

SOOTH EASE

An IOT-Driven Smart Cradle for Baby's Comfort and Well-Being

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Problem Statement Identified: Traditional baby cradles lack automated features to monitor and respond to a baby's needs, leading to challenges in providing timely care and comfort. Parents often face difficulties in addressing a baby's movements or discomfort, such as wet conditions or prolonged inactivity, especially during or night time. This project aims to address these challenges by developing a smart cradle system using IoT, which can automate cradle oscillation, detect moisture, and respond to a baby's motion, ensuring enhanced care and reduced parental stress.

Project Idea: The project involves designing and developing a smart cradle system integrated with IoT technology to assist parents in monitoring and soothing their baby efficiently. The cradle will automate key functionalities like oscillation, moisture detection, and motion-based soothing, making it responsive, and parent-friendly solution.

Abstract: This project proposes the design of a Smart Baby Cradle integrated with IoT technology to automate key functions aimed at improving infant care and reducing parental stress. The cradle will feature automated oscillation, motion detection, moisture sensing, and temperature monitoring, ensuring that the baby remains comfortable and well cared for even when parents are unavailable. Using a moisture sensor, the system can detect wet conditions and alert parents, while a motion sensor triggers oscillations to soothe the baby based on movement. Additionally, a temperature sensor ensures an optimal environment for the baby. The cradle will be powered by a microcontroller ESP32 and a motor to automate oscillation, with a buzzer providing notifications. This IoT-enabled system aims to improve the baby's sleep comfortability, reduce the need for constant monitoring, and enhance convenience for parents, offering a responsive, automated solution for infant care.

Objectives:

1. **Timely Oscillation of the Cradle:** Implement a system to automate the cradle's oscillations at regular, pre-configured intervals to ensure the baby remains calm and comforted.
2. **Moisture Detection and Notification:** Integrate moisture sensors to detect wet conditions in the cradle, triggering alerts to parents for prompt action.
3. **Motion-Triggered Oscillation:** Enable the cradle to detect baby movements and initiate oscillations automatically to soothe the baby in moments of discomfort or restlessness.
4. **Temperature Monitoring and Notification:** Integrate a temperature sensor to continuously monitor the cradle's environment, ensuring the baby's comfort.

Potential Components:

1. Moisture sensor
 - Soil Hygrometer Moisture sensor –100 to 200/-
 - <https://amzn.in/d/5Es8ztG>
2. Motion sensor
 - MPU6050 (with a gyroscope) – 150 to 300/-
 - <https://amzn.in/d/dRzwDVx>
3. Motor for cradle oscillation
 - Tower Pro MG995 Servo Motor – 200 to 300/-
 - <https://robu.in/product/towerpro-mg995-metal-gear-servo-motor/>
4. Microcontroller – ESP32
5. Buzzer for Sounds
 - Speaker Buzzer – 100/-
 - <https://amzn.in/d/5NYXhrs>
6. Temperature
 - DHT11 Sensor – 200/-
 - <https://amzn.in/d/cJkDP93>
7. Relay Module – 200/-
 - <https://amzn.in/d/ie8cK2Y>
8. Bread board Jumper Wires
9. Breadboard – 90/-

Benefits:

- Reduces the constant need for parental intervention.
- Provides timely alerts for wet conditions or baby discomfort.
- Helps maintain the baby's comfort and sleep patterns.
- Enhances convenience for parents, especially during nighttime or while multitasking.

