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IOT-BASED SMART CRADLE SYSTEM FOR BABY MONITORING

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I. ABSTRACT

As the number of working mothers rises, families often grapple with ensuring adequate baby care. Many resort to relying on grandparents' homes or baby care facilities, yet continuous monitoring remains a challenge. To tackle this, we propose an Internet of Things-based Baby Monitoring System (IoT-BBMS) for real-time and affordable monitoring. Our system features an innovative algorithm to enhance baby care during parental absence. Using a Node MCU Controller Board, it gathers data from diverse sensors, transmitting it via Wi-Fi to the Blynk app. These sensors track vital parameters such as ambient temperature, moisture levels, and instances of crying. Additionally, the system includes a motorized baby cradle that swings automatically upon detecting the baby's cries. Through the Blynk app, parents can remotely access a web camera for real-time monitoring. In conclusion, the project offers a comprehensive solution to the challenges faced by working parents in monitoring their babies. By leveraging IoT technology, we provide real-time data collection and monitoring capabilities, enhancing parental peace of mind and ensuring optimal baby care even in their absence. This system not only addresses the practical concerns of modern families but also showcases the potential of IoT in revolutionizing childcare solutions for a more connected and responsive parenting experience.

Keywords:
Internet of things (IOT), Baby Monitoring System, BLYNK app, Real-time monitoring, Node MCU microcontroller board, optimal baby care.

II. INTRODUCTION

In The Internet of Things (IoT) is a revolutionary concept that has transformed the way we interact with technology and the world around us. At its core, IoT refers to the interconnectivity of everyday objects and devices through the internet, enabling them to collect, exchange, and act upon data without human intervention. This interconnected network encompasses a wide range of devices, from smartphones and wearables to home appliances, industrial machinery, and even vehicles, all communicating and sharing information seamlessly. One of the key features of IoT is its ability to gather vast amounts of data from various sources in real time. Sensors embedded in IoT devices can monitor everything from temperature and humidity to motion and location, creating a wealth of information that can be analysed to derive valuable insights. These insights drive informed decision making, enhance operational efficiency, and improve overall user experience across industries. Furthermore, IoT plays a pivotal role in enabling automation and remote-control functionalities. Through IoT platforms and applications, users can remotely monitor and manage connected devices, adjust settings, and receive notifications or alerts based on predefined conditions. This capability not only enhances convenience for consumers but also unlocks new possibilities for businesses to optimize processes, reduce costs, and deliver innovative services. As IoT continues to evolve and expand its reach, it is reshaping various sectors such as healthcare, transportation, agriculture, and smart cities. The potential of IoT lies in its ability to create interconnected ecosystems where devices, systems, and humans collaborate seamlessly to drive progress, efficiency, and sustainability. But as the Internet of Things grows quickly, it also presents new problems in terms of data security, privacy, interoperability, and ethical issues. These concerns underline the necessity for strong frameworks and standards to guarantee the IoT's beneficial and responsible integration into our daily lives. Baby monitoring using a smart cradle system involves using technology to monitor baby's well-being and activities while they

are sleeping or resting in their cradle. This system typically includes sensors embedded in the cradle to monitor vital signs such as heart rate, breathing, and temperature. These sensors transmit data to a centralized hub or smartphone app like blynk, allowing parents to remotely monitor their baby's status in real-time. Additionally, some smart cradle systems may offer features like automatic rocking or soothing sounds to help calm the baby. Overall, it provides parents with peace of mind and allows them to respond promptly to any changes or concerns regarding their baby's health and comfort.

III. LITERATURE SURVEY

S.P.PatilandM.R.Mhetre,‘‘Intelligent baby monitoring system,’’ITSI Trans. Elect. Electron. Eng., vol. 2, no. 1, pp. 11–16, 2014. This paper describes the construction of a baby monitoring system based on the GSM network. A prototype is created, resulting in a dependable and efficient baby monitoring system that can play an important role in improving infant care. This technology monitors essential indicators such as an infant's body temperature, heart rate, moisture status, and movement and transmits this information to their parents via the GSM network. Measurements of these essential parameters can be taken, and the risk status can be communicated to the parents via an alarm triggering system to initiate the appropriate control procedures. The system architecture includes sensors for monitoring vital data, an LCD screen, a GSM interface, and a sound buzzer, all controlled by a single microcontroller core.

A. F. Symon, N. Hassan, H. Rashid, I. U. Ahmed, and S. M. T. Reza, ‘‘Design and development of a smart baby monitoring system based on Raspberry Pi and Pi camera,’’ in Proc. 4th Int. Conf. Adv. Elect. Eng. (ICAEE), 2017, pp. 117–122. This paper describes a baby monitoring system designed for busy parents to ensure their newborns' adequate care and safety. This system can detect the baby's movements and sound, particularly crying, and video output of the infant's current position can be displayed on a display monitor, allowing the mother or another responsible person to observe the baby while away from him or her. This baby monitoring system detects motion and the baby's crying condition automatically. This proposed approach can make it easier and more convenient for busy parents to care for their babies.

