International Journal of Engineering & Technology, 7 (2.25) (2018) 6-9

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Deisgn of Mobile Infant Incubator with Comforting Pillow

Bethanney Janney.J *, S.KrishnaKumar, AnuShree.P.B, Rayshma.V and Sanjana Suresh

Department of Biomedical Engineering, School of Bio and Chemical Engineering,
Sathyabama Institute of Science and Technology, Chennai, Tamilnadu, India.
**Email: jannydoll@gmail.com*

Abstract

A mobile infant incubator is a preterm infant care medical tool which provides warmth, humidity and oxygen all in a controlled state of affairs as required by the New born baby. This incubator offers a clean condition, which has natural air, perfect and clean encompassing conditions for the infants. The main aim of the paper is to design and develop an Arudino based temperature and humidity control in an incubator.In the course of their initial weeks of lives infants are subjected to pain and soreness, so to conquer this major problem we have introduced a mechanism to traject maternal features to the infant. For this reasons the features are mimicked viva a pillow unit that has embedded with sensors and actuators. Our proposed system consists of sensors for monitoring critical parameters, Pillow unit for comforting the infants, GSM for transferring information to doctors and parents and Labview for output evaluation and all together controlled by Arudino microcontroller. Advances in electronic procedures combined with sparing costs influence humidity and temperature to govern realistic with fantastically precise and solid performance.

Keywords: *Temperature; Humidity; Pillow unit; Arudino microcontroller; GSM; Labview.*

1. Introduction

Preterm babies are babies born less than normal gestation period which is 36 weeks. Preterm infants are not fully developed. Major cause for infant mortality is preterm birth. Approximates more than 13 million babies are born preterm. Preterm infant's lives are vague. To increase the life expectancy there is need for them to be placed in a specialized environment, like incubator [1].

Newborn child incubator is a medical device which is used as life support for preterm. It supplies heat,humidness and oxygen all in a controlled space as required by the New conceived. Dr. Alexander Lyon in 1891, composed the essential present day incubator. A temperature sensor is taped to the child's skin, and the incubation facility hotter acclimates to keep up the infant at the reliable temperature or, the temperature is controlled by an indoor controller in the warmed air stream. Underneath the newborn child is an air-blown electric warming framework and humidification framework which streams warmed sticky air at a coveted temperature and moistness through the hatchery chamber. Additional oxygen may similarly be brought into the chamber. The infant hatchery is normally as a trolley with a little sleeping pad on the best secured by a rigid clear plastic cover. Hatchery chamber gives a perfect situation, and shields the child from commotion, clean, pollution, and abundance dealing with.But the incubators available in NICU nowadays are expensive which makes it not available for people with low economy. People are working on low cost incubators [2], [3].

Preterm also face a lot of health issues. Medical treatment provided to the babies may root in some discomfort and soreness. These discomfort and soreness is mainly due to invasive methods of treatment; placement and removal of sensors for checking the critical parameters. Environmental conditions, absence of parents also affect the infants. Studies say that, if these discomforts are not treated, it can cause deterioration in pain and stress management skills on lateral stages [4]. Responses to discomfort may be shown as physiological changes such as changes in vital parameter, discoloration etc. Any sort of problems of an infant can be smoothed and reduced by maternal features. A gentle touch or breathe of the mom can also stimulates the baby's growth.So non-invasively infant can be made feel some of the parent's physiological features [5].

2. Materials and Methods

The Proposed work describes how to design a mobile infant incubator at low cost and to embed a comforting pillow so the discomfort of a neonate could be reduced. This is likely to give the feeling of the neonate is very close to the mom. This subdivision gives the detail portrayal of block diagram (Fig.1) of our paper.

Copyright © 2016 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

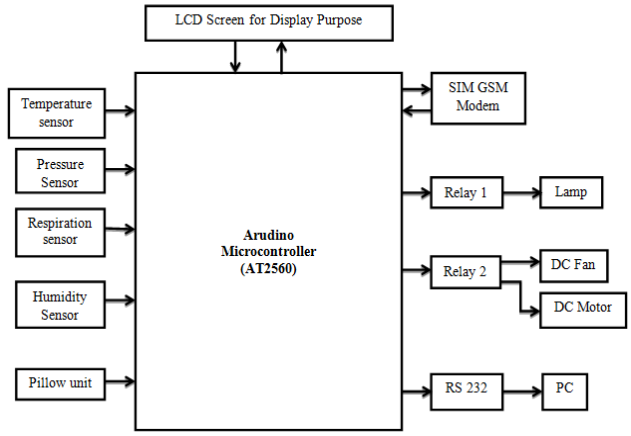


Fig. 1: Block diagram of Proposed method.

