Smart Child Cradle

S Asha Kiranmai*[1] | B Vishali[2] | B Tanvika[3] | A Poojitha[4]

1 Associate Professor, EEE Department, Bhoj Reddy Engineering College for Women,Hyderabad, Telangana, India.

2, 3&4 Undergraduate Students, Bhoj Reddy Engineering College for Women, Hyderabad, Telangana, India.

Abstract: *In recent years, baby care has become more important and challenging for working mothers. Even at home, working mothers will not have enough time to monitor their babies continuously. In the proposed work, a smart child cradle with an automated baby monitoring system was developed. In the baby monitoring system, the necessary parameters of the infant like dampness of the baby bed, crying, feeding alerts were measured and monitored. The Arduino is used for interfacing the sensors and actuators. The baby monitoring system is attached to the cradle so that an incubator kind of environment will be created for the baby. The measured parameters will be displayed in the mobile application through its Bluetooth interface and notify the parents through buzzer and SMS. Additionally it also have increment and decrement keys to control the swing count of cradle. This system proposes a simple voice detection system which can be used to detect a baby's cry and automatically turn on the cradle. And also alerts the mother for milk at regular intervals of time through SMS.*

Keywords: *Arduino UNO, Wet Sensor, Bluetooth Module, Microphone, DC motor, Cradle*

1. Introduction

The current number of working mothers has greatly increased. Subsequently, baby care has become a daily challenge for many families. However, the parents cannot continuously monitor their baby's conditions either in normal or abnormal situations. Therefore, this paper proposes a system that plays a key role in providing better baby care while parents are in work. In the designed system, Arduino Controller Board is used to gather the data read by the sensors and send SMS via Bluetooth to the android App. The proposed system uses sensors to monitor the baby's vital parameters, such as crying, dampness of baby bed. The system architecture consists of a baby cradle that will swing using a DC motor when the baby cries automatically. The parents can also control the cradle swing and its count through control keys. It also gives SMS alerts to the parents for feeding at regular intervals of time through HC-05 Bluetooth module[7]. The proposed system prototype is fabricated and tested to prove its effectiveness in terms of cost and simplicity and to ensure safe operation to enable the baby-parenting anywhere and anytime through the network.

Y. George (1949) introduced one of the earliest concepts of an electric-powered cradle in "Baby cradle rocked by electricity." This work emphasized the potential to ease the caregiver's burden by automating the rocking function using electrical mechanisms, marking a milestone in the integration of electricity in baby care. [1]

Ronen Luzon (2002) advanced the idea by developing an "Infant monitoring system." His work presented a system capable of monitoring various infant parameters, showcasing a transition from simple cradle automation to adding functionalities like health monitoring, ensuring both comfort and safety for the child.[2]

Mishal Goyal and Dilip Kumar (2013) focused on making baby cradles responsive to a baby's cry in their paper titled "Automatic E-baby Cradle Swing based on baby cry." Published in the International Journal of Computer Applications, their research involved using audio sensors to detect when a baby is crying, triggering the cradle to swing automatically. This innovation integrated artificial intelligence and sensor-based technology, providing a dynamic solution to soothe infants without human intervention.[3]

K. Narasimha Rao, G. Sarvagna Naidu, Mallam Tharun, and Mohd Sohail (2023) took this idea further in their research, "Automatic Baby cradle swing based on baby cry," published in IJETMS. They improved upon previous models by incorporating more advanced swing mechanisms and sensor accuracy, ensuring that the cradle reacts appropriately to the intensity and frequency of the baby's cries, thus making it more efficient and reliable.[4]

2. Block Diagram

The block diagram for Smart Child Cradle with sound alert and tracking system is shown in the Figure 1.

