Smart Cradle System for Child Monitoring using IoT

Amol Srivastava, B. E. Yashaswini, Akshit Jagnani, Sindhu K

Abstract*: The current era of digitization provides a large-scale availability of data as well as computing capability which can be used to bridge the gap between a child and a working mother. This paper proposes the use of "Smart Cradle" an E-Cradle which involves the use of Internet of Things. The proposed solution involves live monitoring of the child through a mobile application remotely. The smart cradle incorporates the use of PIR sensor for monitoring the movement of the child; Noise sensor for the detection of the child's crying activity and automatically swings the cradle to soothe the child. The DHT sensor notifies the parent about the body temperature of the child via text message, when the temperature goes above the set threshold. The solution also includes moisture sensor to maintain the hygiene of the child. The proposed system uses the cloud service for remotely monitoring the child.

Index Terms: Cloud, Cradle, IOT, Mobile Application

I. INTRODUCTION

Child care is of most extreme significance for a parent. The present quick paced world makes it hard for parent to continuously look after their kid. After long working hours, it is hard for parent to constantly watch out their kid. Keeping an eye on child or employing caretaker is an expensive undertaking which not every parent can bear the cost of it. Thus, innovation acts the hero in managing this issue. Smart support enables guardians to screen their child as they get ready messages that furnish them with vital data. In addition, cradle structure consequently swings when it detects noise of cry made by kid. The noise of cry is detected by the sensor when the noise level goes beyond the threshold value. In this manner, the proposed cradle structure bridges the gap between parent and the kid and empowers guardians to take great consideration of their child. The proposed framework gives savvy, basic and effective support to the child. The proposed framework utilizes PIR sensor that estimates infrared lighting emanating from articles in its field of view and consequently identifies the movement of the infant. The noise sensor distinguishes the sound of cry and temperature sensor recognizes the temperature and sends the information to cloud. The information from the cloud can be recovered by the parent to monitor the child. Besides, live coverage will be given by the camera which sends the information to android application from where the parent gets live update of the child, which gives parent a feeling that their child is safe and playing in the cradle. Child care is of vital importance for a parent as the infant is very sensitive for the different climatic changes. However, due to current fast paced world it is difficult for a parent to manage work as well as take care of their child. After the busy schedule work of the day, it is difficult for parent to pay complete attention to the child. As baby sitting is expensive and comes with various other limitations. Hence, the use of Internet of Things helps in dealing with this problem. Smart cradle system for child monitoring using IoT allows parent to monitor the child through the Mobile application. The scope of this work is to make a smart, safe and economic cradle for infants making them comfortable. The main circuits used for this work are PIR sensor, Noise sensor, Moisture sensor, Servo motor and Temperature sensor. The PIR sensor is used for the movement of the baby and will make the cradle swing back and forth by sending a signal to the servo motor. The proposed work implements a Smart Cradle System using cloud services for monitoring the baby inside the cradle and measuring the body temperature , measuring bed wet condition and using PIR sensor to locate the position of the child with respect to the cradle. Thus, the project bridges the gap between the working parent and their child. There are certain products named "Smart baby cradle" which are conventional models using constant mechanism to address baby's distress. The mechanism followed in swinging the cradle is an east to west method which might lead to Shaken Baby Syndrome. This also leads to damage of Intelligent Quotient and cognitive function of the brain. Most of the products are expensive as it implements the Bluetooth module for controlling the cradle. These products have a limitation where the cradle can be controlled only at a limited distance from the cradle's location as the frequency of Bluetooth module will be out of range. Most of the products lack the feature of live monitoring as the usage of camera on the cradle is way too expensive. The purpose of this project is to reduce the physical interface of the working parents with greater reliability, efficiency, better adaptability, security and cost effectiveness. The entire system works with the purpose of providing convenience by continuously monitoring every activity of the infant and thereby providing real time details and updates to the parents. The proposed work has been successfully

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monitoring the activities which include conditions like movements of infants, Care taking through recorded voice, Automatic Cradle Swing and Alerts to parents. This system uses eco-friendly electronic sensors for detecting the various movements and activities of the child. Also provides various updates of the child to the parent through mobile application. This system can be marketed among the general audience as it is very reasonable and every person from different backgrounds and culture can afford it.

