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Baby Cradle Monitoring System Using IOT

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Abstract - The Baby Cradle Monitoring System Using IoT is an innovative solution designed to enhance infant safety by continuously monitoring environmental and physiological conditions inside a cradle. The system employs NodeMCU (ESP8266) as the primary microcontroller, integrating multiple sensors including DHT11 (temperature and humidity), water/rain sensor, sound sensor, and soil moisture sensor to detect critical parameters such as ambient temperature, wetness, infant crying, and diaper moisture levels. A servo motor is utilized to simulate cradle rocking motion, while a buzzer provides immediate local alerts in case of anomalies. All sensor data is transmitted in real-time via the MQTT (Message Queuing Telemetry Transport) protocol to a cloud-based IoT panel app, enabling remote monitoring and notifications for caregivers.

This paper presents a comprehensive study on the system architecture, hardware-software integration, data transmission methodology, and experimental validation. Results demonstrate that the system effectively ensures infant comfort and safety by providing timely alerts and automated responses. Future enhancements include the integration of machine learning algorithms for predictive analysis of infant behavior and the implementation of solar power for energy efficiency.

Keywords— IoT, NodeMCU, MQTT, Smart Cradle, Infant Monitoring, Real-Time Alerts

1.INTRODUCTION

Iot is internet of things, which is designed to save time, and for making work easy and accurate. as far as time and security is concern with the help of iot, we will build a cradle system, which will make parents stress free, and most important it will be safe and secure for the baby. therefore, managing the work in time and taking care of baby is very important factors. cradle system will give parents required time to parent for rest, as if the parents both mother and father goes for the job or even if the mother is house wife. being stress free will definitely create the great atmosphere, which will make great atmosphere around the baby. therefore, it does not matter if there is no one to swing cradle it will do swing automatically if the baby is crying. it does not matter if baby has done pee and no one knows about for long time, but not need to worry cradle system will also give the alert about the wetness in cradle. also, if baby is getting fever or cold cradle system also have the ability to detect it and send the alert. proposed system will help the parents, so that they can take good care of their baby

infant safety is a paramount concern for parents and caregivers, particularly during the early stages of development. traditional baby cradles lack real-time monitoring capabilities, which can lead to risks such as overheating, excessive humidity, wetness due to spills or urine, and prolonged crying episodes. these conditions, if left unaddressed, may result in discomfort, health issues, or even life-threatening situations such as sudden infant death syndrome (sids).

the advent of internet of things (iot) technology has revolutionized childcare by enabling smart monitoring systems that provide real-time data and automated responses. this paper introduces an iot-based baby cradle monitoring system that leverages low-cost sensors, wireless communication, and cloud-based analytics to ensure infant well-being.

1. **real-time monitoring** of critical parameters (temperature, humidity, wetness, sound).
2. **automated alerts** via buzzer and mqtt-based notifications to caregivers.
3. **remote accessibility** through an iot dashboard for continuous supervision.
4. **simulation of cradle movement** using a servo motor to soothe the infant.

2. BLOCK DIAGRAM

The IoT-based smart cradle monitoring system employs a **NodeMCU ESP8266** microcontroller interfaced with multiple sensors to ensure infant safety and comfort. A **DHT11 sensor** monitors real-time temperature and humidity, while a **water/rain sensor** detects liquid presence

(e.g., spills or urine). A **soil moisture sensor** checks diaper wetness, and a **sound sensor** identifies infant crying. The NodeMCU processes all sensor data and transmits it wirelessly via the **MQTT protocol** to a cloud-based **IoT panel app** (e.g., Cayenne or Blynk) for remote monitoring and alerts. When the sound sensor detects crying (sound intensity >60dB), a **servo motor** automatically activates to rock the cradle. If any abnormal conditions are detected—such as high temperature (>30°C), excessive humidity (>70%), or moisture—the system triggers a **buzzer** for local alerts while simultaneously pushing real-time notifications to caregivers through the MQTT-connected IoT app. The system prioritizes low-latency communication (<500ms) using MQTT's publish-subscribe model, with sensor data published to dedicated topics (e.g., babycradle/temperature). Caregivers can monitor all parameters and receive instant alerts through the intuitive IoT dashboard, ensuring prompt response to critical events. This design eliminates the need for physical displays (LCD) by leveraging cloud visualization, while maintaining reliability through local buzzer alerts that function even during network interruptions. The servo motor includes an auto-shutoff feature after 2 minutes of continuous operation to conserve power. By combining multi-sensor data fusion with efficient MQTT communication, the system delivers a robust, cost-effective solution for modern infant care.

