Child/Infant Monitoring Device

Group 9

Create-X Capstone

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II. Executive Summary

Raising a child is extremely mentally taxing to new parents – while there are tips and heuristics to keeping a child safe from infancy through toddlerhood, a lot of parents play each day "by ear" and become exhausted in the process. No doubt constant concerns about Sudden Infant Death Syndrome, drowning, accidental strangulation, abduction, losing their child, choking, etc. take a toll on a parent's ability to relax, recharge, and be the parents they want to be for their children. Therefore, providing a robust, easy-to-use solution for parents to possess peace-of-mind around their child's safety is an incredible opportunity.

Interviewing over forty parents and cross-referencing with independent market research provide the insight required to drill down to two key areas of parent's concerns that also have a market potential of at least $100 Million and captures the interest of the engineering team responsible for designing a solution. Simply, these two areas are monitoring infant biometrics (primarily heartrate and blood-oxygen content) to provide parents peace-of-mind when they put their child down to bed and monitoring toddler and young-child proximity, particularly in dangerous situations (near bodies of water, around dangerous home settings, areas with a high concentration of strangers, etc.).

The "state of the art" in child safety monitoring remains in its infancy – a handful of products aim to provide ideas of children's bio-metrics, location, sleep patterns, and emergency situations. A couple of notable solutions include the Owlet (an infant sleep monitor) and Verizon Gizmo 2 (a child locator and communication device). The Owlet recently had to cut back its value proposition after pressure from the FDA, and the Gizmo 2 gets lack-luster reviews. After speaking with over forty parents, clearly none of these tools have captured the market. However, these solutions are attracting the attention of parents and venture capital – the Owlet even being evaluated at over one-billion dollars within the last five years. Clearly, there is need and potential for a solution. Most of the current solutions lack the "toughness" and reliability required to hold-up under normal use by children, especially active toddlers. Parents that are early adopters of this technology cite liking the idea of the value proposition, but are frustrated with the interface, reliability of the wireless components, and overall robustness of build-quality. Therefore, an opportunity exists to meet and exceed these design needs inside of an already-proven value proposition.

To this end, the team has gathered early design input and feedback from parents. Since the team is still ironing out the specifics of the value proposition it wishes to fulfill, designs stay in early conceptual stages and are subject to change as more information is gathered. Regardless, key functional requirements for either value proposition include a minimum of one day battery life, monitoring of heart rate, a non-irritating and non-toxic mechanical build, easy-to-use parent interface, ability to remotely connect to the device within a predefined range, zero choking risk, and a stand-alone alarm system. In the case of toddler/small child proximity monitoring, further functional requirements include detection of full submersion in water and proximity detection unaided by GPS.

The team will conduct more interviews and surveys in the immediate term to identify which value proposition poses the best opportunity for the team to execute. At this point, concrete requirements and design inputs will be captured from parents to inform the first stage of prototypes.

III. Nomenclature

Sudden Infant Death Syndrome (SIDS)

Pulse-Ox (Pulse-Oxygen) – a combined measurement of heartrate and blood oxygen content.

1. Introduction and Background

Raising children is a daunting task. Unlike so many other aspects of life, being a good parent isn't something one is taught or instructed how to do – for many people, a combination of intuition, drawing on previous experience, and a fair amount of trial and error are all major components in developing a parenting style. Perhaps the most significant fear, corroborated by many of our interviews, is the general fear of harm or misfortune befalling one's child. These fears vary with age: for infants, sudden infant death syndrome (SIDS) ranks the top concern for over 90% of parents, while for young children, locating the child around the parent (in grocery stores, parks) and drowning (pools, bodies of water) both ranked in the top major concerns of most parents (70%). Parents of infants described very high mental loads regarding their child's sleep, which resulted in more restless and less fulfilling sleep for the parents themselves, even when the infant was sleeping soundly. Similarly, parents of young children describe heightened cognitive loads whenever their children are in public spaces, including parks, stores, or pools. Reducing this mental load by designing a device which monitors the aspects of a child's life which make parents most uncomfortable is our main goal.

