BABY MONITORING CRADLE SYSTEM USING IOT AND AI

CAPSTONE PROJECT REPORT-PHASE II

Submitted by

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In partial fulfillment of the award of the degree

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in

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SCHOOL OF COMPUTING

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

KRISHNANKOIL 626 126

MAY 2024

DECLARATION

I hereby certify that the work which is being presented in the B.Tech. Capstone project entitled **"BABY MONITORING CRADLE SYSTEM WITH IOT AND AI ",** in partial fulfillment of the requirements for the award of the Bachelor of Technology in Computer Science And Engineering and submitted to the Department of Computer Science And Engineering of Kalasalingam Academy of Research and Education (Deemed to be University) – Tamil Nadu., is an authentic record of my work carried out during a period from December 2023 to May 2024 under the supervision of Dr.T.Dhiliphan Rajkumar.

The matter presented in this thesis has not been submitted by me for the award of any other degree elsewhere.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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BONAFIDE CERTIFICATE

I certify that this project report "BABY MONITORING CRADLE SYSTEM WITH IOT AND AI "is the bonafide work of S.RAKESH (9920004583), CH. GURU SAI NITHIN (9920004564), A.KAVYA SIVA DURGA(9920004392), M. LEENA JYOTHI(9920004674), who carried out the project work under mysupervision.

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PROJECT SUMMARY

Project Title	**BABY MONITORING CRADLE SYSTEM WITH IOT AND AI**	
Project Team Members	S. RAKESH (9920004583) CH. GURU SAI NITHIN (9920004564) M. LEENA JYOTHI (9920004674) A. KAVYA SIVA DURGA (9920004392)	
Guide Name/Designation	Dr T. DHILIPHAN RAJKUMAR Associate Professor	
Program Concentration Area	IOT	
Technical Requirements	Python	
Engineering standards and realistic constraints in these areas		
Area	**Codes & Standards / Realistic Constraints**	**Tick ✓**
Economic	The baby project using a microcontroller aligns with sustainability goals and minimizes its economic impact	✓
Environmental		
Social	Building a smart baby monitoring system Balancing privacy, connectivity, and noise control while ensuring ease of use and regulatory compliance cost-effectively.	✓
Ethical		
Health and Safety		
Sustainability	Balancing privacy, connectivity, and noise control while ensuring ease of use and regulatory compliance cost-effectively.	✓

ABSTRACT

This project presents the design and implementation of an innovative Baby Monitoring Cradle System that integrates cutting-edge technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT) using various components including Arduino, LM35 temperature sensor, water sensor, buzzer, ESP module, acoustic sensor, MP3 module, DC motor, and an ESP32 Cam board. The system is designed to provide real-time monitoring and care for infants, offering a comprehensive set of features to ensure the baby's well-being.

The system employs an LM35 temperature sensor and a water sensor to continuously monitor the baby's environment. The water sensor detects urinary events and triggers a buzzer to alert caregivers, ensuring timely diaper changes. Data from the sensors are transmitted to a central server via an ESP module for monitoring and historical tracking.

To cater to the baby's comfort and soothing needs, an acoustic sensor detects crying and triggers a 20-second MP3 module playback of calming songs. Additionally, a DC motor is activated for 20 seconds to gently rock the cradle, helping the baby fall asleep. These features aim to provide quick responses to the baby's needs and promote better sleep.

For remote surveillance, an ESP32 Cam board enables 24/7 monitoring of the baby through Wi-Fi. This feature allows parents or caregivers to keep a watchful eye on the baby from any location, enhancing the baby's safety and convenience for caregivers.

This AI and IoT-based Baby Monitoring Cradle System represents a significant advancement in infant care technology, providing real-time data monitoring, timely alerts, and remote access for caregivers. It combines innovative hardware components with AI and IoT technologies to ensure the safety, comfort, and well-being of infants, providing peace of mind for parents and caregivers

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LIST OF ABBREVIATIONS

ABBREVIATIONS	
AI	Artificial intelligence
IOT	Internet of Things
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
DC	Direct current
MCU	Micro Controller Unit

