ISSN: 2350-0328

International Journal of AdvancedResearch in Science, Engineering and Technology

Vol. 6, Special Issue 1, March 2019

"National Conference On Convergent Communication Technologies And Telemedicine Networking
(NC²CT²N–2019)"
27th March 2019

Organized by

Department of ECE & BME,Vinayaka Missions Kirupananda Variyar Engineering College, India

NEONATE Monitoring System

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ABSTRACT: This paper proposes a system for monitoring infant in an incubator and records the relevant data into a computer. The data recorded by the system can be further referred by the Neonatal Intensive Care Unit (NICU) personnel for diagnostic or research purposes. The study focuses on designing the monitoring system that consists of an incubator equipped with humidity sensor to measure the humidity level, and a pulse sensor that can be attached on an infant placed inside the incubator to monitor infant's heart pulse and a camera is fixed to detect the color change in babies using image processing techniques. The measurement results which are the pulse rate and humidity level are sent to the PC via Arduino microcontroller. The advantage of this system is, it enable doctors to closely monitor the infant condition through local area network and internet using mobile application. This system is also useful for the parents to know the condition of their child. During emergency condition, alert will be provided.

KEYWORDS: Arduino, Local Area Network (LAN), Neonatal Intensive Care Unit (NICU), image processing, mobile application.

I. INTRODUCTION

In the past few decades, female participation in the labour force in the industrialized nations has greatly increased in present society. In India, both the parents need to work and look after their babies/infants, so more workload and stress is there on such families especially on female counterparts. This proposed system gives a peace of mind to loved ones when they are away from their infant as they can get an update status of their wellbeing. The architecture of Neonate Health Monitoring System contains three phases; they are collection phase, transmission phase, utilization phase. Pulse sensor is used to sense pulse rate of babies, humidity sensor to detect the humidity level, two temperature sensors-one to detecting the temperature of the baby and other for detecting the temperature of the incubator and also a camera is fixed to detect the color change of the babies using image processing techniques. The data collected in the collection phase is communicated to the doctor to evaluate the parameter for diagnosis. The collected data is communicated to the doctor through different communication channel depend on the neonates' position.

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The transmission device used in the transmission phases are GPRS devices. All information collected from the IOT devices are communicated to the local system which contains the software to check the threshold levels of parameter.

If the detected values exceed the threshold level, an alert will be provided to avoid menace.

II. LITERATURE REVIEW

A. INTELLIGENT BABY MONITORING SYSTEM

SavitaP.Patil, Manisha R. Mhetre(2014) states that Infants cannot express themselves like old people, e. g when an infant has a fever, he/she can only express his/her discomfort by crying. In support of this requirement many research papers and patents for healthcare application are studied with the intention of possible solutions to take care of the infant. The author had developed a system which is based on commercial GSM network. The vital parameters such as body temperature measurement using LM 35, heart rate using IR Transmitter and Receiver, respiratory rate by using piezo film sensor located on Patient's Chest and blood Pressure are sensed, amplified with variable gain, filtered and given to microcontroller. Remote subsystem with GSM module receives data which is then send to a server by a USB port. Data are stored on the server and remotely displayed in a web site. In SMS based telemedicine system, patient's temperature measured by Infrared temperature sensor MLX 90614 and ECG signals acquired with electrodes interfaced with the microcontroller PIC16F877. A wearable hardware gadget is developed which captures the biological status of the baby such as motion, temperature and heart rate sensors (both optical and pressure) which are controlled by the microcontroller and connected to the Bluetooth module to provide wireless communication. In this paper, the temperature and humidity parameters are monitored.

B.TELE-HEALTH MOBILE SYSTEM

J.E.Garcia, R.A.Torres (2013) designs a tele-health mobile system based on the commercial GSM network. The system is composed by three blocks: data acquisition system, data sending and receiving and data visualization. In the data acquisition block several devices for sensing vital parameters were designed constituting a Body Sensor Network (BSN). Temperature, Heart Rate, Respiratory Rate and Blood Pressure were sensed. Some mobile applications for both cell phones and smartphones were developed in order to acquire other clinical data. A system under the GSM network was programmed for sending the information. This constitutes the second block. The connectivity capabilities of the Cell phones and smartphones were used for sending the forms. For sending the vital signs acquired a commercial hardware was implemented. A web application was developed in the third block. This application allows the remote visualization of the data. The system proposed provides an affordable, efficient and flexible platform for tele-monitoring relevant clinical parameters from patients.

