Pediatric Pulse Oximeter

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Biomedical Engineering Capstone Design

Background

- Respiratory illnesses can affect the amount of oxygen the blood is receiving which is dangerous for infants
- **1 in 5 infants** are admitted to the hospital for hypoxia (acute oxygen in blood) in **low resource countries**
  - Medical technology is old/scarce due to costs and materials
  - Most infantile respiratory conditions/illnesses could be prevented if the environment & economic conditions were different
- **Pneumonia is most prevalent in Sub-Saharan Africa**
  → Pulse Oximetry is effective in monitoring blood oxygen saturation (amount of oxygen in blood)
- **Blood oxygen saturation**→ measured by a photoluminescence sensor, using changes in light absorption to see how oxygenated/ deoxygenated the blood is

Design Objectives & Functions

Objective: Enhance quality of infant care along with reducing mortality rates for treatable/preventable respiratory illnesses, by providing:

- Pulse Oximeter attachment that improves accuracy of readings during movement, while enhancing comfort
- Feasible device for the needs within low resource countries

Main Functions: **Control Unit & Sensor Attachment**

Control Unit: contains **screen, speaker system, light system**

Pulse Ox Levels for Infants:

Green Zone (95-98): Safely maintained, >98 is dangerous for premature infants

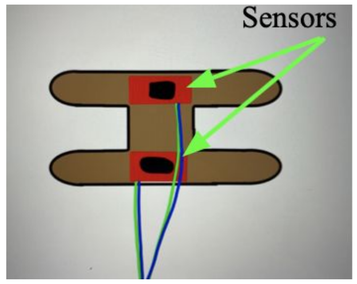
Yellow Zone (93-95): Decreasing but not dangerous, should be closely monitored

Red Zone (<93): Dangerous, intervention/oxygen therapy required

Each level corresponds to a color indicated by an LED in the light system. Readings which fall below the green zone trigger a notification system to alert the user.

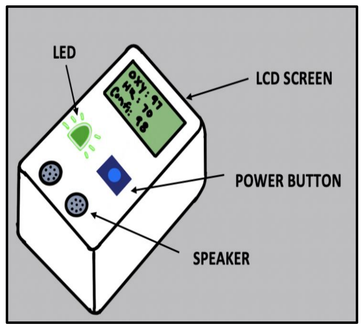
Design Description

Our design incorporates two adjustable sensors for better accuracy of readings and maximum comfort for the infant. This design reduces the anxiety of the user by guaranteeing that if one sensor stops working, the other will continue to produce accurate readings.



Attachment Style

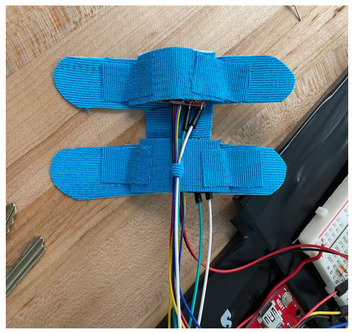
- 2 sensors are used in an adhesive bandage style attachment.
- Allows for usage on wrist/palm or for ankle/foot.
- Adjustable



Display Screen and User Interface

- **LCD screen** → displays oxygen levels, heart rate, and confidence level of the sensor.
- **On/Off Button**
- **LEDs**→ communicates strength (green=95-98, yellow=93-95, red=>93)
- **Speaker system** → alarm when levels are lowering (<93)

Prototype Updates



Physical prototype of attachment

- Our design will incorporate gel-based adhesives which are intended for sensitive newborn skin
- The adhesive is also disposable to reduce the cost for low resource areas

Prototype Updates Cont.

- The model shown replicates how the pulse oximeter will connect to the infant's hand and foot. The sensors on the hand will line up with the wrist and the palm, where as on the foot it will line up with the bottom of the foot and the ankle.

Validation Results

- The sensor attachment fit was tested manually by using our baby doll → snug, adjustable fit
- Readings were consistent with an Equate Pulse Ox (adult)
- Unable to test our sensor on an infant → in process of finding an alternative to simulate the sensor readings on an infant

Discussion & Future Plans

- Feet and palms are known to be good locations for pulse oximetry within infants.
- Streamlined circuit design
- Control unit & attachment is feasible for use in low resource areas. The inexpensive design provides accurate readings, allowing for stability and comfort.
- Our goal is to improve pediatric care among clinics within these countries hoping to reduce infant mortality.
- A final prototype will be created combining the attachment with the electrical display confined in the control unit.

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