

Infant Incubator Monitoring system with Remote Access (IIMRA)

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ABSTRACT: Telecommunication and information technology in healthcare can substantially improve the quality of care delivery system. Use of these technologies can help to change the approach from reactive to proactive healthcare. Further, bounds of distance and cost are reduced to cater more number of people at affordable costs. Incubators and radiant warmers are very common medical equipment used in neonatal hospitals. These are primarily heating devices that are used to keep newborn babies warm and help them to achieve thermoregulation in order to prevent diseases related to hypothermia. In this paper, design of a low-cost system for monitoring and control of incubator and radiant warmer is discussed. Vital parameters like air and body temperature, heart rate and humidity level are continuously measured. On basis of this a servo control is implemented to regulate the heat output of the heating element in the machine to maintain a constant temperature. Facility is provided to monitoring and control the machine locally using a touch screen based operators console as well as remotely over internet. A dedicated web server maintains the data in real time and give access to doctor or any authorized medical personal to monitor and control the machine. Facility is also provided to generate alarm both locally in terms audible notification and remotely in terms of a SMS. Completed system has been designed on Arduino Mega platform. Proposed system does not incur substantial rise in the cost compared to cost of existing machines without such facilities and is certainly a cheaper solution compared to such high-end machines available in market.

KEYWORDS: Embedded system, Telemedicine, temperature control, incubator, radiant warmer.

I. INTRODUCTION

Health monitoring systems become a hot topic and important research field today. Electronic Patient Records and sensor networks for the patient monitoring are at the current forefront of new technologies. Remote patient monitoring (RPM) is a technology which is used to monitoring of the patient from the remote place or outside the patient's room or conventional clinical setup. Advantages of remote patient monitoring are:

- Increase access to care
- Monitoring many patients at a time.
- Decrease health delivery costs etc.

An incubator machine is a very useful medical device which is used to maintain and regulate an appropriate environment for the newborns. To maintain and control the temperatures and humidity level in the newborns, baby incubator is required. Interested industrial parties so they can meet, share experiences, present research, and exchange ideas.*

II. MOTIVATION

Most of existing technology's baby incubator shows a value of temperature and other vital parameters on the local display in digital form and these parameters can be set as per our requirement but generally existing incubator machine cannot able to send these parameters at remote place and control it from remote place. Some of the machines are available with the features of remote monitoring but their tentative cost is near about 30 thousand rupees/piece. Now a day's use of incubator machine increasing, so it is needed to develop a low-cost design.

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III. SYSTEM ARCHITECTURE

Any biomedical controlling and remote monitoring system consists of bio-sensors, control system unit based on controller unit, communication gateway and central monitoring system with GSM Module. The system is mainly composed of various types of sensors which is used to measure vital parameters of newborn. The electronic control system for controlling and monitoring the sensed temperatures, humidity, Heart rate data and transmit all parameter at remote place using RS232 to Ethernet converter. The GSM based remote monitoring is to be designed and monitoring and controlling can be done by PC/Laptop or mobile phone which support internet facility.

The main functions of the system are:

- 1) To sense the temperatures, humidity & Heartbeat of the infant continuously and display it on to the local display (Touch screen LCD), as well as to set the temperatures, humidity & Heartbeat as per requirement, by the control unit.
- 2) To transmit the sensed and set point values of temperatures, humidity & Heartbeat over USB by help of RS232 to Ethernet converter.
- 3) To display current value and set point value of temperatures, humidity & Heartbeat on to the GUI using local area network.
- 4) To transmit current values and set point values of temperatures, humidity & Heartbeat at the remote place via GSM module
- 5) To monitor the current values and set point values temperatures, humidity & Heartbeat by help of PC or laptop.

IV. SYSTEM HARDWARE DESIGN

The control system mainly consists of PIC16F877A microcontroller, sensors like air & body temperature sensors and humidity sensor. Present system also consists LCD to display air & body temperature and humidity as well as to display set points of air & body temperature and humidity which is helpful to the doctor and nurse to monitor infant's air & body temperatures and humidity locally means where immature infants are kept. Present system also consists a buzzer as an Alarm system. It also has heater and heating control system, RS 232 to Ethernet converter and specially designed GUI / Web Page for remote monitoring purpose. The designed control system block diagram is shown in the Fig. 1.