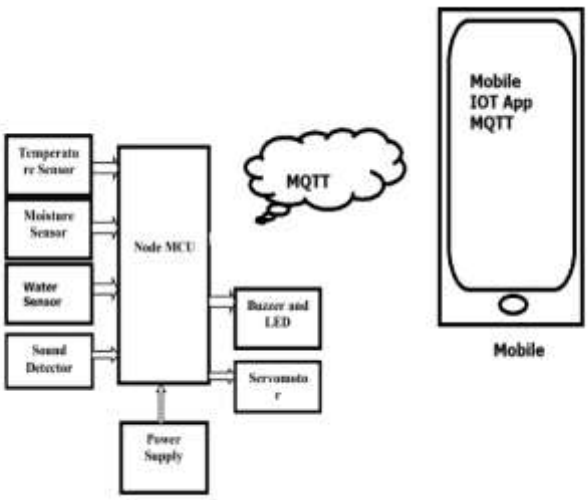


Fig. 1 Block Diagram

3. LITERATURE REVIEW

[1] senoj joseph, ajay gautham.j, akshaya kumar, harish babu m.k "iot based baby monitoring system smart cradle", in ieee, 2021. the system is developed to recognize each and every moment of baby by connecting various sensors to the cradle such as 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. parents may be certain of their babies' safety and wellbeing at any time, in any location, using all of those data and photographs.

[2] waheb a. jabbar, hiew kuet shang, saidatul, akram a. almohammedi, roshahliza m. ramli, mohammed a. h. ali "iot-bbms: internet of things-based baby monitoring system for smart cradle", in ieee, 2019. 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.

[3] natasha saude, dr.p.a.harsha vardhini "iot based smart baby cradle system using raspberry pi b+", in ieee, 2019. this smart baby monitoring system have n number of parameters such as live video and sound, set down audio and leisure moment 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.

[4] kavitha s, neela r r, sowndarya m, madhucha-ndra, harsh-itha k "analysis on iot based smart cradle system with an android application for baby monitoring", in ieee, 2019. 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 brings out a survey on various sensors and actuator which is used in the implementation of smart cradle.

[5] aniruddha rajendra patil, nitesh janardhan patil, anjali deepak mishra, prof. yogita deepak mane "smart baby cradle", in ieee, 2019. the proposed smart cradle system which can be monitored by parents on mobile apps. the system has very distinct features. it has four sensors which

are used to check the condition of the baby. there are 2 apps to monitor the baby, one for swinging the cradle and checking all the accurate responses. another is for live monitoring of the baby. this system is made using two main modules arduino and raspberry pi3.

4. PROPOSED SYSTEM

The IoT-based smart cradle monitoring system employs a **NodeMCU ESP8266** microcontroller interfaced with multiple sensors to ensure infant safety and comfort. A **DHT11 sensor** monitors real-time temperature and humidity, while a **water/rain sensor** detects liquid presence (e.g., spills or urine). A **soil moisture sensor** checks diaper wetness, and a **sound sensor** identifies infant crying. The NodeMCU processes all sensor data and transmits it wirelessly via the **MQTT protocol** to a cloud-based **IoT panel app** (e.g., Cayenne or Blynk) for remote monitoring and alerts. When the sound sensor detects crying (sound intensity >60dB), a **servo motor** automatically activates to rock the cradle. If any abnormal conditions are detected—such as high temperature (>30°C), excessive humidity (>70%), or moisture—the system triggers a **buzzer** for local alerts while simultaneously pushing real-time notifications to caregivers through the MQTT-connected IoT app. The system prioritizes low-latency communication (<500ms) using MQTT's publish-subscribe model, with sensor data published to dedicated topics (e.g., babycradle/temperature). Caregivers can monitor all parameters and receive instant alerts through the intuitive IoT dashboard, ensuring prompt response to critical events. This design eliminates the need for physical displays (LCD) by leveraging cloud visualization, while maintaining reliability through local buzzer alerts that function even during network interruptions. The servo motor includes an auto-shutoff feature after 2 minutes of continuous operation to conserve power. By combining multi-sensor data fusion with efficient MQTT communication, the system delivers a robust, cost-effective solution for modern infant care.