II. LITERATURE SURVEY

The main creative thought of safe and consequently shaking support was imagined by Marie R. Harper. She arranged a crib which was programmed for swinging. At the point where the cradle is physically inclined in one direction and discharged then it enables the inactivity to activate the triggering and locking it to work under the pre-established voltages and power of spring in combination with the crib structure. Hence, the spring stacked engine start to work and the switch, which is connected, to lodging is swayed in forward and backward motion thereby providing oscillatory motion. Thus the spring-stacked motor was utilized to give repeated movement to shake the crib as it might have been shaken by the guardian or in a mother's lap.[1] A child cry recognizer was included which consisted an intensifier circuit for intensifying the sound signal received. Because of the strengthened signal of sound, heartbeat generator circuit produces a heartbeat sign or rate of pulse having 0 intersections which are lined up with 0 intersections of the intensified signal of the sound. Beat signal is provided as an input to a signal affirmation circuit. The signal affirmation circuit yields a sign exhibiting that a baby's cry was perceived. [2] The traditional crib is connected with electronic equipment which is electrically incited for shaking. The crib comprises of affectability supervision with the goal that the child cry voice distinguished by the receiver can incite shaking activity for quite a while utilizing clock. There is efficient control by which child voice simply execute the shaking activity and there is clock to control the length of shaking activity. [3] A self-regulating baby rocker containing noise sensor for determining the cry of the baby is proposed. Audio or noise sensor contains electronic MIC having a pre-amplifier that amplifies the input sound signal which is in turn passed to Arduino atmega328 microprogrammed control unit to supervise dc motor for swinging. Few beautiful LED lights are used to engage the baby while the swing is set. [4] A self-regulating automatic baby cradle for cry detection was proposed which involves use of microcontrollers. Micro controller converts sound to electrical signals. It controls the output signal and output is sent to DC motor that makes the cradle to start swinging. The model has wet sensor to demonstrate baby's wetness situation, at the point newborn child wets, resistance value would change subsequently sending a signal. Distinctive sensor like respiratory sensor is used to monitor apnea condition and temperature sensor to indicate temperature around the infant. GSM modem has been utilized to send the SMS to the parent if infant is constantly crying. [5] Computation of adjusting the cradle affecting degree by the sensor signal is proposed. The cradle is comprised of an adaptable affecting device and distinctive sensor framework. A calculation for modifying the support influencing degree by the sensor sign is proposed. Whenever the baby is crying, the sensor framework can survey the cause as demonstrated by recognizing the important standards, offering the unmistakable hints to control circuit. Meanwhile, the cradle possibly starts to impact. The affecting mind-set can be adjusted as demonstrated by the parameters from status of the toddler. They utilized 3 wet sensors arranged in the base of the cradle, one at the concentration and second at left and third at the right of the base. [6] The Slider-crank mechanism has been proposed which is applied to change rotatory movement into translatory movement with the help of a rotating driving beam that has been proposed in the framework which includes utilization of sensors. Motion detector is an apparatus that identifies moving articles, especially individuals. Sound sensors distinguish both balanced decibel [dBA] and decibels [dB]. Decibel is an estimation of sound weight. Primary constraint of this proposed system is that it makes greater commotion because of which child gets aggravated. The proposed framework isn't sufficiently talented for taking care of sound and giving solace to the child. [7] Andrew et. al. proposed to make a Cradle that ought to be controllable by an advanced cell which transmits information for example, video/sound stream. The proposition for keen support framework was made. It ought to have a programmed approach to comfort the infant if the guardian cannot get to the child immediately. The proposed arrangement concocted a few highlights. They have utilized an embedded controller or microprogrammed control unit, wireless internet access module shield, router, speaker, stepper engine, electronic mic. The drawbacks of this work are child's curiosity: Next to the risk of electrically powered stagger, the sections may tumble down or be damaged by the newborn child and might even endeavor to snack or consume the parts. [8] Structuring a smart infant care, which has capacity to screen child development, bedwetting condition and temperature of the body is proposed. As indicated by the specialist there are helpful approaches to mitigate, assuage and quiet the child, for example, rocking movement, singing a melody. The equipment which is being utilized are Motor shield, Arduino UNO which acts as a microcontroller, PIR sensor for detecting the distance of the baby with respect to cradle, GPRS shield, wet sensor, surface temperature sensor, with a power source (9 Volt battery-powered battery) and a DC engine. The real downside is that the sound locators are not utilized and in this manner sound recognition is beyond the realm of imagination. Presence of camera and toy lacks in the proposed system which in turn makes video communication difficult. [10] Elmas et. al. proposes a rocking motion for the sleeping baby which looks into degree of rotation, speed, and all other data drivers that are accountable for swing advancement. [12] Proposal for a system of monitoring a baby on the basis of Global System for Mobile network was made by the researcher. The provided framework checks