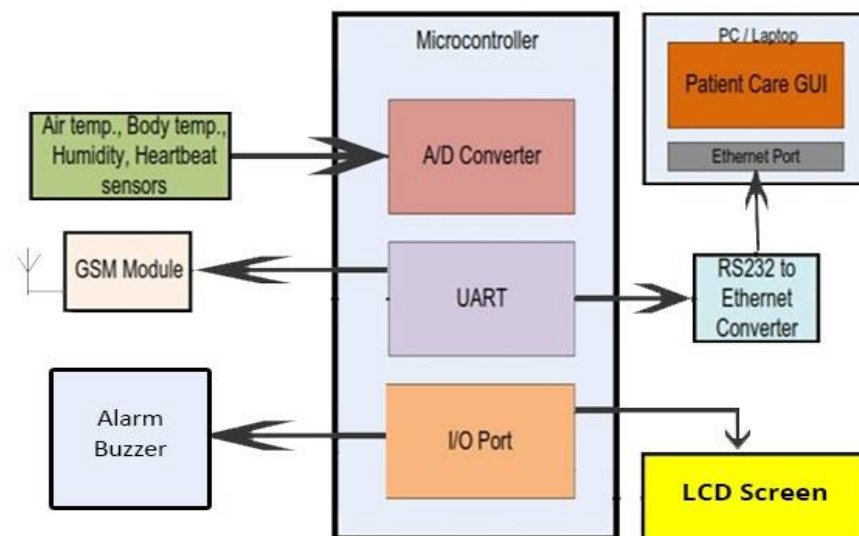


Fig.1 Block Diagram

The functionality of each blocks of the control system is explain as below:

A. SENSORS

This designed system mainly consists of three kind of sensors; 1) Air temperature sensor 2) Body temperature sensor and 3) Heart beat sensor

1) Air Temperature Sensor

For present work LM35 is selected as an air temperature sensor as it much accurate and low cost.

2) Body Temperature Sensor

For present work special type of baby incubator body temperature sensor LM35 is selected on a basis of its characteristics of linearity, accuracy, and low self-heating capability.

3) Heart beat sensor

The heartbeat sensor is basically Infra-red based sensor. Which computes heartbeat using pulse.

B. MICROCONTROLLER UNIT

For present system PIC16F887A microcontroller is used for couple of reasons that, it has inbuilt analog to digital converter and EEPROM. Also, its cost is less compare to other DSP controller.

C. ALARM SYSTEM

As an alarm system buzzer is used. An alarm raise if the any measured parameter goes beyond the set point value and it gives indication to the concern doctor or nurse.

D. LCD DISPLAY

The display device is 16x2 LCD displays that is capable of displaying 32 characters, 16 characters in 2 lines.

E. RS232 TO ETHERNET CONVERTER

WIZ110SR is a gateway module that converts RS232 protocol into TCP/IP protocol. Current values and set point values of the temperatures and humidity are converting in to the serial form using UART & RS232 by the control system and give this converted data to the WIZ 110SR module. [9]

This converter is needed because we want to transmit data over LAN as well as over internet network, so first of all it is required to convert RS232 protocol into the TCP/IP protocol for long distance transmission. WIZ110SR module is shown in Fig. 2.