LIST OF ACADEMIC REFERENCE COURSES

S. NO.	COURSE CODE	COURSE NAME
1.	CSE18R110	Introduction to the Internet of Things
2.	CSE18R254	Introduction to Python Programming
3.	CSE18R210	Introduction to Sensor Technology and Instrumentation
4.	CSE18R392	IoT for Industries (Use Case Scenarios)

CHAPTER-1
INTRODUCTION

1.1 OVERVIEW

Internet of Things (IoT) simply means a network of objects connected to the Internet. It gives devices the ability to transfer sensor data online without the need for intervention. IoT integrates multiple devices and grows rapidly because it is a broad phase. The forecast says that by 2019, approximately 26.66 billion IoTs will be operational; by 2025, 75 Billion IoT devices worldwide will be available and connected wirelessly online. Among these connected devices, millions of wearable sensors are widely used in healthcare systems. The total amount of money spent worldwide on IoT in 2016 was $ 737 billion and was projected to reach $ 1.29 trillion by 2020. IoT is an outstanding sector that will grow and expand significantly. The function of the IoT is to control, monitor in real-time, and perform independent or independent work and efficiency. Perhaps one of the main reasons why IoT is so big is that it aims to make life easier, and people tend to invest in things that make their lives easier. Thus, the number of IoT applications continues to grow in various sectors. In this study, IoT was integrated into our child monitoring system to achieve a faster response time and provide a greater sense of parental safety.

It is a new, smart, and protective program for Cradle to breastfeed the baby properly. This program considers all the minutes necessary to care for and protect the unborn child. Intelligent design and innovation come with the use of technologies/methods that include the Internet Of Things (IoT) (Modules such as nodeMCU board, Humidity & Temperature sensing), Swing Automation, Cry Detecting Mechanism, Live Video Surveillance, and Mobile App. Computer Making (Data Storage) and Android Friendly User (User Management) mobile app.

1.1 Define Objectives and Requirements:

Conduct stakeholder interviews or surveys to determine the specific needs and expectations of caregivers. Define the scope, including functionalities (e.g., vital sign monitoring, environmental sensing, audio/video feed), scalability, compatibility with existing systems, and user interface preferences.

1.2 Select IoT Components:

Research and select appropriate sensors (temperature, humidity, motion, etc.), cameras, microcontrollers, communication modules (Wi-Fi, Bluetooth, Zigbee), and data storage solutions considering power consumption, accuracy, and ease of integration.

1.3 Hardware and Software Setup:

Develop or assemble the hardware components, ensuring compatibility and reliability between different components. Design and develop software components for data acquisition, processing, storage, and user interface considering real-time data visualization and user interaction.

1.4 Data Collection and Analysis:

Implement data collection mechanisms from sensors and devices. Analyze collected data to identify patterns, anomalies, and correlations, refining algorithms for accurate monitoring and alerts.

CHAPTER-2
LITERATURE REVIEW

S.No.	Paper details	Methodology Adopted	Inference From the Study
1.	Inanc Moran et al 2020 IEEE Access A prototype of Baby Monitoring Use Raspberry Pi	Process Tool works IE the first time turned on the Raspberry Pi by connecting the adapter as a power Raspberry Pi then the Raspberry Pi will determine the existing port on the board i s to be used according to the program that has been set. Then it performs the process of running the camera, and sensor In this paper, 4 steps were carried on such as: 1. Creating and installing RPiCam Interface application on Raspberry Pi. 2. Setup Raspberry PI CameraNoir. 3. Set up the DHT22 sensor. 4. System testing.	Based on the research conclusion, then the baby monitor equipment designed using Raspberry Pi can work properly, but still, a shortage of them can only be access using local area networks. It is recommended to be developed again to use the public IP so that it can be accessed anywhere and anytime. Using Raspberry Pi attached to Raspberry Pi Camera Noir as image input and the DHT22 sensor as air temperature and air humidity input proof helps as a monitoring security system.
2.	Y. Hamada 2021 IEEE Sensors Journal, Internet of ThingsBased Patient Cradle System an Android App for Baby Monitoring with Machine Learning	A cradle is a bed for a newborn that is in some manner powered by a motor The cradle is made consisting of a spinning toy that rotates when a baby cry is detected or according to the parents' desires. The Cradle swings when the motor control unit detects a baby cry. Both motors are controlled by the device driver. (ii) Camera: for video monitoring, a camera is placed close to the cradle. It is always snapping images. It is used to determine whether or not a baby is on the way	A reliable and efficient patient the monitoring system that facilitates the continuous collection of body parameters is the goal of the "Secure Automated Patient Monitoring System" project. There were many difficulties related to wireless sensor-based patient monitoring systems that were addressed in this thesis. The BSN is created with the assistance of a a temperature sensor. As a local database, the Android smartphone removes the need for a computer and is capable of outside surveillance.

