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IoT BASED BABY MONITORING SYSTEM SMART CRADLE

B. Bhargavi[1], A. Suneetha[2], D. Srinivas Rao[3], E. Gowthami[4], Mrs. J. Pushpa Rani[5]

[1,2,3,4]*Department of Electronics and Communication Engineering, Tirumala Engineering College, Narasaraopet, Guntur Dist. Andhra Pradesh, India, 522601*

[5]*M. Tech, Department of Electronics and Communication Engineering, Tirumala Engineering College, Narasaraopet, Guntur Dist. Andhra Pradesh, India, 522601*

ABSTRACT:

The IOT (Internet of Things) revolution has led to the development of innovative solutions across various domains, including childcare. This paper presents a novel IOT-based baby monitoring system implemented through a smart cradle utilizing Raspberry Pi. The system aims to provide caregivers with real-time monitoring and management capabilities, ensuring the safety and well-being of infants. The smart cradle integrates various sensors and actuators to collect data on the baby's vital signs, environment, and movements. These sensors include temperature sensors, motion sensors, and a camera for video monitoring. Raspberry Pi serves as the central processing unit, collecting data from sensors and transmitting it to a cloud-based platform for analysis and storage. Caregivers can remotely access the data through a smartphone application or web interface, enabling them to monitor the baby's status from anywhere at any time. Additionally, the system incorporates alert mechanisms to notify caregivers in case of any abnormalities or emergencies, ensuring prompt intervention when necessary.

Keywords — Baby cradle, Sensors, Raspberry pi, Buzzer, LCD display.

I . INTRODUCTION

The early years of a child's life are marked by heightened vigilance and care, with parents and caregivers constantly monitoring their well-being. However, the demands of modern life often necessitate solutions that can provide remote monitoring and management capabilities. In response to this need, the Internet of Things (IOT) has emerged as a transformative force, revolutionizing various aspects of daily life, including childcare. This paper introduces an innovative IOT-based baby monitoring system centered around a smart cradle, leveraging the capabilities of Raspberry Pi. Traditional methods of baby monitoring often rely on standalone devices such as audio monitors or video cameras. While these solutions offer basic surveillance, they lack the integration and intelligence required for comprehensive monitoring. The core component of the system is the smart cradle, equipped with an array of sensors and actuators to monitor various aspects of the baby's environment and health. These sensors include temperature sensors to monitor ambient conditions, motion sensors to detect movement within the cradle, and a camera for visual surveillance. Additionally, the cradle incorporates actuators to facilitate remote adjustments, such as rocking or soothing the baby. Central to the system's functionality is the Raspberry Pi, a versatile single-board computer that serves as the brain of the smart cradle. The integration of IoT technology and Raspberry Pi not only enhances the convenience and accessibility of baby monitoring but also opens up possibilities for advanced features such as predictive analytics and personalized recommendations. By leveraging the power of connected devices, this system represents a significant advancement in modern childcare, offering caregivers a comprehensive solution for ensuring the safety and well-being of infants.

II . LITERATURE REVIEW

Our exploration begins by examining the foundational research and development efforts that laid the groundwork for IoT-enabled infant monitoring solutions. We delve into the technical aspects, including sensor technologies, communication protocols, data processing algorithms, and user interface design considerations, all of which contribute to the efficacy and usability of such systems.

Furthermore, we survey existing literature to understand the current landscape of IoT-based baby monitoring systems, analyzing their strengths, limitations, and potential areas for improvement. By critically evaluating the methodologies, outcomes, and user feedback from previous studies and commercial implementations, we aim to glean insights that can inform the design and implementation of an optimized smart cradle solution. . H. Chegini, R. K. Naha, A. Mahanti, and P. Thulasiram (2021). The proposes the idea of automatic caretaker room for a baby. The main motive of this idea is to save time and energy of very busy parents. So, the whole room is set up as it can sense the activities of the baby and work according to requirement. Parents can save their time and energy as they don't have to go and check their baby again and again until they don't get any information about baby. Electric energy is also being saved because the devices will work only when they are needed. H and U.K (2018) proposes a capable health monitoring system for infants, with wireless communication based on IoT technology. So a system is built for the easy and comfortable baby monitoring which can be a great machine caretaker by providing better baby monitoring. The prototype measures various functionalities such as temperature of the body, baby movement, rate of pulse and these alert information are intimated to the corresponding person in charge. Aziz, O. Schelen, and U. Bod(2020) system is very useful for those who can't spend their entire day in taking care of the baby by sitting nearby and watching them. So, in this system, they have created a prototype to monitor the baby in the cradle. Cradle is the only place where the baby can be easily monitored and it is also a safe place for the baby. By using the cradle, we can able to track the activities of the baby in an efficient manner. In this prototype, they have allowed the smart cradle to directly interact and provide information with the corresponding person's mobile. Here all the hardware components along with the sensors are fused with the Arduino microcontroller for monitoring the urination and waking up of baby and it will give a SMS alert to their parent's device.

