

IoT Based Healthy Baby Cradle System

Sagar S Bachhav^{#1}, Dr.Nilkanth B Chopade^{*2}

[#]Master Of Engineering & Electronics and Telecommunication Engineering & Savitribai Phule Pune University,

[#]Professor and Head Of Department & Electronics and Telecommunication Engineering & Savitribai Phule Pune University,

Pimpri Chinchwad College Of Engineering, Nigdi, Pune, India

¹ bachhavsagar785@gmail.com

² nilkanth.chopade@pccoepune.org

Abstract

Infants needs parents attention 24 hours a day and 7 days a week, which is practically impossible due to other priorities like house hold activities, official works and personal works. Baby care centre or nanny is the two options available which involves lot of passion. Now a day's lot of incidents is reported in social media featuring human attack to the toddlers in a brutal way. So, there is a need for safe and secure place to take good care of the children's need with minimum human intervention. We live in a world where technologies are used all around us. The new generations of parents were raised with technology. There are many things these parents will buy to help them care for their baby (Cradle, Crib, Baby Monitor, etc.). We noticed that a lot of the products can be put into one product. "Smart Baby Cradle" "provide parents a smart system help these parents monitor and comfort the baby. The Smart Baby Cradle allows them to monitoring their babies, the cradle, play soothing music and even speak to the baby. This paper portrays the configuration of a programmed musical cradle which fundamentally chips away at location of infant development with the assistance of a IoT and AWS Cloud technology.

Keywords — Internet of Things; Amazon Web Service; Smart Baby Cradle

I. INTRODUCTION

Generally, the baby cradle is used for to make sleep and soothe to baby. For example guardian have to take care of their child till as they asleep. However, conventional cradle does not electronically equipped such like battery or adapter to automate the cradle automatically. In addition to that, these kind of conventional cradle is used in villages areas or non-developed cities due to its low prices. But the problem of this kind of designated cradle is that you need manpower to take care of your child and your child may not be safe and feel comfortable in the conventional cradle. Thus, we need automatic cradle to take care of child which uses the battery or power source.

Besides, there are extra features or function is provided by the newly automatic cradle that is beneficial for parents. Because in the present world people are very busy in their professional life so they do not get ample time to take care of their infants. It will be very difficult control the babies and if someone is hiring professional to take care of their infants. It may increase your expenses from monthly expenditure. Moreover, in today, life it is very hard to even for the homemakers (mummy) to sit nearby their babies and sooth them whenever they feel uncomfortable. Though, this application is very useful for the nurses in maternity units of hospital.

The unpredictable growth of the Internet of Things is changing the world towards digital. The rapid drop in pricing for typical IoT components is allow people to innovate new designs, thoughts and products at home with their own minds. IoT can be used in monitoring smart cardles, for making smart home and smart city with security. In this project specialized Aws IoT Core services are used to monitor smart baby cradle.

II. LITERATURE REVIEW

In technology trends a prerequisite for the Internet of Things in the early days. If all objects and people in day today life were equipped with identifiers, they could be managed remotely and inventoried by computers. Steven Bang designed automatic baby rocker having a noise sensor to detect baby cry. Noise sensor consists of Electret MIC with a pre amplifier (2n3904 transistor). Signal from noise sensor is fed to microcontroller Arduino ATmega 328, which is used to control the DC motor. Few colorful lights made up of LED are used to

entertain the baby while being rocked. Mabuchi RE-260RA DC motor with Tamiya 6 speed gear box is used to create the rocking motion of the crib with gear ratio of 505.9:1.

Yang Hu proposed an algorithm for adjusting the bassinet swaying extent by the sensor signals. The bassinet is made up of an adaptive swaying device and other sensors network. While baby is crying, the sensors network can judge the reason according to detecting parameters, giving the different signals to control circuit. At the same time, the bassinet starts to sway slightly. The swaying rhythm can be adjusted according to parameters from baby status. They used three pressure sensor located in the bassinet bottom, one at the centre and others at left and right of the bottom.

Marie R. Harper invented a crib adapted to be rocked automatically. Once the crib is manually tilted in one direction and released, this permits the inertia to actuate the locking and actuating arms to operate under the biasing force of spring in conjunction with the gear. Thus spring loaded motor begin to operate and the lever arm is oscillated in back and forth movement. This provides the same effect as would be achieved by the mother rocking the crib containing the baby. Oscillation of crib is stopped when the slightest resistance is incurred.

