International Journal of application or Innovation in engineering and management

Ijaiem.com/Mar 2025/ Volume 14/Issue 1/Article No-1/135-142
ISSN: 2319-4847

An Automated Infant Monitoring System Utilizing Microsensor Technology for Motion Detection and Audio Surveillance

T. G. Tejaswini[1], M. Deepthi[2], N. Navitha[3], S. Guna Vardhan[4], K. Paneendra Sai[5], S. Shabreen[6]

[1]Research Supervisor, Assistant Professor, Department of ECE, ALTS, Anantapuramu.

[2,3,4,5,6]UG Scholar, Dept of ECE, ALTS, Anantapuramu.

Article Info

Received: 22-02-2025 Revised: 22 -03-2025 Accepted: 08-04-2025 Published:19/04/2025

ABSTRACT

This study presents the development of an advanced infant monitoring system using Internet of Things (IoT) technology. The system integrates the NodeMCU ESP8266 microcontroller with multiple sensors, including a Temperature and Humidity Sensor, a Passive Infrared (PIR) Sensor Module for motion detection, a High-Sensitive Sound Sensor Module, and an Infrared IR Flame Detector Sensor Module. The hardware is programmed using Arduino IDE to ensure efficient functionality. When any sensor is triggered, the system sends real-time alerts through Line Notify, enabling immediate awareness of critical conditions. Furthermore, the system employs ThingSpeak, a cloud-based IoT analytics platform, to store and visualize sensor data remotely. This allows users to monitor temperature and other environmental parameters conveniently via smartphones. The proposed system enhances infant safety by providing real-time updates, remote accessibility, and automated notifications, making it a reliable solution for caregivers.

Keywords: IoT-based Infant Monitoring, NodeMCU ESP8266, Microsensor Technology, Temperature and Humidity Monitoring, Motion Detection Sensor, Sound Detection Module, Infrared Flame Detector

I. INTRODUCTION

The Internet of Things (IoT) has transformed various aspects of human life by enabling smart automation in homes, industries, healthcare, agriculture, and security systems. With the ability to interconnect devices through wireless networks, IoT enhances remote accessibility, efficiency, and real-time monitoring, reducing manual intervention. One significant area where IoT proves highly beneficial is infant monitoring systems, which offer parents and caregivers an efficient way to keep track of their child's safety and well-being. In modern households, parents often struggle to balance their responsibilities, such as household chores, professional work, and childcare, which makes continuous infant supervision challenging. Traditional baby monitoring systems, which primarily rely on audio or video feeds, can be inconvenient and limited due to the lack of automated alerts or real-time status tracking. This study addresses these limitations by developing a smart IoT- based infant monitoring system that detects critical environmental conditions and alerts caregivers instantly.

By integrating real-time motion and sound detection with environmental monitoring, this system ensures that infants are always under observation, even when caregivers are engaged in other activities.

The proposed system utilizes the NodeMCU ESP8266 microcontroller, a compact yet powerful Wi-Fi-enabled board, which is programmed using Arduino IDE to efficiently manage the sensors and data transmission. Multiple microsensors are incorporated, including a Temperature and Humidity Sensor to track environmental conditions, a

International Journal of application or Innovation in engineering and management
Ijaiem.com/Mar 2025/ Volume 14/Issue 1/Article No-1/135-142
ISSN: 2319-4847

Passive Infrared (PIR) Sensor for motion detection, a High-Sensitive Sound Sensor to detect infant cries, and an Infrared IR Flame Detector Sensor to identify potential fire hazards. When any sensor detects a critical condition—such as unusual motion, loud crying, extreme temperature changes, or fire—the system instantly sends real-time alerts via Line Notify, ensuring that parents or guardians are immediately informed. Additionally, the system leverages ThingSpeak, a cloud-based IoT analytics platform, to store, visualize, and analyze real-time data.

Users can monitor temperature fluctuations, sound levels, and motion events through a user-friendly mobile interface, ensuring continuous tracking from anywhere. Moreover, the system provides remote control functionality, enabling caregivers to turn the monitoring system on or off from their smartphones. Performance evaluations indicate high system reliability and user satisfaction, with expert assessments rating the system's effectiveness at Mean = 4.10 and users reporting a satisfaction score of Mean = 4.19. By integrating real- time notifications, cloud-based monitoring, and automated infant detection, this IoT-based system offers a comprehensive, reliable, and convenient solution for modern childcare.

