The Serenity Monitor

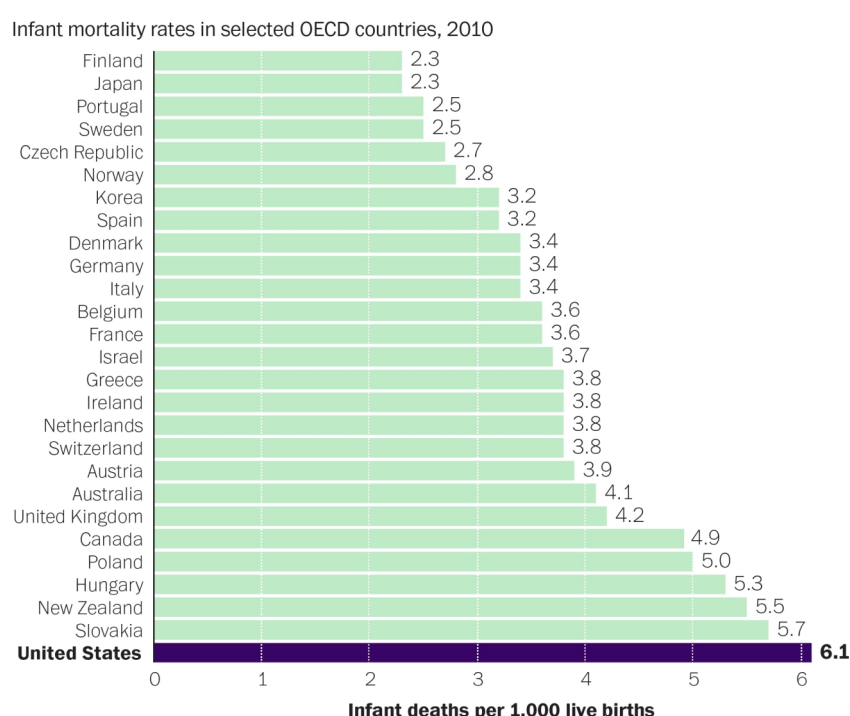**BMEN 3151** *Medical Device Practicum*   **Dallas Carey, Isabel Melton, Terry Sullivan, Thomas Younger**

Clinical Problem

The United States consistently ranks lower than almost all other developed countries when it comes to infant mortality. This is largely due to its high rates of preterm birth, maternal pregnancy complications, and socioeconomic inequality. One of the leading causes for infant fatalities in the US is sudden infant death syndrome (SIDS). There are a few vitals which could alert to SIDS including heart rate, oxygen levels, and temperature. This device is targeted for high risk infants including those with premature births, low birthweight, and siblings who passed from SIDS. This device protects babies against SIDS, and gives parents peace of mind that their child is being looked out for; allowing for improved quality of sleep and better parenting.

Infant mortality rates in selected OECD countries, 2010

Country	Infant deaths per 1,000 live births
Finland	2.3
Japan	2.3
Portugal	2.5
Sweden	2.5
Czech Republic	2.7
Norway	2.8
Korea	3.2
Spain	3.2
Denmark	3.4
Germany	3.4
Italy	3.4
Belgium	3.6
France	3.6
Israel	3.7
Greece	3.8
Ireland	3.8
Netherlands	3.8
Switzerland	3.8
Austria	3.9
Australia	4.1
United Kingdom	4.2
Canada	4.9
Poland	5.0
Hungary	5.3
New Zealand	5.5
Slovakia	5.7
United States	6.1

Needs Statement

Caretakers of infants need an affordable and effective at-home device to monitor critical physiological parameters, specifically heart rate, temperature, and blood oxygen to proactively halt the possibility of sudden infant death.

Market Analysis

Premature babies are at significantly higher risk for SIDS and approximately 384,000 premature babies (1 out of every 10 births) in the United States alone are born every year. The average cost of having a baby in the United States is upwards of $18,000, and with the median American family having 1.93 kids and only $4,710 savings in the bank, a baby monitoring device that costs less than the $600 device on market is less of a hope and more of a need for parents of premature babies.