An Embedded, GSM Based, Multi-Parameter,

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C.REAL TIME PATIENT MONITORING SYSTEM AND CONTROL

Nitin P. Jain, Preeti N. Jain, and Trupti P. Agarkar (2013) proposed a Wireless, remote patient monitoring system and control using feedback and GSM technology is used to monitor the different parameters of an ICU patient remotely and also control over medicine dosage is provided. The measurement of vital parameters can be done remotely. Also, the risk developing situation can be conveyed to the physician with alarm triggering systems in order to initiate the proper control actions. The implemented system plays a vital role in providing better patient care. This system enables expert doctors to monitor vital parameters such as body temperature, blood pressure and heart rate of patients in remote areas of hospital as well as he can monitor the patient when he is out of the premises. The system in addition also provides a feedback to control the dosage of medicine to the patient as guided by the doctor remotely, in response to the health condition message received by the doctor. Mobile phones transfer measured parameters via SMS to clinicians for further analysis or diagnosis. The timely manner of conveying the real time monitored parameter to the doctor and control action taken by him is given high priority which is very much needed and which is the uniqueness of the developed system. The system even facilitates the doctor to monitor the patient's previous history from the data in memory. Also thedata can be sent to several doctors in case a doctor fails to respond urgently.

D.DESIGN OF A HOME CARE INSTRUMENT BASED ON EMBEDDED SYSTEM

Jia-Ren Chang Chien (2008) a proposed an infant monitoring system based on the ARM embedded platform. Since both the parents need to work and look after their babies/infants simultaneously, these families bear more workload. Thus, this paper presents an innovative infant monitoring system consisting of an embedded system platform with a Linux kernel 2.4.18 embedded operation system using the TCP/IP protocol, a CMOS image sensor, and peripheral control systems. The key feature of the system is that, it can be used to monitor the living environment and the activities of the babies and/or infants through a web browser at any time from any place in the world. In order to increase the accuracy of the temperature sensor, the measured values from the TMP75 digital temperature sensor were calibrated using regression analysis methods. The experimental results show that the proposed concept and the resulting system are feasible.

E.LOW COST INFANT MONITORING AND COMMUNICATION SYSTEM

ElhamSaadatian, ShrutiPriyaIyer, Chen Lihui, Owen Noel Newton Fernando, Nii Hideaki, Adrian David Cheok, AjithPerakum Madurapperuma, Gopalakrishnakone Ponnampalam, and Zubair Amin (2011) proposes a low-cost, mobile-based monitoring and advisory system that continuously monitors the baby and remotely updates the mother on child status. This technology involves continuous measurement of the temperature, heart rate and motion and send it to a server where the data is processed. The server analyses the received data and sends the processed biological information of the baby to the mother and generates an alert system if the conditions of the baby are found abnormal. These alert messages are transmitted to support systems and nearby health clinics in emergency situations. Also, advisory first-aid information is sent to the mother in

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order to take immediate action. Thus, this ubiquitous system would enhance mother's awareness of their baby health status.

III. PROPOSED SYSTEM

The proposed infant incubator is consists of a monitoring system which utilizes pulse sensor to detect heart rate, humidity sensor to detect humidity level, temperature sensors to detect the temperature of the baby and also the temperature of the incubator and a camera to detect the colour change of the babies using image processing techniques.