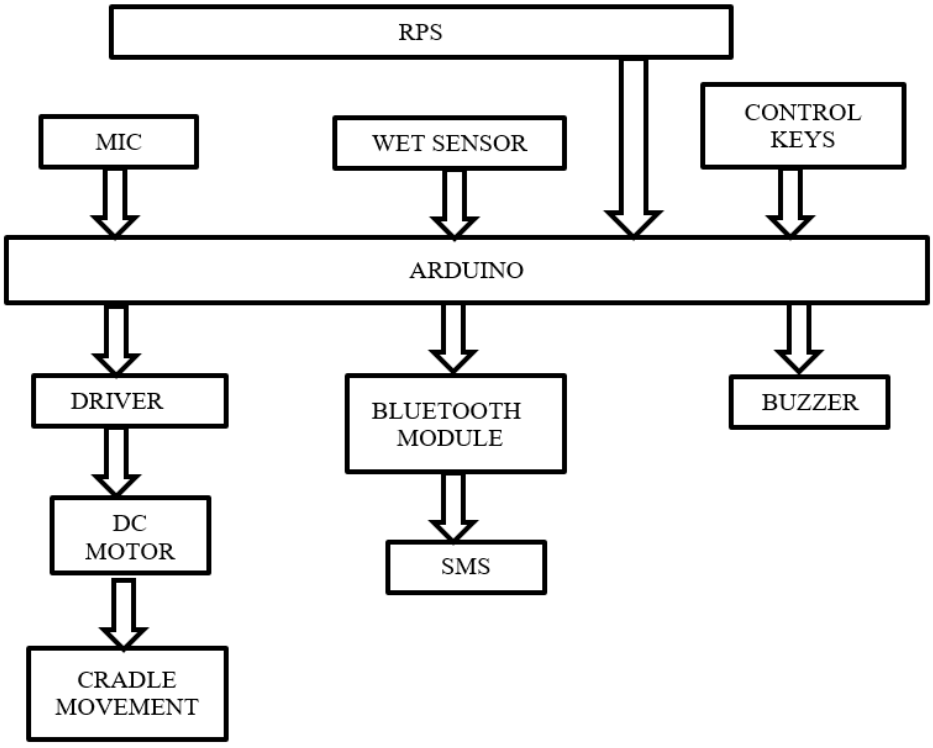

Figure 1. Block Diagram

RPS contains rectifier, voltage regulator and a stepdown transformer. The single phase 230V, 50Hz AC supply is provided to a step-down transformer, which reduces the voltage from 230V to 12V AC. This 12V AC is then input to a bridge rectifier, which converts it into 12V DC supply. This 12V DC supply is subsequently regulated to 5V, which is required for all the components. The system uses an Arduino-based design to automate and monitor a baby cradle, ensuring efficient and convenient baby care. When the microphone detects the sound of a baby crying, it sends a signal to the Arduino. The Arduino processes this input and activates the L293 IC driver, which powers the motor responsible for moving the cradle automatically. Additionally, the system sends an SMS notification to a paired mobile device via a Bluetooth module, alerting the parent or caregiver that the baby is crying. The wet sensor is another critical component of the system. When it detects urination, it sends a signal to the Arduino. In response, the Arduino triggers a buzzer to alert nearby caregivers and simultaneously sends an SMS notification to the paired mobile device, informing them that the cradle is wet and requires attention. Control keys are integrated into the system to allow users to manually adjust the cradle's swing count. These keys send signals to the Arduino, enabling customization of the cradle's movement based on the user's preferences.

