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Miku Smart Baby Monitor
Hospital Study

Summary

The Miku Smart Baby Monitor is a consumer-facing baby monitor which is shown to often track the respiration waveform of newborn babies, as well as hospital grade vitals monitoring hardware.

1.

Summary

Miku marks a whole new generation in baby monitoring. Miku tracks your baby's breathing and sleeping patterns with no wires or wearables. providing parents with a greater sense of awareness and instant peace of mind. Our monitor works with your smartphone to display live breathing and nursery conditions and to alert parents of important changes. To achieve this level of contact-free accuracy, our team of military engineers created SensorFusion, a proprietary combination of multiple sensor modalities combined with a brilliant machine learning platform that gets smarter as data sets grow. Miku's powerful Qualcomm processor does its thinking locally, greatly lowering latency and creating a higher level of security by keeping data processing out of a cloud. Miku is also equipped with crypto chip hardware to safeguard all of its processes, the first of its kind in a baby monitor. Miku allows parents to check in on their child from anywhere in the world, see live breathing waveforms, use two-way talk, and play rich custom sleep sounds and lullabies through its powerful dual Ole Wolff speakers.

2.

Miku Technical Overview

With the advent of new ultra-low power contactless sensors, machine learning and machine vision supported artificial intelligence models, and miniaturized multi-core/coprocessor-enabled processors, the Miku Smart Baby Monitor is designed to measure vital signs in neonatal patients at least as well, or better, than contact-based sensors deployed in hospitals.

Miku hospital data collection setup collects data from the MP50 and the Miku, and stays out of the way of hospital personnel

Miku provides parents with real-time (typically <1 second latency) reporting of the baby's respiration waveform. The Miku will send the parent an alert if the baby has an apnea event which lasts for longer than 20 seconds. This is made possible in large part by our proprietary technology known as SensorFusion. SensorFusion uses multiple sensor modalities (stimulus modalities) in order to make the best decision possible. This model is similar to how the human body is able to use one brain to process multiple sensors – eyes, ears, touch, etc. Using this philosophy, Miku leans on one sensor modality in situations where another is weak.

This makes the Miku less susceptible to the perils a single-sensor technology will face, allowing for a confidence we are able to pass on to our most valuable customers, the parents.

3.

NICU Hospital Study

Newborn babies in the Neonatal Intensive Care Unit (NICU) may have been born prematurely, or be at increased risk for respiratory complications such as sleep apnea, periodic breathing, and choking. Doctors and nurses track the heart rate, SpO2, respiration waveform, and respiration rate with contact sensors such as electrocardiogram and pulse oximetry. These sensors are potential points of infection in these vulnerable newborns, especially for premature infants with fragile skin. Therefore contactless sensors such as the Miku Smart Baby Monitor are of particular interest to hospital personnel and a study is being performed to investigate its viability.

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Test Setup

The MIKU001-Single Center Observational Pilot Study Of Efficacy Of A New Baby Monitor, is being performed with support of the Monmouth Medical Center (MMC) NICU in Long Branch, NJ. MMC used a Philips IntelliVue MP50 in order to monitor neonatal patient vital signs. The MP50 is a standard portable patient monitor trusted by doctors and nurses in NICUs around the world. The MP50 uses standard contact-based sensors to measure respiration rate and waveform, SpO2, and other vital signs.

Data is collected from the MP50 using a tablet and stored using secure local data storage. Additionally, sensor data from a Miku Smart Baby Monitor is collected and stored using the same method, allowing for data synchronization and privacy by design. Data is deidentified, anonymized, and encrypted prior to storage. Consent from volunteer parents is handled with help from hospital personnel. To execute the test, first the patient is monitored with the MP50 using the doctors' and nurses' typical methods. Next, the Miku hospital data collection setup is placed next to do the baby's bassinet such that the doctors and nurses can see the baby in the Miku's video field of view on the tablet. Then, a data collection cable is plugged from the Miku hospital data collection setup into the MP50. Finally, a button is pressed on the tablet which begins the data recording process. Data is then being recorded and stored using both the MP50 and the Miku.

https://www.ncbi.nlm.nih.gov/pubmed/24135159

Sensor data is collected and stored automatically to the secure storage device. Doctors and nurses manually keep a checklist of events of interest which happen to the patient, including periodic breathing, apnea events, choking events, as well as what the baby is doing at the time and what action is required of the nurse. Apnea events are typically identified, in part, using the MP50 to identify a 20 second duration of breathing apnea. After this, an alarm is generated by the unit and a doctor or nurse must verify the validity of the alarm and take any necessary action. These documents are then stored digitally.


The Philips IntelliVue MP50 Portable Patient Monitor is used and trusted by medical professionals to monitor neonatal vital signs and send an alert to nurses in the NICU (image from Philips.com)

