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Cradle Care: Intelligent Baby Monitoring System

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Abstract: ***The proposed work presents an IoT-based intelligent baby cradle that continuously monitors an infant's condition and surrounding environment using a NodeMCU/ESP8266 controller including cry, temperature–humidity, and diaper-wetness sensors. Sensor data are periodically processed by embedded firmware following a decision-flow in which crying, abnormal environmental conditions, or wetness and automatically cradle swings and generate real-time SMS or mobile-app alerts to caregivers, as shown in the system flowchart. The hardware implementation integrates a DC motor driver, regulated DC power supply, and Wi-Fi connectivity on a cradle prototype, enables remote supervision and automation of infant care while reducing the workload and stress of busy or working parents.***

I. INTRODUCTION

Modern parents face the struggle to balance work and childcare, making it difficult to continuously monitor their baby in person. The proposed "Cradle Care – Intelligent Baby Monitoring System" aims to reduce this burden by combining automatic cradle motion with continuous sensing and remote alerts. A NodeMCU-based controller reads signals from cry, temperature, and wetness sensors, then decides whether to swing the cradle, notify the parents, or continue observation. When the baby cries or the diaper becomes wet, the system amplifies the sensor signal, drives the DC motor to swing the cradle, and can also send notifications so that caregivers can respond quickly even if they are away.

II. LITERATURE REVIEW

Earlier works mostly used mechanical or single-sensor cradles, or complex Raspberry-Pi-based systems for monitoring. The contribution was a model of a compact NodeMCU controller is combined with a camera and a speech-processing module that can play soothing songs, detect the baby's condition, and automatically rock the cradle when needed, giving smarter and more affordable solution for parents.

[1] Marie R. Harper, La Mirada, Maxine R. Blea, "Automatically rocking baby cradle".

Harper and Blea designed an early automatic rocking cradle that swings horizontally using a spring motor to imitate human rocking. The motor stops safely when any resistance is detected, making it cost-effective and reducing human effort, but the system does not provide any video-based baby monitoring.

[2] Yang Hu, Weihua Gui; "Sway control baby bassinet based on Artificial Algorithm":

Yang HU developed an algorithm to control the speed of motors based on the parameters obtained from baby monitoring this model help the user to control the speed of swinging on pattern of intensity of baby crying.

[3] M. P. Joshi and D. C. Mehetre , "IoT Based Smart Cradle System with an android app":

The authors have designed a cradle system with an android app to monitor baby, which swings automatically after detection of baby crying sound. The principle behind this mechanism is that a sound sensor detect sound made by baby during crying and compare it to Preset value in microcontroller if sound made by baby is greater than preset value a signal is generated by microcontroller who activates the swing mechanism also an SMS is sent to parent phone using GSM module.

[4] N. Saude and P. A. H. Vardhini;" IoT based smart cradle using Raspberry Pi B+":

The authors have used a Gas sensor (MQ-135), Temperature sensor (LM-35), sound sensor (KY-038) and a cloud server to integrated it with Raspberry pi in order to upgrade the conventional cradle system to meet needs of parents.

[5] S. Durga, S. Itnal, K. Soujanya, C. Z. Basha and C. Saxena; "Advanced and effective baby care monitoring Smart cradle system using IoT":

These authors introduced a framework which observe all necessary indication of the child like heartbeats and the internal heat level utilizing remote innovation and sound sensors which is used for observing the cry pattern of the child. Additionally, the live images of the infant is obtained through camera module through a Wide Area Network (WAN) which can be sent through mail and it can keep surveillance on the baby from distant areas around the world.

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III. SYSTEM ARCHITECTURE

A. Overview

The system architecture uses a NodeMCU as the central controller connected to temperature, moisture, and noise sensors to monitor the baby and cradle environment. A DC motor driver and motor from the actuation unit that rocks the cradle whenever the controller detects discomfort, while a wifi module sends status and alerts to the parent's mobile application in real time.

B. Components Used

Hardware: The hardware components used in the system are NodeMCU, ESP32 CAM, 16x2 LCD display, 5V power supply, DC motor, Sensors (Temperature, Moisture, Noise), DF Player MP3.
Software: The software components used in the system are Arduino IDE, BLYNK App, ESP32-CAM firmware.

IV. METHODOLOGY

A. System Partitioning

The architecture is divided into input, processing, and output stages, where sound, temperature, and moisture sensors form the input block feeding a NodeMCU controller that drives motor, audio, and Wi-Fi modules as outputs.

B. Hardware and Software Implementation

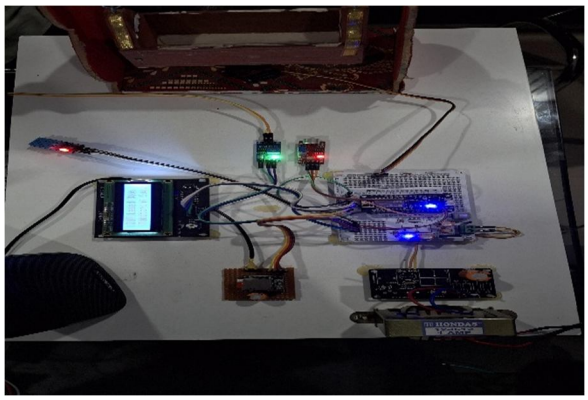
In hardware, all sensors are wired to the NodeMCU, which controls the DC motor driver, Wi-Fi, camera, and speech-processing module; in software, firmware executes a monitoring loop that reads sensors, compares them with thresholds, and then activates cradle rocking or sends alerts via the IoT platform.

