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IOT Based Smart Baby Cradle

Prof. Siddesh Khanvilkar[1], Nivedi Naresh Joshi[2], Poorva Atul Patil[3], Preity Jagdish Patil[4], Dnyaneshwari Vikaram Hande[5]
Pillai HOC College of Engineering and Technology, Rasayani

***Abstract:** An infant/toddler care monitoring system utilizing IOT is a system that uses the Internet of Things (IoT) to monitor and care for a baby while they are in their cradle is known as an infant/toddler care monitoring system. A microcontroller, a cloud-based platform, and a cradle with sensors and actuators typically make up the system. The sensors can track the temperature, respiration rate, and heart rate of the infant. They can be used to track the baby's movements and cries. The cradle's swinging motion as well as other elements like a nightlight and lullaby music player can be controlled by the actuators. The microcontroller, which also controls the actuators, processes the sensor data. Additionally, it is in charge of interacting with the cloud-based platform. The cloud-based technology retains the sensor data and makes it accessible to parents via a web or mobile app. Parents can watch their child's vital signs, get warnings if something is wrong, and manage the cradle's capabilities using the web or a mobile app. For instance, if the infant starts to cry, the parent can start the cradle swaying or play lullaby music from a distance to assist in soothing the child.*

I. INTRODUCTION

It has become typical in India in recent times for both parents to be employed. For working parents, keeping an eye on their infant will be the most challenging task these days. Even though they could have a caregiver, it would be challenging for them to keep an eye on the infant's condition. The infant's condition must be checked periodically and every two seconds. They will be under constant observation, minute by minute, in a closed chamber or incubator [1]. The introduction of a Baby Cradle Monitoring System marks a significant advancement in ensuring the safety and wellbeing of infants during their sleep. This innovative technology combines modern sensor capabilities, connectivity, and data processing to create a comprehensive solution that provides peace of mind for parents and caregivers. The primary goal of the Baby Cradle Monitoring System is to enhance the safety and comfort of babies while they rest in their cradles or cribs. The system employs various sensors to monitor crucial parameters such as the baby's movements, position, and vital signs in real-time. This continuous monitoring allows caregivers to respond promptly to any irregularities or potential issues. Integrated cameras provide a visual feed of the baby's sleeping area, allowing parents to remotely observe their child. This feature not only adds an extra layer of security but also offers a convenient way for parents to check on their baby without physically entering the room [3]. The system includes sensors to monitor the ambient temperature and humidity levels in the baby's sleeping environment. Maintaining optimal conditions is essential for a baby's comfort and well-being. The monitoring system is equipped with sound and motion detectors. Caregivers receive immediate alerts if the system detects unusual noises or sudden movements, ensuring that they can respond promptly to attend to the baby's needs. The Baby Cradle Monitoring System is typically designed to be accessible through a mobile application. This allows parents and caregivers to receive notifications, view real-time data, and control settings remotely, providing convenience and flexibility [5].

II. LITERATURE REVIEW

The objective of this project is to create and install a brand-new, inexpensive, homegrown Smart Baby Cradle that soothes wailing infants with music. The cradle's cry-analysing technology accomplishes this by identifying a baby's cry and reacting by playing calming music to help the infant feel better. Two conditions are signalled by the system's built-in alert system: first, when the mattress is damp, which is important for keeping the baby hygienic; and second, when the baby continues to cry after a set period of time, which notifies the user or the user's parents that the baby needs attention. Parents and nurses can take care of infants without having to touch them directly with the help of this technology.[1]

The baby either stops crying or goes to sleep once in the cradle. In today's world, it's quite hard for nannies and grandparents to sit next to their child and be honest, whenever they scream or take a nap. Consequently, we developed a system that might let parents take care of their kids without having to give them direct care.[2] This research presents the creation of a programmed cradle that significantly modifies the location of infant growth using a PIR sensor. An infrared sensor is used to detect movement in babies. [3,4].

