Cost Effective Infant Incubator with Integrated Billipad and Telemonitoring

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Abstract - In present scenario it is quintessential to continuously monitor the vital parameters of the infant in the incubator for which the doctors needs to visit the neonatal ICU incase of a conventional type incubator. Unlike the conventional type incubator this project design aims at acquiring the respiratory event detection, temperature, humidity and rate of heartbeat automatically at regular intervals. The project is also designed to integrate a new age phototherapy unit called the Billipad. Parameters like temperature, humidity, rate of respiration and heartbeat rate are sensed using cost effective sensors like LM35, HTMR035, MPX5010, HRM2115.In addition to the above sensor modules a phototherapy unit to treat jaundice that is caused in neonates due to increase in bilirubin level is treated.The output of the sensor unit and billipad is interfaced with a PIC 18F45K22 microcontroller unit. Whenever the vital parameter such as temperature and rate of respiration varies from its threshold level (normal value), an alert is transmitted to the doctor unit and the controlling unit such as the cooler, warmer and oxygen supply will automatically turn on by the help of relays. Thus all the four vital neonatal parameters along with the treatment of jaundice are monitored continuously and Telemonitored. A cost effective infant incubator is thus developed to save the precious life of neonates.

Keywords:-Incubator, Respiration, rate, Temperature, Humidity, Heartbeat, Billipad, Bilirubin, Telemonitored, Neonates

I. INTRODUCTION

Neonates are referred to as low weight and premature babies. Neonates are frequently affected by jaundice. This proposed system in this paper focuses on improved monitoring of health conditions of neonates and also have a integrated incubator with billipad to cure jaundice and telemonitoring the parameters information to the doctor. Present system provides only non-integrated billipad and phototherapy unit. An individual and unified system usually leads to increased cost for their operation whereas the proposed system meets all the operational demands at a much lower cost.

1.1. Jaundice

Jaundice is a disease often expressed as the symptoms of yellowish color skin and white part of the eyes. It is a sign that there is too much bilirubin in the baby's blood, which is often referred as hyperbilirubinemia . Mild jaundice is common in most of the premature babies (about 60%).It usually gets better or goes away on its own

within a week or two without causing problems. But jaundice should be taken seriously. In rare cases, if the bilirubin level stays high and is not treated, it can cause brain damage which is called kernicterus. This can lead to serious lifelong problems. Generally the jaundice in new born babies does not need any treatment but some exceptional cases this jaundice can surpass the safe limit. For those cases the babies need to be kept in phototherapy, in which babies are kept under a blue tube light(billipad).

1.2 Heat Loss Mechanism

To prevent heat loss the most commonly used mechanism is a neutral thermal environment called incubator. In biology, an incubator is a device used to grow and maintain microbiological cultures or cell cultures. The incubatormaintains optimal temperature, humidity and other conditions such as the carbon dioxide (CO2) and oxygen content of the atmosphere inside. It is more serious matter for the premature babies affected by jaundice.

1.3 Jaundice Treatment by billipad

Billipad refersmatrix of LED which treats jaundice by keeping the baby under blue LED which is represented in figure 3. It is a process called photo-oxidation to decrease the level of bilirubin. Addition oxygen can change the substance that help dissolve easily in water. During phototherapy it is important to monitor babies temperature to ensure that they are not getting too hot as well as not showing the signs of dehydration. Phototherapy in this method will be improved method for treatment of preemies jaundice with less chance of complication. It is an easy and convenient system to use.

1.4 Telemonitoring

The neonates condition is continuously monitored by the doctor with the help of telemonitoringsystem.The four vital parameters such as humidity, temperature, heartbeat and respiration rate is stored in LabVIEW and communicated to the doctor with the help of Zigbee transceiver, through which can be neonates condition can be continuosly monitored and controlled from anywhere .It is a wireless mode of communication to the doctor about the neonates.