C. Testing Procedure

The prototype is tested by imitating baby cries, varying room temperature, and wetting the pad to ensure that the system quickly performs the correct actions—swinging, notifications, and audio feedback—while maintaining reliable Wi-Fi connectivity and stable continuous operation.

V. RESULT

The prototype successfully detected baby cry, temperature rise, and bed wetness and responded with the actions like automatic cradle swinging, audio soothing, and mobile notifications. Sensor readings were transmitted to the IoT platform, and continuous operation of the cradle mechanism during monitoring sessions.





VI. CONCLUSION

The proposed Cradle Care system offers automatic rocking and continuous monitoring of the baby's cry, temperature, and diaper wetness, giving parents greater comfort and peace of mind. Experimental results show that the NodeMCU-based design detects abnormal conditions, sends timely alerts through and mobile app, and operates stably over long durations, proving it to be a low-cost and practical solution for smart baby care in homes and hospitals.

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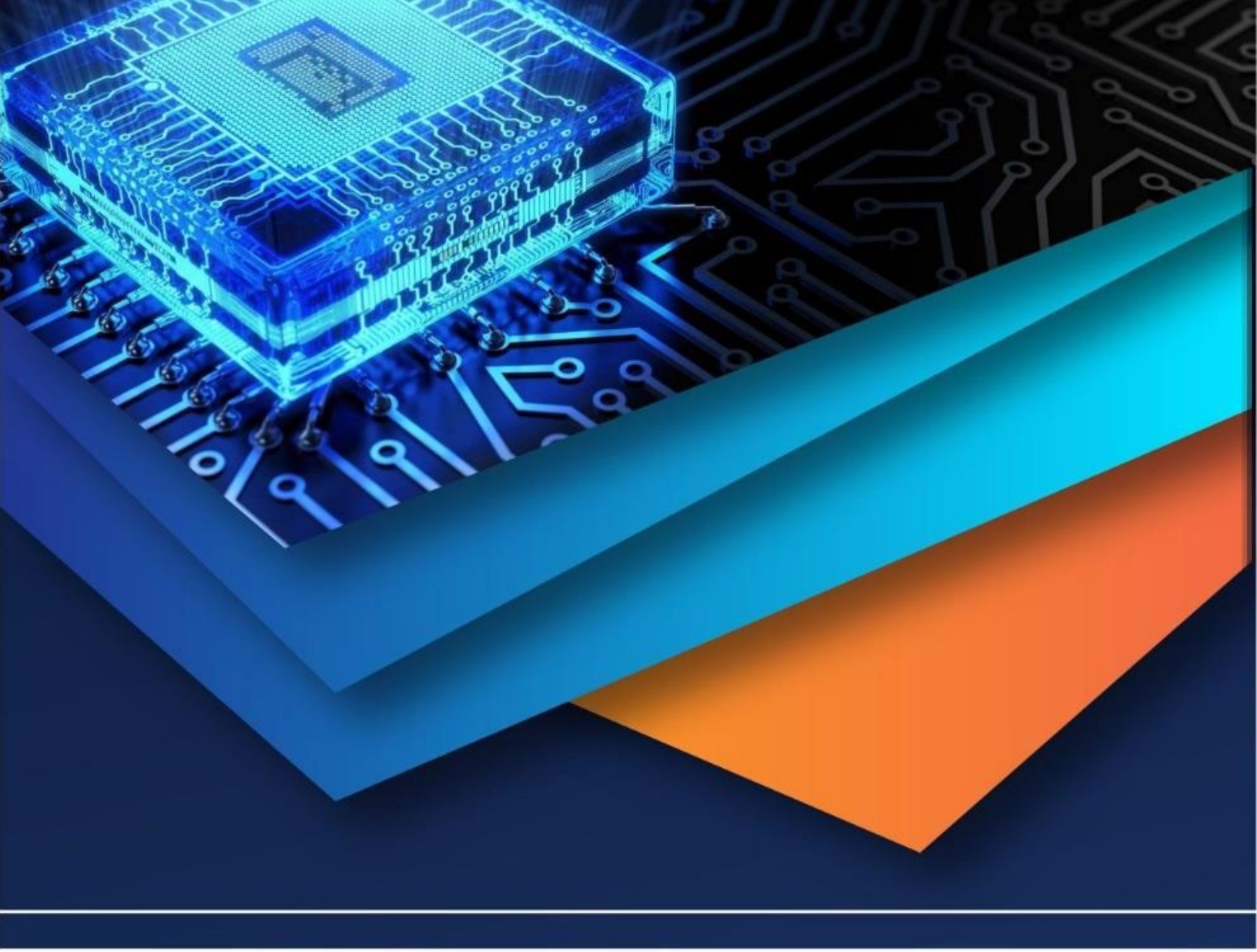
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