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Project Proposal Report

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An intelligent robot for monitoring and protecting toddlers.

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Project Proposal Report

Lakshan W. R

IT20093150

Supervisor - Prof. Sanath Jayawardena

Co-Supervisor - Ms. Rangi Liyanage

Computer Systems and Network Engineering

Computer Systems and Engineering Department

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DECLARATION

We declare that this is our own work, and this project does not incorporate without acknowledgment any material previously submitted by anyone else in SLIIT or any other university/Institute. And we declare that each one of us equally contributed to the completion of this project.

ABSTRACT

In recent years, there has been a surge in interest in developing intelligent robots for a variety of applications, including monitoring and protecting toddlers. This document describes the design and development of an intelligent robot system for monitoring and protecting toddlers in homes and childcare facilities. The proposed robot system is intended to monitor toddlers and their activities in real time. In this study, an intelligent robot was designed and developed to assist parents and caregivers in monitoring and protecting toddlers. This robot is outfitted with a variety of sensors, including cameras, microphones, and motion sensors, which can detect the toddler's movements and activities. The robot can also learn and adapt to the toddler's behavior over time, making it a more personalized and effective monitoring and security tool. The robot also has an intelligent algorithm that detects potential hazards and alerts guardians or parents if their children are in danger. The robot has several functions, including alerting, navigating, automatically playing lullabies, and capturing toddler behaviors. The robot is to ensure the safety and well-being of toddlers while providing parents and caregivers with peace of mind. Overall, the intelligent robot that monitors and protects toddlers is a useful tool for parents and caregivers. Its advanced features ensure that the toddler is safe, stimulated, and well cared for. This technology has the potential to transform the way we care for and interact with toddlers, and we anticipate it will be a valuable addition to the parenting framework.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In recent years, the field of robotics has made significant advances in developing intelligent robots capable of performing a variety of tasks. Robots have shown particular promise in childcare, where they can provide invaluable assistance to parents and caregivers. Intelligent robots for monitoring and protecting toddlers are a particularly important application of this technology, as they can help ensure young children's safety and well-being. This study describes the design and implementation of an intelligent robot for monitoring and protecting toddlers.

The robot has several advanced features, such as alerting, navigating, playing lullabies automatically, and capturing toddler behaviors. These functions are intended to ensure that the robot is capable of providing comprehensive care to toddlers as well as support to both toddlers and parents. The robot's alerting function is especially important because it is designed to detect behaviors and alert parents or caregivers of any potential risks to the toddler. This function is dependent on sensors and cameras, as well as microphones strategically placed in the robot, to monitor the toddler's movements and behavior. If the robot detects any abnormal behavior, such as crying or struggling, it can immediately alert the parents or caregivers, allowing them to intervene quickly and protect the child. The navigation system of the robot is also an important feature because it allows the robot to move around the toddler's bed autonomously and track the toddler's movements. This feature ensures that the toddler is always visible and that the robot can react quickly to any potential danger. Developing the robot's automatic lullaby-playing function is my personal contribution to this research project. It aims to provide extra support to parents and caregivers by soothing the toddlers by playing automated lullabies when they are restless or need to sleep. The music selection of the robot can be customized, allowing parents to select songs that they know will be soothing and calming for their child. The automatic voice call communication feature is developed to generate a voice call for parents so that they can talk to the toddlers in case of special behavior or problem situations. This feature can be especially useful to communicate in special situations when their little one

is not in the same room or when they are away from home. This function also developing as my personal contribution for this research project. The intelligent robot for monitoring and protecting toddlers has the potential to provide parents with a trustworthy and innovative tool for ensuring the safety of their child. It has the potential to revolutionize childcare by providing parents with an automated tool for monitoring and protecting their toddlers.

