E-Cradle with Activity Monitoring and Real Time Alerts to Parents using Bluetooth Terminal

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***Abstract*- The paper cites the Infant Monitoring System with Real-Time Alerts to Parents using Bluetooth Terminal. Activity Monitoring includes Infant's cry detection which makes the cradle swing with pre-recorded song play and alert to parents for their intimidation. The Ultrasound Sensor [1] continuously monitors infant's respiration and if there is no detection for a certain interval of time an alert is sent. A wireless RF Transmitter module with Accelerometers [1] monitors infant's movements which can be attached to infant's hands or legs which are again monitored for a time interval and if there is no movement an alert is sent. A RFID module attached to cradle monitors infant's presence in the cradle, if there is no presence within a time interval an alert is sent to the parents (in case of babysitters to know infant's whereabouts). The types of alert to parents include Infant's Cry Detection, Movements, Apnea Detection and Infant missing alert which are transmitted through the microcontroller via the Bluetooth HC-05 Module to the Smart Phones of the Parents. It provides benefit to parents by taking care of their infants with reduced physical interface.**

***Index Terms*- Ultrasound Sensor, RF Transmitter with Accelerometers, RFID Module, Bluetooth HC-05.**

I. INTRODUCTION

THE idea of cry detection is based upon the voice detection of infant's cry as they don't have any other communications which is done using an Electret Condenser Microphone (ECM). ECM consists of a diaphragm and a back plate opposite to it. Diaphragm's motion by Infant cry (audio input) is detected as variation in capacitance between the diaphragm and back plate hence generating time varying electrical signals which is further sampled and quantized to obtain digital data sequence of voice and then analyzed by the microcontroller. Frequency of Infant's cry is typically reported to lie between 200 to 500Hz [2], which is detected by the ECM and when the output voltage reaches above 2.4V it's detected as infant cry, making it immune to other noises around reducing false detection rate. Infants recovering from surgery and anaesthesia are at increased risk of life threatening postoperative apnea (POA), a clinical entity associated with respiratory pauses in excess of 15 s. It's handled using Ultrasound Sensor [1] that extracts the amplitude, frequency and phase information from the ribcage and abdomen signals obtained from respiratory inductive plethysmography (RIP) [3]. Whenever the module doesn't get the reading for an interval greater than 35 s the alert immediately goes to the parent.

The Infant's movements are monitored using the Wireless RF Transmitter with Accelerometer, a dynamic sensor capable of a vast range of sensing. Accelerometers are available that can measure acceleration in one, two, or three orthogonal axes. The basic principle of operation behind the MEMS accelerometer is the displacement of a small proof mass etched into the silicon surface of the integrated circuit and suspended by small beams.

There has been report of babysitters carrying infants without parent's consent for their own benefits (begging, medical experiments). To avoid such cases we are adapting new method in this system, RFID based infant presence monitoring in cradle.

II. METHODS

Proposed approach is useful for parents to reduce the effort for taking care of infant. Basically it consists of modules which are respect to the infant cry, infant movement, and infant security. Renesas micro-controller is the heart of the system which will interface with all other modules. Microcontroller receives the information from all the modules and processes the data for further uses. Whenever infant face's any problem it will give the alerts to the parent regarding respective issues. LCD use to display the ongoing process. Details of all modules used in the model are:

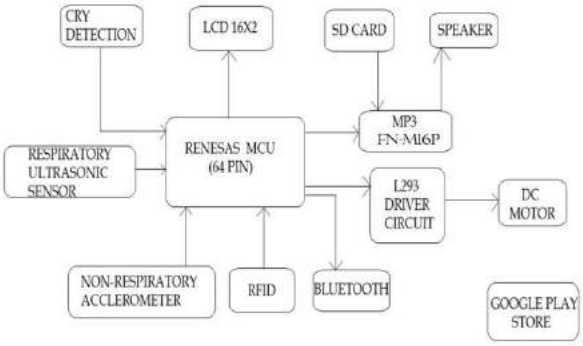

Fig: Proposed Block Diagram

A. Cry detection

M213 sound sensor based on ECM is used to detect the cry and sends the information to the microcontroller. It analyzes the input , makes cradle to swing automatically using motor with the driver circuit after a time interval of 3 counts, if infant cry continues mother voice will be played after 5 counts .Now if the cry does not stop, an alert will be sent to the parents.