3.	Trio Adiono et al,2022, IEEE Transactions on Biomedical Circuits and Systems, IoT-based on Smart Cradle for Baby Monitoring System	In this, an IoTcontrolled baby monitoring the system is designed to continuously monitor and control the baby's condition like temperature, pulse, baby crying, and dampness, and sends the control signals according to it to the parents to alert the position. This system is designed by using an S.ODI microcontroller which has a built-in wi-fi module to utilize for remote surveillance, along with those sensors	In the developed system all the necessary sensors that are used for measuring the parameters like temperature, moisture, pulse rate, microphone and the camera are interfaced with the S.ODI and Blynk. Blynk is the backend coding interface for S.ODI. In the Blynk application, the caretaker gets a necessary alarm messages or alerts regarding the baby's temperature, moisture, baby's bed dampness, and pulse rate of the baby.
4.	Jung-Yoon Kim,2022, Jung-Yoon KimBaby's Monitoring System using Image Processing and IoT	The Raspberry Pi camera is set up in such a way that it can capture the doll's face and body correctly. Image processing is used to detect the baby's movement after detecting the movement or the baby is near the edge of the bed the Pi camera triggers, will click the	An automatic noncontact-based baby monitoring system using image processing is proposed in this paper. This system sends a message to parents through mail when an abnormal condition occurs. The main advantage of this is that it is more user-friendly,

5.	Mohsen Annabestani 2021 ICIAET, Design and Development of a Smart Baby Monitoring System based on Raspberry Pi and Pi Camera	The Raspberry Pi B+ module will be used here as the central controlling unit. This Raspberry Pi is a low-cost credit card-sized microcontroller, which can provide data when plugged into a monitor B+ model of Raspberry Pi has some advantages over another previous model and this model's 4 USB ports are available as well as it has 40 GPIO (General Purpose Input/Output) pins along with micro- S D , card socket alter of full-size SD	An automatic baby monitoring system is the best solution for parents to observe their babies in this busy era. It is just an approach to taking advantage of modern technology that does not affect the daily activities of the parents. As we said in the introduction, we aim to develop a monitoring system that will provide a high level of baby security as well as whose security technique is unique. That's why we have chosen a video monitoring for baby's protections
6.	Vahid Soleimani,2020, " IEEE Transactions on the Biomedical Engineering, Anthropo-Mechanical Cradles: A Multidisciplinary	Robust security and privacy measures are essential for the future expansion and sustainability of cloud computing industry. The most effective security and and privacy measure for cloud computing are strict access control as used in Kaliya and Hussain	We reviewed recent literature to identify the overarching features and characteristics of IoT- cloud-based e-health systems and the motivations driving their use. In this paper, we explored the utilization of computers in health systems
7.	Hongshuo Zou,2021, Journal of Micro electro mechanical medical Systems, A Remote Baby Surveillance System with RFID and GPS Tracking	the system will connect to the Wi-Fi internet and turn on every sensor used in the project. Then, it will start to check if the RFID tag worn on the baby is detected. If so, it will extract the values of the latitude and longitude from the Firebase database generated from the GPS and send a notification to the smartphone via Blynk	New centuries of guardians do not ensure their babies' safety whenever they send them to the babysitting center. Due to the careless mistakes made by the caretaker, there have been a lot of cases of child abuse or baby casualties in Malaysia recently

