Chapter 1
REQUIREMENT ANALYSIS

1.1 Background Problem

In household activities, a parent's job is not only taking care of their babies, but also cooking, tidy up the house. They also have other jobs, such as doing their job to fill their household needs. However, the babies must also be closely monitored; it is extremely dangerous if the baby is not supervised. As reported from smartcolaw.com, entitled "Regulation on Working Hours in Indonesia," Indonesia has seven hours within one day to work [8]. Of course, parents do not have enough time to supervise their babies. This is not a problem if they have a babysitter or caregivers if both parents work, but it is a problem for parents who don't have a babysitter or caregivers; even if a housewife supervises the baby, they also have household work to be done such as preparing food, cleaning their house, and others. While doing household activities, a housewife can't supervise their babies intensively. **It needs a solution to supervise the baby that can make housewives or parents run both things simultaneously to minimize the possibility of unwanted outcomes for their babies.**

The rate of injury or death to infants under one year is usually caused by a lack of supervision of infants. From one case of infant death that has occurred due to parental negligence so that the baby fell from a highchair [1], During infancy, babies have spontaneous movements such as moving their hands or legs that can make their bodies shift unconsciously [2], So babies need extra such as provision to supervise their movement. Sudden Infant Death Syndrome (SIDS) is an unexplained death that can happen because of a proning position during sleep. It can make the baby not breathe well because their nose is closed or because the baby's nose is closed by a blanket or other obstacle that can make SIDS happen. It can happen to infants under one year because they cannot move the blanket or get back to the right position when proning. SIDS usually befalls a four-month-old baby or under four-month-old baby. Only a few parents know about SIDS [3].

In traditional way some parents will using more of their time to caregiving their baby, and also some of them will hire a babysitter to sit and watch their baby to make sure the baby safe. Therefore, **a device that can accurately detect the baby and alert caregivers can be an important tool for ensuring the safety and well-being of infants.** According to research published in the journal [10], a baby's cry can be detected when the baby's peak sound is greater

than 73 dB. However, as the volume of a baby's cry is often low, it may be difficult for parents to hear the cry if they are not in close proximity to the baby.

Therefore, a device that can detect a baby's cry and alert caregivers is needed, even when they are not physically present with the baby. 3 The "Baby Monitoring and Control System" described in the journal "Design and Development of a Smart Baby Monitoring System" [5] is a tool designed to alert busy parents when their baby wakes up and to prevent incidents of Sudden Infant Death Syndrome (SIDS) using ultra-wideband technology [2] [5]. The system utilizes sensors, a camera, and a microphone to detect and alert caregivers to a baby's movements or cries and may also be able to detect the presence of other humans or babies in the surrounding area. In addition to these capabilities, research has shown that the use of white noise may be effective in helping infants with poor sleep quality fall asleep and improving their overall sleep quality, as described in the journal "The Baby Sleep Quality Using of White Noise in Hypno Sleeping Process" [9**]. Good-quality sleep is important for a baby's growth and development, as it can impact factors such as growth hormone levels and the immune system.** Therefore, incorporating white noise as a feature in a baby monitoring system may be beneficial in ensuring the well-being and healthy development of infants.

Fig 1. 1 SIDS Illustration

From previous research [5], which also explains the baby monitoring system**, the device has certain limitations, such as relying on multiple sensors for detecting the baby's movements and cries.** However, incorporating Artificial Intelligence (AI) into the system could improve its effectiveness and efficiency. AI systems are being increasingly used for various applications because they are considered more efficient and have lower energy costs [6]. In addition, previous research has shown that PIR sensors may not always accurately detect the presence of humans and babies around the baby, leading to potential false predictions. Therefore, it would be beneficial to expand the coverage area of the system beyond just the baby's bed in order to monitor the baby's activities and movements. By implementing AI to

detect the baby's cries and automatically generate white noise to soothe the baby, if necessary, the system could be more efficient in providing comprehensive care and supervision for the baby.