Research Paper Work

S NO	Title	Citation	Methodology	Conclusion
01	Internet of Things-Based Baby Monitoring System for Smart Cradle	W. A. Jabbar, H. K. Shang, S. N. I. S. Hamid, A. A. Almohammed, R. M. Ramli and M. A. H. Ali, "IoT-BBMS: Internet of Things-Based Baby Monitoring System for Smart Cradle," in <i>IEEE Access</i> , vol. 7, pp. 93791-93805, 2019, doi: 10.1109/ACCESS.2019.2928481.	<p>The current number of working mothers has greatly increased. Subsequently, baby care has become a daily challenge for many families. Thus, most parents send their babies to their grandparents' house or to baby care houses. However, the parents cannot continuously monitor their babies' conditions either in normal or abnormal situations. Therefore, an Internet of Things-based Baby Monitoring System (IoT-BBMS) is proposed as an efficient and low-cost IoT-based system for monitoring in real time. We also proposed a new algorithm for our system that plays a key role in providing better baby care while parents are away.</p> <p>In the designed system, Node Micro-Controller Unit (NodeMCU) Controller Board is exploited to gather the data read by the sensors and uploaded via Wi-Fi to the AdaFruit MQTT server. The proposed system exploits sensors to monitor the baby's vital parameters, such as ambient temperature, moisture, and crying. A prototype of the proposed baby cradle has been designed using Nx Siemens software, and a red meranti wood is used as the material for the cradle. The system architecture consists of a baby cradle that will automatically swing using a motor when the baby cries. Parents can also monitor their babies' condition through an external web camera and switch on the lullaby toy located on the baby cradle remotely via the MQTT server to entertain the baby. The proposed system prototype is fabricated and tested to prove its effectiveness in terms of cost and simplicity and to ensure safe operation to enable the baby-parenting anywhere and anytime through the network. Finally, the baby monitoring system is proven to work effectively in monitoring the baby's situation and surrounding conditions according to the prototype.</p>	<p>A smart cradle with a baby monitoring system over IoT has been designed and fabricated to monitor a baby's vital parameters, such as crying condition, humidity, and ambient temperature. NodeMCU was used as the main controller board in the project's circuit design, because it had a built-in Wi-Fi module, which enabled the implementation of IoT concept in the developed system. The demand of IoT was achieved by using the NodeMCU due to its simplicity and open-source nature. Red meranti wood was used as the material to build the baby's cradle, because of its general use in woodworks and due to its workability. Improvements were made during the enhancement phases to ensure that the research outcomes achieved the objectives. The finished prototype was tested by using a mobile phone with a baby crying ringtone, which was placed in the cradle. When the mobile phone rang for a few seconds, the cradle started swinging because of the system's assumption that the baby was crying due to the detected sound. A notification was sent to the mobile phone of the user to signal that the baby is crying. The temperature and humidity of the surroundings were determined, and the mini fan was turned on if the measured temperature was above 28 °C. With the aid of NodeMCU, the parents can control the baby cradle and the mini fan using mobile apps or an Internet-connected computer. Realtime vision monitoring was achieved with the help of the wireless camera. The user can monitor the baby through the camera mobile application and talk to the baby through the built-in microphone on the wireless camera. The total cost of the developed system is greatly reduced to approximately RM 700 per unit, which is suitable for mass production after finalizing the prototype. Our system's GUI needs to be improved to overcome limitations of both Adafruit.io MQTT server webpage and MQTT Dash mobile application. We will develop our own web-based and Android-based dashboards for laptops, PCs and smartphones, to add more monitoring and controlling functionalities based on our system requirements. Another limitation of the developed system is the wireless camera used, which is can only be connected to a local network. Parents can only view the section where the camera is positioned when they are connected to the same network as that of the wireless camera. TransFlash card can be used for the camera to record the baby's activities, but it is not considered real-time monitoring. Therefore, for future works, the wireless camera can be changed into an IP camera to enable IP hosting viewing in the network. The parents can type the set IP address for the IP camera in the network browser to monitor the baby's conditions in real time. In addition, other future works can be conducted to further improve this system. A lighter and safer material, such as soft plastic, can be used to replace the wood materials to ensure the safety of the baby and reduce the weight of the baby cradle. A sound sensor with better quality can be implemented for better noise capturing; along with some coding changes, the level of the</p>