Prof. A.D. Anijkar et.al, “General Idea About Smart Baby Cradle”, Int. J. of Innovative Science and Eng., Jan-Feb 2014 [2] A cradle is a device designed to put babies to sleep. The cradle includes a side-to-side rocking action that calms the infant and puts it to sleep. It takes a lot of work for the parent to physically rock the cradle to create a swinging motion. When a baby is confined within a cradle, the parent must constantly observe the baby's activities. The proposed idea of this smart cradle prototype will allow it to efficiently connect with a smartphone, typically an Android device. An Arduino microcontroller will be utilized to connect all of the sensors and hardware components required.

METHODOLOGY

The development process for the smart cradle involves several key stages. Initially, a thorough requirement analysis is conducted to define its features and functionalities, such as monitoring the baby's movements, temperature, and sounds, and sending alerts to caregivers. Subsequently, appropriate IoT hardware components are selected, including sensors like motion sensors, temperature sensors, sound sensors, wet sensors, and gas sensors, as well as microcontrollers such as Arduino or Node MCU, and communication modules like Wi-Fi or Bluetooth. Following this, firmware is developed for the microcontroller to collect data from sensors, process it, and establish communication with the designated IoT platform or mobile app, utilizing suitable programming languages like C or Python.

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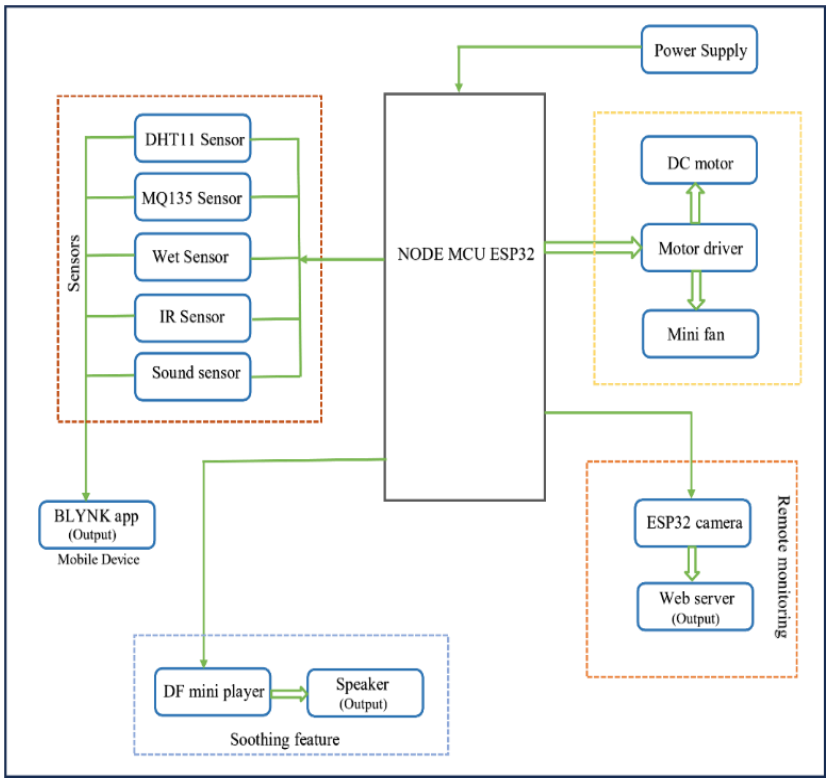

Fig.1. Block Diagram of the proposed system

Integration with an IoT platform such as AWS IoT or Google Cloud IoT is then achieved, enabling device management, data collection, and alert dissemination through APIs or SDKs. Data transmission protocols like MQTT or HTTP are set up to securely send sensor data to the IoT platform, where data processing algorithms analyse the information to detect events like baby crying or abnormal movements. Concurrently, mobile application development is undertaken to create a user-friendly app for caregivers to monitor the baby's status, receive alerts, and control the smart cradle remotely, ensuring compatibility across iOS and Android platforms. The design of a simple and intuitive user interface for the mobile app enhances accessibility to the baby's data and smart cradle controls. Thorough testing and validation are then conducted to ensure the system's functionality, reliability, and security, with real-world user feedback informing continual improvement efforts. Upon successful testing, the smart cradle system is deployed in a real environment, with regular maintenance and updates provided to ensure ongoing performance and security. Compliance with relevant safety standards and regulations, such as FCC and CE, is also ensured to prioritize the safety of the baby and caregivers throughout the deployment process.