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The study attempts to enhance the quality of the current infant cradle systems by modifying a new module that simplifies newborn care. Giving a baby cries survey and, in response, notifying the caretakers. [5,6]. This infant cradle was designed utilizing an Android application, allowing parents to monitor their children conveniently from their workplace. They can log in anytime to observe their children's activities. The proposed design incorporates a system connected to the baby cradle, featuring a cry detection mechanism to identify if the baby is crying, a DC motor for swinging the cradle, and a wet sensor to determine the mattress's moisture level.[5]

The baby monitoring system design presented by the author is based on the GSM network. This technology tracks important metrics like body temperature, heart rate, moisture content, and baby movement. It then sends the data to the baby's parents over the GSM network. The following hardware parts were assembled: LCD screen, GSM module, motion sensor, temperature sensor, pulse rate sensor, moisture detection sensor, and controller. The lack of a rock motion and cradle or crib are the system's drawbacks. The infant feels uncomfortable as a result. [6,7]. The design specifications of the prototype smart infant cradle are described in this suggested design specification document. This design document will also be followed by the finished smart baby cradle product, however new, more integrated and efficient electrical components will be used in place of the old ones. All of the designs in this document will take into account the safety and customer requirements that were outlined in the functional specification. The functional specification requirement labels and the requirement labels found in this document match. The restrictions are Baby's inquisitiveness: In addition to the potential for electrical shock, the baby could try to bite or consume the parts, or they could knock them off or break them. Concerns of parents: Parents give safety concerns a lot more thought than product features. [9,10]

III. PROPOSED SYSTEM

The proposed prototype of smart baby cradle will track the activities of the baby. The IOT based smart baby cradle has sound detection which will sense the noise when the baby is crying or making loud noise [Fig 2]. A camera will be used to track the condition of baby inside the crib. This System helps to provide real time monitoring. A GSM module to communicate with a remote device that is operated by parents and an Arduino microcontroller to control and monitor the activities of the cradle. It consists of moisture, temperature, sound sensor. Camera monitoring is done via WIFI module [Fig5,6]. Data from the sensors is gathered by the system, which then sends it to a cloud server or mobile app. The information is subsequently processed and examined to find any anomalies. The technology can notify the parents or carers if an anomaly is found. The system may also do automated tasks like changing the temperature of the cradle or turning on music to calm the baby. A website is created to check the data recorded.

Data recorded is stored in website database. It would help to maintain recent conditions of baby. It is also helpful to doctors as if the child is sick, they get to know about their conditions by viewing the data. Seconds of data is recorded and stored. The user(parent) can delete the data after viewing if they want to. In case of increase in temperature and crying of baby emergency notification is sent.

A. Algorithm for Baby Cradle:

STEP 1: The cradle is started by turning it on.
STEP 2: Check the conditions of baby.
STEP 3: Display the data on Screen.
STEP 4: The Data is stored on website and is viewed anytime and anywhere.
STEP 5: Real Time Camera Monitoring is activated for monitoring conditions of baby.
STEP 6: G- Mail notification is sent to parent in case the temperature or crying sound increases above the range set in code.

- *For Sound(cry) of baby:*

STEP 1: Sound level is set to 1000
STEP 2: If sound is above that level a notification is sent to parent.

- *For Temperature of baby:*

STEP 1: Temperature level is set to 40.
STEP 2: If temperature is above that level notification is sent to parents.