The humidity readings in the incubator were taken continuously by placing the humidity sensor inside the incubator. The experiment was carried out in air-conditioned rooms, which has riskier moisture condition. This is because the moisture in the air-conditioning is lower compared to normal rooms. Moreover, the humidity sensor is also tested with extremely hot condition (by placing the sensor near a fire source) and extremely cold condition (by placing the sensor in a container full of ice cubes) for the reliability test. Regarding the information for preparation of incubators, for infants less than 37 weeks gestational age and/or less than 2 kg body weight must be placed in the incubator that can provide humidification within 24-48 hours of life. Humidity values for gestational age infants less than 37 weeks are in the range between 64% and 94%.

Sensing the heartbeat of a baby is a little bit different compared to adult. Instead of using a pulse oximeter, a pulse rate sensor is placed on the right hand or wrist of an infant to measure baby's pulse rate continuously. Table 1 shows the normal pulse rate for infants and children. In this experiment, the sensor readings were taken from babies from three categories only based on Table 1, which are newborn (0 ~ 3 months), infants (3 ~ 6 months) and infants (6 ~ 12 months).

Type of the specimen	**Age**	**Pulse Rate Range (BPM)**
Newborn baby	(0 ~ 3 months)	100 ~ 150
Infants	(3 ~ 6 months)	90 ~ 120
Infants	(6 ~ 12 months)	80 ~ 120
Children	(1 ~ 10 year)	70 ~ 130
Children	10 years old and above	60 ~120

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Table 1: Normal pulse rate for infants and children

Two temperature sensors are used. One is used to detect the temperature of the baby while the other is used to detect the temperature of the incubator.

The main innovation of this system is detecting the colour changes in babies using image processing technique. The algorithm used here is RCB algorithm which is the simple algorithm in image processing. Using this algorithm, colour changes in babes are detected and alerted during emergency conditions. Initially, the study is done for colour changes in babies during jaundice and lack of blood circulation.

During jaundice, the baby turns pale yellow and during the lack of blood circulation, the babies turn pale blue and sometimes blackish blue. The normal colour of the babies is pinkish red. This change incolour is detected using image processing techniques along with health monitoring.

Fig.1. Colour change due to lack of blood circulation in babies

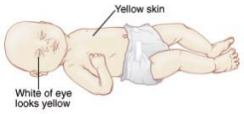

Fig.2. Colour change due to Jaundice in babies

Other colour changes that may be detected includes redness around the baby's umbilical cord or circumcision site, which could be a sign of infection and red spots (caused by broken blood vessels), which may be a sign of trauma or infection or could be due to a problem with the blood's ability to clot.

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IV. BLOCK DIAGRAM

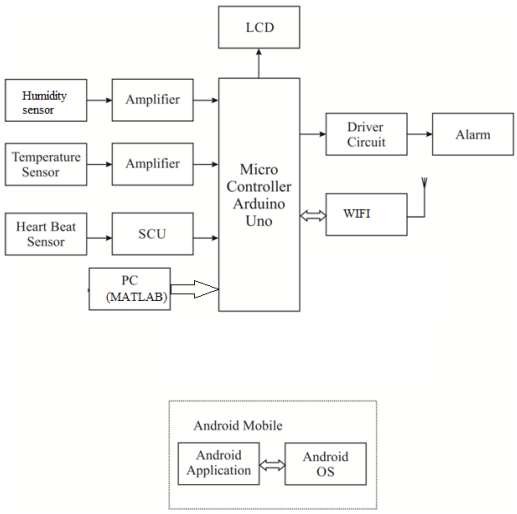

Fig.3. Block diagram of Neonate Monitoring System

V. BLOCK DIAGRAM DESCRIPTION

A.ARDUINO UNO:

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

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Fig.4. Arduino UNO

B.TECHNICAL SPECS

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 Ma
DC Current for 3.3V Pin	50 Ma
Flash Memory	32 KB (Atmega328P) of which 0.5 KB used by boot loader
SRAM	2 KB (Atmega328P)
EEPROM	1 KB (Atmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

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Table.2. Technical specifications of Arduino UNO

C. POWER:

The Arduino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm centre-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and VIN pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

D.MEMORY:

The ATmega328 has 32 KB (with 0.5 KB occupied by the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

E. INPUT AND OUTPUT:

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(),digitalWrite()and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

F. LCD Display:

Fig.5. LCD Display

A **liquid crystal display** (**LCD**) is a thin, flat electronic visual display that uses the light modulating properties of Liquid Crystals (LCs). LCs do not emit light directly.

