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SMART CRADLE SYSTEM USING IoT

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Abstract In this paper, The proposed idea of a smart cradle seems to be an innovative solution to the problem of taking care of infants when the mother is away due to work or other reasons. The cradle integrates with a smartphone, allowing constant monitoring of the baby through sensors and hardware components such as an Arduino Uno microcontroller, IR sensor, Moisture sensor, Sound sensor, Speaker module, and Servo motor mechanism. With the use of these components, the cradle can detect various activities such as urination, crying and show the baby status through the Tcp Telnet Terminal
app. The cradle's rocking feature and live camera monitoring further add to its efficiency and convenience for the parent. In addition, aside from being helpful for personal use at home, the smart cradle also has the potential to assist maternity hospitals in caring for newborns. This technology can offer a practical answer to the obstacles encountered by employed mothers, and promote the security and welfare of babies.

Keywords: Integrated Development Environment (IDE), Espressif Systems (ESP), Internet of Things (IoT), Infrared (IR), Passive Infrared (PIR), Reduced Instruction Set Computer (RISC), Radio Frequency (RF), Global System for Mobile (GSM), Wireless Fidelity (WIFI), Microcontroller Unit (MCU), Arithmetic Logic Unit (ALU), Serial Peripheral Interface (SPI), Static Random Access Memory (SRAM), Universal Serial Bus (USB), Ground (GND), General Purpose Input Output (GPIOS)

1 INTRODUCTION

The proposed cradle system addresses a common problem faced by working parents who find it difficult to manage work and take care of their babies simultaneously. The manual swinging of the cradle may not always be possible, and leaving the baby with a babysitter can cause safety concerns for parents. The cradle system aims to bridge this gap and provide a solution that enables parents to take good care of their babies. The system is designed to address the issue of infant crying, which is a common phenomenon that can be difficult for parents to handle. The crying of an infant is a way for them to communicate their needs, and it is important for caregivers to respond appropriately to these cries. The proposed cradle system takes into account the emotional and physical needs of the baby, rather than just following strict routines for feeding, waking, and sleeping. Research has shown that ignoring an infant's cries can have negative effects on their intellectual and social development while leaving a distressed baby to cry regularly can damage brain development. Therefore, the cradle system's focus on addressing the needs of the baby is important for their overall well-being and development. Overall, the proposed cradle system offers a practical solution for parents who find it challenging to balance work and caregiving, while also promoting healthy development for infants.

1.1 Literature Survey

The Smart Cradle System has enabled several innovative ideas and achievements in the field of baby cribs. Marie R. Harper, La Mirada, and Maxine R. Blea devised a concept for a self-rocking cradle that uses an oscillatory motor to mimic a mother's rocking motion. The cradle is supported by swivel supports at both ends and a motor device that regulates a smooth rocking motion to the crib [1]. Yang Hu and Weihua Gui proposed an adaptive sway control cradle that utilizes sensors to detect changes in the baby's condition and adjust the rhythm of the cradle accordingly [2]. Gim Wong introduced an electrically actuated "Automatic baby crib rocker" that can be controlled by a baby's voice or a switch [3]. Dr. M. Levy, Deepali Bhiwapurkar, and Gokul Viswanathan suggested an infant monitoring system that sends real-time alerts to parents through GSM technology. This system has a cry detection module that can activate the cradle swing with a pre-recorded voice and use sensors to detect the baby's motions [4]. Chau-Kai-Hsieh and Chiung Lin proposed a voice identification device that can recognize specific sounds of an infant's cry or voice using the filter bank and Zero crossing rate methods. The device is simple, affordable, accurate, and does not require prior training on the subject being monitored [5].

1.2 Objectives

- The proposed system detects when a baby cries and automatically swings to soothe the baby.
- It includes a system to detect baby crying and inform the guardian through their phone.
- With the live monitoring feature, the guardian can remotely keep a watchful eye on their baby using their smartphone.

- Wetness detector alerts the guardian through their phone, helping to keep the baby clean and comfortable.
- Smart Cradle System senses temperature, humidity, and crying patterns to help the guardian keep track of the baby's health.
- The system aims to provide a comprehensive solution for baby care and make it easier for guardians to take care of their little ones.