8.	Filip Velickovski, 2020, IGEAP,An Automated baby monitoring system	This proposed monitoring system is for the safety of the infant, initially, the system is on by giving a power supply	The baby monitoring system can be utilized in situations when individuals must be closely monitored. This device is utilized whenever manually monitoring the safety of anything is problematic.
9.	BJ Taylor, 2022, IEEE Access, Design and development of IOT‐based Baby cradle NITTTR Rekha devi 2020	This system consists of a cry sensor, a wet sensor, and a smartphone application. The proposed system is attached to the cradle. When the baby cries or wets the mattress, the sensor detects and sends the signal to the microcontroller	Thus, the proposed system will be very helpful to the working parents as well as it will be also beneficial for the hospitals and creches.
10.	Amirhossein Shahshahani,2021, IEEE Sensors Journal, Development of an intelligent baby cradle for home and hospital use NIT, Rourkela Kunal Pal 2019	In the present study, an intelligent baby cradle system was developed. The cradle was capable of detecting the movement of the baby and initiating the cradle swing.	The different monitoring systems were merged to have an automatic cradle that can initiate a swing in the presence of the movement of the child. The integrated system was able to detect the bed wetness and body temperature of the child.

CHAPTER-3

METHODOLOGY

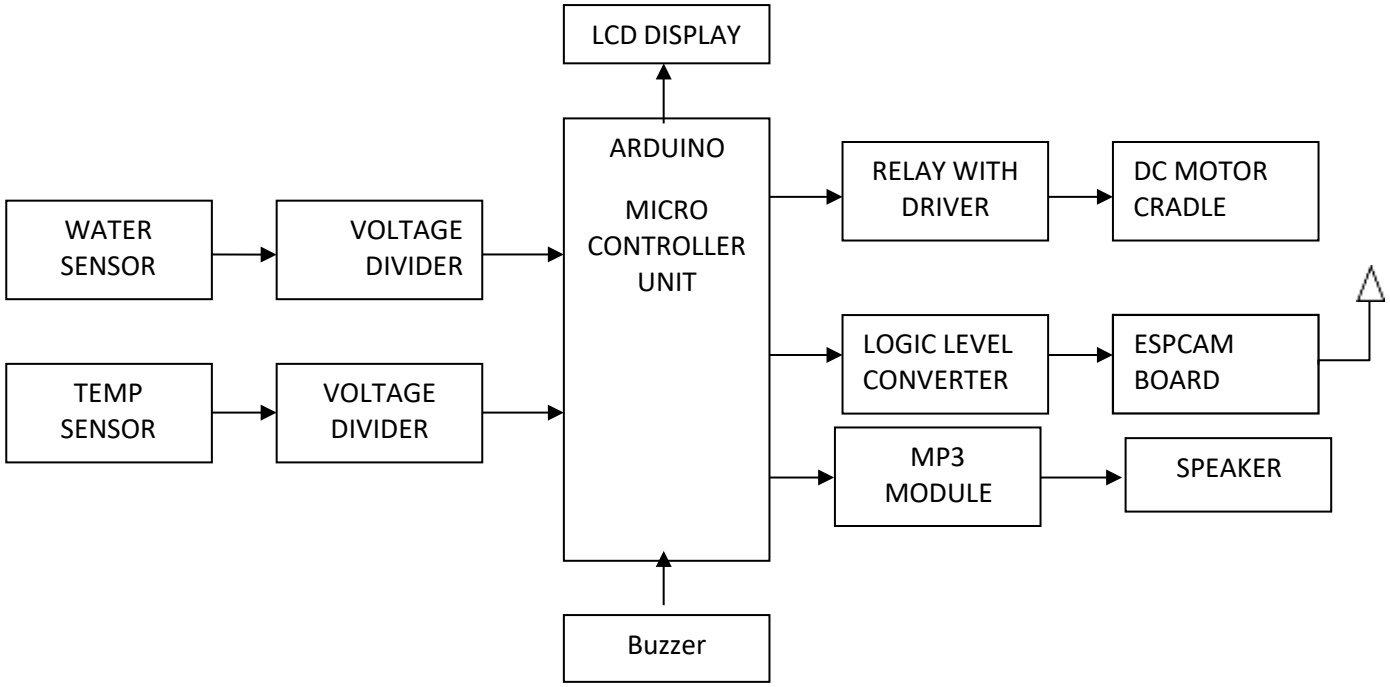

Fig.3.1 System architecture

This system architecture shows how the entire connection of sensors to our cradle prototype is implemented. Mainly the sensors like the water sensor and temperature sensor are connected to the Arduino board as an input sensor and the buzzer, speaker and LCD Display show the output. If the infant's diaper gets wet then the water sensor reacts and transmits the levels of water and will hear the buzz sound from the buzzer and the same working principle for the temperature sensor also. If an infant cries then MP3 reacts and gives a song with the help of a speaker and also the DC motor which is attached to the cradle starts moving so that the baby can relax. We can live monitor the cradle by using this ESP32 cam module in teachable machine learning software.