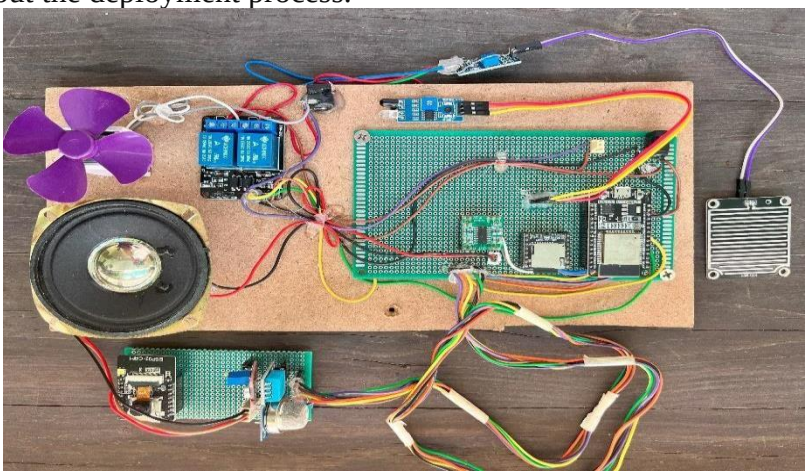

Fig.2. Internal Hardware setup

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IV. RESULTS

The data obtained from the sensors and IOT platforms are suggested for system efficiency and reliable accuracy. Human sensor data in IOT is sent to the Thing speak server with the internet. We have created an effective healthcare service that provides numerous opportunities. In this platform, we can observe vital information for the requirement specification during emergency conditions.

Fig.3. BLYNK App

For further implementation of health care monitoring system, we have to add visualizations and create widgets in the Thing speak platform. After creating widgets, source code is uploaded in the Arduino IDE. Now the code is successfully compiled and
we have to upload the code to the ESP32 board.

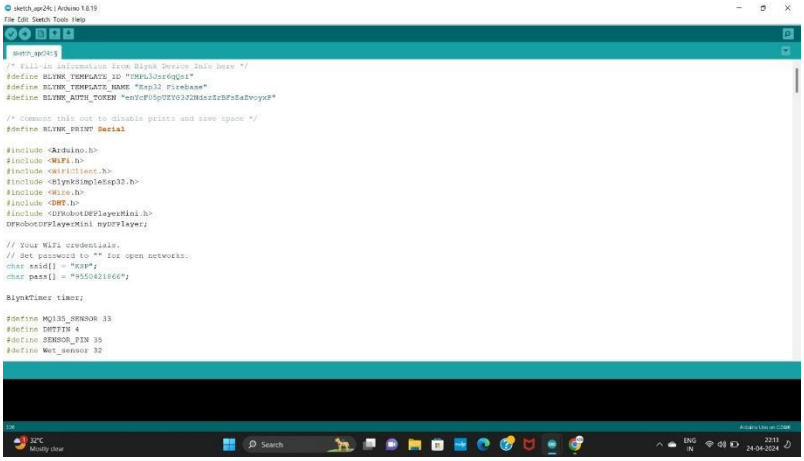

Fig.4. Uploading source code to the ESP32 board

When the code is uploaded to the ESP32 board, connect the software code to the hardware through a USB cable. After they are interconnected with each other, the LCD display and the other sensors starts accepting the input from the user.

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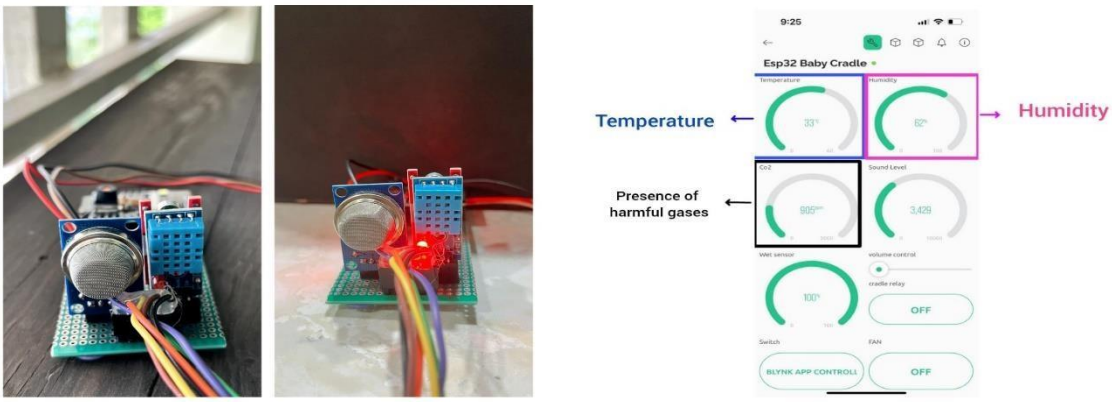

Fig.5. Output of DHT11 & MQ135 Setup and Data Display in Blynk App

The Node MCU ESP32 board is intricately connected to a DHT11 sensor for monitoring temperature and humidity levels, along with an MQ-135 sensor dedicated to detecting harmful gases in the surroundings. This setup allows for continuous data collection, enabling the Blynk app to display real-time information on temperature, humidity, and gas presence. These immediate insights into the environment empower users to take proactive measures for ensuring a safe and comfortable setting for the baby.