B. System architecture and System flow:

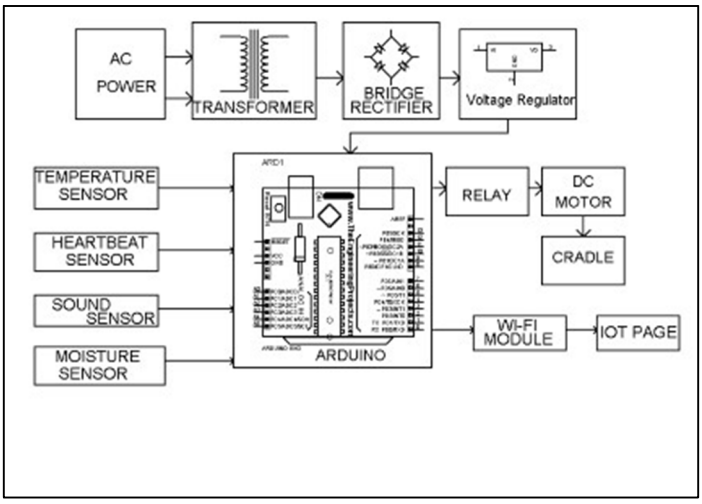


Figure 1. System Architecture

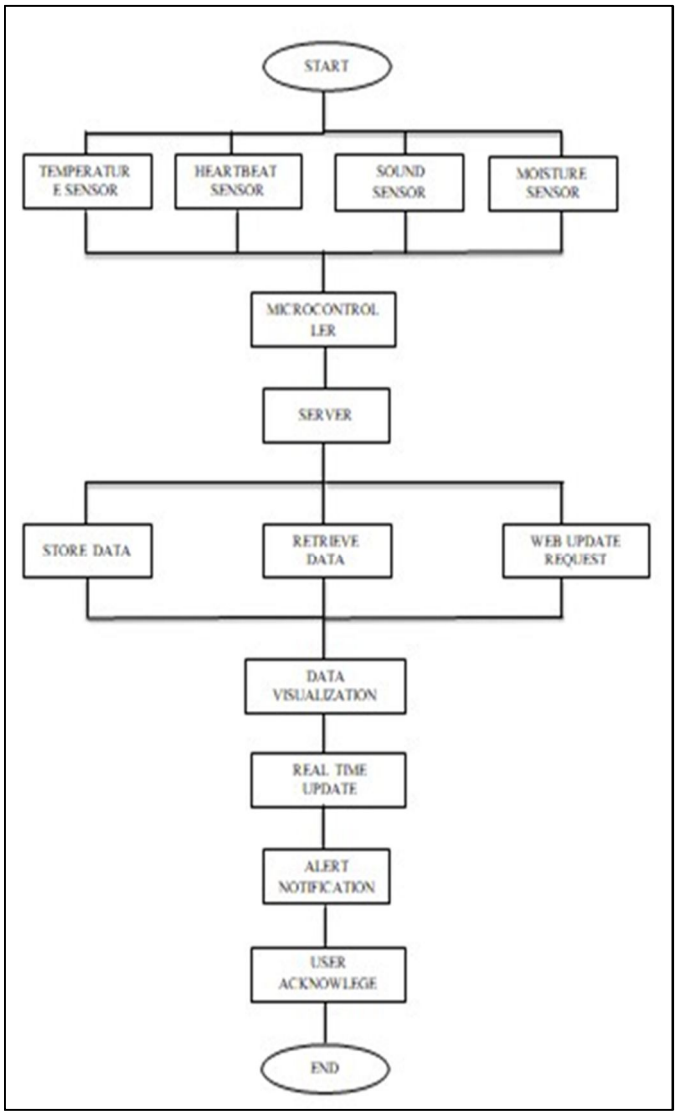


Figure 2. System Flow

C. Working

1) Connections: The cradle is turned on (hardware) [Fig 1]. All the sensors are light up and start recording data. The data is displayed on LED Screen connected to PCB board. The sensors used like temperature, sound, moisture, heart rate sensor. All the sensors are connected to Arduino Microcontroller. A power source of 9 volt is provided. Transformer is used to manage the voltage. PCB board is used for secure connections [Fig 3].

2) Server: The Arduino connects the server to display the data. The server stores and retrieves the data [Fig 4]. A further web update request is sent for data visualization. On child monitoring website data is displayed. The data is updated every now and then [Fig 7]. It is a real time update system. In case of high temperature and crying sound, the parent is alerted with a notification [Fig 8,9].

3) Components:

a) Arduino Uno: The board has a built-in USB interface that allows it to be easily connected to a computer for programming and communication. The Atmega328P microcontroller has an internal clock oscillator, or you can connect an external one for more precise timing in your projects.

b) Moisture Sensor: A moisture sensor is a device used to detect the presence or absence of moisture in a substance or environment. These sensors are commonly used in various applications such as agriculture, construction, industrial processes, and environmental monitoring.

c) WIFI Camera module: It is an Arduino microcontroller camera module. Parents will be able to see their child in the crib thanks to it. Baby can be observed using a suitable equipment at a distance.

d) Temperature Sensor: A temperature sensor is a device used to measure the temperature of a substance or environment and convert it into a usable output, typically an electrical signal or digital data.

e) Sound Sensor: A sound sensor is a device designed to detect sound waves and convert them into electrical signals. The electrical signals generated by the microphone are then processed by the sensor's circuitry. This circuitry may include amplifiers and filters to enhance and isolate the relevant audio signals while minimizing interference.