Gim Wong presented an Electronic device that can be attached to conventional pivotally mounted type crib. Which is actuated by baby cry voice picked up by the microphone giving short throw type rocking action to crib. Very similar to a person rocking the crib by pushing and pulling on the foot or headboard. There is a sensitivity control so that baby voice only actuate the rocking action and a timer to controlled the duration of rocking action.

III.SYSTEM DEVELOPMENT

This section contains experimental setup for Smart Baby Cradle System as shown in Fig.1.Experimental setup made with raspberry pi processor, Accelerometer Sensor, Temperature Sensor ,Heartbeat Sensor LEDs, speaker and camera. Designed device gateway is interfaced to raspberry pi processor for musical, lighten features of proposed Baby Cradle System.



Fig.1.Experimental setup for Smart Baby Cradle System

In today's world, everyone is busy in its own life. Nowadays, even the mothers are working and there is a requirement of unattended cradle. The proposed E-Cradle is a novel solution to this problem. In the proposed design, there will be a circuit placed along the cradle which will sense the sound intensity of the cry of the child and takes necessary actions based on the sound intensity of the child's cry.

The system is designed to help parents and nurses in infants care. Wireless communication is strictly relied upon to transmit data to a mobile applications or any access point and configure the information to a nearby remote center via the Internet. In today scenario there are several ideas and ways to make real time smart baby cradle system and remotely handle and store data through cloud. Emergency situations are detected via data processing units throughout the system and an alarm message can be easily sent to an emergency remote service center to provide immediate assistance to parents..

A. Heart Beat Sensor

The heartbeat sensor is based on the principle of photo plethysmograph. This sensor module measures the change in volume of blood through any organ of the users body which instant causes a change in the light intensity through that organ. In case of clinical applications where heart pulse rate is to be measured and monitored, the timing of the patient pulses is more important. The continuous flow of blood volume is decided by the rate of patient heart pulses and since relatively light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses. The basic heartbeat sensor is consists of a light emitting diode and also a detector like a light detecting resistor or a photodiode.



Fig.2.Digital Heart Beat Sensor Module

The heart beat pulses of patient causes apparently variation in the flow of blood to different regions of the patient body while measuring heart beats. When a sample tissue is illuminated with the light source, i.e. light is emitted by the device led, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed by the blood and the transmitted or the reacted light is received by the light detector. The amount of total light absorbed is totally depends on the blood volume in that tissue. The detector output shown is in form of electrical signal and is exactly proportional to the heart beat rate. Thus the major requirement is to isolate that AC component as it is of prime importance.

B. Temperature Sensor

The MAX30205 temperature sensor shown which accurately measures temperature and provide an over temperature alarm/interrupt/shutdown output when interfaced with hardware. This device converts the analog temperature measurements to digital form using a high-resolution concepts, sigma-delta, analogy-to-digital converter (ADC). Accuracy of temperature sensor module throughout meets clinical thermometry specification of the ASTM E1112 when soldered on the final PCB or hardware platform. Communication is through an I2C-compatible protocol, 2-wire serial interface.

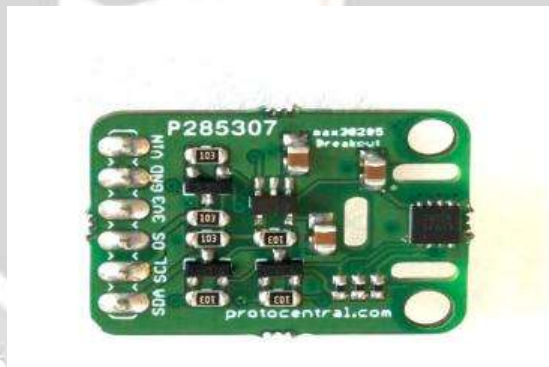


Fig.3.Temperature Sensor Module

The I2C serial interface protocol accepts the standard write byte, read byte, send byte, and receive byte commands to read the temperature data from sensor module and configure the overall behaviour of the open-drain over temperature shutdown output. The MAX30205 has features of three address select lines with a total of 32 available addresses. The sensor also has a 2.7V to 3.3V supply voltage range, low 600 μ A supply current, and a lockup-protected I2C-compatible interface that make it ideal for wearable fitness and safe medical applications. This device is available in an 8-pin TDFN package standards and operates over the specific 0 $^{\circ}$ C to +50 $^{\circ}$ C temperature range.

C. Accelerometer Sensor

The ADXL345 is a relatively small, thin, ultralow power, 3-axis accelerometer with high and standard resolution (13-bit) measurement at up to ± 16 g. Digital output data for this sensor module is timely formatted as 16-bit twos complement values and can be accessible using either a SPI (3- or 4-wire) or I2C digital interface.