II. DESIGNS

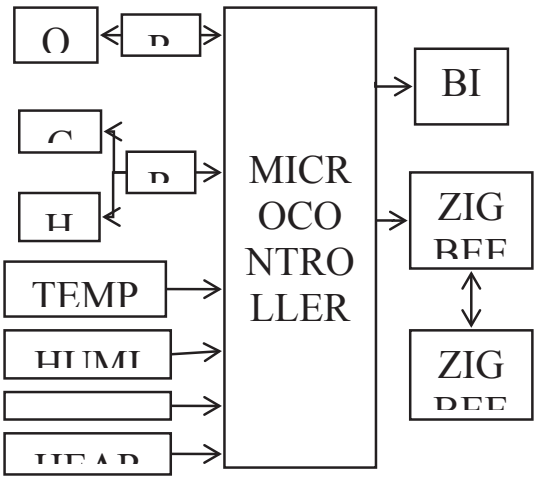

Figure 1:Block diagram of integrated billipad inside incubator.

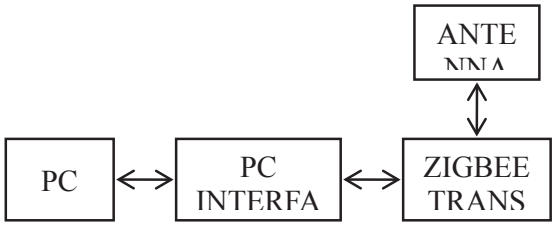

Figure 2:Block diagram of control module.

2.1. Methodology

The vital parameters which are controlled and monitored are Heartbeat rate, respiration rate, humidity and temperature.

2.2. Components:

Billipad :Nichia NSPB500S is the blue color led used for phototheraphy unit. Normal intensity level-420nm.

Temperature sensor : LM35.
Humidity sensor : HTMR035.
Peripheral interface controller :PIC 18F45K22
Respiratory sensor : MPX5010.
Heartbeat rate sensor :HRM2115.
Communication :Zigbee transceiver.
PC interface :RS232.

III. OPERATING PRINCIPLE

The four vital parameters are analysed and stored in LabVIEW software for telemonitoring purpose. The parameters are controlled with the help of PIC18F45k22 which is the microcontroller .The controller has peripheral features like inbuilt ADC, required to get the signals from the various sensors. Maximum clock frequency is 48MHz and hence faster than 8051.Embedded C is used for programming the microcontroller.Zigbee is a digital wireless communication protocol which helps in communicating the information to the doctor in a wireless mode .Data rate of upto 250Kbps are possible using zigbee.Zigbee uses 2.4GHz frequency for data communication.It uses QPSK modulationIn general upto 256 devices can communicate in a Zigbee network.PAN – Personal area networks can be implemented using Zigbee

Figure 4: Normal and abnormal rates of the parameter.

PARAMETERS	NORMAL VALUES	ABNORMAL VALUES
TEMPERATURE	36.4 degree Celsius (97.5F)	<35 degree Celsius
RATE OF RESPIRATION	50-60 breaths per minute	<40 breaths per minute
HEART BEAT RATE	70-90counts per min	<40 counts per min
HUMIDITY	Ambient(40-60%) In hospitals(55%)	>90%
BILIRUBIN LEVEL	5 mg/dL	Above 10 mg/dL (>200 mg /dL increases per day)

The whole system is connected through Zigbee transceiver.LabView is used to monitor the parameter from monitoringsection

The parameters which is represented in figure 4 are controlled by setting a threshold value which are the normal values and the obtaines values are compared with the standard value .To make this control relay has been used which controls the parameter values automaticallyRelays are electromechanical switches that can be controlled by ordinary digital pins.But relays require more current than that can be given by a microcontroller or PLC.Hence a relay drive is required for current amplification between the low current digital circuitry and the relays.In this project a general purpose NPN transistor is used for the relay drive.The transistor used is BC547, which is small signal general purpose transistor.

IV. SOFTWARE

4.1. LabView

LabVIEW is a system-design platform and development environment for a visual programming language from National Instruments . The G programming language is central to LabVIEW; so much so that it is often called "LabVIEW programming." Using it, you can quickly tie together data acquisition, analysis, and logical operations and understand how data is being modified. From a technical standpoint, G is a graphical dataflow language in which nodes (operations or functions) operate on data as soon as it becomes available, rather than in the sequential line-by-line manner that most programming languages employ. The "flow" of data through the application can be laid out graphically with wires connecting the output of one node to the input of another

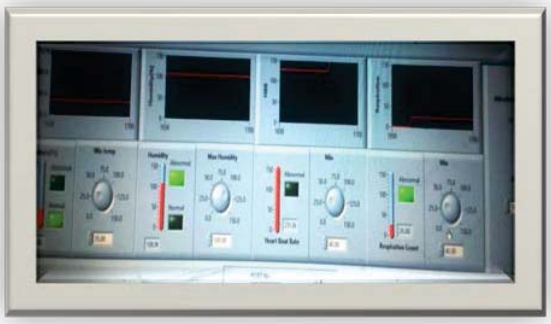

Figure 5: Output of the system in LabVIEW.