G. HEART BEAT SENSOR:

A device for holding a heartbeat sensor in a relatively fixed relationship with respect to the end of a user's fingertip. More particularly, a device is disclosed wherein a single sheet of resilient material is formed into a base portion for holding the heartbeat sensor and three resilient bands that extend upwardly therefrom. The bands are

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adapted to grip the user's fingertip. In one embodiment of the invention, the bands and base portion define a U-shaped channel of constant cross-sectional area. In this embodiment a holding structure for the heartbeat sensor is wedge-shaped, the wedge-shaped holding structure being adapted to be held by the base portion so that the cross-sectional area defined by each band and the wedge-shaped holding structure decreases along the longitudinal length of the base portion. In another embodiment of the invention, each band defines a smaller cross-sectional area with respect to the base portion. Thus both embodiments result in more pressure being applied to the sensor at the portion of the user's fingertip closest to the end.

H. HUMIDITY SENSOR:

A humidity sensor also called a hygrometer, measures and regularly reports the relative humidity in the air. They may be used in homes for people with illnesses affected by humidity; as part of home heating, ventilating, and air conditioning (HVAC) systems; and in humidors or wine cellars. Humidity sensors can also be used in cars, office and industrial HVAC systems, and in meteorology stations to report and predict weather.

I. **TEMPERATURE SENSOR:**

A thermistor is a type of resistor whose resistance varies with temperature. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements.

J.IMAGE PROCESSING:

Image processing is computer imaging where application involves a human being in the visual loop. In other words the images are to be examined and acted upon by people. The major topics within the field of image processing include:

- Image Restoration
- Image Enhancement
- Image Compression

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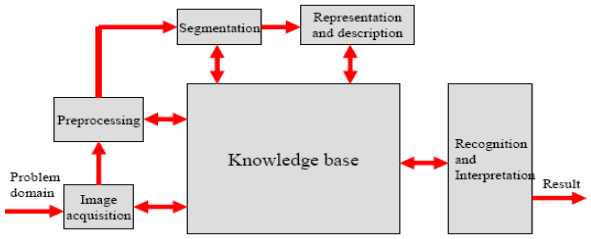
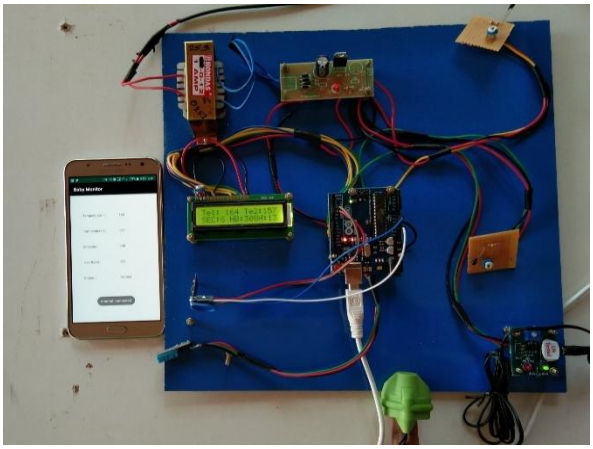


Fig.6. Fundamental Block Diagram of Image Processing

VI. CONCLUSION

The neonate monitoring system proposed here differs from other methods in the way that image processing is also included in normal health monitoring system. During emergency conditions, this system alerts the doctors and also the parents through alarm and IOT using mobile. The image of babies is captured, processed, changes are detected and the doctors and parents are alerted in case of emergency.