Results

Over 2,500 cumulative hours have so far been collected from 13 volunteer parents. This data included a number of events of interest, including periodic breathing, apnea events, choking events, and other respiratory events. Some of these events occur during feeding, when the baby is typically out of the crib. The Miku Smart Baby Monitor and the MP50 are able to cleanly track the patient while it is asleep and is able to identify apnea events that occurred during these times. In total, 100% of apnea events identified by doctors and nurses were also identified by the Miku if the patient had been resting at the time.
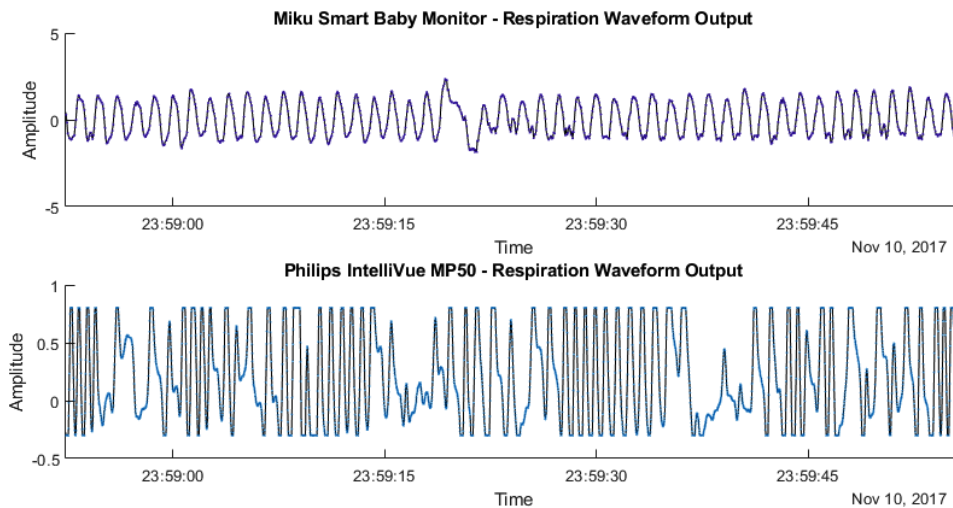
Apnea events which were not identified by the Miku took place when the nurses reported that the patient was being fed at the time.
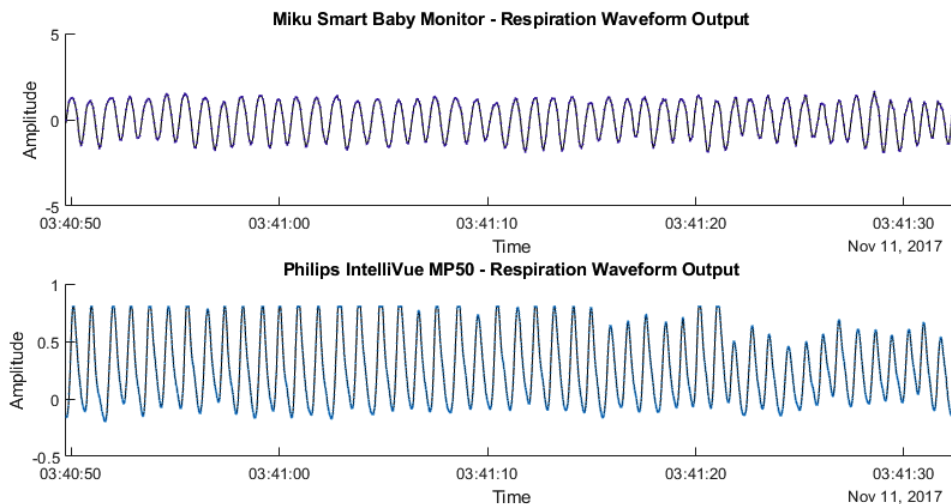
A resting patient's breathing waveform is tracked
by the Miku and the MP50
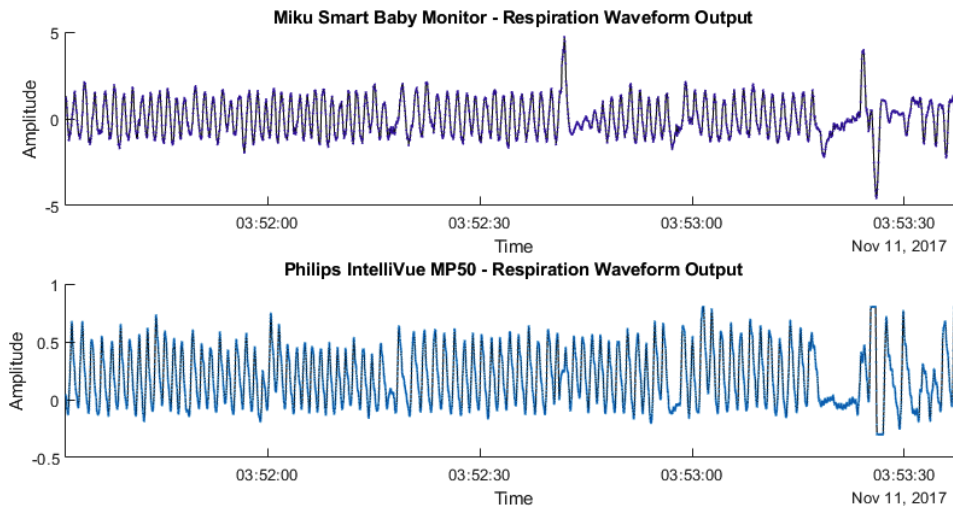
Periods of yawning and brief (normal) apnea, indicated by momentary lack of breathing and corresponding drop in SpO2, are seen by both the Miku and the MP50

In this instance, the Miku was able to capture the patient's breathing when the MP50 was unable to

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Conclusion

The Miku Smart Baby Monitor was validated using the hospital's MP50 as ground truth information, combined with expert knowledge and wisdom gleaned from Doctors, Nurses, and Parents in the MMC NICU. Just like the vitals sensor in the hospital, Miku identified the resting patient's respiration waveform, and will warn the parent of apnea event lasts for longer than 20 seconds.

We see the opportunity to use this data in the future to identify heart rate, predict medical conditions such as sleep apnea, or other breathing related illnesses.