To further understand this problem, the team began by interviewing over 40 parents, ranging from parents of infants to parents of older children or past parents. In these interviews, parents were questioned about the difficulties of parenting, what activities brought them the most stress at different age ranges within their child's life, and what their significant or reoccurring fears were in regard to their child's wellbeing. Additionally, parents were questioned as to how interested they were in devices which monitored their children, and if so, what products currently on the market they had either purchased or had been interested in purchasing. They were also asked about their experience with such devices, or the stigma or opinion of such devices in their immediate parenting community. Additionally, a market analysis was conducted to identify competing products in the space and their relative successes and shortcomings. Across these interviews, SIDS was identified as the most common concern of parents of infants, while proximity monitoring and drowning were identified as significant concerns for parents of young children. At this stage, the team is pursuing both ideas, and will select one very soon, based on our immediate next steps.

The potential solution identified by the team is a wearable device which monitors the child's wellbeing, and sends this data wireless to a parent's phone, or a mobile base station. In the case of the infant, monitoring of heartrate and blood oxygen content (pulse-oxygen) which alerting the parent if the child stops breathing. In the case of the young child, pulse-ox will be combined with proximity detection, GPS, and water submersion alerts to address the significant stressors in parents' lives. Key performance aspects will be reliability (unreliable device connections or service drops place parents under even more stress than not having the device at all), safety (no choking hazards, ect.), and accuracy of provided metrics.

If pulse-ox is used in potentially life-saving applications, such as to monitor an infant's breath while sleeping, this will require FDA approval to be sold in the United States. However, if only used to monitor stress or provide quality of sleep information, this FDA approval is no longer necessary.

2. Teams and Founders

Team Member	Primary Role	Primary Task(s)
Dillon Wells	Firmware Development	Customer Engagement, Firmware specifications, Firmware implementation
Dustin Coha	Mechanical Engineer	Design, Prototyping, and Testing of Mechanical Components
Will Compton	Sensor Fusion	Interpreting Sensor Data Specifying and Implementing Sensors
Sandeepan Mukherjee	Mechanical Engineer	Mechanical Design, Prototyping, and Testing
Sathya Gummadi	Electrical Engineering	Electrical Design, Implementation, and Testing

2.1 Commitment:

- Dillon Wells
    - Dillon is committed to proving out a proof-of-concept and MVP by the end of the semester. His further involvement will be determined based on ability to achieve a viable MVP by end of semester and what options exist post-graduation. His current plan is to take a full-time job starting in August which would preclude him from being a full-time member of the founding team of this potential startup. Most immediately, his inclination is still towards starting in this position full-time post college.
- Sathya Gummadi
    - Sathya is committed to creating a high-quality MVP and prototype by the end of the semester with most of his work likely on the electrical design and implementation of the product. His plans after taking this class are to do an internship over the summer and then come back to Georgia Tech in the fall as a master's student. His inclination currently is to work on the potential startup part-time while interning and being a student.
- Will Compton
    - Will is committed to demonstrating a proof-of-concept functional prototype as well as an MVP by the end of the semester. His main contributions will likely come in signal process and firmware development. Future involvement in the program hinges upon admissions to graduate school; if accepted, he is leaning towards beginning his PhD in the fall, which would
- Dustin Coha
    - Dustin is committed to developing a working prototype and MVP by the end of the semester. His involvement at the end of the semester will be based on the success of the project as well as full-time employment options available after his graduation in May of 2022. He will be focusing on the mechanical functionality of the device.
- Sandeepan Mukherjee
    - Sandeepan is committed to developing a working prototype and MVP by the end of the semester. He has currently accepted a full time offer to start post-graduation, but the success of the project may have an effect on the commitment to the project after the Capstone Expo. He is focused on developing the mechanical functionality of the device.

2.2 Post-Semester Involvement:

There is no requirement that team members must continue with this project after the semester has ended. If the team is selected to participate in the Summer Launch program, each team member will have to make their own decision of whether they would like to participate or not. If the project is not selected to participate in the Summer Launch program and certain team members believe that the product has potential and would like to continue working on the project, they are more than welcome to do that.

2.3 Losing Interest:

If a founding member loses interest or otherwise does not want to continue working on the project, the team member will relinquish his or her non-vested equity stake in the company to be spread equally among the remaining members of the founding team. The team member will also surrender all company property or assets to the remaining founding team.