VII.RESULT & DISCUSSION



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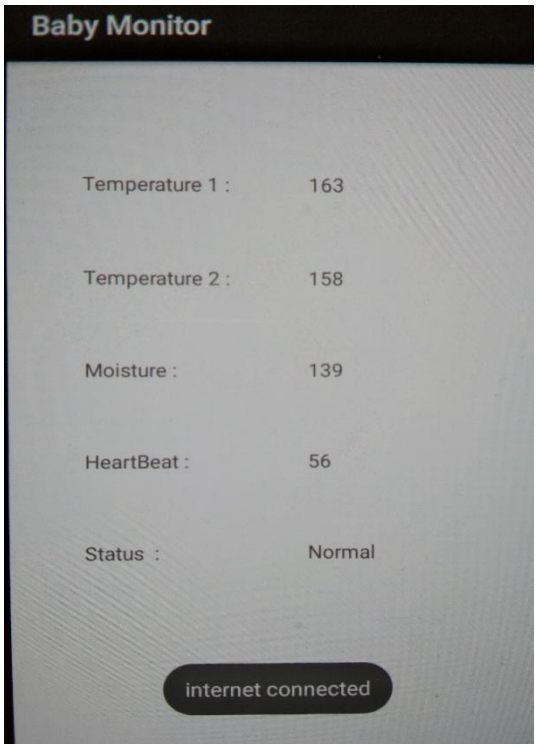

REFERENCES

[1]. J.E.Garcia,R.A.Torres, "Telehealth mobile system ", IEEE Conference publication on Pan American Health Care Exchanges, May 4,2013.

[2]. Nitin P. Jain, Preeti N. Jain,andTrupti P. Agarkar, "An Embedded, GSM based,Multiparameter,Realtime Patient Monitoring System and Control", IEEE Conference publication in World Congress on Information and Communication Technologies,Nov 2,2013.

[3]. Ashraf A Tahat, "Body Temperature and Electrocardiogram Monitoring Using SMS-Based Telemedicine System", IEEE international conference on Wireless pervasive computing (ISWPC), 13 Feb 2009.

[4]. Jia-Ren Chang Chien, "Design of a Home Care Instrument Based on Embedded System",IEEE international conference on industrial technology(ICIT), 24 April 2008.

[5]. [6]. Baker Mohammad, HazemElgabra, ReemAshour, and Hani Saleh, "Portable Wireless Biomedical Temperature Monitoring System", IEEE international conference publication on innovations in information technology (IIT), 19 March 2013.

[7]. N. M. Z. Hashim, "Development of Optimal Photosensors Based Heart Pulse Detector",International Journal of Engineering and Technology (IJET) Aug-Sep2013.

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(NC²CT²N–2019)"
27th March 2019

Organized by

Department of ECE & BME,Vinayaka Missions Kirupananda Variyar Engineering College, India

[8]. NurIlyaniRamli, Mansour Youseffi, and Peter Widdop, "Design and Fabrication of a low cost heart monitor using reflectance Photoplethysmogram",World Academy of science, Engineering and Technology 08 2011,pages 417 to 418.

[9]. CarstenLinti, HansjurgenHorter, Peter Osterreicher,and Heinrich Planck, "Sensory baby vest for the monitoring of infant", International workshop on Wearable and Implantable Body Sensor Networks, BSN 2006,3-5 April 2006.

[10]. Sharief F. Babiker, LienaElrayah Abdel-Khair, and Samah M. Elbasheer, "Microcontroller Based Heart Rate Monitor using Fingertip Sensors", UofKEJ Vol. 1 Issue 2 pp. 47-51 (October 2011.

[11]. Prof.K.Padmanabhan, "Microcontroller-Based Heart-Rate Meter", electronics for you ,www.efymag.com.

[12]. S.Deepika, V.Saravanan, "An Implementation of Embedded Multi Parameter Monitoring System for Biomedical Engineering", International ITSI Transactions on Electrical and Electronics Engineering (ITSI-TEEE) Journal of Scientific & Engineering Research, Volume 4, Issue 5, May-2013.

[13]. G. Ramachandran, T. Sheela, S. Kannan, A. Malarvizhi, PM Murali, G. Sureshkumar" Future Network and Technology -IoT Healthcare Solutions and Applications" International Journal of Advanced Research in Basic Engineering Sciences and Technology" Vol.5, Issue.1, February 2019" ISSN (ONLINE):2456-5717

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