Infantastic: Infant Heart and Lung Monitor

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Abstract

Shaken baby syndrome and sudden infant death syndrome (SIDS) represent significant risks to infant health and safety, prompting a critical need for continuous monitoring solutions.

Shaken baby syndrome, a severe yet preventable form of child abuse, underscores the urgency for reliable monitoring tools, as symptoms often manifest hours after the event, leading to high fatality and disability rates. Similarly, parental anxiety regarding SIDS highlights the demand for proactive monitoring solutions.

Our project addresses the gap in current monitoring methods by introducing a wearable Infant Heart and Lung Monitor. The proposed monitor offers real-time tracking of infants' heartbeat and breathing, along with alerts for potential hazards like flipping over, shaking, or falling.

Introduction

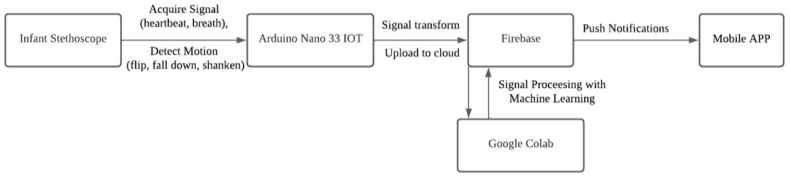
A very preventable yet under addressed problem regarding babies' health and safety is shaken baby syndrome. It is the deadliest form of child abuse in children under the age of 5. There are estimated to be 1,300 cases annually, but many sources note this is likely an extreme underestimate of the actual number. Shaken baby syndrome has a 25 percent fatality rate and 80 percent of survivors have lifelong disabilities. Another concerning statistic regarding baby health and safety is that 1 in 100 babies in the United States have a heart condition.

New parents are extremely worried about their child's health and safety. Despite only 3,400 annual cases of SIDS in the United States, a 2022 study proved that 90 percent of parents worry about SIDS and 70% worry about their baby's safety in general. Additionally, 58% of parents worldwide experience anxiety related to sudden infant death syndrome (SIDS), with an additional 20.5% reporting severe levels of SIDS-related anxiety.

Our product stands out compared to current market options because of additional features such as a gyroscope to monitor if the baby has rolled over, has fallen, or has been shaken and sends alerts when one of these movements occurs. Additionally, our device utilizes a stethoscope, which allows us to monitor both heartbeat and breathing, and our device has the potential to live broadcast these sounds. Our baby monitor also allows use from anywhere as it has Wi-Fi and Bluetooth sharing capabilities and it is conveniently located on the chest area so it will not interfere with the child's mobility. This feature will give parents the ability to leave their child in the care of someone else, anxiety free.

Proposed Solution

The baby heart and lung monitor we are creating is a simple amplification device. It utilizes a stethoscope and microphone to detect and amplify sounds of the heart and lungs of an infant. The device also features a gyroscope, which is currently located in the Arduino, to detect the movement of the child. The code written will use machine learning and signal processing to detect events from the data to identify life threatening events for the infant. The device works alongside a mobile app that acts as the notification channel for the parents.



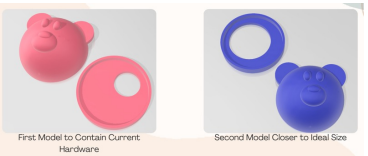
Results

We have prototyped a device that monitors real time heart and lung sound, processing these signals and detecting and reporting abnormalities and the current heart rate of the infant. The device also can continually monitor for if it was flipped, shook, or dropped and sends corresponding notifications to the mobile device. The device is currently powered through a rechargeable battery.

Future Directions

One current limitation of our device is its inability to check for heart rate/ lung sounds at the same time as the readings from the gyroscope. We believe this is due to limitations in the Arduino used. We have been exploring alternate microcontroller options whether that be switching to a different one or adding an additional microcontroller.

The next biggest step for this project is to work to reduce the size of the prototype and design the case in softer material.



One future decision for us is to decide on the adhesive to attach the device. The device would either be attached to the onesie of the infant or directly to their skin with a painless heat-based silicone.