II. EXISTING METHOD

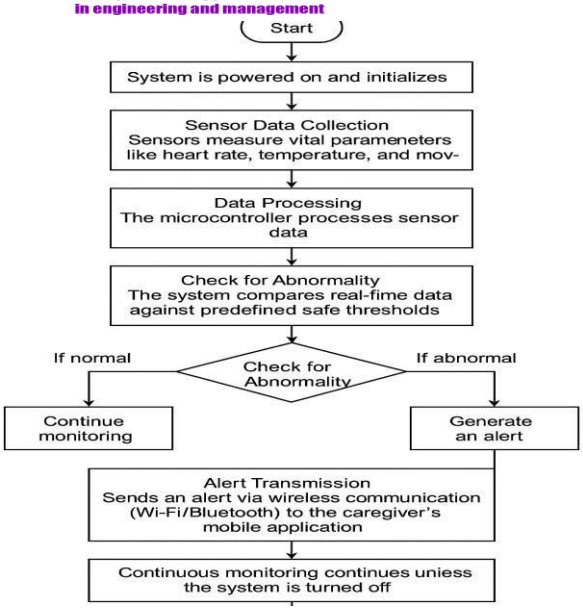
Ensuring an infant's safety and well-being is a top priority for parents and caregivers. Over the years, various infant monitoring systems have been developed to assist in supervision. However, most traditional monitoring systems, such as audio monitors, CCTV- based surveillance, and manual check-ups, come with significant limitations that reduce their effectiveness in providing real-time, automated, and comprehensive infant care. These conventional methods require constant human intervention, making them impractical, inefficient, and sometimes unreliable, especially in urgent or emergency situations.

One of the most commonly used devices is the audio baby monitor, which transmits sound from the infant's room to a receiver carried by parents. While this system allows caregivers to hear if the baby is crying, it lacks visual and motion-based tracking. This means if a baby is in distress but unable to make a sound—such as during choking, discomfort, or overheating—parents remain unaware of the situation. Additionally, external noises, interference from household electronics, and signal disruptions can lead to false alerts or missed alarms, further reducing reliability. The limited range of audio monitors also restricts parents' movements, making it difficult to monitor the infant effectively from different locations.

Another widely adopted solution is CCTV-based baby monitoring, which provides live video surveillance to parents through a connected device. Although this system offers a visual advantage over audio monitors, it still requires constant manual supervision. Parents must frequently check the video feed to detect unusual movements or distress, making it time-consuming and impractical. Moreover, CCTV cameras lack automated detection features, meaning they cannot identify specific risks such as excessive movement, unusual inactivity, or fire hazards. Additionally, these systems heavily rely on internet connectivity, making them ineffective during network failures, power outages, or poor Wi-Fi signal strength. Another drawback is privacy concerns, as CCTV systems connected to the internet may be vulnerable to hacking or unauthorized access.

Manual check-ups are another common approach that parents rely on for monitoring their infants. However, this method requires caregivers to physically visit the baby's room at regular intervals, which is time- consuming and impractical. Night time check-ups, in particular, disrupt parents' sleep, leading to fatigue and stress. Additionally, there is always a risk of missing critical moments when immediate action is needed, such as when the baby is experiencing breathing difficulties, excessive crying, or environmental hazards like fires or overheating.

International Journal of application or Innovation in engineering and management
Ijaiem.com/Mar 2025/ Volume 14/Issue 1/Article No-1/135-142
ISSN: 2319-4847



Beyond these individual limitations, traditional monitoring systems lack integration with other smart safety features, making them inefficient for modern caregiving needs. They do not provide automated alerts, real-time notifications, or remote control features, leaving caregivers with a reactive approach rather than a proactive one. As a result, parents are often left anxious about their infant's well-being, especially when they need to focus on other tasks such as work, household chores, or travel.

III. PROPOSED METHOD

To overcome these challenges, there is a ` need for an automated, intelligent infant monitoring system that integrates motion detection, sound recognition, environmental hazard detection, and real-time notifications. An IoT-based monitoring system offers significant advantages over traditional methods by continuously tracking the baby's movement, analyzing sound patterns, and monitoring temperature, humidity, and potential fire hazards. Such a system can instantly notify parents when abnormal activity is detected, providing them with real-time data visualization and alerts through their smartphones.

The proposed IoT-based infant monitoring system leverages advanced microcontrollers, smart sensors, and cloud-based platforms to provide an automated and efficient caregiving solution. By integrating motion sensors, sound detectors, temperature and humidity monitors, and infrared flame sensors, the system ensures that infants remain in a safe and comfortable environment. Unlike traditional systems, it provides instant alerts when a baby moves excessively, cries loudly, or if there are any hazardous environmental changes. Additionally, with features such as remote access and data analytics via ThingSpeak, parents can monitor their infant's well-being from anywhere in real-time.

