Int. Conf. on Signal, Image Processing Communication & Automation, ICSIPCA

Instrumentation Sensors Based Infant Safety Smart Cradle

Sanjeev Prasad Shastry[1], Harshitha S[2], Raja Vamsi[3], Vybhav Lokende[4] and Bhanumathi K.S[5]
[1234] Final year B.E students, Dept. of E&IE, JSSATE, Bengaluru, India
[5]Assistant Professor, Dept. of E&IE, JSSATE, Bengaluru, India
bhanuvishwas@gmail.com

***Abstract*—Parents of today's generation are often busy in their professional life. This demands a requirement to develop a new low cost indigenous infant safety system based smart cradle system. Since existing cradles are very expensive, this project presents the design and implementation of a low cost Infant Safety Smart Baby's Cradle System that not only swings automatically when baby cry is detected, but also produces a soothing lullaby. For this, it incorporates a cry detecting and analyzing system which detects the baby cry and accordingly the cradle swings and music plays through the speaker. The system has an inbuilt sensor that senses the condition when the baby's diaper or the mattress is wet and sends an e-mail alert to the parent's or the caretaker. This is an important parameter to keep the baby in hygienic and healthy condition. This project uses high sensitivity sound sensor and is fixed within the cradle and it turns senses the baby's cry sound and actuates the motor. Continuous live-stream of the baby's status is also monitored.**

***Index Terms*—SMTP Protocol, Sensors, Raspberry Pi.**

I. INTRODUCTION

This whole system aims to provide a Tech-Savvy and a simple solution to child care problem. This will surely come as a boon to the modern era parents who find it rather difficult to manage their children in their busy schedules. With the joint interface of both mechanical and electrical systems, the project combines two of the most influential engineering fields. By interfacing the sensors with a software system, we bring in the IOT (Internet of Things) into picture. In simple words, IOT can be defined as a phenomenon which follows the fact that each and every thing in the physical world can be connected to a network and made smarter. Here, for example, we are connecting the moisture sensor to the internet via Gmail's SMTP (Simple Mail Transfer Protocol) . This feature is a very useful phenomenon by the Google which enables the e-mails to be sent and received in a simplified manner.

The moisture sensor being used in the project also works as a rain drop sensor. Hence the sensitivity is reasonably high compared to others present in the market. The moisture sensor has two different circuit boards- A copper board and an Electric board. The webcam fixed on the cradle detects baby's motion and uploads or live-streams it in the IP-address. The Webcam is interfaced with the Raspberry Pi. The sound sensor being used can detect sound up to 3 meters only. But as we here are detecting only the baby's cry from a close range, the sensitivity is adjusted so as to avoid interference of other noises. The motor used is a stepper motor as it is way easier to enable the swinging of the cradle in number of steps, rather than

Grenze ID: 02.ICSIPCA.2017.1.13

continuous swinging. Obviously, the motor cannot run without a motor driver circuit even with the help of latest Arduino Uno board. Hence, in our project, we are using a TB6560 motor driver which goes pretty well with the stepper motor being used in our project. Raspberry Pi 3 model B is the latest available option with in-built Wi-Fi system. As soon as the baby cry is detected, the stepper motor starts running and swinging the cradle. The sensor data is sent to Raspberry Pi serially through USB Serial Communication.. This ensures faster data transfer. As our project is mainly internet based, we are employing this board. The moisture sensor is the only component connected to raspberry Pi whereas the Arduino has more complex connections in the form of Stepper motor, Motor Driver and the sound sensor. We are using both the Arduino and Raspberry Pi so as to reduce the workload.

II. Literature Survey

A baby rocker or crib was developed by Steve Bang which worked automatically when a sensor had sensed a noise or sound matching that of a baby cry. The sensor was made of a microphone which ran on electricity along with the help of a pre-amplifier. Arduino was used to receive the signal from the above mentioned noise sensor and a simple DC motor was used for the rocking operation [1].

The fact that a bassinet swaying can be controlled through varying rhythms which can be adjusted when desired was displayed by Yang Hu. Pressure Sensors were placed at different positions on the bassinet for this purpose. The controlling circuit operates whenever different signals are generated by the sensor networks. These sensor networks posses the capability to determine the reason for the baby's cry by considering different parameters [2].

An electronic machine or device attached to a typical crib which is pivotally mounted was designed by Gim Wong. An ordinary microphone was placed which detected the infant's cry and actuated a movement such that a throw was actuated which is more or less similar to how a person does the push-pull operation. [3].

The latest development in this field is the SNOO Smart Sleeper designed and developed by Dr. Harvey Karp. The bassinet designed is very easy to set up initially and takes complete care of the baby inside. It comes with three swaddle sizes and also prevents the baby rolling over the bassinet. The setup has Smartphone app interface and can also be operated manually. The only possible drawback however is the fact that the cost is very high [4].