1.2 Research Gap

The use of intelligent robots to monitor and protect toddlers is a new area of research that has the potential to improve child safety while reducing caregiver burden. These robots can perform advanced functions such as alerting, navigation, automated lullabies playing, toddler behavior capturing functions, and automated voice call mechanism as a communication method, which can aid in the prevention of accidents and the improvement of childcare. However, there are several gaps in the literature that must be filled in order to fully comprehend the feasibility and effectiveness of such robots. This research gap document aims to identify some of the key areas in this field that require further investigation. Lullaby playback can be a useful function of an intelligent robot for toddlers, especially during naps or bedtime. However, there has been little research into how to design the robot's lullaby-playing functionality to ensure that it is effective in promoting relaxation and sleep. More research is being conducted to determine how to choose appropriate music and sounds for the infant's age and preferences, as well as how to automatically design the robot's lullaby system to be interactive and engaging for the toddler. An automated voice call mechanism can be a useful way for the robot and caregiver to communicate, especially in an emergency. However, there has been little research into how to design the voice call system so that it communicates important information to the caregiver effectively. More research is needed to determine how to design the voice call system to be clear and concise, how to ensure that the caregiver is always reachable, and how to make the voice call system interactive, particularly how to automatically generate a voice call to the caregivers in order to communicate with the toddlers.

1.3 Research Problem

The busy schedules of today's parents are causing them a lot of issues. Our project team was able to pinpoint the need for more time to care for their children as the main issue. The fact that there are still a lot of requirements to fulfill is still a major problem. When a parent neglects to care for their child when it is necessary, it can result in abuse on both sides. The parent and child were considered when choosing a solution for the research project. With the help of our solution, parents will be able to keep an eye on their kids from a distance, learn more about the influences outside their home, recognize when their kids are acting in ways that require their attention, and even play music or engage in conversation with them. In this instance, it was decided to create a robot that can help parents tend to their children's needs. The robot is mobile and can move around the child's current location. Additionally, it wants to use this robot to monitor the child by coordinating its movements with the child's actions. This allows the parents to remain focused on the child. Also made the decision to create a system for identifying the child's behaviors and alerting the parents. In this way, even when the parents are not paying attention to the child, their needs and behaviors can be understood. We also hope to enable the child to use the robot to converse with the parents or play a particular song or lullabies. Finally, the robot we plan to build will allow parents to communicate with their children even when they are not around.

1.4 Research Objective

Toddlers are likely to cause accidents and injuries due to their inquisitive and exploratory nature. Parents and guardians are frequently unable to provide constant supervision, especially when multitasking or in potentially hazardous situations. The main objective is to develop an intelligent robot that can monitor and protect toddlers, which can be a valuable child safety solution. The robot can detect potential hazards, track toddler movements, alert caregivers in the event of an emergency, navigate through the environment while avoiding obstacles and hazards, and play lullabies to soothe the toddler. The use of soothing lullabies can improve a toddler's overall well-being. Lullabies can help a toddler relax and sleep better while also reducing stress. The ability of the robot to automatically play lullabies can be a valuable solution for parents and caregivers who may not have the time or ability to do so themselves. During a special situation, the robot's

automated voice call mechanism can be a valuable communication tool. If the robot detects a potential hazard or the toddler is in danger, it can automatically notify the caregiver via voice call, allowing for quick and effective communication. In the present, often busy parents do not have an opportunity to know about the special events and behaviors of their little ones while away from home. Based on these facts, this robot is being developed primarily as a solution to the busyness of parents.

1.5 Research Questions

- How can lullabies be chosen and played by an automatic system based on a child's needs, sleep patterns, and mood?
- What kinds of sensors and software are needed to instantly identify a child's mood and sleep patterns?
- What type of sensor modules and mechanisms need to generate the automated voice call?
- How can the system be made so that parents or other caregivers can choose their favorite lullabies or add their own recordings with ease?
- What is the output source that can be used to play lullabies?
- What type of data need to measure from the toddlers?
- How can generate an automated voice call to the parents?
- In which occasions does the system generate the automated voice call to the parents?
- Can parents talk live with their toddlers in these special situations?

CHAPTER 2: BACKGROUND & LITERATURE SURVEY

This chapter provides a description of the previous research works that have been carried out in relation to the project that were proposed, as well as the current work status of the project. The following is a summary of the different researchers and projects that have been attempted in the past that are similar to the proposed project.