2.4 Decision Making:

All major decisions will be made with a super-majority of team members, according to the following formula, where team is a positive integer:

$$ceil((2/3) * sizeof(team))$$

3. Business Theses

Through about fifty interviews with parents, two major problems surfaced: combatting Sudden Infant Death Syndrome (SIDS) and knowing where children ages 2-7 are located relative to the parent (particularly around bodies of water).

SIDS was mentioned with higher frequency as a primary concern (almost always in top three, >= 90% of parents), with parents citing that it is a strong and constant concern. Some parents have spent over $400 on a device that claims to help prevent this problem, even when there is some controversy over the efficacy of the product. All parents who mentioned SIDS as one of their primary concerns had developed best practices around putting children to bed in hopes of avoiding such a situation (e.g., removing toys from the crib, placing the child on its back, etc.), and some had even gone as far as to take a baby CPR course so that they could attempt to resuscitate their child at home if the child were to stop breathing.

SIDS remains largely a mystery, though there is evidence to support the idea that monitoring a baby's heartrate and blood oxygen level when the child is asleep (at night or during nap time) can serve as early warning systems for parents to act if a lull in either is seen [1]. As such, the team developed the following business thesis:

> Parents of infants (between the ages of 0 and 2) will buy an over-the-counter heart-rate and blood oxygen content sensor because it gives them peace of mind in order to let them rest.

Moving towards toddler/school-aged kids, parents often talked about their desire to know what their kids were doing, particularly around bodies of water. Most parents (>= 70%) listed drowning as a major concern, and for this age group, lakes and backyard pools are the most frequent offenders (anecdotal information gathered from a general pediatrician and a pediatric ICU doctor). According to the CDC, drowning is the number one cause of preventable death in children aged 1-4, and it is the number two cause of preventable death in children aged four to nineteen [2]. Most commonly, the fears espoused by parents around pools and other bodies of water are simply knowing that their child is near the water or has entered the water. Multiple parents had stories of friends who had children that drowned or had drowning scares with their

own child. An extremely frequent complaint was wishing they had a "second set of eyes" or "second set of hands" just to keep an unwavering stare on their child. Secondarily, parents often recounted times of losing children in grocery stores, amusement parks, parks, and museums. Some even suggested (unprompted) that they wished they had a way just to know where their children were relative to them (within a few hundred feet). Similarly, most parents mentioned that they would love to know if their kids were getting into areas in which they were not allowed inside the house. All of these considerations led the team to develop the following business thesis:

> First time parents of children between the age of 2 and 7 will buy a device that monitors their child's proximity, detects water submersion, and provides heartrate, blood-oxygen level, and stress metrics because it will reduce the mental stress associated with constant child monitoring.

4. Landscape Deep Dive

4.1 Target Market:

In the case of infants, interviews established that SIDS is a primary concern of all parents, regardless of the number of children they have had previously. Therefore, the target market for the infant-monitoring device will be parents of infants between the ages of 0 and 2. The initial market will target the United States, although there are no significant barriers to selling this product internationally (some competitors, such as Owlet, see Existing Products, operate internationally). The CDC recorded 3,747,540 births in the United States in 2019, a number which declined by ~1% for the fifth year in a row [3][1]. Considering that around 75% of new parents buy a baby monitor for their newborn, at most ¾ of the remaining parents could be expected to be interested in purchasing the infant monitoring device [4]. This factor reduces the addressable market to a size of 2,800,000 parents/year. Placing approximate bounds on the price of the infant monitoring device from $40-$400 (see Existing Products), the total market size falls within the range $112 million to $1.12 billion per year.

A similar analysis of target market size is in order for the child monitoring device. The target market will be parents of children aged 2-7. ChildStats.gov places the number of children in the 2-7 age group around 23,500,000 [5]. This group will experience turnover (new children turning 2 years old) approximately equal with the birth rate, of 3,750,000 children per year [3]. Based on the fact that roughly 1/3 of parents track their children's location, at least 1/3 of parents would reasonably be expected to show interest in our product, which includes significantly more desired functionality beyond location monitoring [6]. With this factor, the total addressable market is sized at 7,800,000 parents, with a turnover rate of 1,250,000 parents/year. Again, assuming a product price range of $40-400, the total market size is $312 million to $3.12 billion, but with a yearly turnover of $50 million to $500 million.