3. Hardware Module

The top view of hardware module is shown in the Figure 2

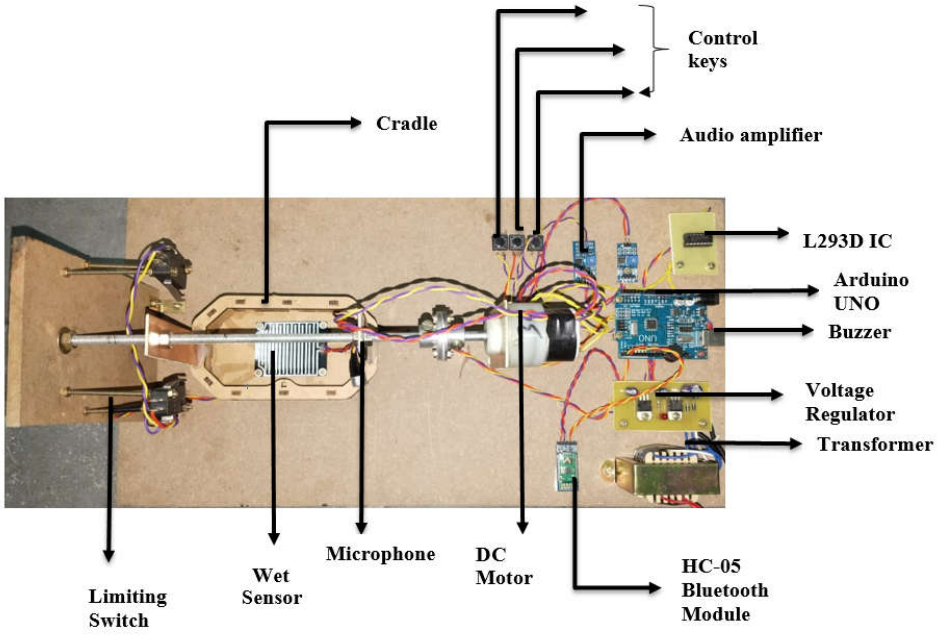

Figure 2. Hardware Module

The power supply circuit begins with a single-phase 230V, 50Hz AC supply, which is then fed into a step-down transformer. This transformer effectively reduces the voltage from 230V to 12V AC. Next, a bridge rectifier converts the 12V AC into 12V DC, although this output remains unregulated. Finally, a voltage regulator takes the 12V DC input and stabilizes it to a precise 5V DC output, suitable for powering various components. The LED glows when the system is turned on, signaling that it has been activated. Install a serial communication app on an Android smartphone to start a conversation. Turn on Bluetooth by entering the default password, "1234", and use the app to connect to the HC-05 device. The device will show "connected" once connected. The Arduino Nano is programmed in Embedded C [5] to get an SMS to parents. An HC-05 Bluetooth Module[7] is connected to the microcontroller as an output, facilitating the transfer of text messages from a microcontroller to mobile application.

4. Testing and Results

The hardware was tested for different cases to observe its operation

4.1 Case (1): Crying Detection

When the baby cries, the microphone detects the sound and sends a signal to the microcontroller, which processes the input and activates the DC motor and triggers the Cradle movement as shown in Figure 4.1 (a) and also an SMS “Alert! Baby is crying” is sent to paired mobile through Bluetooth as shown in Figure 4.1 (b).

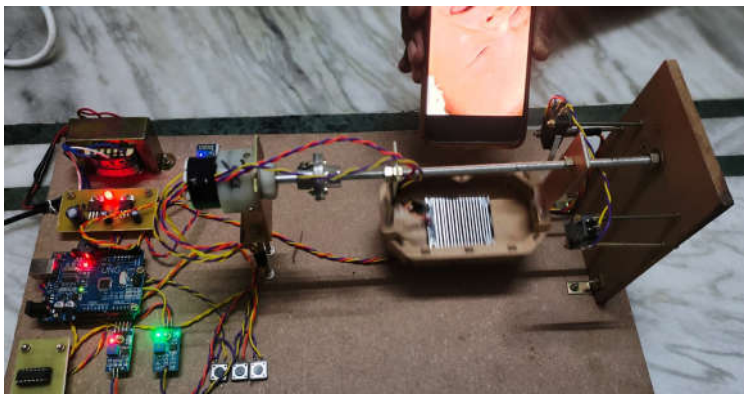

Figure 4.1(a) Automatic swinging of cradle on baby’s cry

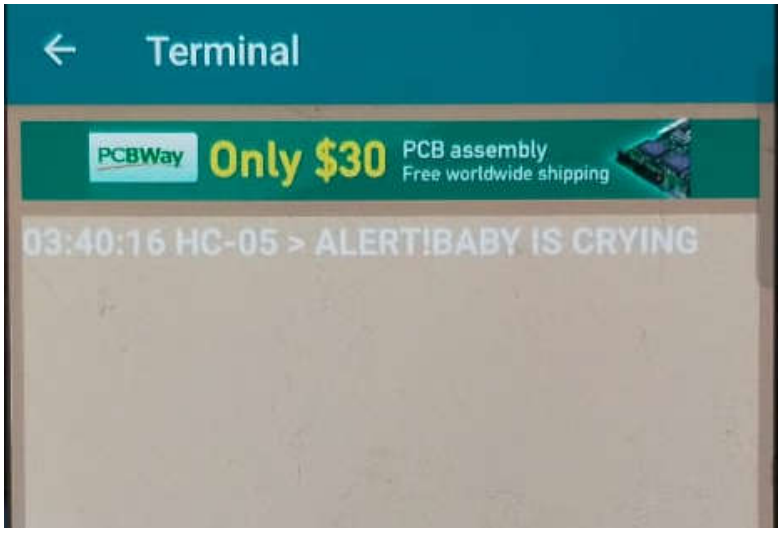

Figure 4.1(b) Message Alert during Baby is Crying

Case (2): Urine Detection

When baby urinates, wet sensor detect the urine and sends a signal to the microcontroller, which processes the input and activates the buzzer as shown in Figure 4.2(a) and also sends an SMS “Alert! Cradle is Wet” is sent to the paired mobile through Bluetooth as shown in Figure 4.2(b).