Software components:

1. **Cradle Movement:** Integrate a DC motor to automate the cradle's movement. Arduino can control the motor, allowing parents to start and stop it remotely.
2. **Temperature Monitoring:** Use the LM35 temperature sensor to continuously monitor room temperature. The data can be sent to the central server for remote access.
3. **Urine Detection:** Implement a water sensor in the baby's diaper. When moisture is detected, an alert is sent to the parents through the system.
4. **Crying Baby Monitoring:** Utilize an acoustic sensor to detect when the baby cries. Upon detection, the system can play soothing music through the MP3 module and start the cradle motion.
5. **Soothing Music:** Integrate an MP3 module to play predefined soothing songs when needed. Parents can control the music remotely.
6. **Video Monitoring:** Utilize the ESP32-CAM board for continuous video monitoring. The camera feed can be accessed through a mobile app or web interface for 24/7 monitoring.
7. **Connectivity:** Use an ESP module to connect the system to the Blink server for remote monitoring, data storage, and control.
8. **Alerts:** Implement a buzzer system to notify parents in case of urine detection or any unusual event.
9. **User Interface:** Develop a mobile app or web interface for parents to monitor and control the entire system remotely.
10. **Power Management:** Ensure a reliable power source, and include a backup power supply for uninterrupted operation.

Hardware Components:

1. Arduino Board (e.g., Arduino Uno or Arduino Nano): The main controller for your system.

Fig.3.2. Arduino Board

2. LM35 Temperature Sensor: To measure the temperature in the baby's environment.

Fig.3.3.Temperature sensor

3. Water Sensor: To detect moisture and check for baby urination.

Fig.3.4 Water sensor

4. Buzzer: To provide alerts when the water sensor detects moisture.

Fig.3.5 Buzzer

5. ESP8266 or ESP32 Module: For connecting to Wi-Fi and sending data to a cloud server (e.g., Blink server).

Fig3.6 ESP32 Module

6. Acoustic Sensor: To detect if the baby is crying.

Fig.3.7 Auostic sensor

7. MP3 Module: To play a 20-second lullaby or soothing sound when the baby cries.

Fig.3.8 MP3 module

8. DC Motor: To simulate the motion of a cradle for a certain duration (e.g., 20 seconds).

9. ESP32 Cam Board: To provide a live video feed of the baby over Wi-Fi.
10. Power Supply: You'll need a suitable power supply for your components, ensuring they get the required voltage and current.
11. Relay Module: To control the DC motor.
12. 16x2 LCD
13. Speaker

Software and Programming:

1. **Arduino Code**: Write the Arduino code to interface with all the hardware components. This includes reading data from the LM35, water sensor, and acoustic sensor, controlling the DC motor, and triggering the MP3 module.
2. **Wi-Fi Configuration**: Configure the ESP module to connect to your Wi-Fi network. You'll also need to set up communication with a remote server to send temperature, water sensor, and baby sound data.
3. **Remote Server**: Set up a remote server to receive data from the ESP module. You can use platforms like Blynk, and Adafruit IO, or create your server using platforms like Node.js.
4. **AI and IoT Integration**: Implement AI for analyzing the data received from the baby's environment, such as temperature, diaper status, and sound levels. You can use machine learning models to detect patterns and provide insights.
5. **User Interface**: Create a user interface, either a web application or a mobile app, to view the baby's live video feed and receive alerts or notifications when the baby cries, or when the diaper is wet.
6. **Security**: Ensure the security of the IoT system by using encryption for data transmission, secure login for the video feed, and other security measures.
7. **Testing**: Thoroughly test the system to ensure it works as expected. Make sure that the MP3 module plays music and the cradle rocks the baby properly in response to crying.
8. **Power Supply**: Arrange a stable power supply for all components to ensure continuous operation.