Both analyses can be fine-tuned as the team conducts more quantitative customer interviews, to gauge interest more directly in the exact products hypothesized. Additionally, costing the device will significantly narrow the total market ranges, which are broad simply because the device is so lightly defined yet.

4.2 Major Competitors:

The major competitors for the infant monitoring device are somewhat limited, including the Owlet Dream Smart Sock, and Sense-U (detailed in the existing product section). The Owlet Smart Sock has sold over 1 million units, at a cost of $359. The Owlet Smart Sock was originally sold in department stores, online both through a first-party website and retailers such as Amazon. Due to recent pressure from the FDA, Owlet halted their sales in the US to pursue FDA certification of the sock as a medical device; currently, their product is still available for purchase in other countries. A rebranded version of the product, which does not include oxygen level monitoring, is available for sale in the US and online, from either their website or online retailers such as Amazon, and costs $299. At this price point, Owlet aims at a luxury to

mid-market device, as this price may be prohibitive for many prospective buyers. The Sense-U sells its sensor suite for $499, and it aims at a similar market sector to the Owlet devices. It also sells the sleeping sensor by itself, for $120, aiming at a more economical sector of the market. This may also be an excellent option for people who have already purchased a video-monitoring system for their infant. These devices are sold online at the company website or at online retailers such as Amazon, in addition to in department stores.

The FDA pressure applied to Owlet came in the form of a Warning Letter, which deemed Owlet in violation of the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. § 351(f)(1)(B), which states that the device requires premarket approval to be sold in the US [7]. Because the Owlet Dream Smart Sock measures pulse-oxygen in life-critical applications, the device needs to be certified as medical grade (similar to the certification given to the Apple-Watch for their EKG measurements). Our infant monitoring device would certainly fall into a similar category, while the toddler monitoring device may be able to dodge this certification depending on advertising and functionality claims.

In the space of infant monitoring systems, there exists some significant competition. However, feedback during our customer interviews indicates that many of these devices perform only some small subset of desired functions, have accuracy or connectivity issues, or are poorly received for other implementation reasons, although the intent behind the product is highly desired. The proposed infant monitoring device aims to tap into this unmet need and provide a desirable solution in a space where most existing products just miss the mark.

The major competitors for the child monitoring device hit a significantly lower price point than that for the infant monitors. Ranging from purely proximity detection at $35 in the My Buddy Tag up to $99 plus a monthly fee for GPS tracking and messaging capabilities in the Gizmo Watch 2, products in this space hit a lower price range than the $100s spent in the infant monitoring space. To be competitive, the team's device must come into this sub-$100 price range and will implement an array of functionalities specifically requested by parents. The ability to detect drowning, or at least the presence of water, will be a major unique feature which competing devices lack.

5. Existing Products

There are many existing products on the market that claim to solve these problems, although the products that currently exist tend to be poorly made, unreliable, and of poor build quality. Many of the current products that do provide this reliability and high build quality are costly and require monthly subscriptions. A few existing products in both the child and infant monitoring space are shown below.

5.1 Toddler Proximity Sensing Devices:

Gizmo Watch 2 – $99 plus activation cost and monthly fee - The Gizmo watch is a device designed for children to wear around their wrist. The watch is connected to 4G LTE through the Verizon network and provides location information to the parent's smartphone. The watch enables children to text up to ten contacts. It also includes step count, notifications, and calls. Many of the reviews claim that the watch has a poor build quality, does not change, and that the battery dies very quickly. Overall, the watch is not reliable and seems to be marketed towards older children who are often away from their parents.

Monkey KID Sensor – $39 - Strictly a proximity sensor that will send a notification to the user's phone when the sensor has gone past a user specified range. Claims to allow the user to choose a perimeter between 15 and 150 feet. The product cannot currently be purchased. On the website it says that the

product is sold out and on amazon it says it is currently unavailable. The reviews from when the device was available are also extremely low, claiming that the device does not accurately monitor distance.