1.2 Supporting Information

According to the article in "kid.spot.au" with the title "A baby loses his life in a highchair accident," the parent had to leave the baby, then she heard a thump twice followed by screaming from the baby. When the parent was not present to supervise, the baby fell [1]. In this article, it is explained that a baby died because the baby was separated from the supervision of his parents. Because of the lack of supervision from their parents, the baby had spontaneous movement.

Zulfa Meizanita, in her journal, explains that in the motor development experienced in infants, babies have spontaneous movements, starting from shaking their feet and squeezing their fingers, and crying [2]. Therefore, babies need extra supervision to avoid the risk of falling.

Besides the baby's spontaneous movements, the baby must be watched in his sleeping position (SIDS). In the journal article entitled it is explained that babies who have the wrong sleeping position (prone) can cause sudden death [3]. Therefore, it needs a system that can detect the baby's sleeping position. If the baby is in the wrong sleeping position, the system immediately sends a notification that the baby is in danger. Of course, caring for a baby is very complicated and must be monitored constantly. Aside from SIDS, another issue that always befalls the baby is that the parents do not understand the meaning of the baby's cries.

Fig 1. 2 Baby monitoring device on amazon.com

Baby monitoring tools on the market are expensive, with features that only show real-time baby videos and only send the sound of the baby crying in the application. From the data obtained, the price of the baby monitoring tool is $399.00 on the Amazon.com website. The features that exist in these tools can only help parents when they are using their smartphones. The device also does not provide notifications when the baby is in danger, such as the wrong sleeping position and crying.

Table 1. 1 Summary based on survey

NO	Question	Answer	
		Yes	No
1	Do you have other jobs besides babysitting?	2	19
2	Do you have a babysitter or babysitter to watch over your baby?	0	21
3	Do you have any trouble supervising your baby?	14	7

From the survey gathered from the housewife, working mom, and newly weds, 7 out of 21 respondents had difficulties supervising babies, and 2 out of 21 had a babysitter at home. In the survey, two respondents with a babysitter had no difficulty supervising the baby. Seven respondents who did not have a babysitter at home had difficulty supervising the baby. There are three reasons respondents have activities other than taking care of their babies, such as taking care of their household activities, because they do not have a babysitter at home. For these reasons, it is explained that it is a concern for parents because the baby is very active [2].

1.3 Constraint

1.3.1 Security and Privacy Aspect

The baby monitoring device must prioritize user privacy and data security. It should implement robust encryption protocols to protect the sensitive data transmitted or stored by the device. ensuring that unauthorized individuals cannot access or intercept the information. The device should also provide options for secure and private communication between the device and the accompanying mobile app or parent unit and should adhere to applicable privacy regulation and standards.

1.3.2 Manufacturability Aspect

In the manufacturing aspect, this system must be easier to build, it has to be easy to get the material for building the device. Also this system has to be integrated with web-based applications that will make the installation and duplication lots easier.

1.3.3 Safety Aspect

For this aspect there are several safety considerations to take into account when implementing a baby monitoring and control system, one important aspect is the reliability and accuracy of the system's sensor and algorithm. The system should be able to accurately detect the baby's movement and cries, and alert caregivers when necessary. If the system produces false alarms or fails to detect important events, it could create unnecessary stress for caregivers and potentially compromise the safety of the baby.

1.4 Direct Needs

Based on the analysis that has been done, the system for monitoring children in the cradle is very much needed in child supervision, considering the dangers when children experience danger without parental supervision, therefore an intelligent system is needed as follows.

1. System can track and decide the baby position and movement inside the cradle.
2. System can detect if the baby is crying or not.
3. System can give notification, whether the baby is crying or in a dangerous situation.
4. System can provide a live monitoring to the parents.
5. System can help the baby sleep even if the parents are not around.

1.5 Objective

To fulfill the required objectives, several tasks must be accomplished. First, a system needs to be developed to track the baby's position accurately. Next, another system should be designed with the capability to detect whether the baby is crying or not. Additionally, there is a need to create a system that can promptly notify and alarm the user in case the baby is in a dangerous situation. Moreover, the development of a system allowing live monitoring of the baby from a long distance is crucial. Lastly, it is essential to incorporate a feature in the system that provides comforting white noise when the baby cries. By achieving these tasks, the needs related to baby monitoring and care can be effectively met.