IV. IMPLEMENTATION AND RESULTS

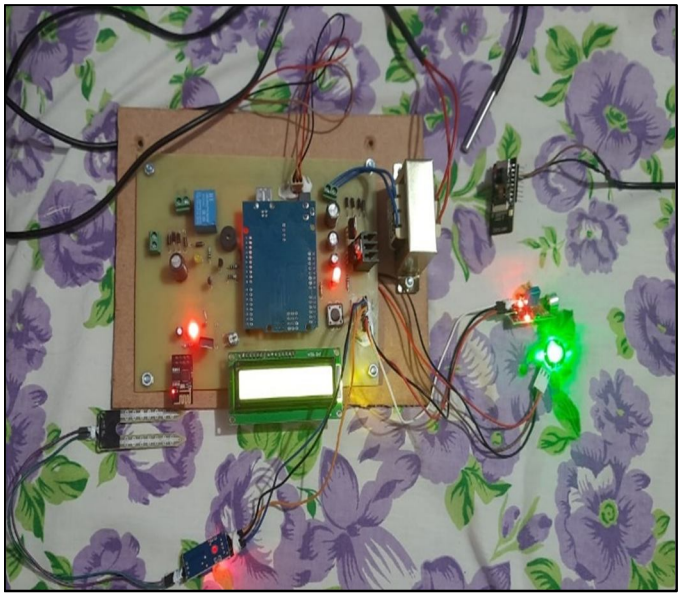


Figure 3. Hardware Model

1) The cradle is turned on (hardware). All the sensors are light up and start recording data.
2) The data is displayed on LED Screen connected to PCB board. The sensors used like temperature, sound, moisture, heart rate sensor.
3) All the sensors are connected to Arduino Microcontroller. A power source of 9 volt is provided.
4) Transformer is used to manage the voltage. PCB board is used for secure connections.



Figure 4. Child Monitoring Website

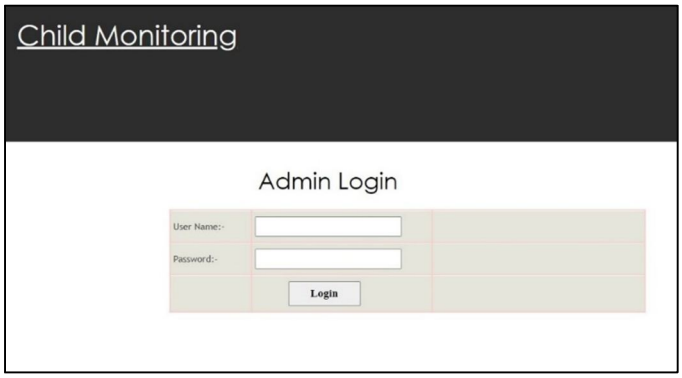


Figure 5. Login Page

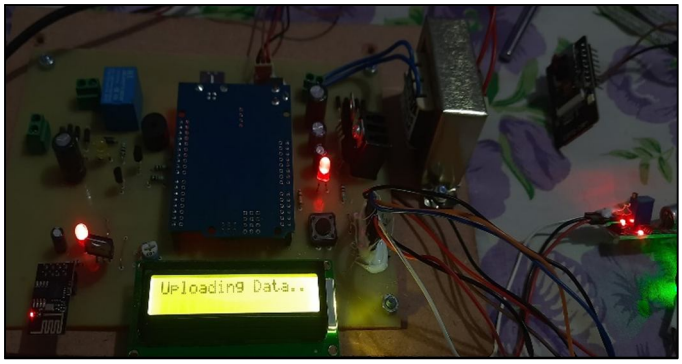


Figure 6. Uploading values from sensors

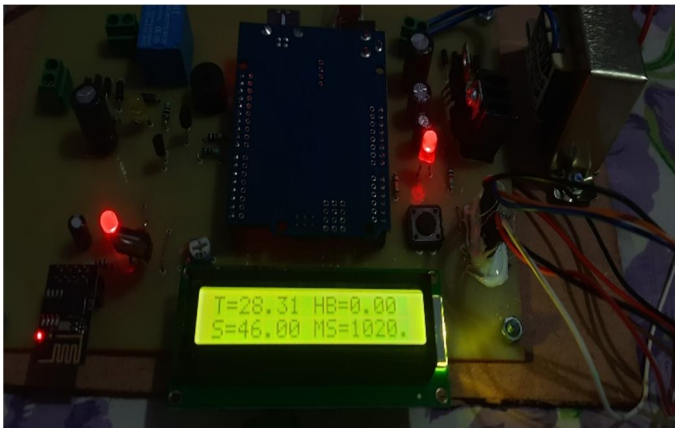


Figure 7. Values uploaded

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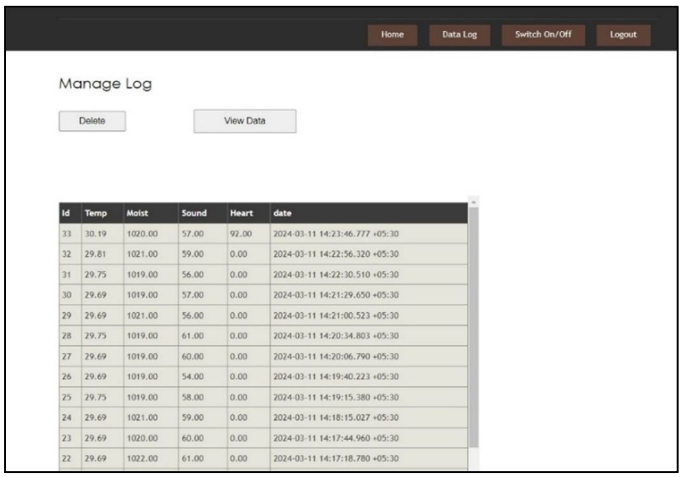