Kiddo – price unknown – Strictly a health monitoring device. Marked to children aged 2-10 and claims to monitor temperature, blood oxygen, pulse, and stress. The device has recently received FDA approval. An article about the product claims that the company plans to work with hospitals to provide children with wearable devices.

My Buddy Tag - $35 – The My Buddy Tag is wristband that provides proximity detection to alert the parent when the child wanders outside of a range, and it will provide data on the child's last seen location. It also gives water safety alerts if a child falls into a water body or pool. This device contains no health monitoring technology, and instead is a very bare minimal wristband with a nice one-year battery life but poor aesthetic quality. The reviews for the device are average with some saying that it is unreliable and gives too many false alarms. The company has also stopped selling wristbands, citing the supply chain issues and chip shortage.

There currently are not any devices on the market that are readily available to parents that provide accurate biometric information about their child, accurate proximity sensing, and drowning detection. The Kiddo device is the most similar what we are looking to develop and there is little information on the quality of this device.

5.2 Baby Monitoring Devices:

Owlet Dream Sock - The Owlet Dream sock is a sleep monitoring sock for children aged 0-5. The main function of the Dream Sock is to monitor sleep, providing parents with sleep data. The sock tracks walking, heart, and movement. The product is now classified as a medical device. The cost is $400.

Sense-U - This device tracks breathing, roll-over, body temperature, and ambient temperature. The device costs $130. The parent interface currently includes a smartphone app as well as a "puck" that has an LED strip that changes colors to indicate different metrics.

NEEBO - Measures heart rate, blood oxygen, and temperature. Cost is $270. Wrist bracelet design. Claims that it is not a medical device and does not replace any prescribed medical device. Does not include a standalone alarm system.

Levana Oma – The Oma stays on a baby's diaper and constantly monitors abdominal movements. When no movements are detected for 15 seconds or more, the device creates vibrations to gently rouse the baby, and if the baby doesn't respond within 5 seconds, then an emergency alarm is triggered to notify the parents. The device costs $95 and has high reviews for its accuracy and simplicity.

For infant monitoring devices, the most impressive device is the Owlet Dream Sock. Many of the parents we interviewed brought up the Owlet Dream Sock and stated that it is something they would have purchased if available when they had children or were considering purchasing (if it were available in the US). The infant monitoring device will likely contain a combination of the above devices, providing meaningful insights and features such as heart rate / rhythm, sleep data, roll-over, breathing / O2 data, and temperature while having a simple design, effective alert system, and a fair cost.

6. Customer Requirements and Engineering Design Specifications

Given that the team is considering two potential paths to go down, two sets of functional requirements for both potential problems and their respective solutions have been outlined. The functional requirements are listed in Table 1. Both problems require a solution that addresses similar functional requirements. One of

the most important requirements is that the devices must have a battery life of at least one day to remain operational without risk of the device running out of power. In addition, both devices would need to be child-proof, so that the children/babies do not easily remove the device. A deterrent for removal would be to minimize the irritation on the child and be completely free of any toxic materials which would be unsafe for the child. The devices must be non-restrictive to the child's breathing to keep them safe and provide peace of mind to the parent. The device must also communicate or display the data collected with the parent, as they are the primary stakeholders, to quickly alert them to any danger the child is in or keep the parent aware of the status of the child in normal life.

However, each problem does pose a different set of functional requirements that specifically serve their respective solutions. In the case of the infant monitoring device, the device must be able to monitor the baby's heart rate and blood oxygen levels constantly. There is less of an emphasis on determining a child's proximity, but rather being able to detect relevant biometrics from anywhere in the house. Another important function is to be able to quickly alert the parent of any major sudden health complications that could be life threatening for the child. The toddler monitoring system, on the other hand, does need to be able to constantly determine the proximity between the child and parent on a near-constant basis. This proximity detection needs to be operable without the need for GPS as well because GPS tracking is a more involved implementation that does not work in locations without cell service. Given that parents need to be able to always monitor their children's proximity regardless of cell service, GPS is not a viable option.