02	IoT based Smart Cradle for Baby Monitoring System	N. L. Pratap, K. Anuroop, P. N. Devi, A. Sandeep and S. Nalajala, "IoT based Smart Cradle for Baby Monitoring System," <i>2021 6th International Conference on Inventive Computation Technologies (ICICT)</i> , Coimbatore, India, 2021, pp. 1298-1303, doi: 10.1109/ICICT50816.2021.9358684.	In recent years, baby care has become more important and challenging for working mothers. Even at home, working mothers will not have enough time to monitor their babies continuously. They give the responsibility of their baby to either a baby caretaker or they send the baby to their grandparents' house. In the proposed work, a smart cradle with an automated baby monitoring system was developed. In the baby monitoring system, the necessary parameters of the infant like temperature, heartbeat rate, gas molecules, capture the motion and position of the baby were measured and monitored. The S.ODI board is used for interfacing the sensors and actuators. The baby monitoring system is attached to the cradle so that an incubator kind of environment will be created for the baby. The baby monitoring system monitors the baby 24x7. The measured parameters regarding the baby's health like temperature, heartbeat rate, dampness on the baby bed will be displayed in the mobile application. If the recorded readings show any abnormalities, the necessary actions like controlling temperature, switching on or off the fan, setting up cradle's movement, playing music for the baby will be taken. If the readings seem abnormal, the caretaker along with the parents will get an alert message. The motion and posture status of the infant can be monitored using motion Eye OS. The baby monitoring system prototype helps the parents in time management and makes it easier for the caretakers as well. This baby monitoring system is proven to have less harm for the baby with the most accuracy. This monitoring system is a highly efficient IoT based system for realtime monitoring with the best security measures.	baby's crying can VOLUME 7, 2019 9 In the developed system all the necessary sensors that are used for measuring the parameters like temperature, moisture, pulse rate, microphone, and the camera is interfaced with the S.ODI and Blynk. Blynk is the backend coding interface for S.ODI. In the Blynk application, the caretaker gets necessary alarm messages or alerts regarding the baby's temperature, moisture, baby's bed dampness, and pulse rate of the baby. Minute to minute monitoring of the child and posture monitoring can be done with a spi camera that is installed with the Motion EyeOS. The necessary framework for baby monitoring with the screening of necessary parameters like health monitoring and full-time surveillance of the baby is demonstrated
03	IoT Based Smart Cradle System with an Android App for Baby Monitoring	M. P. Joshi and D. C. Mehetre, "IoT Based Smart Cradle System with an Android App for Baby Monitoring," <i>2017 International Conference on Computing, Communication, Control and Automation (ICCUBEA)</i> , Pune, India, 2017, pp. 1-4, doi: 10.1109/ICCUBEA.2017.8463676.	Availability of high speed internet and wide use of mobile phones leads to gain the popularity to IoT. One such important concept of the same is the use of mobile phones by working parents to watch the activities of baby while babysitting. This paper presents the design of Smart Cradle which supports such video monitoring. This cradle swings automatically on detection of baby cry sound. Also it activates buzzer and gives alerts on phone if-first, baby cry continues till specific time which means now cradle cannot handle baby and baby needs personal attention and second, if the mattress in the cradle is wet. This cradle has an automatic rotating toy for baby's entertainment which will reduce the baby cry possibility.	Baby care is hard problem worldwide. It is very important duty as they are our future. Though mother's lap is best for baby, considering the need of present world and knowing the significance of baby care, this system is designed. This system is economical and easy to operate which helps working parents to manage their work. Video monitoring is made available through most commonly used android smart phones. In future, more features like IR(Infrared) camera for night vision can be an extension of this system. Also other client applications i.e. applications for ios etc. can be designed for this system.
04	IOT Based Baby Monitoring System Smart Cradle	S. Joseph, A. Gautham,J, A. Kumar and M. K. Harish Babu, "IOT Based Baby Monitoring System Smart Cradle," <i>2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)</i> , Coimbatore, India, 2021, pp. 748-751, doi: 10.1109/ICACCS51430.2021.9442022.	This paper is centered around a plan to develop a IOT based Smart baby cradle that would assist the Parents with monitoring and keeping an eye on their infants regardless of whether they are at home or at work and can identify each activity of the infants from any inaccessible corner of the world. It is a brilliant, imaginative and defensive Cradle System to support a newborn child in a productive manner. This framework considers all the moment subtleties that are needed for the consideration and insurance of the Baby in the support. The plan of keenness and development accompanies the utilization of advancements which incorporate Internet of Things (IOT), Modules like Raspberry Pi, Gas sensor, sound sensor and Temperature sensor, Cry Detecting Mechanism, camera surveillance, and much more. To recognize each and every movement of Baby, various Sensors are connected to the Cradle: Gas & Temperature Sensing Module	Our proposed framework targets observing the indispensable indications of the child, for example, pulses and internal heat level utilizing remote innovation and sound sensor used to quantify infant cry's. We additionally center around increment the extent of sending the data over the web to give far off access. The camera module consolidated empowers showing the visual feeds of the whereabouts of the child and keeping an eye over their developments in a limited territory. This framework defeats the disadvantage of the current frameworks which are awkward, less easy to use and costly