The baby cradle is a need of day-to-day life that helps the parent to sooth a baby. It is the safest place for a baby to sleep comfortably and enjoy in the cradle. There are many devices or cradles available in market, such as conventional or manually operated cradles. However, these conventional cradles are not able to provide a safe or hygienic environment to their infants. To address this, the researcher developed some devices or technologies which helps to parents to sooth their infant. These devices include remote controlled, or voice activated cradles which swing automatically when baby starts crying, and a voice activated device which swings automatically with soft music when baby start crying. [1] In general, parents find that the current cradles are not very helpful and have some issues. Parents must constantly monitor their children in these types of traditional cradles. However, some working women do not have enough time to care for their young children. The researcher claims that there are practical approaches to soothe and maintain their calm. The main goal of the system is to create a fully automated baby cradle to assist working mothers. It offers music, a body temperature monitor, and automatic swing. offers a product that is less expensive and more flexible. Easy to use, straightforward operation, DIY product. [1]

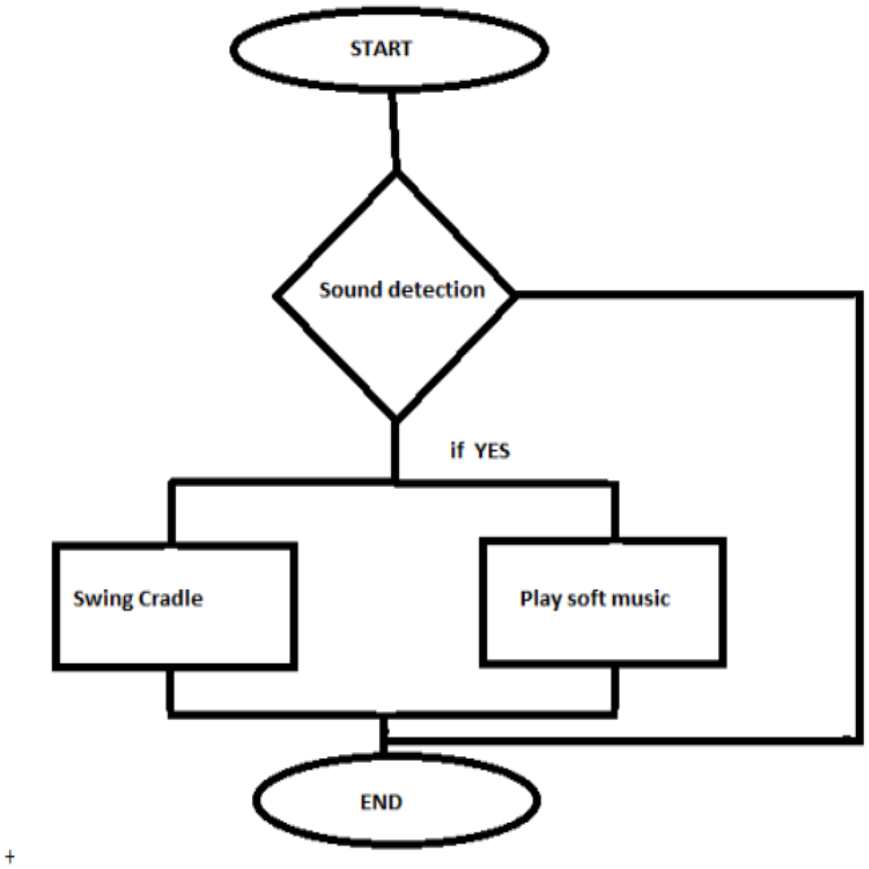

Figure 1: Flow chart

The system's flow diagram, which shows the soft music playback, automated cradle swing, and sound detection. The sound sensor notifies the microcontroller when a baby's sound is detected, and the microcontroller uses the information to start the motor that swings the cradle while also playing soft music. [1]