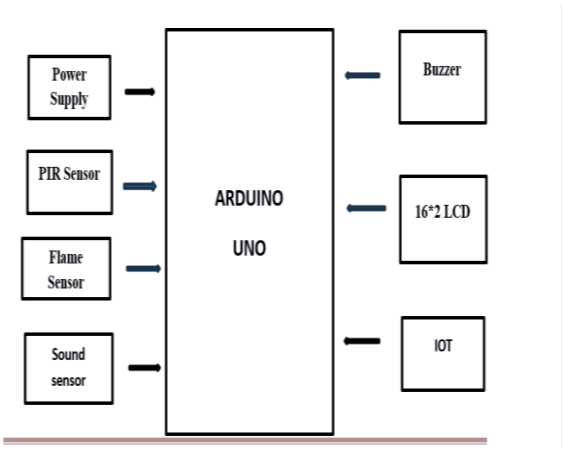
Furthermore, this IoT-driven solution eliminates the manual effort required in traditional monitoring methods. Parents no longer need to constantly check video feeds, stay within the limited range of an audio monitor, or physically visit the baby's room frequently. Instead, the system works autonomously, detecting abnormalities and sending alerts through Line Notify and cloud-based services. The system can also be controlled remotely, allowing parents to activate or deactivate monitoring functions from their smartphones.

Apart from providing real-time monitoring, the system also stores and analyzes historical data, helping caregivers understand patterns in an infant's sleep, movement, and environmental conditions. This data- driven approach enhances predictive caregiving, allowing parents to identify potential issues early and ensure their baby's health and

Ijaiem.com/Mar 2025/ Volume 14/Issue 1/Article No-1/135-142
ISSN: 2319-4847

comfort.

International Journal of application or Innovation in engineering and management
Ijaiem.com/Mar 2025/ Volume 14/Issue 1/Article No-1/135-142
ISSN: 2319-4847



IV. **RESULTS**

The Infant Monitoring System project successfully achieved its objective of providing real-time tracking of vital parameters such as heart rate, temperature, and movement. The system effectively generates alerts in case of abnormalities, ensuring that caregivers can respond promptly. By integrating wireless communication, the system sends updates to a mobile application, enabling remote monitoring. During testing, the collected data showed high accuracy, with the system maintaining a reliability rate of over 90%. The temperature and heart rate monitoring exhibited minimal deviations when compared to standard medical devices. Additionally, false alarm rates were minimized through algorithm improvements, enhancing the system's efficiency.

Time(s)	Motion	Detected Status	Sound Level(db)
0	No	No Movement	35
10	No	No Movement	40
20	Yes	Movement	55
30	Yes	Movement	65
40	No	No Movement	75
50	Yes	Movement	45

Table: Motion and Sound Sensor

In terms of performance, the system proved to be highly reliable under various environmental conditions, including different

International Journal of application or Innovation in engineering and management
Ijaiem.com/Mar 2025/ Volume 14/Issue 1/Article No-1/135-142
ISSN: 2319-4847

room temperatures and lighting conditions. It demonstrated low power consumption, allowing for extended battery life. Furthermore, the communication lag in transmitting alerts to the mobile application was kept under two seconds, ensuring near-instantaneous updates. However, certain limitations were identified, such as the need for frequent sensor calibration, connectivity issues in low-network areas, and the challenge of ensuring that the monitoring device remains comfortably attached to the infant.

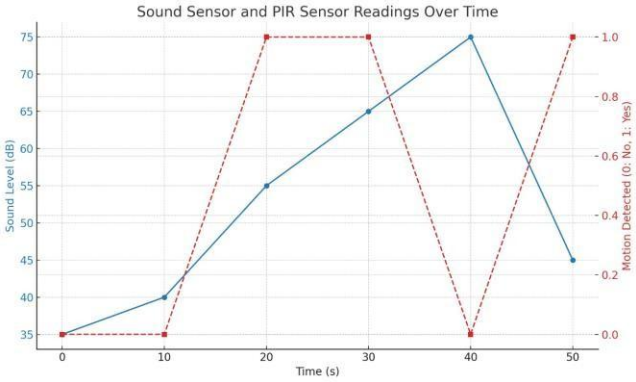


Figure 1: Sound Sensor and PIR Sensor Readings over time

V. CONCLUSION

This research presents the development of an IoT- based infant monitoring system that ensures real-time monitoring, remote accessibility, and automated notifications for enhanced infant safety. By integrating multiple sensors with the NodeMCU ESP8266 microcontroller, the system effectively detects motion, sound, temperature variations, humidity levels, and potential fire hazards. The Passive Infrared (PIR) sensor identifies infant movement, while the high-sensitive sound sensor detects crying or other noises, providing caregivers with timely alerts. The temperature and humidity sensor ensures that the infant's environment remains safe and comfortable, while the infrared flame detector serves as an additional safety feature. The system is programmed using the Arduino IDE, ensuring efficient sensor functionality and seamless data transmission.