2.1 Mobile infant incubator

The block diagram gives detailed view about the connections between the Arudino microcontroller, sensors and other components used in mobile infant incubator. The Arudino microcontroller is the base for this incubator. It has temperature, pressure, humidity and respiration sensors and pillow unit connected to it. The sensors sense their respective parameters and those signals are given to Arudino microcontroller and are displayed. With the help of embedded C program, Arudino microcontroller gives instructions to other components connected to it. Relay operates the ON and OFF mechanism of lamp, DC fan and DC motor.For GSM modem can use any type of network that has GSM network operator supportability. A SIM card of that specific network can be used and each GSM modem has its own unique number.Keypad is the only mode of input for typing and sending alert messages. Zigbee is the wireless connection between PC and hardware equipment for transmitting and receiving of signals, thus output is displayed on front panel of LABVIEW in the form of waveform. RS232 port is to communicate and develop embedded applications [6].

2.2 Arduino microcontroller

The Arduino Mega 2560 contains everything expected to help the microcontroller.It essentially associates to a computer with a USB or power it to start. It consists of 54 digital pins which can be used as an input or output.They work at 5 volts. Each pin can give or get a most extreme of 40 mA and has an internal pull-up resistor. The Mega 2560 has 16 inputs, which in turn gives 10 bits of enhancement. The Arduino Mega 2560 has a number of provisions for communicating with a PC, another Arduino, or different microcontrollers. The ATmega2560 gives four equipment UARTs to TTL (5V) serial correspondence.The ATmega2560 likewise underpins I2C (TWI) and SPI communication [7], [8].

2.3 Temperature sensor

LM35 Temperature Sensor is a semiconductor based sensor with an output voltage directly corresponding to the degree centigrade temperature. LM35 Sensor does not require any external calibration or trimming to give average accuracy. The LM35's low output impedance, linear result, and true characteristic adjustment make the interfacing to readout or supervise hardware particularly simple.It has very high operational accuracy and a wide operating range. Since it uses internal compensation, the output can begin with 0℃ [9], [10].

2.4 Humidity sensor

A humidity sensor senses, approximates and records both temperature and moisture of air. The ratio of moisture in the air to the highest amount of moisture at a specific air temperature is called relative humidity. Relative humidity turns out to be an important parameter, when searching for well-being. Humidity sensors functions by identifying changes that modifies electrical streams or temperature visible throughout [11].

2.5 Pressure sensor

A pressure sensor is a device that measures pressure normally senses atmospheric pressure. Pressure is an expression of the force required to prevent a liquid from growing and is typically expressed as far as force per unit area. The pressure sensor is a coordinated circuit in electronic circuits which act as a transducer; it duplicates a signal as a function of the imposed pressure [12].

2.6 Respiration Sensor

Respiratory rate is basic physiological parameter to screen untimely babies and evaluate wellbeing in both restorative examinations and physical recovery, since they offer essential fundamental data about body capacities. The ordinary respiratory rate is given as 4–50 breaths for each moment under specific conditions [13]. A current new innovation incline stresses the utilization of multisensors to helpfully and at the same time sense different imperative signs, and in addition, new sensors ought to furnish negligible impedance with nature and must require least care; expenses ought to likewise be as low as conceivable [14].

2.7 Pillow unit

The Pillow unit (Fig.2) has temperature sensors which can read the temperature of the incubator and the cushion. The heat is produced on the cushion unit with the help of heat transistor. These transistors are placed in-between the ultra-fabric material used for the cushion.Heart beat is given in the form of vibration, which are produced by speakers. The heartbeat sampled values are transferred through Bluetooth to the speakers. These speakers are also placed inside the cushion. [15].

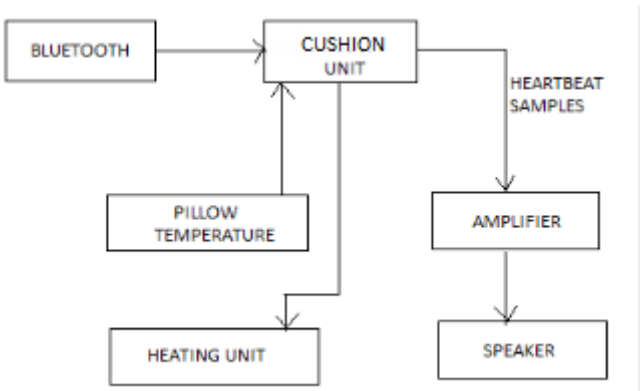


Fig. 2: Pillow Unit

2.8 SIM GSM Modem

The GSM modem can recognize any GSM sort out chairman SIM card and act just like a mobile phone with its own particular unique phone number. It can be used to send and get SMS or get voice calls .Central purposes of using this modem will be that you can use its RS232 port to pass on and make introduced applications. Applications like SMS control, data trade, remote control and logging can be made successfully. The modem can either be related with PC serial port particularly or to any microcontroller through MAX232 [16].

