

- With the designed circuit, the team initially tested the prototype on a finger. Once the concept was proven, the team proceeded to locate the best spot to place the sensor in the vicinity of the ear. After examining how the prototype works on various people and various locations near the ear, the team concluded that different people have different target areas in which a strong signal is obtained.

- Our prototype of a heart rate monitor worked while applying little pressure in the vicinity of the ear as long as the sensor is placed on the correct spot and the user remains relatively still.