CHAPTER-4

EXPERIMENTAL RESULT AND DISCUSSION

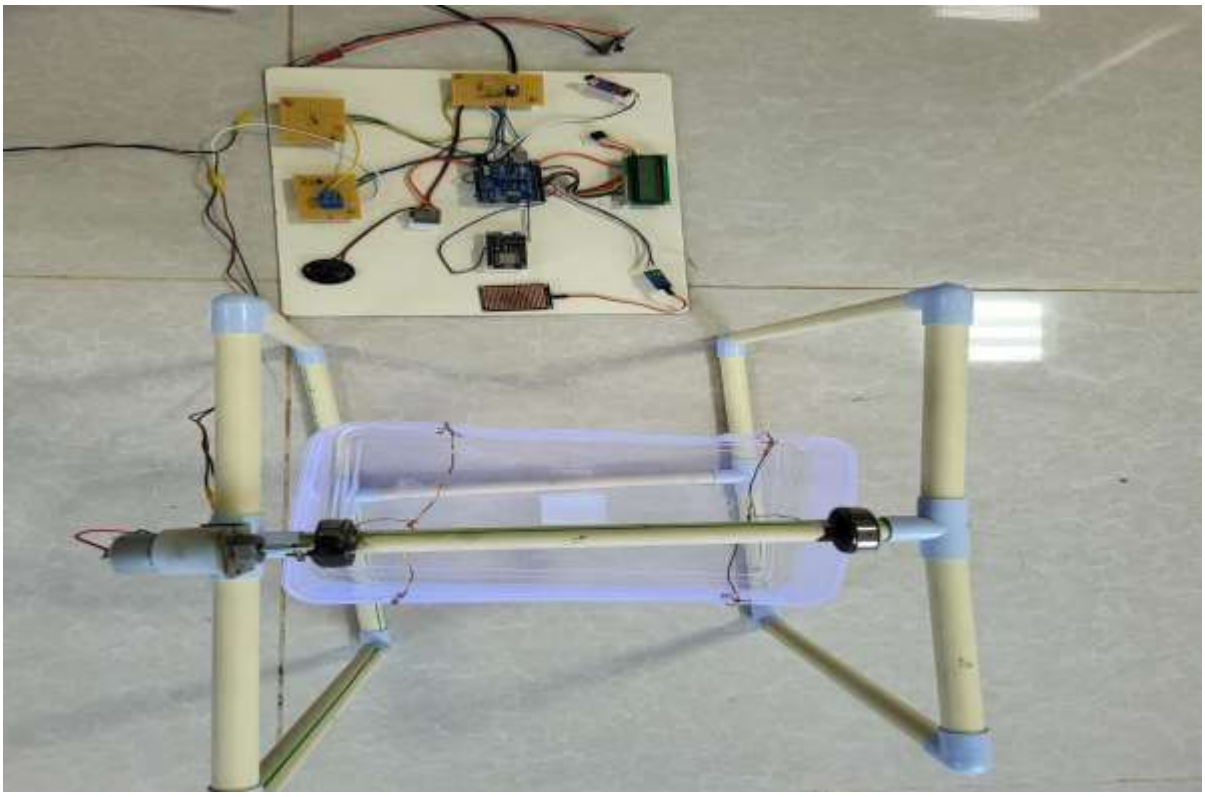

Fig.4.1 Baby monitoring cradle system

4.1 RESULT

Monitoring of Environmental Conditions

Real-time:

Successful integration of water sensors connected to Arduino for real-time monitoring of humidity levels in the baby's room. Data collected and transmitted to the monitoring system indicating fluctuations in humidity levels.

Audio Surveillance and Detection:

Integration of acoustic sensors with Arduino for audio surveillance within the baby's environment. Detection and transmission of sound patterns to the monitoring system, identifying sudden loud noises or unusual sounds.

Relay Module Integration for Remote Control:

Successful incorporation of relay modules allowing remote control of devices such as lights or fans in the baby's room through the monitoring system's interface.

IoT Communication and Data Visualization:

Implementation of effective communication protocols enabling seamless transmission of sensor data to the monitoring system.

Clear visualization of data through user-friendly interfaces, displaying real-time readings of humidity,sound levels, and control options for relay modules.