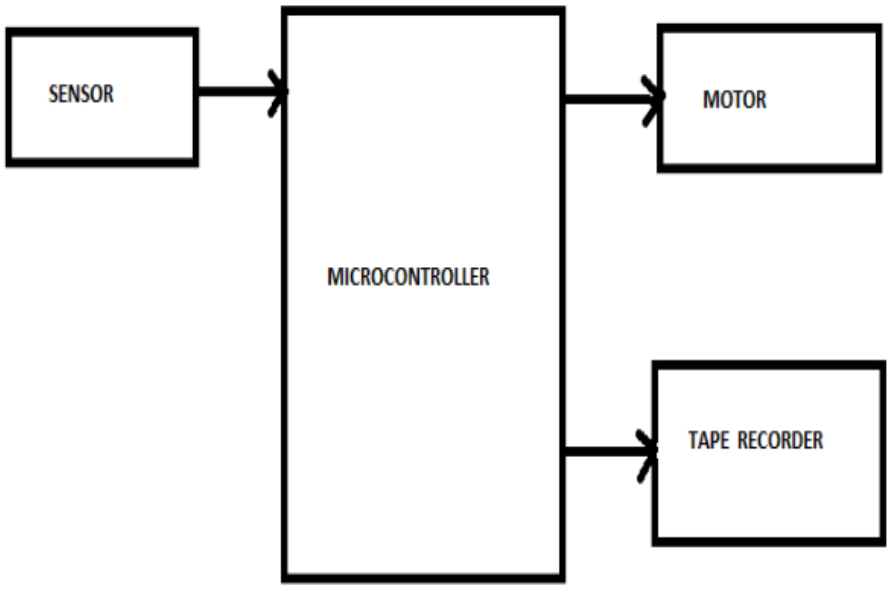

Figure 2: Block diagram

The blocks diagram for the sensor, microcontroller, motor, and sellotape recorder are shown in the block diagram of our system. [1] When a baby is crying, the sound sensor picks up the sound and sends information to the microcontroller. The microcontroller verifies that each condition is met before starting the motor and initiating the cradle swing. Microcontroller starts soft music to calm the baby simultaneously. All parameters in this system are being controlled by a microcontroller. We prioritise the baby's safety before thinking about the mother's needs. The cradle has a lot of controls, including the swing, temperature, and music to calm the baby. [1]

While keeping an eye on infants constantly is important, it can be challenging for parents. Some parents use standard CCTV to keep an eye on their children, but it cannot alert them to emergencies. Additionally, even though some wearable technology is designed to alert parents, many parents are concerned about electromagnetic waves coming from the devices. Additionally,

these systems require users to purchase pricey specialized hardware. We developed an automated baby monitoring service that alerts to emergencies like crying and rolling over while requiring less hardware as a result of these issues. The service's main features include detecting infant cries using EfficientNet, parents-to-baby video streaming and voice transmission, recognizing the baby's emotion, and notifying of detected events. [2] Other features include monitoring dangerous lying posture based on OpenPose. A real-time, open-source system called OpenPose finds body, foot, hand, and facial key points to determine a person's 2D pose. This library offers high-quality estimation that is sufficient for real-time use. We selected OpenPose and modified it to run on TensorFlow in order to accurately identify the baby's body parts and determine whether the baby's posture is dangerous right away. The baby's skeletons are visible in both safe and dangerous sleeping positions in the figure. [2]

Figure 3: 1. Body, foot, hand, and facial key points of a baby sleeping in safe (a) and dangerous (b) positions detected by OpenPose.

Researchers used transfer learning to train deep neural networks of EfficientNet specifically for crying detection using mel-spectrograms of 3599 baby crying sounds ("crying") and 3607 environmental sounds ("not crying"). The sample sounds are obtained from the GitHub repositories "donateacry-corpus" and "ESC-10: Dataset for Environmental Sound Classification". LibROSA is then used to extract the spectrograms. 20% of the datasets were used to test the model,

and the remaining 80% were used to train it. EfficientNet-B3 was the best for our datasets, so we modified it to include a GlobalMaxPooling2D and a Dense layer. [2]

Scikit-classification report Lean's was used to create the classification report data. The precision of model was 0.96 for crying detection, and the accuracy was relatively high for some particular crying patterns when we sliced and recognized the spectrogram at intervals of a second. They always looking for ways to increase accuracy. [2]

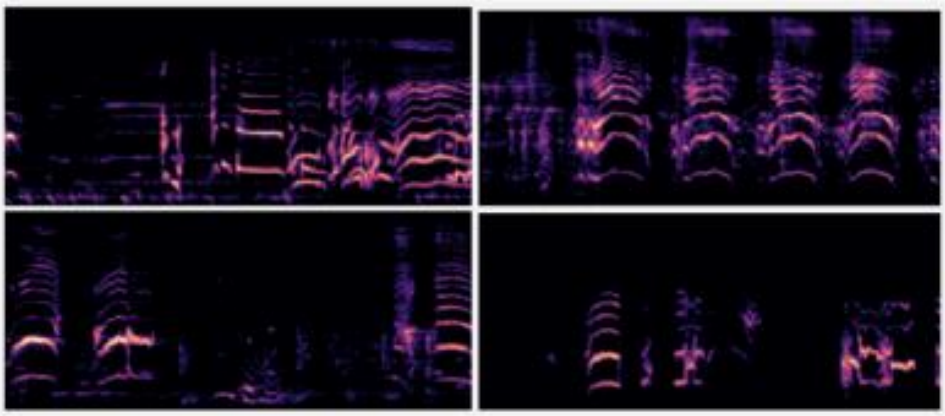

Figure 4:Mel-spectrogram samples of baby crying sounds (x-axis: time, y-axis: frequency).