2.9 Relay

A relay is an electrical switch. Various exchanges use an electromagnet to mechanically work a switch, yet other working benchmarks are in like manner used, for instance, solid state exchanges. Exchanges are used where it is vital to control a circuit by a low-

control movement or where a couple of circuits must be controlled by one flag [17].

2.10 Recording unit

Basic function of the recording unit (Fig.3) is to record the maternal or paternal physiological features and sample them before transmitting them to the cushion unit. It uses a DS18B20 temperature sensor. The temperature sensor is very precise, on contact with the skin it starts sampling the temperature.The pulse sensor is used to sample the heart beats. An initiator button is present only when it is triggered the values are collected for sampling. All the samples collected are analog samples, so they are fed to the analogy pin of Arduino Mega 2560 microcontroller. It has a built-in ADC that converts the analog samples into digital values and sends it via Bluetooth HC05 to the cushion unit [18].

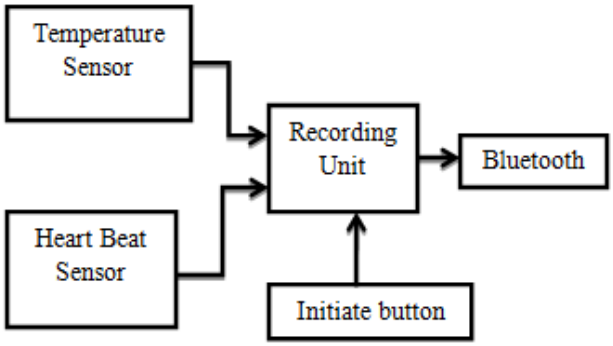


Fig. 3: Recording Unit

3. Methodology

The proposed system developed a mobile infant incubator with comforting pillow unit. The system consists of respiration sensor, humidity sensor, temperature sensor, pressure sensor which senses their respective parameters. The sensed parameter is displayed on LCD screen. It also has SIM GSM modem that can update the parameters through text message. The maternal features like the maternal temperature and the maternal pulse vibrations are recorded in a recording unit prior and the data is fed to the pillow unit through a Bluetooth. The pillow is fitted with heating pads that gives maternal temperature through a heat transistor. The sensor used to sample heart beats is from pulsesensor.com, which is an open-source sensor. The open source library from pulsesensor.com has been modified for our requirements to get interval between the beats and sampled values for every 2ms. This sensor works on the principle of photo plethysmography, used to measure blood volume changes. The output from the sensor is fed to an analog pin of Arduino, where the amplitude of output is measured every 2ms. All the components are connected to an Arduino microcontroller. This system has 2 relay circuits that act like a switch for DC Motor and DC Fan for temperature control and other for lamp. According to the display the relay adjusted. Another temperature sensor is used which gives the feedback about the incubator temperature. The pillow is a cushion unit which effectively spreads the air inside it and keeps the hazard of suffocation. This is a powerful technique which gives comfortness to the neonate under torment.

4. Results and Discussion

The system has been analyzed and the output is evaluated. The mobile incubator being a complete hardware design, the data is available on the cell phone. Mother's heart beat and temperature can be replicated through a comforting pillow containing temperature and heart beat sensor. Pillow temperature is systematically monitored and compared with obtained temperature to maintain similar condition.

This paper presents the design of a mobile incubator with a comforting pillow to improve the effective medication for neonates. The paper aims in providing comfort during distress to infants. In the past papers, the infant incubator controls only temperature but not humidity. Since humidity is also an important factor, this infant incubator considers humidity along with temperature. This apparatus, if made available in the market, can be marked safe, simple, all at a low cost. This proposed system is not only for monitoring and controlling but also provides comfort to neonates. The overall prototype and hardware prototype of pillow unit is shown in Fig.4 and Fig.5.