the indispensable parameters such as body temperature, pulse rate, moisture content and movement of a newborn child. By use of GSM module the collected information is interchanged with their parents. The limitation of the proposed system is that it fails to contain rocking motion or rotatory movement in the cradle. It causes uneasiness to the baby. [13] Misha et. al. presents a framework for self regulating baby cradle which consists of a microphone that detects the cry of the baby. To convert it into electric signal, the electrical device operational amplifier is used for amplifying signal conditioning circuit. A microcontroller is utilized to receive the amplified signal and to transform to digital signal. Microcontroller monitors the driver circuit that begins a motor and swings the baby crib. [14] The proposal for an infant and child-friendly health monitoring system was made. The proposed system detects the body temperature, moisture content in the bedding structure. The signal conditioning is done by the operational amplifier. The proposed system provided live monitoring of the child and included a toy to sooth the child and provides rotatory motion using DC motor. The basic drawback in this proposal is that it lacked android application where the data calibrated from the sensors can be displayed. [15] Sneha et. al. proposed the methodology for electronic healthcare or e-healthcare. The proposed system utilized the sensors for getting the heart rate, electrocardiography (ECG) and temperature of the body. The proposed system also utilized a bluetooth service which provides wireless transmission and receiving of the information within a confined region. The information can then be accessed using the android application through smartphones. The main drawback of the paper is that the proposed model utilized bluetooth module which has a limited range, or a person needs to be in the vicinity of the Bluetooth for the data to be able to transmit and receive. [16] Wesseler et. al. proposed a system that screens fundamental parameters like temperature of the body, beat rate and dampness condition. By the use of GSM the details of the condition of the child is intimated with the parents. Equipment segments used are Temperature Sensor, Moisture detection Sensor, Pulse Rate Sensor, LCD screen, Motion Sensor and GSM Module. The proposed framework included web application from which the information got from the sensors can be remotely shown. [17]

III. BASIC PRINCIPLE

The cradle swing basic principle is based on the baby's level of cry, sound level calculated in dB x with a present value y and it swings if x is greater than y. Generally, the value of y is set to 35 decibels which is the threshold value of baby's cry; the value of the child's cry is measured in the decibel range of 30 decibels – 40 decibels. From the voice input the amplified signal is calculated. Then the amplified signal is converted into a digital signal from which sound level x is calculated as given below.

$$sound\ level\ (x) = 20 \log \left(\frac{vin}{v0}\right) dB$$

Where,

Vin = Voltage calculated when the baby is crying.

V0 = Average reference voltage when baby is happy.

The value y is set initially as default of the system. It is the least value when experimented with various samples of baby cry sound levels and can be modified whenever necessary.

A. *Automatic Swinging Action Principle*

The main principle of the automatic swinging action of the cradle is as follows:

The sound of the baby cry is measured by noise sensor in decibels and it is compared with the threshold value B. The input signal is amplified, converted to digital signal to sound level A which makes the servo motor to rotate at an angle of 180 degree.

Sound level (A)= 20 log (Vinput/V0utput)dB

Where,

Vinput= Voltage level measured when the baby is crying.

V0utput= Average reference level of the voltage when the baby is happy.

B. *Algorithm for presetting threshold values*

1.Set_values(){
Caliberating time =30 time taken by the sensors for Caliberation.
2.ThresholdV1→User Input
3.ThresholdV2→User Input
4.ThresholdV3→User Input
5.ThresholdV4→User Input
6.Database_update(ThresholdV1,ThresholdV2, ThresholdV3, ThresholdV4)}

C. *Algorithm used for remote monitoring*

1. Go to Blynk cloud services
2. Enter correct credentials to monitor values.
3. Check the values of temperature, humidity, moisture.
4. Open the app to get live feed from wifi camera.

IV. METHODOLOGY

The working methodology of the proposed smart cradle system is as shown in Fig. 1.

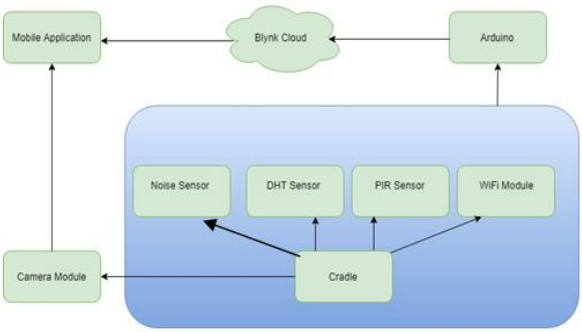

Fig. 1. Block Diagram of the Proposed System

The above diagram depicts the complete working of the smart cradle system. When the child is made to sleep on the cradle various sensors like noise sensor, DHT sensor, PIR sensor and camera module are implemented to monitor the various actions of the child.