2 SOFTWARE DESCRIPTION

The Arduino IDE is a software tool that enables users to write code and upload it to a board to achieve their desired output. This software is open-source, meaning that no specialized hardware components or license are required to install it on systems. It is compatible with various operating systems, including MAC, Windows, and Linux. There are several Arduino modules available, such as Arduino Mega, Arduino Uno, Arduino Leonardo, and more, and coding on this software typically uses C/C++ functions. This project utilizes the Arduino IDE software to interface with all hardware components necessary for the vehicle's functioning. The Arduino IDE (Integrated Development Environment) or Arduino Software comprises a text editor for code writing, a message area, a textual content console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

3 HARDWARE DESCRIPTION

The hardware used in building this device is given below:

The Arduino Uno Microcontroller serves as the primary control device for the Smart Baby Cradle System. It acts as a mediator between the smart app on our phone and the Baby Cradle System. A field is set in the app to establish a virtual connection between the TCP Telnet Terminal app and the microcontroller, and its credentials are utilized in the Arduino code. The Arduino IDE code is loaded into the microcontroller, which is then physically connected to various sensors such as the Moisture Sensor, PIR sensor, Sound Sensor, IR Sensor, Camera, and speaker module, as well as the Servo motor. The regulated power supply board regulates the 12V power supply to all the components on the board. Video monitoring is accomplished using a web address.

The Smart Cradle system operates in the following way:

- When the baby is in the cradle, the IR sensor detects the presence of the baby and displays a status message on the TCP Telnet Terminal app and LCD indicating "Baby in the cradle."
- When the baby wets their diaper, the Moisture sensor detects the wetness and displays the status as "baby is wet" on the TCP Terminal app and LCD.
- When the baby moves around in the cradle, the Servo motor rotates, and the cradle swings.
- When the baby cries, the Sound sensor detects the cries, and the Arduino code sends a notification to the guardian via the TCP Telnet Terminal app stating "Baby is crying." The servo motor attached is also triggered, causing it to rotate and swing the baby's cradle. In addition, a pre-uploaded music file is played on the Speaker Module.
- Video monitoring of the baby can be accomplished using the IP address to observe the baby in the cradle.
- All information about the baby's crying, frequency of urination, temperature, and humidity of the cradle is pushed into the cloud (Thingspeak) and stored. This data may be used for analysis.
- All information about the baby's status is displayed on the LCD connected to the Smart Cradle.

4 BLOCK DIAGRAM AND WORKING

4.1 Block Diagram

This block diagram gives the outlook of the project as a whole. The system is designed to take inputs from sensors and the user and perform the required actions. A block diagram has been created based on a thorough comprehension of the technical specifications and operational principles of all the components utilized.

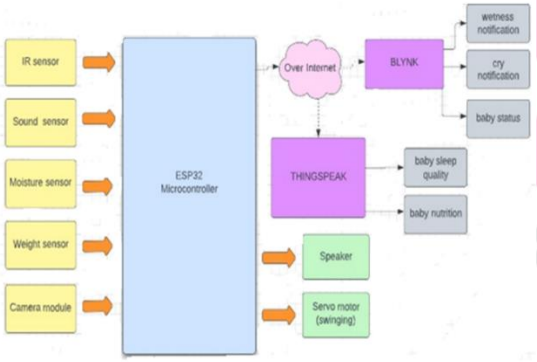

Fig 4.1 Block Diagram of Proposed System

4.2 Working

The circuit is implemented on the breadboard as per the block diagram.