B. Movements of infant

We have considered two types of movement respiratory movement and non-respiratory movement.

i. Respiratory movement: An ultrasonic sensor is used which is to detect the breathing of infant. When baby suffer from apnea, information will be sent to parent by micro-controller via Bluetooth.

ii. Non-respiratory movement: It is a secondary process which plays a major role, if the respiratory part doesn't work properly. Accelerometer is connected to the wrist or ankle of the infant which will help to detect the infant movement with respect to the x-axis and y-axis. When there will be no movement it will be detected and alert will be sent.

C. Infant security

With reference from John Wiley and Sons in 2003, Radio frequency identification (RFID) is an automatic identification system which consists of readers and tags. A tag has an identification number (ID) and a reader recognizes an object through consecutive communications with the tag attached to it (John Wiley & Sons, 2003). Here it's used for infant security. RFID reader is connected to the cradle and a tag is connected to the infant [4]. When the baby is out of the cradle for a long time an alert is delivered. The purpose is to automate the infant security supervision and can provide integration with current home security management.

D. MICRO-CONTROLLER

Renesas micro-controller has been used in this project. ROM: 512 KB, RAM: 32 KB, Data flash memory: 8 KB .On-chip high-speed on-chip oscillator. On-chip single-power-supply flash memory (with prohibition of block erase/writing function). On-chip debugging functions.

E. Flow Diagram

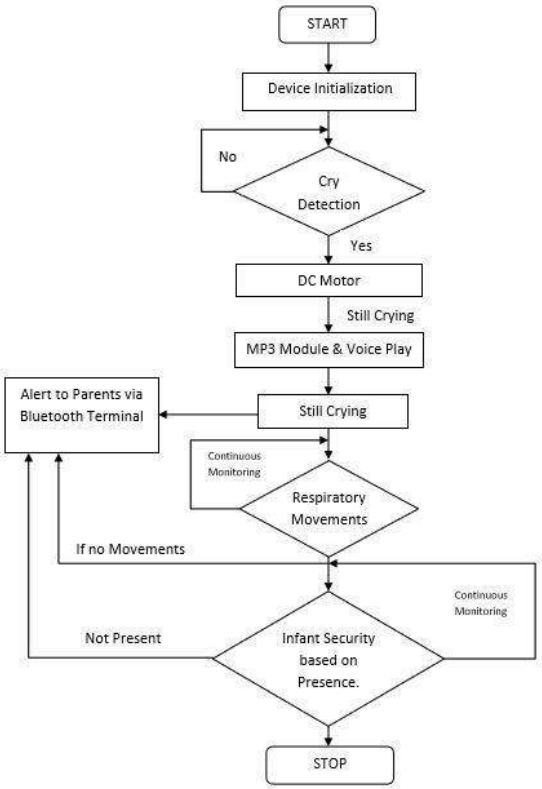

Fig: Proposed Flow Chart

The flow describes the procedural execution of the system. The same has been implemented as code using Embedded C language, complied using IDE (Integrated Development Environment). All conditions are implemented as cases for which there is corresponding operations which have been hardcoded into the code and can be maintained to add further developmental features.

IV. LITERATURE SURVEY

For development of Infant Care Security system , The movement of infant parts (such as leg ,hand movement) and frequency of infant cry is more important parameter as compared to others as it has crucial role in infant growth mechanism and to detect health condition of infant. Hence frequency of the infant cry has high priority while controlling the infant's movement.

In early choke Infant Monitoring Scheme. Infant behavior recognition is based on Neural network. Face region is segmented based on component analysis.

Study of infant expression, features namely mean, variance, skewness and kurtosis are calculated based on the information available from the infant face. Recognition expression includes angry, pain, sadness. The infant face region is then segmented based on the skin colour information and then the eight features are extracted from the face region and calculated. By this way we would be able to judge the infant is suffering from choke.

In Pharyngeal and Esophageal pressure measurements [3] to Evaluate Respiratory mechanics infants, on high flow nasal cannula: A feasibility study the aim of this work was to test the feasibility of measuring pharyngeal and esophageal pressure in young children with ARI treated with HFNC and to use these measures to monitor respiratory mechanics in this population. We specifically designed a new system of monitoring acquisition elaboration (MAES) and used it in a series of young children hospitalized. By this method we believe that HFNC decreases breathing effort and to set optimal flow rate for each infant.