Fig6:ESP32 Cam Setup and Remote Monitoring of Baby's Cradle through Camera

The ESP32 camera is securely connected to the board, capturing the baby's view for remote monitoring. The web interface provides a live feed from the ESP32 cam, offering peace of mind during the baby's nap or when away from the room.

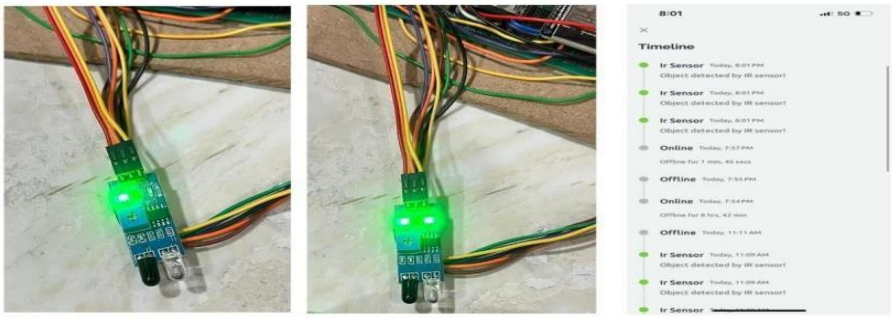

Fig7: Object Detection with IR Sensor and Blynk App Notification

The IR sensor shows its functionality with one light for power and two lights for object detection. It sends instant notifications to the Blynk app upon detecting objects, improving alerting capabilities.

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Fig8: Detection of Moisture and output in Blynk app

The wet sensor, integrated beneath the cradle, shows its readiness with one light and detects moisture with two lights, relaying data to the Blynk app for real-time monitoring. This system enhances baby care by providing timely alerts and ensuring a comfortable environment

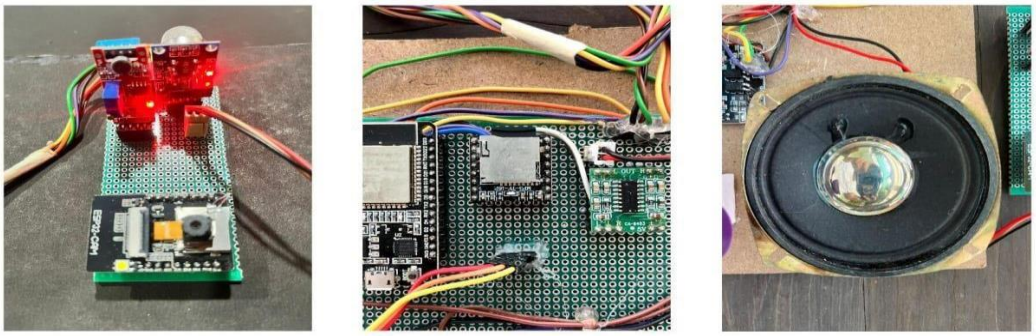

Fig9: Baby's Cry Detection and Music Playback

The SD card in the DF Mini MP3 player stores soothing music for the baby. When cries are detected, the sound sensor activates the player to play calming music through the speaker, providing a comforting response to the baby's signals

V. CONCLUSION

The conclusion of a smart cradle for baby monitoring would likely emphasize its benefits and effectiveness in providing peace of mind to parents while ensuring the safety and well-being of their infants. The implementation of a smart cradle for baby monitoring offers a comprehensive solution to address the concerns of modern parents regarding the safety and well-being of their infants. Through advanced technology and real-time monitoring capabilities, this innovative device provides parents with valuable insights into environmental conditions, quality of air, and features such as temperature regulation, object detection, and remote access via mobile applications, the smart cradle offers convenience and peace of mind to parents, enabling them to monitor their baby's health and safety from anywhere at any time. As a result, the smart cradle not only enhances parental confidence and reduces anxiety but also promotes better sleep quality for both infants and parents. With further advancements and integration of AI-driven functionalities, the potential for smart cradles to revolutionize baby monitoring and childcare is promising, paving the way for safer and more connected parenting experiences".

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