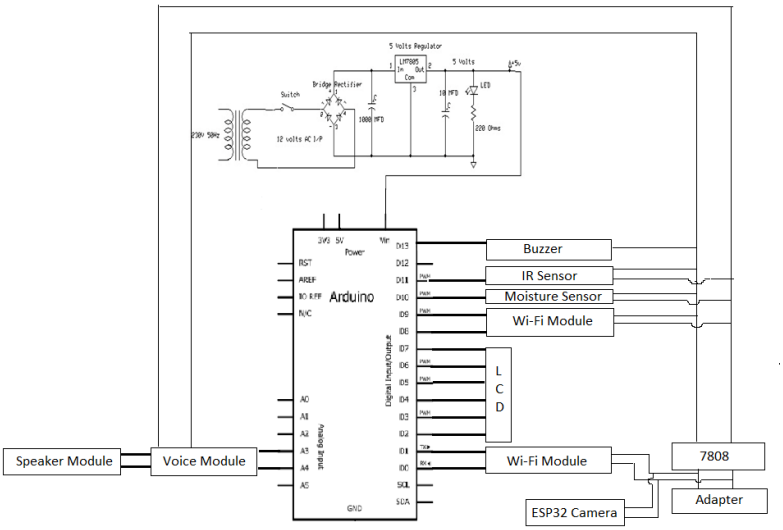

Fig 4.2 Circuit Diagram of the proposed system

The VIN pin of the IR sensor is connected to the D11 pin of the Arduino Uno. The Buzzer is connected to the D13 pin of the Arduino Uno. The Soil moisture sensor is connected to the D10 pin of the Arduino Uno. One of the Wi-Fi modules is connected to both the D9 and D8 pins of the Arduino Uno. The LCD is connected to the D2-D7 pins of the Arduino Uno. The RPS is connected to the power and ground pins of the Arduino Uno. Another Wi-Fi module is connected to the D1 and D0 pins of the Arduino Uno. The voice module is connected to the A3 and A4 pins of the Arduino Uno.

5 RESULTS AND DISCUSSIONS

The complete picture of the Smart Cradle system is shown in Fig. 5.1

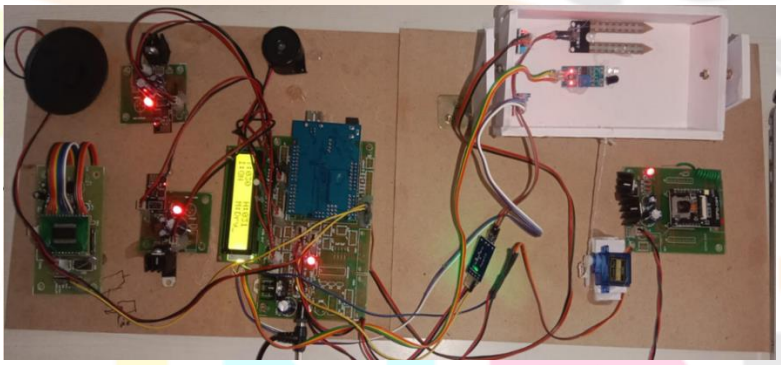

Fig. 5.1. Smart Cradle System

5.1 Cry Detection

When the sound sensor detects the baby crying, then it shows the status in TCP Telnet Terminal as “Baby_Cry” and simultaneously shows it in the LCD screen. To soothe the baby, the swing mechanism gets operated and the speaker plays the sound of Lullaby. Fig 5.2 shows the cry detection of the Smart Cradle System and Fig 5.3 shows the swing mechanism and speaker system to soothe the baby.