Figure 8. Data viewed on website

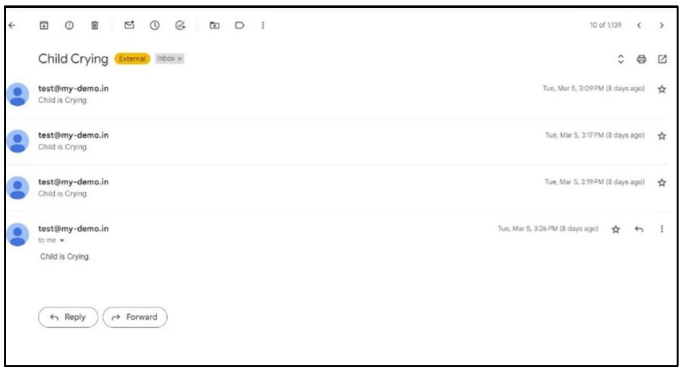


Figure 9. High crying sound detected and notified



Figure 10. High temperature notified

V. PROBLEM STATEMENT AND CHALLENGES

A. Problem Statement

The Smart Baby Cradle project addresses the challenge of ensuring the constant monitoring and well-being of infants, especially when both parents are working. With the increasing trend of dual-income households, the need for a reliable system arises to oversee the vital signs of infants during their sleep. Current solutions are often limited or lack comprehensive features, leaving parents and caregivers anxious about the baby's health and safety. Therefore, the project seeks to fill this gap by developing a technologically advanced cradle equipped with sensors for temperature, heartbeat, and motion monitoring, catering to the specific needs of working parents and caregivers in both home and hospital environments. The identified problem lies in the absence of a holistic and accessible solution that seamlessly integrates real-time data monitoring with user-friendly interfaces for enhanced infant care.

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B. Challenges

The development of the Smart Baby Cradle presents several challenges that need to be addressed during the project. Firstly, ensuring the accuracy and reliability of the sensors for vital sign monitoring, such as temperature and heartbeat detection, is crucial to guarantee the system's effectiveness. Secondly, designing a user-friendly and responsive web interface poses a challenge, as it needs to accommodate real-time data visualization and provide an intuitive experience for parents and caregivers. Additionally, implementing robust security measures, including encryption for data transmission and user authentication, is essential to protect sensitive information. Integrating all components seamlessly, from microcontroller code to server setup, and addressing potential communication issues between devices is another challenge that requires careful consideration. Overcoming these challenges is imperative to deliver a Smart Baby Cradle that meets the high standards of safety, functionality, and user accessibility.

C. Applications and Uses

1) *Home Use:* Working Parents: In households where both parents are working, the Smart Baby Cradle serves as a valuable tool for continuous monitoring of the baby's vital signs, ensuring parents receive real-time updates about their child's well-being even when they are away.
2) *Daycare Centers:* Childcare Facilities: Daycare centers and childcare facilities can deploy the Smart Baby Cradle to enhance the safety and monitoring of infants under their care, offering parents real-time insights into their child's activities and well-being during daycare hours.
3) *Remote Monitoring:* Travel and Temporary Situations: When families are traveling or in temporary situations, the portable nature of the Smart Baby Cradle allows for continuous monitoring, offering parents peace of mind in unfamiliar environments.

VI. FUTURE SCOPE

Integration of artificial intelligence (AI) algorithms could help in creating smart cradles that learn and adapt to a baby's sleep patterns. These cradles could then provide gentle rocking or other soothing motions based on the baby's preferences. There could be an increased focus on developing eco-friendly materials and energy-efficient technologies for baby cradles, considering the growing awareness of environmental sustainability. In the future, baby cradle systems could potentially integrate with healthcare providers, allowing for secure data sharing and remote monitoring. This could enhance paediatric healthcare and provide valuable information for early intervention if any health concerns arise.