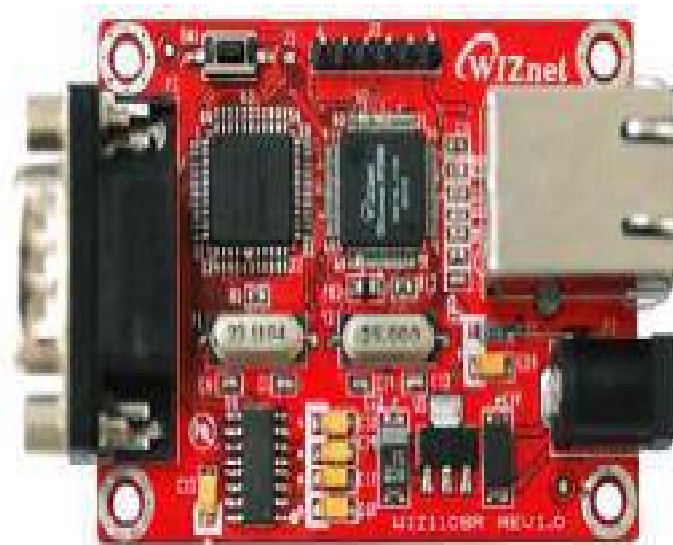


Fig. 2 WIZ110SR modul

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F. GSM MODULE

A GSM modem (SIM800A) is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone.

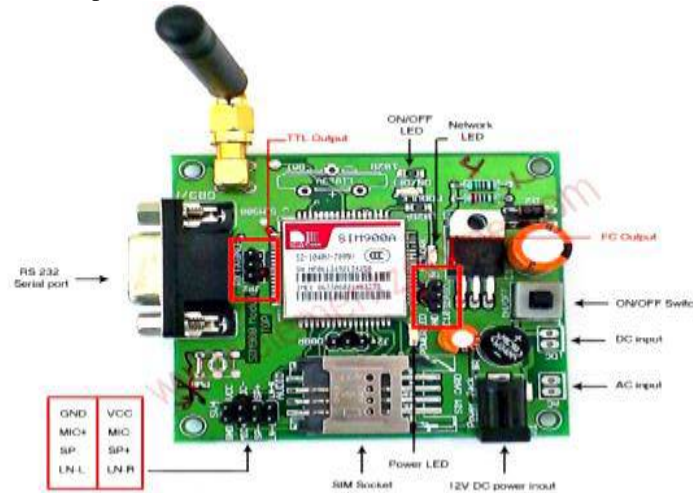


Fig. 3 SIM800A GSM module

When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

V. SYSTEM SOFTWARE DESIGN

Two kind of software are used, one is MP lab IDE (Fig 3) which is used to do programming for control system of Incubator & warmer and second one is Lab-View is used to do programming of GUI (Graphical User Interface) for monitoring various parameters from the remote place.

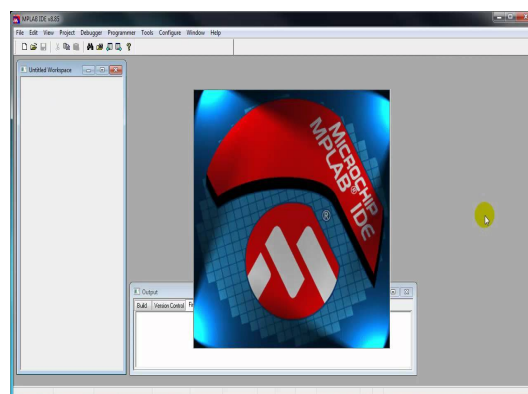


Fig.4 MPLAB IDE

VI. SOFTWARE DESIGN FOR GUI

The complete GUI is to be develop using Lab View, which is show in figure 4. Lab View is a specialized software for designing graphical user interface as per requirement. The proposed GUI will be able to create database of the previous sensed. and set point values of temperatures, humidity and Heartbeat.

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Proposed GUI is to be access to monitor real time data over LAN on to the PC or laptop. The GUI can be created so that it is possible to access real time data from the remote place at any time.