III. Materials and Method

The proposed work uses moisture sensor, sound sensor, Raspberry Pi, Motors and Arduino Uno. The functioning of these elements is discussed in the following section.

A. Moisture Sensor Fc-37

The Moisture Sensor being used is of reasonably high sensitivity as we want to detect moisture even above the diaper or mattress. Hence, the FC-37 is being used. The moisture sensor has two different boards – An electric board and a Copper board. The Copper board is placed on the mattress or diaper and it works on a phenomenon that whenever the copper plate is wet even by a drop, the resistance of the board increases, hence decreasing the output voltage. As soon as this happens, the LED on the electric board glows thus indicating the wetness and an e-mail is sent to the parents. Again whenever the diaper is cleaned off, the resistance decreases and the output voltage increases and accordingly, the mail is sent.

B. Sound Sensor

The Sound Sensor we are using can detect sound up to 3 meters and hence must be calibrated to desired sensitivity.

C. Motor and Driver

The Stepper Motor of 8kg/cm Torque being used here is connected to Arduino via a Motor Driver. This is to ensure that proper voltage through a 12V DC Adapter goes to the 12V stepper motor

D. Arduino Connection with Raspberry Pi

The Arduino and Raspberry Pi are interconnected through USB Serial Communication. The raspberry is further connected to an USB Webcam and a set to speakers to play the lullaby. The programming is done in python.

IV. METHODOLOGY

The following block diagram demonstrates the working of the Smart Cradle system.

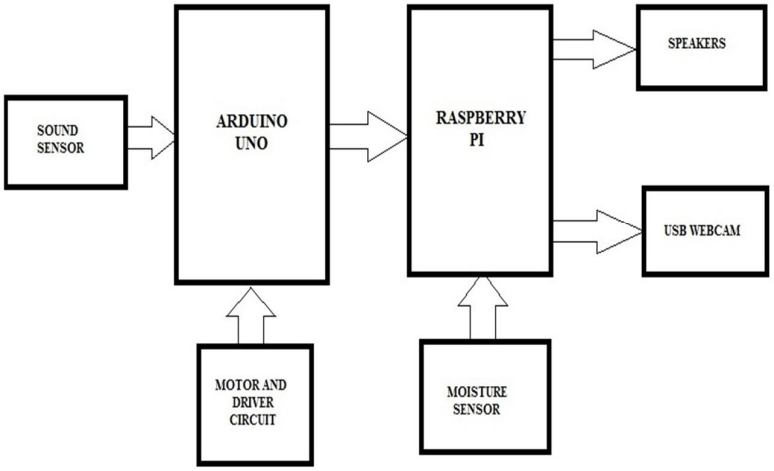

Figure 1. Block diagram of the proposed smart cradle.

The above Block Diagram summarizes the interconnections of various modules in the proposed work. The Raspberry Pi and Arduino form the centre of the whole mechanism. The Motor Driver circuit is connected directly to the Arduino, so that the clock and directions instructions can be received. The 8Kg Stepper motor is connected to the A^+, A^-, B^+ and B^- terminals of the Motor Driver. Similarly the Sound Sensor is also connected to the Arduino and the program is written to interface these two Arduino connections. The Raspberry Pi is employed in our project to make the e-mail or cloud interface easier. Hence, the moisture sensor is connected directly to raspberry pi as shown in the above block diagram. The Raspberry Pi has 4USB ports and accordingly, an USB Webcam is connected to one of the ports. The Audio Jack of the Raspberry Pi is connected to speakers. The data transfer from Arduino to Raspberry Pi is through a concept called USB serial communication.

Physical Connections of the Proposed System: The Setup, when completely ready for practical use looks similar to the following picture:

Figure 2. The physical connections of the smart cradle.

V. Results and Discussion

The proposed smart cradle system was designed and developed. The real time working of this system was tested with baby and other accessories. The performance of the system is evaluated for pre defined conditions. The baby cry was detected and lullaby was played after detecting the baby's cry. The cradle swinging automatically when the baby cry was detected. The live streaming of the baby was monitored using webcam. The moisture sensor was accurately sensed the wetness in the baby's diaper and the message was also sent to the parents or care takers through e-mail. The following screen shots of the real time system illustrate the live streaming of the baby and e-mail details which was sent to the parents.