For the prototyping and ideation stage, the team will be aiming to meet some design parameters and is looking to prioritize the requirements that are necessary for the device to perform its marketed use and pertain to the child's safety (no risk of choking, non-toxic, no strangulation risk, etc.). These will be prioritized for the device to have high accuracy for its targeted use and have zero risk for any child using it. The sensors that are responsible for detecting heart rate, blood oxygen, and other relevant biometrics should be at least 95% accurate. To keep accuracy high and the costs of the sensors low, sensor fusion is a technique being investigated. Also, for the baby monitoring device, the parent should be able to receive data from the device from anywhere in the house. According to several sources, the average square footage of a suburban house is around 2,500 square feet, so the parent should be able to detect the child's biometric data within at least 5,000 square feet of the device. For the toddler monitoring device, the proximity sensor should have a range of at least 150 feet to help keep an eye on a wandering child. Regarding materials used in either device, materials that are flexible, soft, non-toxic, and non-irritating for babies and children such as fabric, microfiber, polyester, and nylon will be prioritized. With the actual electronics inside of the device, the device must produce less than 50dB to avoid waking the child and should produce minimal amounts of heat to reduce power consumption and avoid burning the child.

7. Preliminary Design Concept Ideation

The team has not yet spent a significant amount of time brainstorming design concepts. The designs mentioned in this section have merely been brought up in casual conversation or during the brainstorming of functional requirements. There will be many more brainstorming sessions that will dive deeper into design concepts. Because the team has two business theses, the team is currently looking at design concepts for both an infant monitoring system and a child monitoring system. The main constraint of these designs is that they must be touching the infant or child during use. This is the impetus for the design concepts being wearable like a wrist bracelet, ankle bracelet, sock, or belt attachment. Some of these designs are shown in the figures of table 2. Many of these concepts are applicable to both infant and child monitoring systems. When interviewing parents of young children, many of them brought up the idea of a GPS tracker in the form of jewelry such as a necklace or hair accessory. These types of accessories might be more intuitive for children, possibly preventing them from removing the device.

The crucial functional requirements for the infant monitoring system include monitoring blood oxygen, monitoring heart rate, and remote monitoring anywhere in the user's house. These three requirements have a large impact on the design of the device. A blood oxygen and heart rate monitor will need to be housed inside the device, as well as an antenna that ensures the desired connectivity and a battery that can power these electrical components for at least 24 hours. Another requirement is the ability to charge the battery. The device will have to have some sort of wired or wireless charging capability, further increasing the overall size of the device. A few functional requirements that will determine the physical design of the device include non-irritating, zero risk of choking, and rugged. Material selection will be crucial to achieve the non-irritating and rugged requirements. It is likely that silicon plastic will be used for most of the devices due to its rugged, flexible, and soft properties, but other materials will also be investigated.

Our design concepts for the child monitoring device are very similar to those listed for the infant monitoring device above. A few additional functional requirements are that the device detects child submersion and must be child proof. A water pressure or water level sensor could be used to detect how deep the device is under water. A requirement that comes along with water detection is water resistance. The design must have an IP67 rating. To make the device childproof, a special clip or watch band needs to be designed so that it is easy for the parent to put on and off the child, but difficult for the child to take off.

8. Summary and Next Steps

Parents want to monitor their child's health to give them peace of mind over their child's safety. Two potential ventures of note were determined in this space. The first is to provide real-time data collection and immediate notification of a medical emergency to parents of infants (between 0 and 2 years old), and the second avenue is the proximity and heath detection of young children for parents. Based on several interviews, these two areas were specified to be of interest by parents who wished for "an extra pair of hands" to help keep track of their young children. Further research has found existing solutions within the space already, but very few are readily available and promise the same level of functionality as this team aims to deliver.

The next steps for the project are to conduct further interviews with parents to determine which area of concern is more pressing and should be explored further. In addition, these interviews serve a further purpose to emphasize current functional requirements and/or uncover new needs that have yet to be addressed. Afterward, the team will begin developing the first low fidelity prototypes to test sensor efficacy and compatibility. The objective will be to select sensors that match the design parameters outlined and still be within a reasonable price range for the final product to be priced competitively. An important milestone to reach would be to develop a medium fidelity prototype that can detect readings from all relevant sensors and be implemented into a rudimentary wearable device for young children.