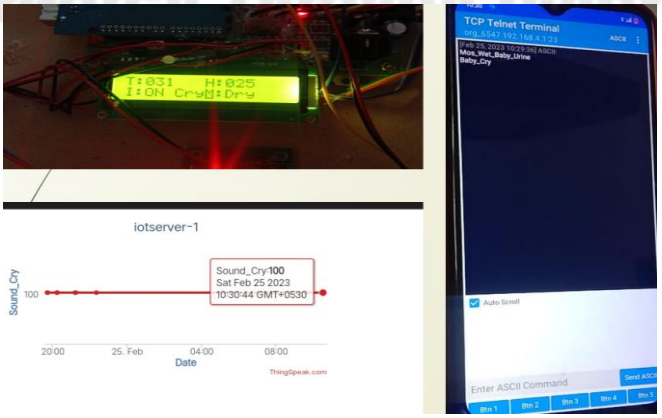

Fig. 5.2 Cry Detection

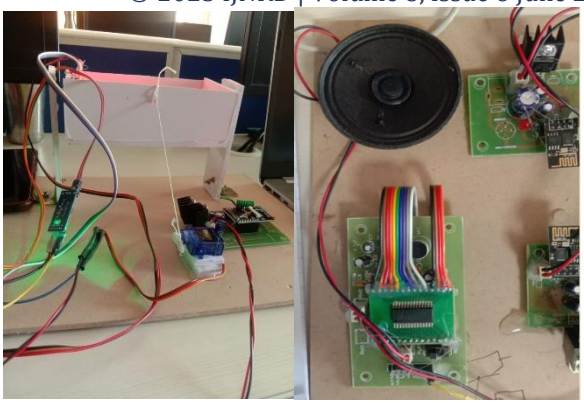

Fig. 5.3 Swing Mechanism and Sound System to soothe baby

5.2 Wetness Detection

When the Moisture sensor detects the wetness of the baby's diaper, then it shows the status in TCP Telnet Terminal as "Wet_Baby_Urine" and simultaneously shows in the LCD screen. Fig 5.4 shows the wetness detection of the Smart Cradle System.

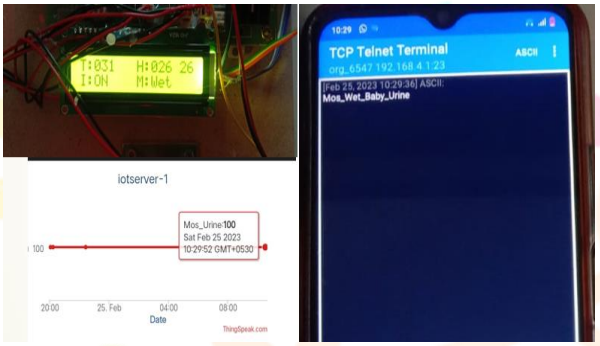

Fig. 5.4. Wetness Detection

5.3 Baby in Cradle

When the IR sensor detects a motion, then it shows the status in TCP Telnet Terminal as "Baby_In_Cradle" and simultaneously shows in the LCD screen. Fig 5.5 shows Baby in Cradle of the Smart Cradle System.

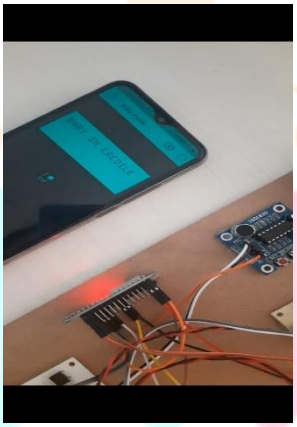

Fig. 5.5. Baby in Cradle

5.4 Live Monitoring System

ESP32 Camera Module shows the live streaming of the baby by entering the IP Address of the module and using any web browser shows us the live monitoring system. Fig 5.6 shows the live monitoring of the baby of the Smart Cradle System.

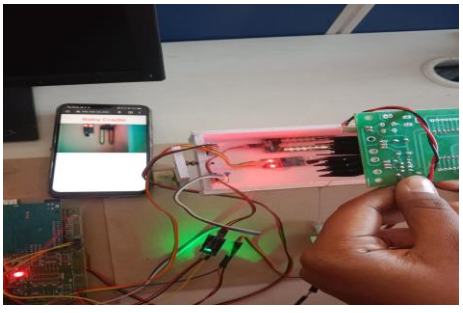

Fig. 5.6. Live Monitoring System

Conclusion: As we are aware, technology has become an essential aspect of our lives and has greatly aided us in various ways. The Smart Cradle System serves as a vital link between a child and their parents in this busy world where parents have to work long hours and cannot give their children the required attention. The system monitors all the sensors' data and alert messages, including baby cry detection, wetness detection, motion detection, and the baby's movements. All of the baby's activities are then sent to the mobile application, which provides live streaming of the child and allows parents to take any necessary action if required. This system assures parents that their baby is safe in the cradle and is receiving the basic support they need. Additionally, this system is user-friendly, efficient, and cost-effective, with new features that enhance its security. Overall, the Smart Cradle System will enable parents to attend to their daily tasks while still caring for their babies.

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