The atmosphere in one's bedroom can have a big impact on how well they sleep. To get the best possible sleep, experts advise choosing a room that is cool, dark, quiet, and free of distractions. It can be challenging for a person to determine which environmental factors might be contributing to interrupted sleep, though. The design, implementation, and preliminary analysis of a capture and access system called Lullaby are presented in this paper. Lullaby creates a thorough record of a person's sleep by combining temperature, light, motion, audio, and photo sensors with an off-the-shelf sleep sensor. [3] Environmental factors have been linked to poor sleep quality and interrupted sleep, which have been linked to daytime drowsiness and fatigue, according to research. It can be particularly difficult to sleep in a room that is too warm, has poor lighting, is noisy, or has poor air quality. While some of these environmental factors can be seen, others might be hidden or challenging to spot. As a result, people with poor sleep quality frequently struggle to determine the origin or severity of their sleep problems. [3]

CHAPTER 3: METHODOLOGY

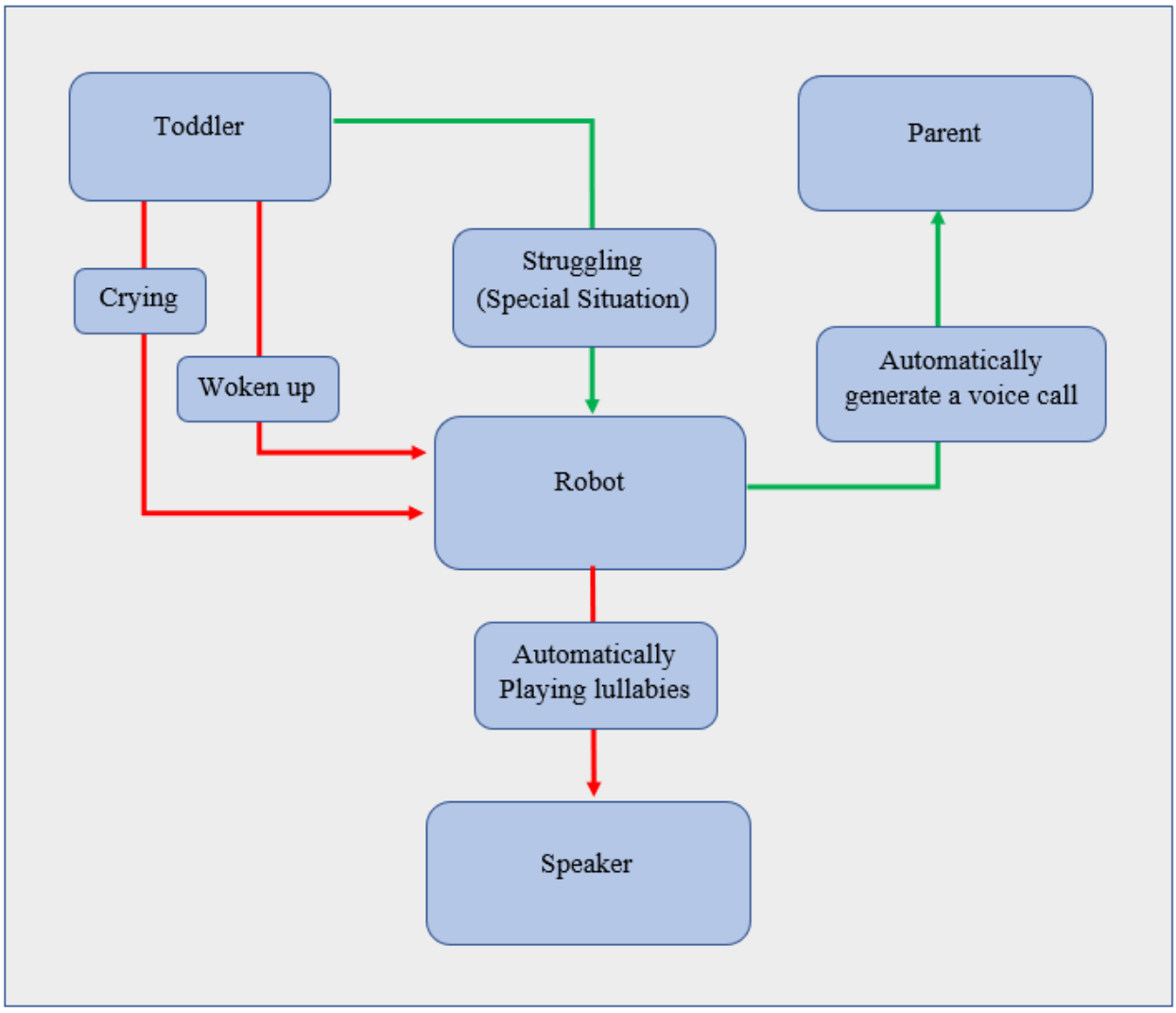

Figure 5: Block diagram of the proposed method

3.1 Equipment and Purposes

Table 1: Table of used equipment and its purposes

Equipment	Purpose
Condenser Microphone	We would need a microphone that is highly sensitive to the frequency range of a baby's cry, which is normally between 300 Hz and 600 Hz, to distinguish a toddler's crying. A condenser microphone with a good frequency response and minimal noise would be ideal for this application. Also, it can use to communicate with the parents in the automated voice call generating function.
GSM Sensor	Developing the voice call system interactive, particularly automatically generate a voice call to the caregivers in order to communicate with the toddlers.
Speaker	To developing the mechanism to automatically playing lullabies according to the captured behaviors of the toddler such as crying or woke up.

3.2 Proposed Methodology

This proposal is to develop a robot to play lullabies and make voice calls when a child is weeping and needs attention, as well as to make automated voice calls to parents in special or dangerous situations, is a very intriguing and important project. According to the project's requirements, this system must select the hardware components. A microphone, speaker, GSM module, and computer are required to conduct voice calls via the GSM network, play calming music, detect weeping, and process sensor data. To connect the components, we must write code that will allow the microcontroller or computer to process sensor data and control the playback and voice call. This code must detect tears and playback lullabies, as well as detect unusual or dangerous conditions and initiate a voice call to the parents.

3.3 Implementation of the proposed method

3.3.1 Hardware and Software Implementation