			for discovery of wetness of the cradle. A Camera is fitted in the top Cradle for live video film & sound sensor to break down Cry Patterns. All the information which is being taken from the sensors will be put away in information base & recognized at normal stretches. Using all those data and images, parents can be sure about the safety and well being of their babies at any time in any given place.	
05	Smart Baby Cradle System: based on Internet of Things and Image Processing	M. N. A, N. M P, R. P, I. P K, N. K M and M. Z. K, "Smart Baby Cradle System: based on Internet of Things and Image Processing, " <i>2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS)</i> , Trichy, India, 2022, pp. 1-5, doi: 10.1109/ICAISS55157.2022.10011036.	This research study intends to design and develop an Internet of Things (IoT) and machine learning based baby monitoring system for smart cradles. A smart baby cradle will provide parents/caretakers an automated system to monitor and comfort the baby through online streaming via camera, which can be further controlled through a mobile app . In this approach, the cradle can sense different facial emotions like crying, sleeping, smiling etc. by implementing an image processing module and further an alert will be sent to the parents when the mattress is wet or baby is in a crying condition. This cradle includes an MPEG-1 Audio Layer 3 player to play a soothing music to the baby. To perform aforementioned task, a bed wet sensor and Light Dependent Resistor [LDR] sensor is embedded into the Arduino.	The most intelligent choice for parents is the proposed smart baby cradle. The baby's condition and emotions has been successfully monitored and picked up by the cradle. The main goal is to make it more user-friendly and lessen the workload for parents. Mobile applications are also offered. It sends alerts to parents when a baby starts to cry and provide soothing music. The intelligent baby care system is effective in helping the busy parents are for their infants. In future, health prediction of the child can also be included. An advanced care can also be provided by using robotic arm
06	IoT based Smart Cradle for Neonatal Monitoring	R. Sonia, S. M. Jayadeva, S. D. P. Ragavendiran, R. N, J. Arumugam and S. S. Kumar, "IoT based Smart Cradle for Neonatal Monitoring," <i>2022 6th International Conference on Electronics, Communication and Aerospace Technology</i> , Coimbatore, India, 2022, pp. 432-437, doi: 10.1109/ICECA55336.2022.10009138.	India has the highest percentage of working women and mothers. It also has a record for the highest number of babies being born every single day. These two statements highly contradict each other. When a woman gives birth to a baby, she needs to spend almost a year or two taking care of the necessities of the baby. But when a need to leave the baby for a certain time arises regularly, it becomes tougher for them to do so. This study provides a solution to this problem. This research aims at the construction of a smart cradle. This cradle is designed using various input elements, output elements, a controller module, and a mobile application. The input elements consist of a temperature sensor, a sound sensor or a microphone, a moisture sensor, and a music player. The output elements include the motor and The controller used in this study is the NodeMCU module. Cloud storage is also used and it is provided by the Arduino IoT software. The sensors in the smart cradle begin recording relevant parameters such as temperature, humidity, and sound as soon as it is turned on. The information is then uploaded to the cloud. The data is then processed in the cloud for analysis. If indeed the child's temperatures is over the safe range, the user receives a warning. Moisture levels above normal suggest that the infant has urinated. The sound of the baby crying will be recorded in the microphone. The output elements are energized as a result of the sensor's data. If the baby has a high fever or has to go to the bathroom, the app will notify the parent.	