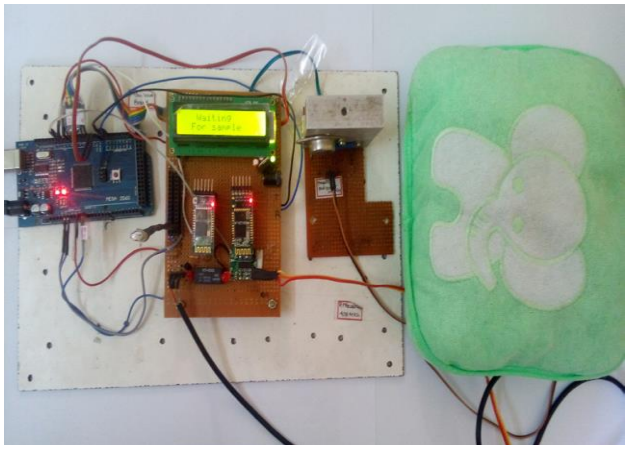


Fig. 4: Hardware Prototype of pillow unit

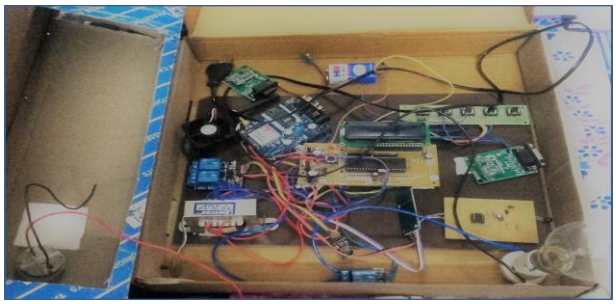


Fig. 5: Overall Prototype

The various parameters such as temperature, humidity, respiration and pressure is monitored in LCD screen as shown in Fig.6 and these parameter values are being transferred through message to parents and doctors by using SIM GSM MODEM. The Fig.7 shows the screenshot of received SMS message. This message clearly gives the values of all the parameters. The overall system design is evaluated using LabView and the output of various parameters is displayed as shown in Fig.8.

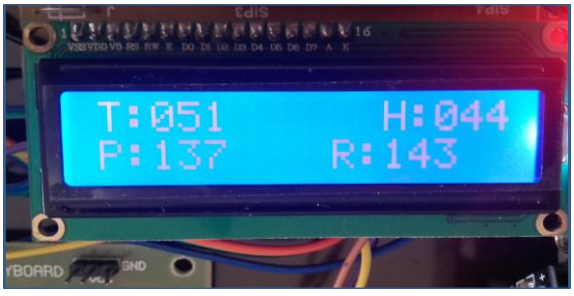


Fig. 6: Sensor values displayed on LCD

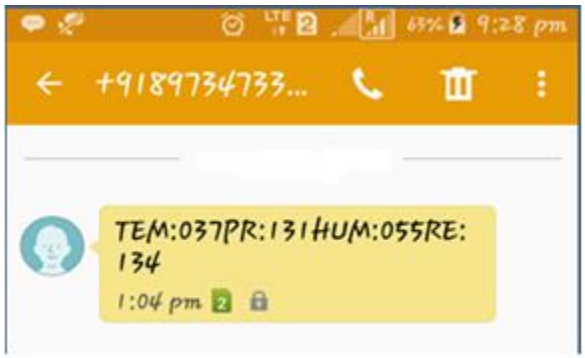


Fig.7: Screenshot of received SMS message

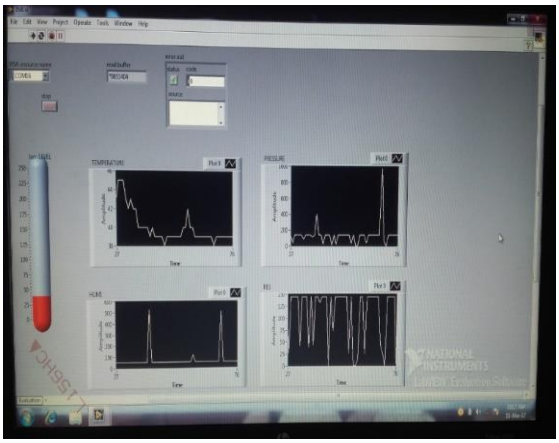


Fig.8: LabView Output

5. Conclusion

This paper presents the design and prototype of an Arduino based mobile incubator with a comforting pillow for effective intervention of mother's presence and neonates with maximum comfort ability. Temperature is one of the important parameter to be maintained and controlled for neonates. This design thus achieves temperature, humidity, comfort and other parameters efficiently by connecting it to an Arduino. Moreover, the neonate's ECG, EMG and heart rate fluctuation can also be measured and documented for further reference. In future, monitoring and controlling various parameters to provide the micro environment to the infant inside the incubator can be introduced. Even more maternal features can be transmitted through the upcoming technology.