III. EXISTING METHODS

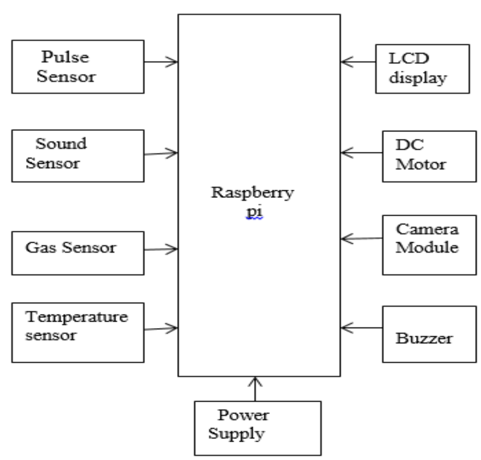
IoT-based baby monitoring systems, particularly smart cradles, employ various methods to enhance infant care. These include integrating sensors such as temperature, humidity, movement, heart rate, and respiration sensors to monitor the baby's environment and vital signs. Connectivity solutions like Wi-Fi, Bluetooth, and cloud integration enable real-time data transmission, storage, and remote access through mobile apps, ensuring caregivers can monitor their infants from anywhere. Data processing utilizes machine learning algorithms and data fusion techniques to analyze sensor data, detect patterns, and provide predictive analytics for preemptive care. Safety features like encryption, fall detection, and remote access control ensure data security and immediate alerts for emergencies. Automation features provide automated alerts and feedback mechanisms, while integration with other IoT devices like smart cameras and speakers enhances monitoring capabilities and caregiver interaction.

IV. METHODOLOGY

The methodology for developing an IoT-based baby monitoring system, particularly a smart cradle, follows a systematic approach to ensure functionality, usability, and reliability. It begins with a thorough needs assessment, understanding the requirements and challenges faced by caregivers and healthcare professionals. Technology selection plays a crucial role, involving the careful evaluation and integration of appropriate sensors, communication protocols, and data processing platforms. The system design phase encompasses creating a cohesive architecture for the smart cradle's hardware and software components, considering factors like accuracy, scalability, and cost-efficiency.

BLOCK DIAGRAM

The block diagram is divided into two parts, one is transmitter system and other is receiver system.



Temperature Sensor: The LM35 temperature sensor stands as a cornerstone in temperature sensing applications, prized for its precision and simplicity. It's wide operating range from -55°C to

+150°C.

Pulse sensor: The KY-039 heartbeat sensor is designed to detect a pulse while a human finger is place between the infrared diode and the photo transistor.

Sound sensor: LM393 Comparator IC is used as a voltage comparator in this Sound Detection Sensor Module. The microphone in the Sound sensor module detects the sound.

Gas sensor: The MQ-2 type smoke the tin dioxide absorbs the oxygen in the air. The MQ2 gas sensor can easily detect smoke, liquefied natural gas (LNG), butane, propane, methane, alcohol, and hydrogen in air.

Raspberry pi: RP2020 MCU designed from the ground up by engineers of Raspberry Pi Foundation. Dual-Core 32-bit ARM Cortex M0+ Processor.Clocked at 48MHz (default) configurable max to 133MHz.

Fig 1 : Raspberry pi

Power Supply: Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronics circuits and other devices.

LCD Display: A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

Shapes and Sizes of LCD's:

Fig 2 : Shapes and Sizes of LCd's

Arduino uno: The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Microcontroller: The Arduino Uno is based on the ATmega328P microcontroller from Microchip (formerly Atmel). It operates at 5 volts and has 32KB of Flash memory for storing code, 2KB of SRAM for variables, and 1KB of EEPROM for data storage. Clock Speed: The ATmega328P microcontroller on the Arduino

Uno typically runs at 16 Mhz.

Digital I/O Pins: The Uno has 14 digital input/output pins, of which 6 can be used as PWM (Pulse Width Modulation) outputs. Analog Input Pins: There are 6 analog input pins on the Uno, labeled A0 through A5, which can also function as digital input/output pins .Operating Voltage: The board operates at 5 volts, although it can be powered via USB or an external power supply that can range from 7 to 12 volts. Input Voltage (recommended): The recommended input voltage for the Uno is 7 to 12 volts. Input Voltage (limits): The limits of the input voltage range are 6 to 20 volts. DC Current per I/O Pin: Each digital I/O pin can source or sink up to 20 mA of current. DC Current for 3.3V Pin: The Uno has a 3.3V pin that can supply a maximum of 50 mA of current. Memory: The ATmega328P microcontroller has 32KB of Flash memory (program memory), 2KB of SRAM (static random-access memory), and 1KB of EEPROM (electrically erasable programmable read-only memory).