Medical Device Solution

Our solution to address this clinical problem was a monitor that goes around the arm of an infant to read pulse, blood oxygen, and temperature values. This would be achieved with an at-home monitoring device capable of not only alerting guardians of abnormal physiological parameters, but also have the ability to report data from 30 minutes before a triggered alert. This data would be used to deepen the understanding of how temperature, pulse, and blood oxygen content relate to SIDS, and in later stages, developing a deep learning algorithm for more accurate predictions of when a SIDS event could be occurring. Ideally, this device would need to have wifi and bluetooth capabilities, a temperature, pulse, and blood sensor. The current prototype developed by our team is able to successfully read temperature and pulse oximetry data in Python. It consists of a Raspberry Pi Zero 1.3, a MAX30102 pulse and oximeter sensor, and a TMP 117 temperature sensor. These devices communicate using an I2C protocol which requires the use of 4.7 kilo ohm pull up resistors to maintain the communication. This first iteration prototype of the device is ideal to define the most important component of the device. This is the core program to detect abnormalities and store the correlated data, as well as to notify parents of abnormal events. The final iteration of the device will likely move past the use of a commercial microprocessor and sensors due to size constraints. A custom circuit would need to be constructed and/or the same sensors downsized. There would need to be a small processing chip with a purpose-built operating system constructed to efficiently run the code that will be developed using this first iteration prototype.

Team Photo

Sources

A profile of prematurity of United States | peristats | March of dimes. (n.d.). Retrieved December 7, 2022.

Erin Duffin, & 30, S. (2022, September 30). *Average children per family U.S. 2021. Statista. Retrieved December 6, 2022.*
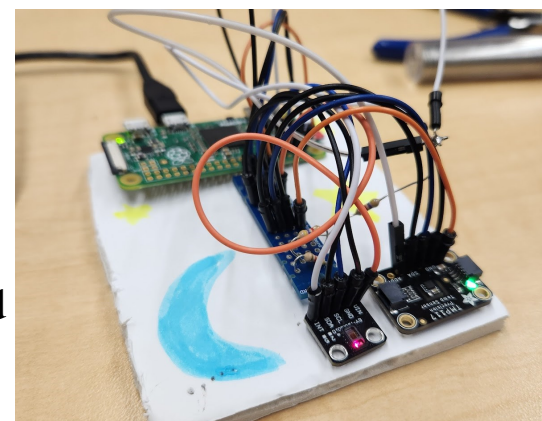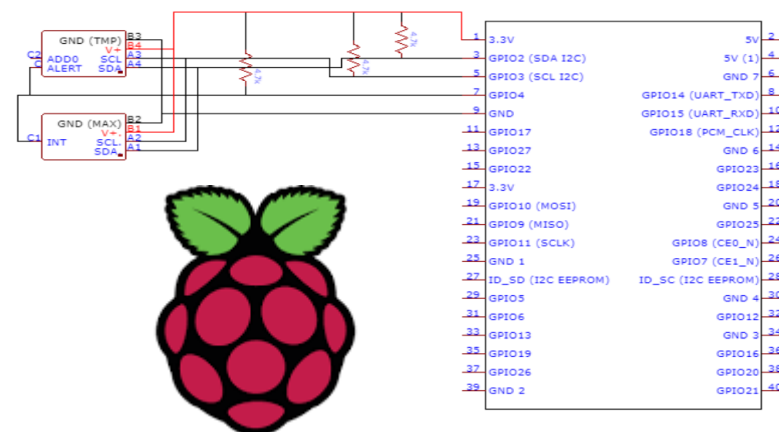
Ingraham, C. (2021, November 25). *Our infant mortality rate is a national embarrassment.* The Washington Post. Retrieved December 6, 2022.

Rivelli, E. (2022, December 1). *How much does it cost to have a baby? 2022 averages. Forbes. Retrieved December 6, 2022.*

Wolfson, A. (2022, November 4). *Average savings by age: How much to save in your 20s, 30s,40s, 50s and 60s. MarketWatch. Retrieved December 6, 2022.*