Evaluation of ultrasound-based sensor to monitor respiratory and non-respiratory movements and timing in infants.[1] In this system we are going to describe and validate a non-contacting sensor that used to reflect ultrasound to separately monitor respiratory, non-respiratory and caretaker movements of infants. The electrical activity of the diaphragm obtained from an infant. The non-respiratory movement output was compared to movement detected by miniature accelerometer attached in the recording.

Further we have added extra feature RFID based presence monitoring. When infant is moved out of the cradle more than the count we specified the information going to mother through Bluetooth, that infant is missing. If infant continue to cry more than the count specified, that time mother voice is being played which is recorded and stored in SD card of MP3 module.

So, this project reduces the efforts of working women to take care of infant and help them to know status of infant at each particular time.

IV. Proposed system

The purpose of this project is to reduce the physical interface of the working class parents with greater reliability, efficiency, better adaptability, security and cost effectiveness. The entire system works with the sole purpose of providing convenience by continuously monitoring every activity of the infant and thereby providing real time details and updates to the parents. The project has been successfully monitoring the activities which include conditions like movements of infants, Apnea detection, Care taking through recorded voice, Automatic Cradle Swing and Alerts to parents. However this project has been in the initial stages but can be optimized in near future with enhanced features and better quality communications between the parents and the E-Cradle which reduces their intimidation and responsibilities only to the extent of upbringing an infant at the initial stages while they were working.

V. Conclusion

The project is developed and designed with intuition of assisting the working class parents by providing a model capable of monitoring details of the infant which include Movements of the infants, Apnea Detection, Provides security by monitoring Infant's presence and Alerts to the parents. The model would decrease the existing complex methods of monitoring where typically involves (Electroencephalogram) EEG, Electrooculogram (EOG), two or three lead chest Electrocardiogram (ECG) were used to monitor are intrusive procedures and not well tolerated by infants and elderly [5].

VI. Results

The ADC values used in our project is calculated using mathematical expression:

ADC_count (0) = (ADC_value/10) +48

ADC_count (1) = (ADC_value%10) +48

The above expression changes the different analog values sensed from different sensors used into digital values that can be manipulated using the code.

The tabular column represents the successfully obtained results from the project and can be modified as per user's requirement enhancing its flexibility.

SL.NO	COUNTS**	DEVICES & FUNCTIONS		OPERATIONS
		DEVICE/MODULES	ACTIVITY MONITORED	
1.	00	All Modules and Devices	_	All Modules and Devices are Initialized.
2.	03	M-213 (ECM Mic)	Cry	Cradle swings.
	05	FN-M16P	Cry	Plays the recorded Voice.
	07	HC-05	Cry	Cry Alert To Parents.
3.	35	HC-SR04	Respiration	While No Respiration, Apnea Detection Alert.
4.	50	Accelerometer	Movements	No Movements Alert.
5.	60	RFID	Infant's Presence	Infant Absence > 60 counts, Infant Missing Alert.

*** Counts are based on screen time units which can be employed into seconds or minutes as per further developments.*

References

[1] Gregory P. Heldt & Raymond J. Ward III "Evaluation of Ultrasound-Based Sensor to Monitor Respiratory and Nonrespiratory Movement and Timing in Infants" *IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 63, NO. 3, MARCH 2016.*

[2] Raina P. Daga and Anagha M. Panditrao Department of Instrumentation and Control Cummins College of Engineering for Women Pune, Maharashtra, India "Acoustical Analysis of Pain Cries' in Neonates: Fundamental Frequency" *Special Issue of International Journal of Computer Applications (0975 – 8887) on Electronics, Information and Communication Engineering - ICEICE No.3, Dec 2011.*

[3] Carlos A. Robles-Rubio, EMBS Student Member, Karen A. Brown, Gianluca Bertolizio "Automated Analysis of Respiratory Behavior for the Prediction of Apnea in Infants following General Anesthesia" *Natural Sciences and Engineering Research Council of Canada 2014.*

[4] Zhiyuan Fang, li Wei, Wei Chen, Yangjun He SYS Business School, Sun Yat-sen University, Guangzhou, China "A RFID-Based Kindergarten Intelligence Security System", *Ninth IEEE International Conference on e-Business Engineering 2012.*

[5] Nadezhda A. Sazonova,, , Edward E. Sazonov Bozhao Tan, Stephanie A. C. Schuckers, "Sleep State Scoring in Infants from Respiratory and Activity Measurements", *28th IEEE EMBS Annual International Conference New York City, USA, Aug 30-Sept 3, 2006*