4.2. Flowchart of Software Implementation.

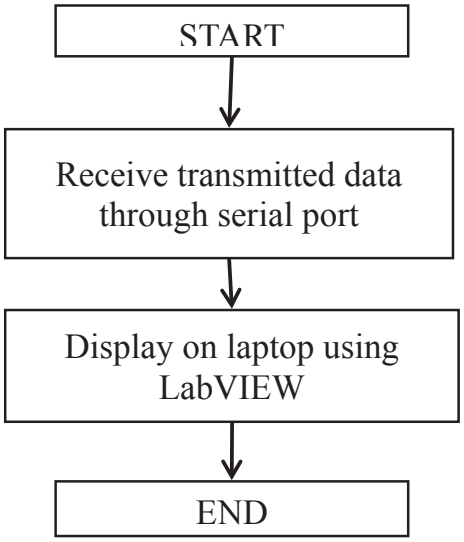

Figure 6: Flowchart of simulation mode.

PC Interface circuit is needed whenever a external hardware project is to be connected to a computer.This circuit is required to connect to the serial port of a computer.The serial port of the computer is also called the RS232 port, because it is based on the RS232 standard.RS232 is a serial communication standard that uses voltages (+12V/-12V) different from conventional digital circuits(0V/5V).Hence a PC interface circuit is needed to do voltage conversions between ordinary digital devices and a computer.

4.3. Circuit diagram

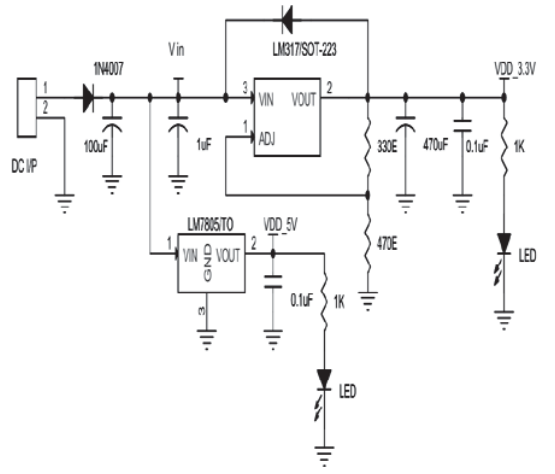

Figure 7: Circuit diagram for power supply

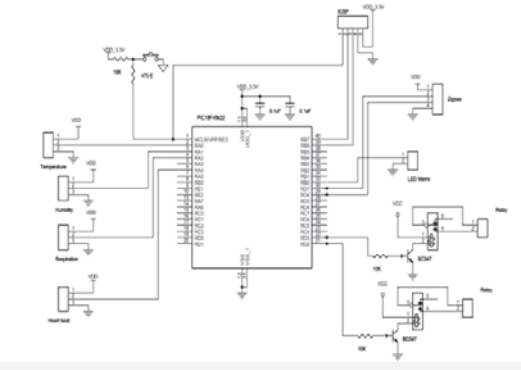

Figure 8: Circuit diagram for controller module

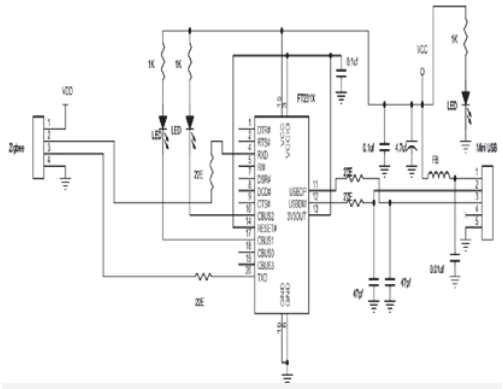

Figure 9: Circuit diagram for receiver module

V. CONCLUSION

This paper presented the development of a microcontroller based integrated billipad inside the incubator with automated control and monitoring system. The main benefit of this system is cost effectiveness and all facility in a single unit. It is not expensive to implement. The proposed system can play avital role in the cost effective design of life supporting units for the premature babies.

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