Fig.4.Accelerometer Sensor Module

The ADXL345 accelerometer sensor module is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock along with physical sensing applications. Its high resolution (3.9 mg/LSB) enables real time measurement of inclination changes less than 1.0° gravity and we can detect exact position of bed. Several special sensing functions are provided to this sensor module. Physical activity sensing is to detect the exact presence by comparing the acceleration position on any of 3-axis with user-set thresholds connected to hardware. Tap sensing allows to detect single and double taps in any direction of devices. Freefall sensing will detect if the device is falling in inclination. These functions can be easily mapped individually to either of two interrupt output pins with this module. An integrated memory management system with a 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor activity and lower overall system power consumption throughout the operations so we can store the angular position of this module. Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at extremely low power dissipation with the inclination. The ADXL345 is supplied in a small package for application, thin, 3 mm × 5 mm × 1 mm, 14-lead, plastic package.

D. Amazon Web Services(AWS) Cloud Services

AWS IoT provides secure and easy cloud platform to connect several devices and it acts upon those devices data enable applications to interact with devices even when they are offline state. With this cloud platform we can easily monitor medical data and patient can take number of advantages of it.

AWS IoT enables Internet-connected things on cloud region to connect to the AWS cloud and lets applications play in the cloud era interact with Internet-connected things. Common IoT applications either collect and process telemetry from devices shadow or enable users to control a device remotely with cloud. Things report their real time state by publishing several messages, in JSON format, on MQTT topics. Each and every MQTT topic has a hierarchical name that identifies the thing whose state is being updated on cloud side. When a message is published on an MQTT topic for communication, the message is sent to the AWS IoT MQTT message broker on AWS window, which is responsible for sending all messages regarding to device console published on an MQTT topic to all clients subscribed to that topic related to connected thing. Main communication between a registered thing and AWS IoT is protected through the use of X.509 certificates provided by AWS Cloud. AWS IoT can generate a certificate for you or you can use your own downloaded certificates. In either case, the certificate must be registered and activated with AWS IoT provided, and then copied onto your thing which is registered for your project. When your thing communicates with AWS IoT, it presents the certificate to AWS IoT as a credential for authentication. AWS recommend all things that connect to AWS IoT have an entry in the thing registry database. The thing registry is nothing but it stores detail information about a thing and the certificates that are used by the thing to secure communication with AWS IoT.

E. Android Application

Android is a mobile operating system developed by Google, based on a modified version of the Linux kernel and other open source software and designed primarily for touch screen mobile devices such as smartphones and tablets. In addition, Google has further developed android televisions, Android Auto for cars, and Wear OS for wrist watches, each with a specialized user interface. Variants of Android are also used on game consoles, digital cameras, PCs and other electronics.

XML stands for Extensible Markup Language. XML is a markup language much like HTML used to describe data. XML tags are not predefined in XML. We must define our own Tags. Xml as itself is well readable both by human and machine. Also, it is scalable and simple to develop. In Android we use xml for designing our layouts because xml is lightweight language so it doesn't make our layout heavy.

IV.RESULTS & DISCUSSIONS

This sections contains results and related discussions for Smart Baby Cradle System.



Fig 2.DURACRIB Android Application Splash and Main Screen

As shown in above Fig.2,DURACRIB android application for Smart Baby Cradle System is designed.In main screen there are several feature buttons like Download Baby Images,Send Parent Voive,Listen Baby Voice,Play Song and Light A Cradle are inserted for monitoring baby cradle at remote location.When user click on feature buttons then same feature can be respond from device gateway and application.

As shown in below Fig.3, there is Download Images feature provided for user. With this feature parents can download and save images of babies. As shown in above Fig.3, there is Download Images feature provided for user. With this feature parents can download and save images of babies.



Fig 3.DURACRIB Android Application Download Images Feature

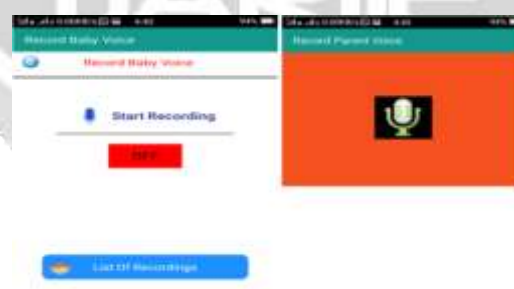


Fig 4.DURACRIB Android Application Parent and Baby Voice Record Feature

As shown in above Fig.4, there is Parent and Baby Voice Record feature provided for user. With this feature parents can record their voice and listen to babies.