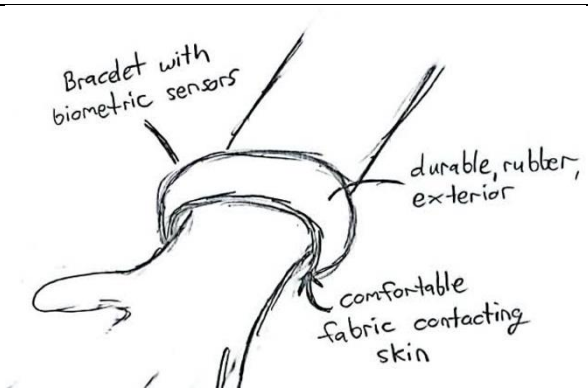
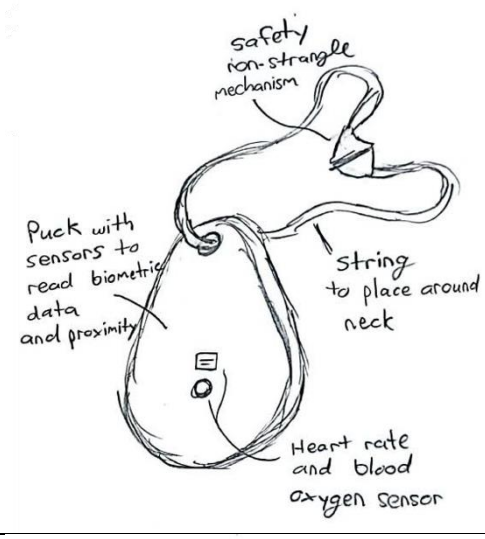
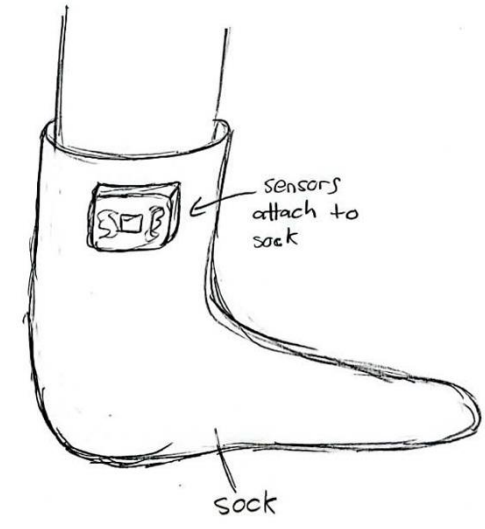
9. Appendix A1

Functional Requirements:

Infant Monitoring Device	• Comfortable • Detects rolling off back • Does not require FDA Compliance • Easy to put on and take off • Low Heat Production • **Minimum 1 day battery life** • **Monitoring Blood Oxygen** • **Monitoring heart rate and heart rate rhythm** • Noiseless • **Non-Irritating / Non-Toxic** • **Parent Interface** • **Poses zero risk of choking** • **Remotely monitored from anywhere in house** • Rugged • Sleep Tracking • Temperature Tracking • **Stand Alone Alarm System** • Stays on baby • UL Certified • Washable • **Zero risk of strangulation** • **Charging capability**
Child Monitoring Device	• **Child Proof** • **Child Submersion Detection** • Comfortable • **Complete Submersion Detection** • Dishwasher Safe • Does not require FDA compliance • Easy to put on and take off • GPS • Low heat Production • **Minimum 1 day battery life** • Monitor Blood Oxygen • Monitor Heart Rate and Heart Rhythm • Monitor Stress • **Non-Irritating / Non-Toxic** • **Parent Interface** • **Proximity without the use of GPS** • Rugged • UL Certified • **Zero Risk of Strangulation or Choking** • **Charging capability**

10. Appendix A2

Design Concepts:

Wrist Bracelet / Watch		-The wrist bracelet would be made of a durable rubber material with a comfortable plastic. -All the sensors and electronics are housed in the wrist bracelet. -There are no screens or buttons on the device.
Necklace		-Design consists of a "puck that hangs from the user's neck by a string. -All biometric and proximity sensors are housed in the puck. On the string there is a break away mechanism that prevents choking.
Ankle Bracelet		-This design consists of a sock that the child or infant wears. -The sock has a sensor box stitched into the fabric.

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