The functions of the sensors implemented are as follows:

- Noise sensor: The noise sensor is used to detect the sound level of the baby's cry and if the sound level is higher than the threshold value, an amplified signal is sent to the servo motor for automatic swinging of the cradle.
- DHT sensor: DHT sensor is used to measure the temperature and humidity of the cradle. The main aim of using DHT sensor is to get the current temperature of the atmosphere around the baby. For instance, the temperature is above 22 degree it causes a discomfort to the baby that time the parent can pay attention to the baby by swinging the cradle through the mobile application.
- PIR sensor: PIR sensor is used to detect the movement of the child inside the cradle. In the proposed model two PIR sensors are used which are placed in the extreme two opposite corner of the cradle for more accurate data. When the child turns to right or left the current status is sent to the mobile application. If the baby is uncomfortable inside the cradle the movement of the baby inside the cradle will be changing continuously.
- Wifi Module: A Wifi module is used to connect the sensors of the cradle system to the Blynk cloud services via Arduino.
- Arduino: Takes the signal from the Wifi module sends the data to the Blynk cloud. The Blynk Cloud sends the data of the sensors to the mobile application.
- Camera module: The parent will be able to speak to the child through the mobile application which is connected to the camera. The parent will be able to see the child live on his/her mobile application.

V. SYSTEM OVERVIEW

The Fig. 2 shows the complete working of the smart cradle system.

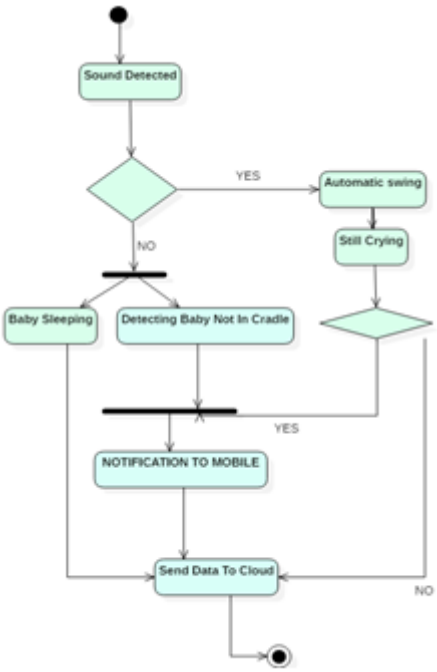

Fig. 2. System Overview

The above diagram depicts the automatic working of the cradle. When the sound of the baby cry is detected the system checks whether the sound level is above the threshold value set initially. If the sound is above the mentioned threshold value a signal is sent to the servo motor for the automatic swing and if the baby is still crying a notification is sent to the mobile application that the baby is crying. When the baby is sleeping the sound will be less than the threshold value and if the baby is not in the cradle the PIR sensor value remains constant for a longer duration, a notification is sent to the mobile application.

VI. RESULTS

The live data from the cradle is sent to the mobile application with the temperature, humidity, the movement of the baby and the sound of the baby. Incase if the child requires a swing the parent can swing the cradle. The app indicates a warning signal to the parent if any sensors are not working.

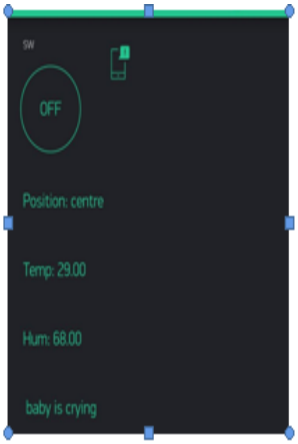

Fig. 3. Screen shot of the mobile application

VII. CONCLUSION

The authors have proposed a smart cradle system using IOT. For an infant, this support will go about as a sitter for around 2 years. Innovation has been created in an extraordinary manner that it makes human work more straightforward. The programmed electronic infant support is the best answer for the present guardians who don't have adequate time for their children. This programmed child support would let the working mother work as well as take care of the child. It is affordable and easy to use. The programmed child support can be utilized in medical clinics and home. It is helpful for working guardians and medical clinics to take care of infants.

VIII. ACKNOWLEDGMENT

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