During this phase, we will create the system's hardware and software. In order to establish a functional system, we must connect the components. To detect sobbing, for example, we will need to link the microphone to the microcontroller, the speaker to the microcontroller to play lullabies, and the GSM module to the microcontroller to make voice calls. Next, we must develop code for the microcontroller or computer to process sensor data and operate the playback and voice call. This can be accomplished with programming languages such as C or Python. The code must detect sobbing and initiate the replay of lullabies, as well as detect exceptional or dangerous conditions and initiate a voice call to the parents. We will also create a mobile app or online interface that will allow parents or caregivers to remotely monitor and control the toddler's status.

CHAPTER 4: PROPOSED TESTING AND EVALUATION

We will perform a user evaluation of the robot with parents and caregivers of young children to determine its usefulness in providing support and meeting the requirements of young children. The evaluation will include a survey to get input on the robot's usability, reliability, and usefulness, as well as interviews to gather more comprehensive comments and suggestions for improvement.

Table 2: Gantt chart

Study and identify the problems facing the parents.										
Planning how to provide solution for proposed problem										
Design the conceptual diagram and circuit diagram										
The hardware for the robot will be designed.										
Implementing speaker to play the lullabies.										
Implementing the sensors to generate the voice call.										
Implementing microphone to communicate with the parents.										
Implement the coding part and design the GUI interface.										
Testing the system										
Present the system										
Month	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct

CHAPTER 5: CONCLUSION

Finally, the proposed virtual interaction approach for toddlers seeks to provide a unique and advanced solution for improving toddlers' sleep quality and general well-being. The device will employ sensors to track the baby's activities, allowing it to automatically play music or lullabies based on the toddler's sleeping patterns. Furthermore, the system will generate voice calls to notify parents when their infant awakens or cries, increasing their awareness and capacity to respond to their child's needs. This research has the potential to greatly assist parents and their toddlers by encouraging a stronger parent-child bond and enhancing family quality of life. Furthermore, the method will assist parents in reducing tension and worry, allowing them to better focus on their work and everyday activities. This research will surely mark a significant advancement in the use of technology to improve the well-being of children and their families.

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