**BABY MONITORING USING SMART CRADLE THROUGH IOT**

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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 real-time 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>

1. Motion sensor

* MPU6050 (with a gyroscope) – 150 to 300/-
* <https://amzn.in/d/dRzwDVx>

1. Motor for cradle oscillation

* Tower Pro MG995 Servo Motor – 200 to 300/-
* <https://robu.in/product/towerpro-mg995-metal-gear-servo-motor/>

1. Microcontroller – ESP32
2. Buzzer for Sounds

* Speaker Buzzer – 100/-
* <https://amzn.in/d/5NYXhrs>

1. Tempreture

* DHT11 Sensor – 200/-
* <https://amzn.in/d/cJkDP93>

1. Relay Module – 200/-

* <https://amzn.in/d/ie8cK2Y>

1. Bread board Jumper Wires
2. 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

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| 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. Almohammedi,  R. M. Ramli and M. A. H. Ali,  "IoT-BBMS: Internet of Things-  Based Baby Monitoring System  for Smart Cradle,"  in IEEE Access,  vol. 7, pp. 93791-93805, 2019,  doi:  10.1109/ACCESS.2019.2928481. | 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.  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. | 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  baby’s crying can VOLUME 7, 2019 9 |
| 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," 2021 6th International  Conference on Inventive  Computation Technologies  (ICICT), 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 24×7. 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. | 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," 2017  International Conference on  Computing, Communication,  Control and Automation  (ICCUBEA), Pune, India, 2017,  pp. 1-4, doi:  10.1109/ICCUBEA.2017.84636  76. | 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,  " 2021 7th International  Conference on Advanced  Computing and Communication  Systems (ICACCS),  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  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. | 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 |
| 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,  " 2022 International Conference  on Augmented Intelligence and  Sustainable Systems (ICAISS)  , 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 c  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," 2022 6th  International Conference on  Electronics, Communication  and Aerospace Technology,  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  des igned 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 loT 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 playersare 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,  " 2021 3rd International  Conference on Advances in  Computing, Communication  Control and Networking  (ICAC3N), 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  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. | 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. |
| 08 | Analysis on IoT Based Smart 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,  " 2019 1st International  Conference on Advanced  Technologies in Intelligent  Control, Environment,  Computing & Communication  Engineering (ICATIECE),  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+,"  2020 International Conference  on Smart Innovations in Design,  Environment, Management,  Planning and Computing  (ICSIDEMPC), 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," 2018 2nd International Conference on Trends in  Electronics and Informatics  (ICOEI), 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 |