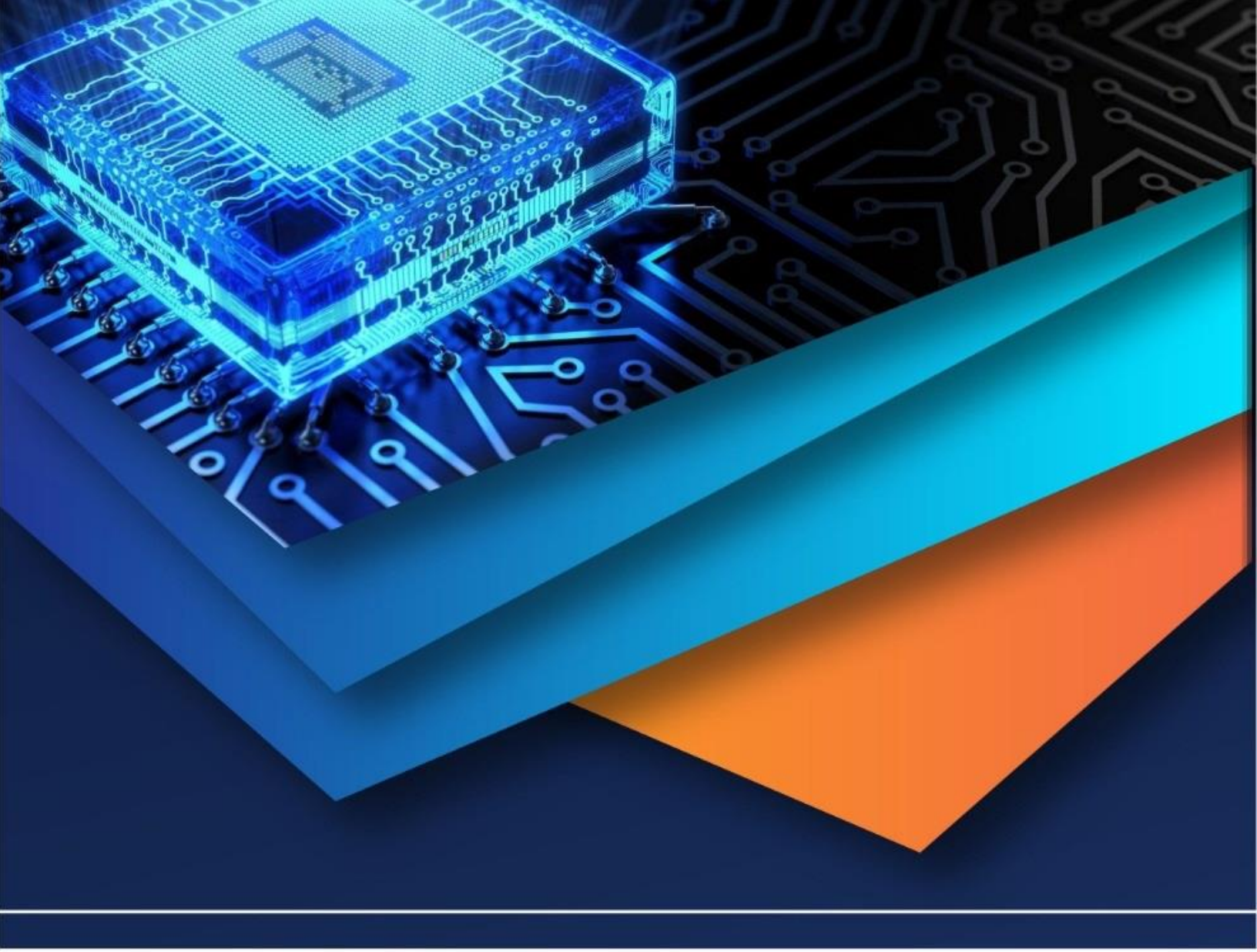
VII. CONCLUSION

This research paper has delved into the critical realm of Smart Baby Cradle utilizing Internet of Things (IOT) techniques, the development of the Smart Baby Cradle represents a significant stride in infant care technology. With its integrated sensors for monitoring vital signs and real-time data transmission, the cradle caters to the needs of working parents, caregivers, and healthcare professionals. The project not only addresses the challenges faced by modern families but also contributes to medical research, healthcare education, and the evolving landscape of telehealth services. The Smart Baby Cradle, with its user-friendly interface and robust security measures, emerges as a valuable tool to ensure the safety, well-being, and peace of mind for both parents and healthcare providers in diverse settings.

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