This study created a smart cradle that is designed to keep a constant eye on the baby. This cradle is equipped with IoT technology, which allows it to control a large number of hardware components via code written in the controller module. Input and output elements make up the majority of the main hardware. The temperature sensor, moisture sensor, and microphone are the input devices. The motor and the music players are the output devices. A software component, in addition to the hardware devices, plays a significant role in this research. The Arduino IoT is the only software component of this study. The music player is used to play music as an output from the Arduino IoT application, which analyses data in the cloud. When activated, the smart cradle's sensors begin collecting data on environmental factors like temperature, humidity, and noise level. The information is then sent to the cloud. After that, cloud computing is used to examine the data. Warnings are given to the parents if the baby's temperature rises over the safe range. If there is a lot of dampness, it means the baby has been to the bathroom. The sounds of the baby's cries will be captured by the microphone. The information from the sensor powers the output devices. The user receives a notification if indeed the baby's temperature rises too high or if the infant has to go to the bathroom. This allows working parents to keep a constant eye on their children. By the same token, this software lessens the need for a babysitter or nanny. Getting rid of the babysitter is a good way to keep unwanted guests out of your house.
07	A Smart Cradle System to Monitor Infants for Healthcare Baby Wards Based on IoT and Block chain	H. Chauhan, D. Gupta, S. Gupta and M. J. Haque, "A Smart Cradle System to Monitor Infants for Healthcare Baby Wards Based on IoT and Blockchain, " <i>2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N)</i> , Greater Noida, India, 2021, pp. 606-609, doi: 10.1109/ICAC3N53548.2021.9725717.	In countries like India, stealing of newborn babies is common now. Despite the CCTV Cameras installed on the healthcare baby centers premises left police with lack of solid evidence to zero on the person who stole the infant. Moreover, there are so many babies who are under supervision in the baby ward. It is difficult for the healthcare center staff to track each and every infant for changing their wet nappies, which leads to severe infection and rashes. However, with the help of emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Blockchain Technology (BT) can provide a solution, as these are the interrelated	Internet of Things (IoT), Artificial Intelligence (AI), Blockchain Technology (BT) can provide a solution, as these are the interrelated computing technologies which provides the ability to share the data on a network without any human interference. In this research article the authors have proposed a solution based on IoT and BT for monitoring the infants or toddlers. The cot works on two modes; first one is parental mode and second is non-parental mode. Parental mode will enable only the registered persons to carry the toddler. All the registered data is saved on the blockchain network so that no one can modify or temper the data as blockchain is immutable. This proposed solution will help to reduce the burden of parents and healthcare staff by enabling the features of security and alarm systems.