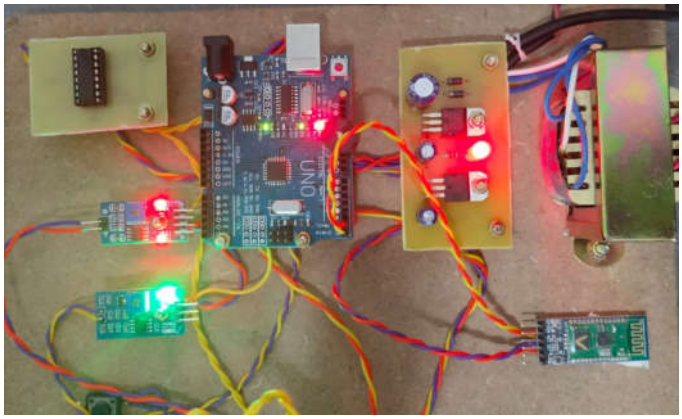

Figure 4.2(a) Automatic beeping during Urination

Figure 4.2(b) Message Alert after detection of baby urination

4.2 Case (3): Testing Feeding Schedule

Hardware enables an SMS “Alert! Its Feeding time” and sends to the mobile through HC-05 Bluetooth module at regular intervals of time (2min in this prototype) as shown in Figure 4.3.

Figure 4.3 Message Alert during Feeding Time

4.3 Case (4): Testing the Cradle Swing with various count settings

In this test case, when the start button is activated manually, the cradle begins to swing as shown in Figure 4.4(a) and each press of the increment button increases the cradle count by 10, while pressing the decrement button reduces the cradle count by 10 as shown in Figure 4.4(b) and Figure 4.4(c). And also the count of cradle swing will be displayed in mobile

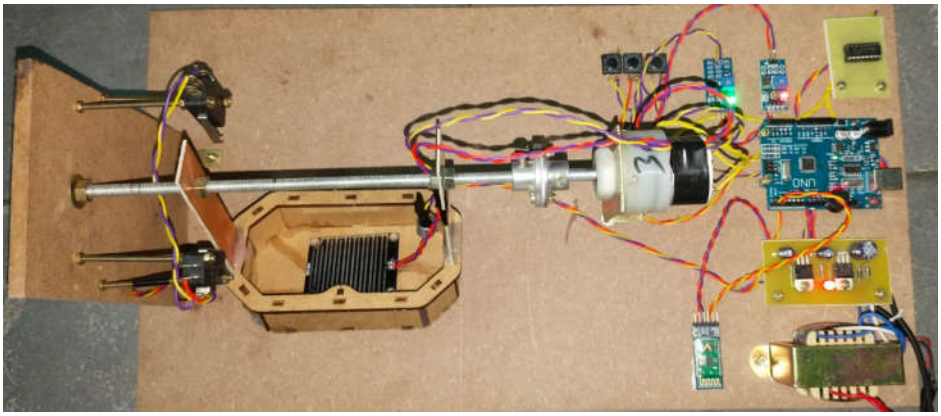

Figure 4.4(a)Cradle swinging as per set count

Figure 4.4(b) Cradle swing count rises by 50

Figure 4.4(c) Cradle swing count falls by 10

Figure 4.4(b) and 4.4(c) the cradle count is increased to 50 by pressing the increment button 4times and decreased to 10 by pressing the decrement buttons

4.4 Results

After testing the Smart Child Cradle with various scenarios and the results obtained are tabulated as indicated in Table 1

Table 1 Result Table

S.NO	TEST CASES	BUZZER	AUTOMATIC SWINGING	CRADLE COUNT	SMS ALERT
1	Crying	OFF	ON	Default	ON
2	Urination	ON	OFF	Default	ON
3	Feeding alert	OFF	OFF	Default	ON
4	Incrementing cradle count	OFF	ON	Incremented by 10	ON
5	Decrementing cradle count	OFF	ON	Decremented by 10	ON

5. Conclusion

The smart child cradle hardware integrates modern technology to address essential aspects of infant care, significantly easing the challenges faced by parents. With a built-in wet sensor and microphone, the cradle can detect when the baby urinates or cries, immediately notifying parents through Bluetooth and an alert buzzer. This timely response system ensures that parents can attend to their baby's needs promptly, enhancing the child's comfort and health. Additionally, the cradle sends feeding schedule reminders via SMS using Bluetooth, helping parents maintain regular feeding intervals and promoting the baby's well-being. These features reduce the risk of missed feeding times, further ensuring the baby's nourishment and growth.By offering real-time updates and alerts, the smart cradle allows parents to monitor their baby's needs more effectively, even when they are not in the same room. Overall, this hardware has been developed successfully and demonstrates a thoughtful and practical application of technology to improve the quality of infant care, providing both convenience and peace of mind for parents. This hardware tested in various scenarios, meeting all the criteria and performing effectively in each test case.

6. Acknowledgment

The authors are thankful to the officials of Department of Electrical and Electronics Engineering, Bhoj Reddy Engineering College for Women, Hyderabad, India, for providing facilities required to carry out this work.

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