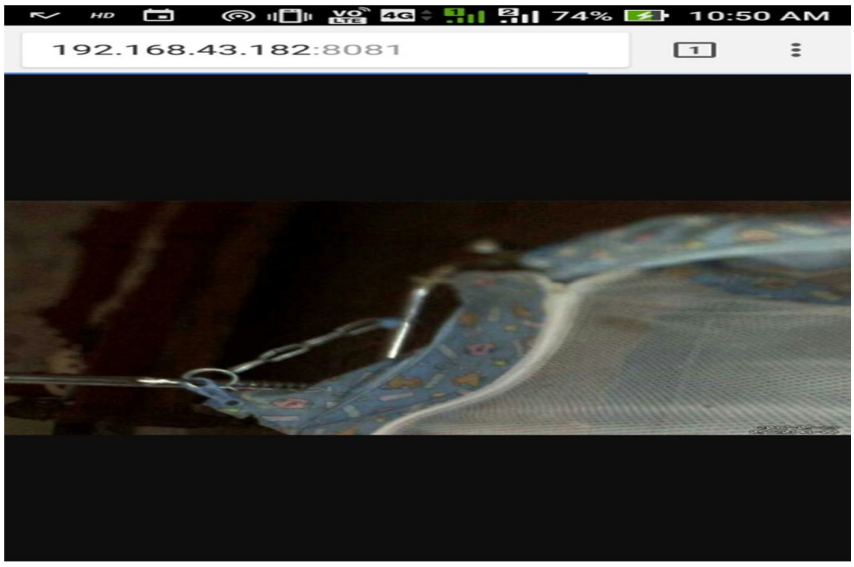

Figure 3. Live streaming of the baby.

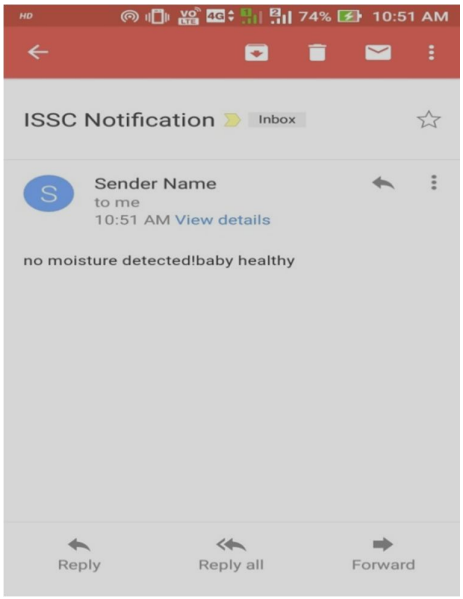

Figure 4. E-mail when the diaper is dry

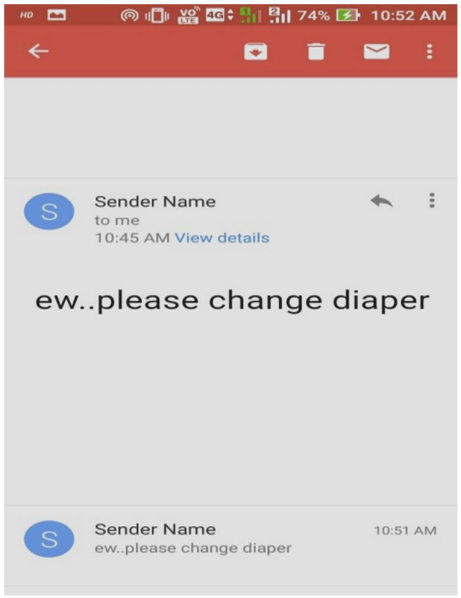

Figure 5. E-mail when the diaper is wet

VI. Conclusion

The project aims to ease the life of parents, especially in households where both the parents are working professionals. Through the webcam, they can always have an eye on the infant. The project also finds its application in orphanages where several babies have to be taken care of simultaneously. In such situations, our project can successfully be implemented so as to maintain peace and harmony. This will immensely reduce the need for nannies as there is an automated and completely safe method as replacement. Future Enhancement can be done in the field of cradle design and use of further more sensors like gas, fire, motion sensor for the creation of a complete child-care system.

References

[1] Steven Bang, Richard Lam, Natallia LoCicero, "Rock Me Baby: The Automatic Baby Rocker," Project for, San Jose State University, Department of Mechanical and Aerospace Engineering, May 17, 2011.

[2] Yang Hu, Weihua Gui, "Adaptive Sway Control for Baby Bassinet Based on Artificial Metabolic Algorithm," School of Information Science and Engineering, Central South University, China.

[3] Marie R. Harper, La Mirada, Maxine R. Blea, "Automatically rocking baby cradle", US 3769641, Date of Patent Nov. 6 1973.

[4] Gim Wong, "Automatic baby crib rocker" US 3952343, Date of Patent: Apr. 27, 1976.

[5] Chau-Kai-Hsieh, Chiung Lin, Taiwan, "Baby Cry Recognizer" US 5668780, Date of Patent Sep. 16, 1997.

[6] Anritha Ebenezer, Anupreethi S, "Automatic Cradle Movement for Infant Care" Undergraduate Academic Research Journal (UARJ), ISSN: 2278 – 1129, Vol.-1, Issue-1, 2012.