Fig 5.DURACRIB Android Application Play Songs and Dancing LEDs Feature

As shown in above Fig.4, there is Play Songs and Lightmode feature provided for user. With this feature parents or made can play songs,also can on dancing LEDs when baby is crying.So this feature is especially provided to entertain babies when they are crying.



Fig 6 .Smart Baby Cradle System AWS Cloud Shadow output

In above Fig 6,AWS Cloud Shadow results of Smart Baby Cradle System are shown. Device gateway console output are firstly store on AWS cloud and further those values are visualize on android application using handheld or display devices.

V. CONCLUSIONS

The present work reduces the human effort and particularly mother's stresses in working times. The overall mechanism is mobile which allows easy movement from room to room. The device affords plenty of scope for modifications for further improvements and operational efficiency, which should make it commercially available and attractive.

ACKNOWLEDGMENT

I wish to acknowledge the support of many people who have contributed to my project. I would like to thank my guide, Dr. N. B. Chopade. Professor in Electronics and Telecommunication Department, for his encouragement and valuable guidance. He motivated me greatly which contributed tremendously to my work. I would like to thank to my external guide Mr. Shubham Kshirsagar, IoT Developer at bitware technologies, Dr. Mahesh T. Kolte, P.G. coordinator for his insightful suggestions .I am also thankful to Dr. N. B. Chopade, H.O.D. Electronics Telecommunication Department and Dr. A. M. Fulambarkar, Principal, Pimpri Chinchwad College of Engineering for their support. At the last but not least, I am thankful to my parents, who encouraged and inspired me with their blessings.

REFERENCES

- [1] Anritha Ebenezer; Anupreethi. S; "Automatic Cradle Movement for Infant Care" Undergraduate Academic Research Journal (UARJ), Vol. 1, No. 1, pp. 2278 – 11292012.
- [2] Acredolo, L. and Goodwyn, S " putting Energy into Vibration, from journal publish in 2000",Graph Frequency of vibration of the swing...2000.

- [3] Andrews, L. "For Baby Swing Consideration before Installing Baby Swing, Automatic baby swing". 2002.
- [4] A.L. Schwab, J.P. Meijaard, and P. Meijers, "A comparison of revolute joint clearance model in the dynamic analysis of rigid and elastic mechanical systems," *Mechanism and Machine Theory*, vol. 37, no. 9, pp. 895- 913, 2002.
- [5] Chau-Kai-Hsieh; Chiung Lin; Taiwan; "Baby Cry Recognizer" US 5668780, Date of Patent ,1997.
- [6] Cabrera J A, Simon A and Prado M (2002), "Optimal Synthesis of Mechanisms with Genetic Algorithm", *Mechanism and Machine Theory*, ol. 37, No. 10, pp. 1165-1177.
- [7] Chiou S-J and Kota S (1999), "Automated Conceptual Design of Mechanisms", *Mechanism and Machine Theory*, Vol. 34, No. 3, pp. 467-495.
- [8] Christiaan Huygen (1665) observed that the cradle link harmonic oscillator and the system models have a single degree of freedom.
- [9] Christenson, T. R., Schmale, D. T., 1999, "A Batch Wafer Scale LIGA Assembly and Packaging Technique Via Diffusion Bonding," Twelfth IEEE International Conference on Microelectromechanical microphone sensig Systems, 17 - 21 Jan. 1999, pp. 476 - 481.
- [10] E.Ngale Haulin, A.A. Lakis, & Ravine, "Optimal synthesis of a cardle link mechanism used in hand prosthesis", *Mechanism and Machine Theory* , 2000, 36, 1203- 1214.
- [11] G. Gilardi, and I. Sharf, "Literature survey of contact dynamics mode-ling," *Mechanism and Machine Theory*, vol. 37, no. 10, pp. 1213-1239, 2002.
- [12] Gim Wong, "Automatic baby crib rocker" US 3952343, Date of Patent:,1976.
- [13] Jimenez J M, Alvarez G, Cardenal J and Cuadrado J (1997), "A Simple and General Method for Kinematic Synthesis of Oscillating Spatial Mechanism", *Mechanism and Machine Theory*, Vol. 32, No. 3, pp. 323-341.
- [14] <https://ap-northeast-1.console.aws.amazon.com/dynamodb/home?region=ap-northeast-1#>