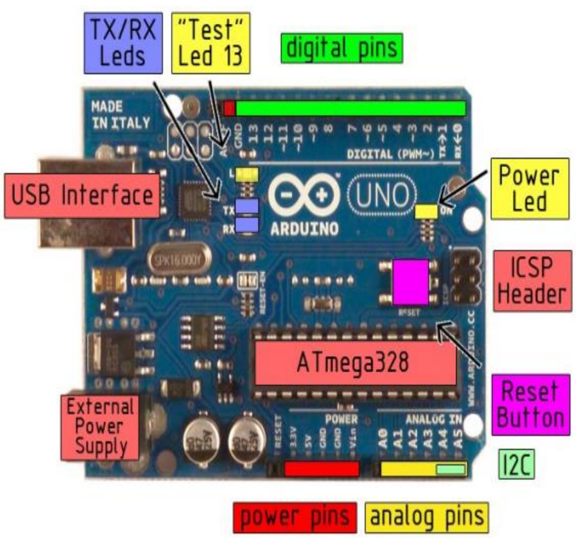


Fig 3: Arduino UNO

Advantages

1. Real-time Monitoring: Caregivers can monitor their baby's well-being in real-time, receiving instant alerts for events like crying or irregularities in vital signs.
2. Enhanced Safety: The system can detect potential risks or emergencies, such as sudden movements indicative of distress, allowing caregivers to respond promptly.
3. Remote Accessibility: Caregivers can monitor their baby from anywhere with internet access, providing peace of mind and flexibility.

Applications

1. Home Use: Smart Cradles can be used in homes to monitor infants and provide caregivers with valuable insights and alerts.
2. Hospitals and Neonatal Care Units: Smart Cradles can be deployed in hospitals and neonatal care units to monitor premature infants or babies with health conditions, enabling continuous monitoring and early intervention.
3. Daycare Centers: Daycare centers can utilize Smart Cradles to monitor multiple infants simultaneously, ensuring their safety and well-being.

V. RESULTS AND ANALYSIS

The results and analysis of a baby monitoring system, particularly one based on IoT technology, encompass a comprehensive assessment of its performance, effectiveness, and impact on caregivers and infants. Moreover, the impact of the baby monitoring system on caregivers' peace of mind, stress levels, and ability to provide

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responsive care is assessed through surveys, interviews, and observational studies. Positive outcomes, such as increased confidence in infant care, reduced anxiety, and improved sleep quality for caregivers, are highlighted alongside any challenges or limitations encountered during system usage. Recommendations for further enhancements, based on the findings, contribute to the continuous refinement and optimization of such systems to meet evolving needs and technological advancements in childcare.

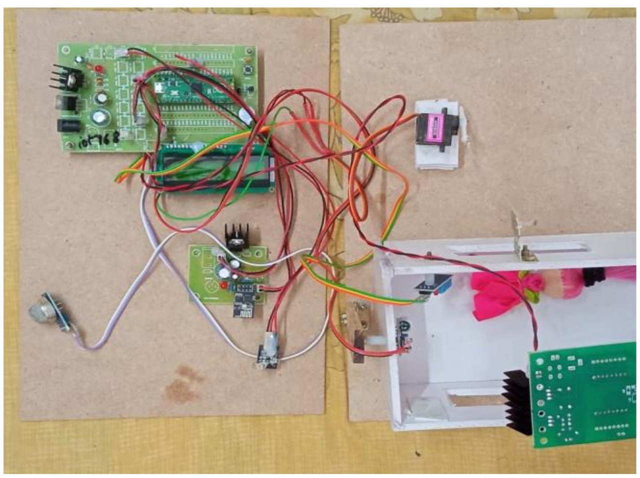

Fig 4: Hardware kit of the Project

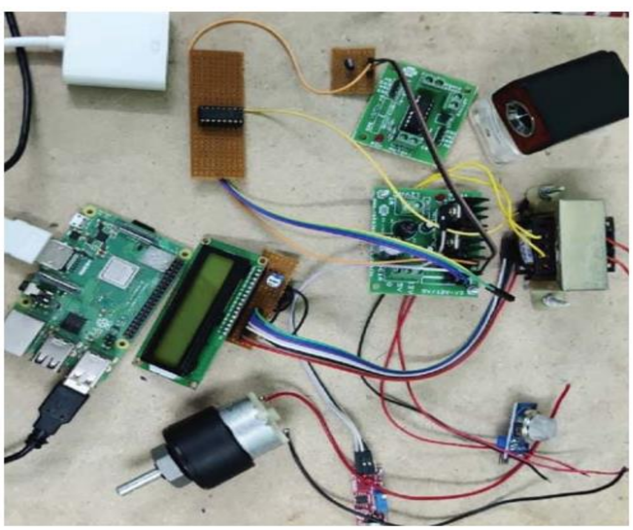

Fig 5: Hardware of the Project

The entire setup is shown in above fig 5 where the setup consists of Sound sensor. Temperature sensor, Pulse sensor, Gas sensor, DC motor, Camera module, Power supply and Buzzer.

It displays a message as crying when baby is crying, simultaneously showing the Temperature and Gas also.

Fig 6 Baby conditions

CONCLUSION

In conclusion, the IoT-based baby monitoring system smart cradle represents a significant advancement in infant care technology. By leveraging IoT connectivity, real-time monitoring, and data analysis capabilities, it offers parents unprecedented peace of mind and convenience. With features such as remote monitoring, alerts, and sleep tracking, it enhances safety, facilitates better sleep management, and fosters a deeper understanding of the baby's needs.

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