			computing technologies which provides the ability to share the data on a network without any human interference. In this research article the authors have proposed a solution based on IoT and BT for monitoring the infants or toddlers. This proposed solution will help to reduce the burden of parents and healthcare staff by enabling the features of security and alarm systems.	
08	Analysis on IoT Based Cradle System with an Android Application for Baby Monitoring	S. Kavitha, R. R. Neela, M. Sowndarya, Madhuchandra and K. Harshitha, "Analysis on IoT Based Smart Cradle System with an Android Application for Baby Monitoring," <i>2019 1st International Conference on Advanced Technologies in Intelligent Control, Environment, Computing & Communication Engineering (ICATIECE)</i> , Bangalore, India, 2019, pp. 136-139, doi: 10.1109/ICATIECE45860.2019.9063773.	A system of interrelated computing devices, mechanical and digital machines that are provided with the ability to transfer data over a network without requiring human interaction constitutes Internet of Things. This brings out automation of things. It is achieved through sensor and actuator devices. This paper brings out a survey on various sensors and actuator which is used in the implementation of Smart Cradle	Internet of Things brings the smartness among the devices. This paper presents the various types of sensors and actuators which brings the automation to cradle. The study of various types of sensors helps to achieve the smartness of cradle with additional features to the cradle and these sensors can be used for securing toddler.
09	IoT based Smart Baby Cradle System using Raspberry Pi B+	N. Saude and P. A. H. Vardhini, "IoT based Smart Baby Cradle System using Raspberry Pi B+," <i>2020 International Conference on Smart Innovations in Design, Environment, Management, Planning and Computing (ICSIDEMPC)</i> , Aurangabad, India, 2020, pp. 273-278, doi: 10.1109/ICSIDEMPC49020.2020.9299602.	This paper presents IoT based smart system that act as baby cradle monitoring system for engaged or working parent so that they can manage properly, and also for proper care and safety of the infant. Parent can recognize baby's movement, sound like crying and video output of baby's present position and motion will be visible on a screen monitor so the parent or any person can watch the infant even while away from baby. This cradle system is useful for monitoring or detecting movement and crying condition of the child automatically. The Raspberry pi B + module is used to have control on the entire hardware, condenser MIC is implemented for baby cry detection, PIR motion sensor is designed to identify baby's motion and pi camera is capturing the infant condition of motion and the display is used to show video output of sleeping baby. This smart baby monitoring system have n number of parameters such as live video and sound, set down audio and leisure movement of infant, measuring the room temperature and the humidity indicates if the baby is sleepless, and the most important characteristic is the ability to listen to the baby noise with cry detection feature.	IOT based smart cradle in comparison with the Earlier Ones support seven different features on one system and all of the required properties. The proposed system monitors temperature condition is favorable for baby or not. Parents can check their babies from another room at home for short range communication with Wi-Fi. Nevertheless, our proposed system does not support the heartbeat-measuring feature. Moreover, the system can send notifications to the parents in some abnormal condition identification such as high temperature crying . This allows parents to observe their babies and perform the necessary
10	S-MOM: Smart Mom on the Move	M. S. Rachana, S. M. Nadig, R. Naveen, N. K. Pooja and M. T. Gopala krishna, "S-MOM: Smart Mom on the Move," <i>2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI)</i> , Tirunelveli, India, 2018, pp. 1341-1344, doi: 10.1109/ICOEI.2018.8553971.	IoT-Internet of things, Internet being the ecosystem for physically connected devices, works with no human intervention for exchanging the data. "Smart Cradle", an automatic cradle, a venture designed especially for those moms who are excessively busy and occupied with work. It swings when the baby cries and also sings soothing music through the speakers. The system also sends the information of the temperature, cautions the attendant about the bunk wetting and has a camera through which the sitter/attendant can watch the live stream on the web application. The hardware components fixed to the cradle is synced to the webpage with the availability of the wifi shield. Arduino's performance is considered to be a great measurement connected with the other sensors such as temperature sensor LM35, moisture sensor, noise detection sensor, wifi shield ESP8266, ARP9600 speaker module and DC motor.	The proposed system will witness the change in the era eventually as it will introduce a facility of rocking the baby virtually without being sitting next to the baby every time. The smart cradle is very easy and simple to use, cost efficient and environment friendly. This will allow parents/attendants to focus back on their daily life having a hassle free lifestyle. The graphical user interface gives the mother a platform to virtually take care and be connected to the baby. For future enhancement, a small hand held device can be built to monitor babies which give better experience and ease for the attendants. This system will surely make rocking baby digitally a reality