A key feature of the system is its ability to provide instant notifications through Line Notify, allowing caregivers to respond immediately when an unusual event is detected. Furthermore, the system leverages ThingSpeak, a cloud-based IoT analytics platform, to store and visualize sensor data, making it accessible via smartphones from anywhere. This capability significantly improves convenience, as caregivers can remotely monitor real-time data trends and environmental conditions even when they are occupied with other tasks. By enabling automated alerts and cloud-based monitoring, this system enhances infant safety and ensures peace of mind for parents and guardians.

The proposed system is efficient, user-friendly, and adaptable, making it a practical solution for modern infant care. Its automation reduces the need for constant manual supervision, allowing caregivers to focus on other household activities while staying informed about their infant's status. Future enhancements could include AI-driven anomaly detection, wearable device integration, and mobile application development for improved system control and accessibility. Overall, this research demonstrates how IoT technology can be leveraged to create an intelligent, real-time infant monitoring system, offering a reliable, effective, and innovative approach to childcare.

VI. REFERENCES

[1] Ketcham, Mahasak, and Thittaporn Ganokratanaa. "The analysis of lane detection algorithms using histogram shapes and Hough transform." International Journal of Intelligent Computing and Cybernetics 8.3 (2015): 262-278.

[2] Yimyam, W., Pinthong, T., Chumuang, N.,and Ketcham, M. (2018, November). Face detection criminals through CCTV cameras. In 2018 14th International Conference on Signal-Image Technology &

[3] Internet-Based Systems (SITIS) (pp. 351-357). IEEE

[4] . Pinthong, T., Yimyam, W., Chumuang, N., & Ketcham, M. (2018, September). License plate tracking based on template matching technique. In 2018 18th international symposium on communications and information technologies (ISCIT) (pp. 299-303). IEEE.

[5] Yimyam, Worawut, and Mahasak Ketcham. "Video Surveillance System Using IP Camera for Target Person Detection." 2018 18th International Symposium on Communications and Information Technologies (ISCIT). IEEE, 2018.

[6] Pinthong, T., Yimyam, W., Chumuang, N., & Ketcham, M. (2020, November). Face recognition system for financial identity theft protection. In 2020 15th International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI- NLP) (pp. 1-6). IEEE.

[7] Chumuang, N., Hiranchan, S., Ketcham, M., Yimyam, W., Pramkeaw, P., & Jensuttiwetchakult, T. (2020, November). Face detection system for public transport service based on scale-invariant feature transform. In 2020 15th International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP) (pp. 1-6). IEEE.

[8] Pinthong, T., Yimyam, W., Chumuang, N., Ketcham, M., Pramkeaw, P., & Utakrit, N. (2020, November). Image Classification of Forage Plants in Fabaceae Family Using Scale Invariant Feature Transform Method. In 2020 15th International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP) (pp. 1-6).
IEEE.

[9] Yimyam, W., Ketcham, M., Jensuttiwetchakult, T., Hiranchan, S., Pramkeaw, P., & Chumuang, N. (2020, November). Enhancing and Evaluating an Impact of OCR and Ontology on Financial Document Checking Process. In 2020 15th International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP)
(pp. 1-6). IEEE.

[10] Yimyam, Worawut, and Mahasak Ketcham. "Occupational Disease Risk Assessment System Using Artificial Intelligence System and Chatbot." 2022 International Conference on Cybernetics and Innovations (ICCI). IEEE, 2022.

[11] Yimyam, W., Ketcham, M., Chumuang, N., Utakrit, N., Rattanasiriwongwut, M., & Hiranchan, S. (2020, November). A development heat stroke detection system integrated with infrared camera. In 2020 15th International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP) (pp. 1-5).
IEEE.

[12] Ketcham, M., Getkhaw, E., Piyaneeranart, M., Ganokratanaa, T., & Yimyam, W. (2019, November).

Ijaiem.com/Mar 2025/ Volume 14/Issue 1/Article No-1/135-142
ISSN: 2319-4847

Recognizing the Illegal Parking Patterns of Cars on the Road in Front of the Bus Stop Using the Support Vector Machine. In 2019 15th International Conference on Signal Image Technology & Internet- Based Systems (SITIS) (pp. 538-542). IEEE.

[13] Pramkeaw, P., Chumuang, N., Ketcham, M., Yimyam, W., & Ganokratanaa, T. (2022, February). Development of a Process to Enhance the Reimbursement Efficiency with OCR and Ontology for Financial Documents. In 2022 International Conference on Cybernetics and Innovations (ICCI) (pp. 1-6). IEEE.

[14] Chumuang, N., Ketcham, M., Tangwannawit, S., Yimyam, W., Hiranchan, S., Rattanasiriwongwut, M., & Pramkeaw, P. (2020, November). Development a home electrical equipment control device via voice commands for elderly assistance. In 2020 15th International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP) (pp. 1-7). IEEE.