Acknowledgement

We Would like to thank management of Sathyabama University, Faculty of Bio and Chemical Engineering and Department of Biomedical Engineering for their guidance and support to complete the research successfully.

References

[1] Joshi N S, RK Kamat, PK Gaikwad, "Development of wireless monitoring system for neonatal intensive care unit", *International Journal of Advanced Computer Research*, Vol.3, No.3, (2013), pp.106-109.

[2] Brangui S, El Kihal M, Salih-Alj Y, "An ergonomic comprehensive system for monitoring and control of baby environments", *6th International Conference on Information and Communication Systems (ICICS)*, (2015), pp. 251-256.

[3] Sumathi OM, Malini M, Vikram T, " Wireless data acquisition system for vital sign monitoring of neonates", *International Conference Computer and Communications Technologies (ICCCT)*, (2014), pp.1- 4.

[4] Harshad Joshi, Dattu, Akluj, "PIC Microcontroller based Baby Incubator ", *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, Vol. 4, No.2, (2015).

[5] Corbishley P, Rodríguez-Villegas E, "Breathing detection: towards a miniaturized, wearable, battery-operated monitoring system", *IEEE Trans. Biomed. Eng. J.* , Vol. 55, (2008), pp. 196-204.

[6] Kumar P.A, Akshay N, Kumar T.A, Jagannath B," Real time monitoring and control of neonatal incubator using labVIEW", *Int. J. Appl. Innov. Eng. Manag*, Vol. 2, (2013), pp.375–380.

[7] Hadi N A, M. H. C Hasan, N. M. Z. Hashim ,"Temperature Monitoring System for Infant Incubator Using Arduino", *International Journal for Advance research in engineering and Technology*, 2015, Vol.3, No.6, (2015), pp.8-11.

[8] Zermani M A, Feki, Elyes, Abdelkader M, "Temperature Acquisition and Control System based on the Arduino", *International Journal of Emerging Science and Engineering*, Vol. 2, No.12, (2014), pp.1-6.

[9] Dollberg.S,"Continuous measurement of core body temperature in preterm infants", *American Journal of Perinatology*, Vol. 17, No.5, (2000), pp. 257-264.

[10] Harpin V, Rutter N, "Humidification of Incubators", *Archives of disease in childhood*, 1985, Vol. 60, No.3, (1985), pp. 219-224.

[11] Ashish Gupta, Lini Mathew, "Design and Development of an Infant Incubator for Controlling Multiple Parameters", *International Journal of Emerging Trends in Electrical and Electronics*, Vol.11, No.5, (2015), pp. 65-72.

[12] Murkovic I, Steinberg M. D, andMurkovicB, "Sensors in neonatal monitoring: Current practiceand future trends", *Technology and Health Care*, Vol.11, No.6, (2003), pp.399–412.

[13] Hitu Mittal, Lini Mathew, Ashish Gupta, "Design and Development of an Infant Incubator for Controlling Multiple Parameters", *International Journal of Emerging Trends in Electrical and Electronics*, Vol.11, No.5, (2015), pp.65-72.

[14] Savita P. Patil, Manisha R. Mhetre, "Intelligent Baby Monitoring System", *ITSI Transactions on Electrical and Electronics Engineering*, Vol. 2, No.1, (2014), pp. 11-16.

[15] Chen W, Oetomo SB, Tetteroo D, Versteegh F, Mamagkaki T, Pereira MS, Janssen L, Meurs AV. "Mimo Pillow - an intelligent cushion designed with maternal heart beat vibrations for comforting newborn infant", *IEEE Journal of Biomedical and Health Informatics*, Vol.19, No.3, (2015), pp.1–8.

[16] Deepika.S, V.Saravanan, "An Implementation of Embedded Multi Parameter Monitoring System for Biomedical Engineering", *Journal of Scientific & Engineering Research*, Vol.4, No.5, (2013).

[17] VidyaDhatrak, Revati Gholap, "Intelligent Baby Incubator Using LabVIEW", 2nd International Conference on Emerging Trends in Engineering & Techno-Sciences (ETETS), Vol.3, No.3, (2014), pp.50-54.

[18] Nandhini P, J. Bethanney Janney and Sindu Divakaran, "Design of an Intelligent Pillow with Maternal Temperature and Heartbeat Vibrations for Comforting NICU Infants", *Indian Journal of Science and Technology*, Vol. 9, No.33, (2016), pp.1-5.