5. FLOWCHART

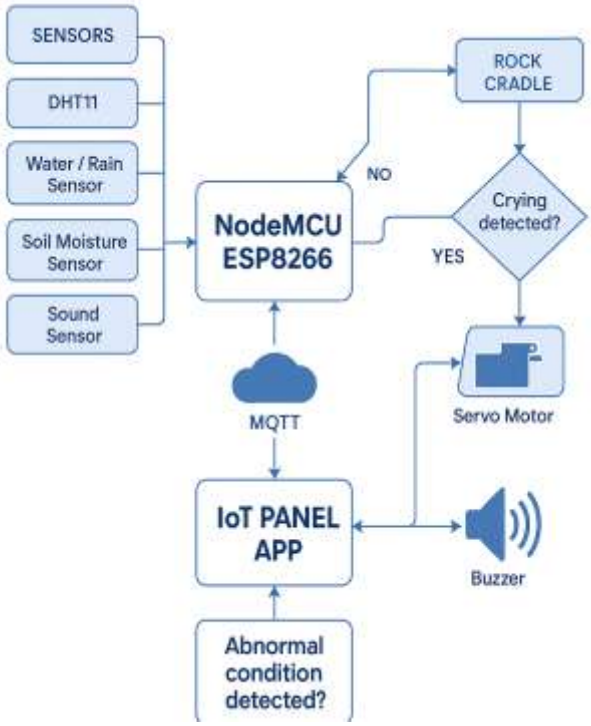
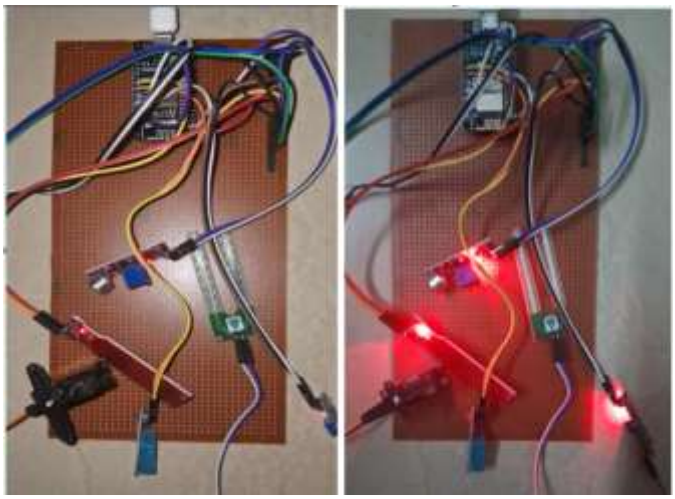
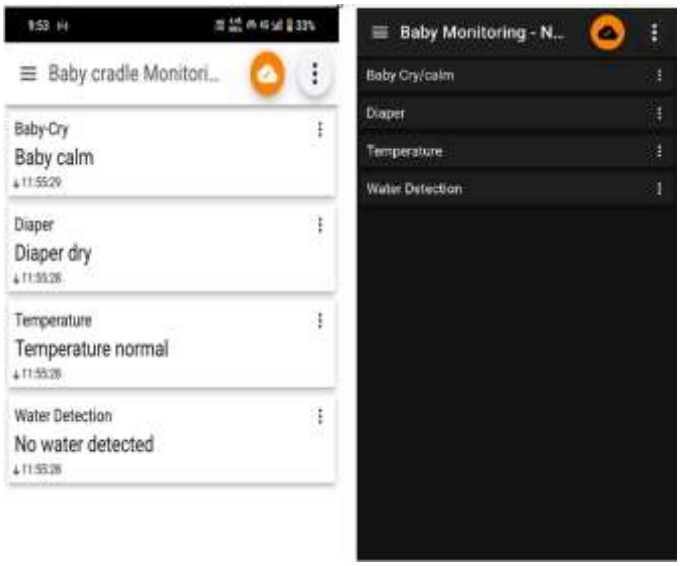


Fig. 2 Flowchart

6. RESULTS

HARDWARE SETUP





7. CONCLUSIONS

The proposed project "IOT based Smart cradle system for infant monitoring "has been implemented. We have tested the system and carefully and closely observed the results achieved thereafter. All the hardware components have been integrated to develop the system. The working of each module has been reasoned out with utter carefulness and they have been placed in such a way that they contribute towards getting the best results from the system.We are grateful to God for giving us faith and perseverance to overcome all the difficulties and obstacles that we faced while working on the project. We worked hard on our project, which took up a lot of our time, but we were happy to finish it neatly and neatly, especially the reporting on it. IoT based smart cradle system give convenience and surveillance to parent in real time as compared to conventional cradle It also ensure baby safety while they are not physically present near cradle, so it is efficient to use IOT based smart cradle system to take care of infant in proficient manner. The Smart Cradle System would also give certain alerts in case of emergency. Hence, the overall project is cost effective and helps the parent to have his or her own time and relieve some stress. In future, it is possible to add more features to make more efficient and user-friendly. The feature can be added to this device such like rotating toy with music. Another implementation can be continuous video streaming of the baby activities using an IP camera. This will help the parents to look after the baby even if they are not around. Another feature to be added to device is to send SMS to the parent about continuous monitoring of baby. More sensors can be added like to sleeping pattern can be Observed using data science technology. Additional facilities can be triggering emergency from app tracking the baby using GPS can also be added.

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