Fig.4.1.1: Output graphs in Thingspeak cloud

Fig.4.1.2: Output of Baby monitoring Cradle system shown in LCD

4.2:DISCUSSION:

Infant Safety and Well-being:

The integration of water sensors provides caregivers with essential insights into humidity levels, aiding in maintaining a comfortable environment for the baby and preventing potential health risks associated with excessive moisture. Audio surveillance using acoustic sensors contributes to monitoring the baby's activities andidentifying unusual sounds, potentially indicating distress or discomfort.

Remote Control and Automation:

The relay module's successful integration allows caregivers to remotely control environmental factors like lighting or ventilation, enhancing the baby's comfort and ensuring optimal conditions.

Data Accuracy and Reliability:

Discussion on the accuracy and reliability of sensor data, addressing any discrepancies or limitations observed during testing to ensure accurate monitoring.

User Interface and Accessibility:

Emphasis on the user-friendly interface enabling caregivers to access and interact with the monitoring system easily. Considerations for improving accessibility and user experience.

Security and Privacy Measures:

Addressing the security measures in place to protect data transmission and user privacy, including encryption protocols and secure data handling.

Challenges and Future Improvements:

Discussion on encountered challenges, such as calibration of sensors or signal interference, and proposed im- improvements for future iterations, considering more sensors or advanced analytics for better insights.

Ethical Considerations:

Focus on ethical considerations, such as user consent, data ownership, and responsible use of monitoring systems, ensuring alignment with ethical guidelines and regulations.

CHAPTER-5
CONCLUSION AND FUTURE SCOPE

5.1 :CONCLUSION:

An IoT-based baby monitoring system integrated into a smart cradle has been designed to track a baby's vital indicators, such as the level of crying, ambient temperature, and humidity. The ESP32, the primary controller board for the project, has an integrated Wi-Fi module that allows the Internet of Things (IoT) concept to be implemented in the developed system.

Because it was open-source and easy to use, the ESP32 was used to meet Internet of Things requirements. Red meranti wood, which is easy to work with and frequently used in woodworking projects, was chosen for the baby'scradle.

Enhancement phases involved making adjustments to guarantee that the study outputs fulfilled the goals. A cell phone with a sobbing baby ringtone was put in the cradle to test the finished prototype. The cradle began to swingwhen the phone briefly rang, presumably because the system mistook the sound it had detected for crying from thebaby.

The user's phone is displaying a notification indicating that the baby is crying. The temperature and humidity of the surrounding air were recorded, and the small fan activated when the temperature increased above 28 C. Parents use a PC with an Internet connection or a mobile app to control the baby's cradle and small fan thanks to ESP32.

5.2 : FUTURE SCOPE:

- We can integrate Deep learning Algorithms so that the movement and mood of the baby can be detected.
- We can also add more actuators so that we can protect the cradle of a baby from insects.

REFERENCES:

[1] Inanc Moran et al., "Deep Transfer Learning for Chronic Obstructive Pulmonary Disease Detection Utilizing Electrocardiogram Signals," IEEE Access, vol. 11, pp. 125952-125963, 2023. DOI: 10.1109/ACCESS.2023.3269397.

[2] Y. Hamada, T. Yoshida, Y. Kurihara, and K. Watanabe, "Respirometry Rate Measurement by Pyroelectric Effect of a Piezo Sounder—Monitor and Alarm by Single Device," IEEE Sensors Journal, vol. 22, no. 21, pp. 21197- 21204, Nov. 2022.

[3] Trio Adiono et al., "Respinos: A Portable Device for Remote Vital Signs Monitoring of COVID-19 Patients," IEEE Transactions on Biomedical Circuits and Systems, vol. 16, no. 5, pp. 947-954, Oct. 2022.

[4] Jung-Yoon Kim, Youngchan Jang, Eunshin Byon, Dawn M. Tilbury, Milo Engoren, Satya Krishna Ramachandran, and Mi-Sun Kang, "New Unobtrusive Tidal Volume Monitoring System Using Channel State Information in Wi-Fi Signal: Preliminary Result," IEEE Sensors Journal, vol. 21, no. 3, pp. 760-766, Feb. 1, 2021.

[5] Mohsen Annabestani, Pouria Esmaeili-Dokht, Sina Khazaee Nejad, and Mehdi Fardmanesh, "NAFAS: Non-Rigid Air Flow Active Sensor, a CostEffective, Wearable, and Ubiquitous Respiratory Bio-Sensor," IEEE Sensors Journal, vol. 21, no. 4, pp. 4919-4928, Feb. 15, 2021.

[6] Ana Catarina Nepomuceno, Nélia Alberto, Paulo André, Paulo Fernando da Costa Antunes, and Maria de Fátima Domingues, "3D Printed Spirometer for Pulmonary Health Assessment Based on Fiber Bragg Gratings," IEEE Sensors Journal, vol. 21, no. 13, pp. 13595-13600, Jul. 1, 2021.

[7] Jung-Yoon Kim, Youngchan Jang, Eunshin Byon, Dawn M. Tilbury, Milo Engoren, Satya Krishna Ramachandran, and Mi-Sun Kang, "New Unobtrusive Tidal Volume Monitoring System Using Channel State Information in Wi-Fi Signal: Preliminary Result," IEEE Sensors Journal, vol. 21, no. 3, pp. 760-766, Feb. 1, 2021.

[8] Amirhossein Shahshahani, Zeljko Zilic, and Sharmistha Bhadra, "Motion Artifact Reduction for Respiratory Monitoring: A Multichannel Ultrasound Sensor for Diaphragm Tracking," IEEE Sensors Journal, vol. 20, no. 13, pp. 5642-5649, Jul. 1, 2020.

[9] Vahid Soleimani, Majid Mirmehdi, Dima Damen, Massimo Camplani, Sion Hannuna, Charles Sharp, and James Dodd, "Depth-Based Whole Body Photoplethysmography in Remote Pulmonary Function Testing," IEEE Transactions on Biomedical Engineering, vol. 67, no. 1, pp. 50-61, Jan. 2020.

[10] Hassan Aqeel Khan, Amit Gore, Jeffrey Ashe, and Shantanu Chakrabartty, "Virtual Spirometry and Activity Monitoring Using Multichannel Electrical Impedance Plethysmographs in Ambulatory Settings," IEEE Transactions on Biomedical Circuits and Systems, vol. 11, no. 4, pp. 781-789, Aug. 2017.

[11] no. 4, pp. 781-789, Aug. 2022. [11] Hongshuo Zou, Jiachou Wang, and Xinxin Li, "High-Performance Low-Range Differential Pressure Sensors Formed With a Thin-Film Under Bulk Micromachining Technology," Journal of Microelectromechanical Systems, vol. 26, no. 4, pp. 879-888, Aug. 2021.

[12] [12] Filip Velickovski, Luigi Ceccaroni, Robert Marti, Felip Burgos, Concepcion Gistau, Xavier Alsina-Restoy, and Josep Roca, "Automated Spirometry Quality Assurance: Supervised Learning From Multiple Experts," IEEE Journal of Biomedical and Health Informatics, vol. 22, no. 1, pp. 65-75, Jan. 2020.

[13]BJ Taylor, J. Garstang, A. Engelberts, T. Obonai, A. Cote, J. Freemantle, M. Vennemann, M. Healey, P. Sidebotham, EA Mitchell, and RY Moon, \"\' Comparison international cause of sudden untimely death at infant levels using a newly proposed set of death code, \"\' Arch. Childhood Diseases, vol. 100, no. 11, pages 1018–1023, 2015.

[14] A. B. E. Lambert, S. E. Parks, and C. K. Shapiro-Mendoza, ‘‘National and international trends in sudden infant death: 1990–2015’’ Pediatrics, vol. 141, no. 3, 2018, Art. no. e20173519.

[15] I. Jhun, D. A. Mata, F. Nordio, M. Lee, J. Schwartz, and A. Zanobetti, Ambient temperature and sudden infant death syndrome in the United States’’ Epidemiology, vol. 28, no. 5, pages 728-734, 2017.

INTERNAL QUALITY ASSURANCE CELL

PROJECT AUDIT REPORT

This is to certify that the project work entitled "BABY MONITORING SYSTEM USING IOT AND AI" categorized as an internal project done by S. Rakesh, Ch. Guru Sai Nithin, M. Leena Jyothi, A. Kavya Siva Durga of the Department of Computer Science and Engineering, under the guidance of Dr.T.Dhiliphan Rajkumar during the Even semester of the academic year 2023 - 2024 are as per the quality guidelines specified by IQAC.

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