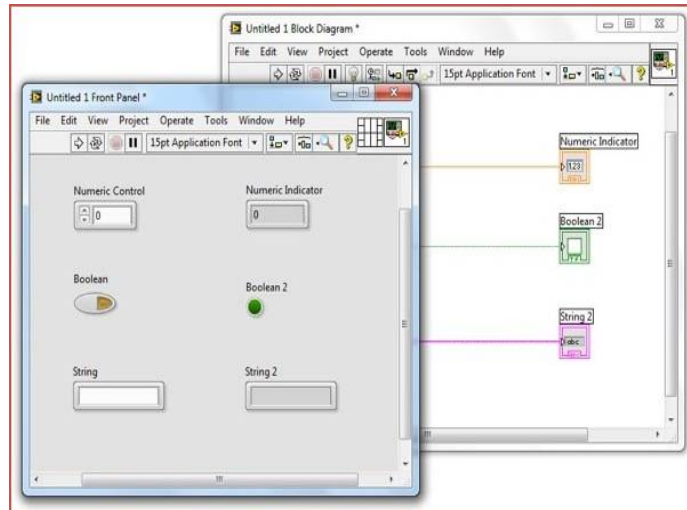


Fig.5 LabView IDE

VII. SYSTEM IMPLEMENTATION & RESULTS

A) GSM OUTPUT TO PHONE

The output from the system is through GSM module and output to mobile device is as shown below.

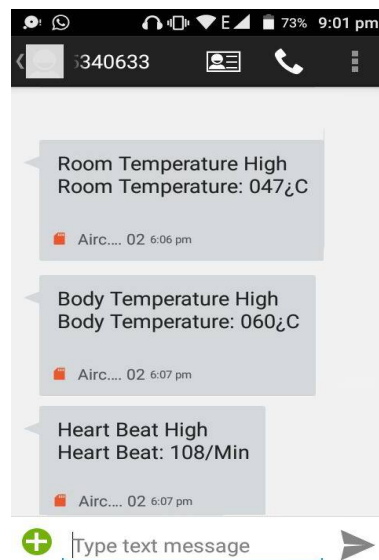


Fig.6 Doctor's Phone

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B) GUI OUTPUT

The output from the system to the personal computer or laptop is as shown below in the Figure 6.

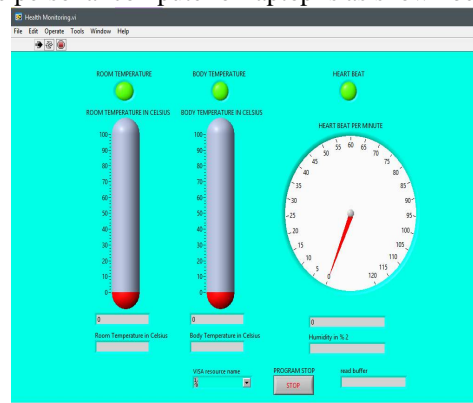


Fig. 6 GUI Output

VIII.CONCLUSION

In this work design and implementation of electronics system for incubator and warmer for an infant has been discussed also different hardware and software unit of the system is described. The main purpose of the whole development is to reduce the cost of control unit for incubator and warmer to provide remote monitoring and controlling facility to the doctors and nurses using LAN as well as internet network. The result is presented which are quite satisfactory. Moreover, in this LCD is used which makes system more interactive and attractive for the user. In presented system GSM module and Alarm system are used to send message to the doctor when any parameters go beyond its set point value so that doctor can take immediate action. The designed electronics system can able to transmit real time and set point values of vital parameters over USB through serial to Ethernet converter for remote monitoring and controlling purpose. Advantage of the remote monitoring system is to increase access to care and doctor can monitor patient from the remote place at any time.

The main advantage of the remote monitoring system is, it can run any PC or Laptop and also it provides all the required information on the screen in any PC to which the device has been connected

REFERENCES

- [1] R. Cichocki, R. O'Laughlin, A. Midouin, B. F. BuSha, "Transportable Infant Incubator for Developing Countries", IEEE 978-1-4673-1142, Dec 2012.
- [2] Mohamed Zahran, Mahmoud Salem, YousryAttia and ArefEliwa, "Design and Implementation of a Digital Control Unit for an Oxygenaire Servo Baby Incubator", Journal of Power Electronics, Vol. 8, No. 2-2, April 2008.
- [3] Zinat Ara Nisha, AHM Fazle Elahi. "Low Cost Neonatal Incubator with Smart Control System".
- [4] N.A.A Hadi, M.H.C. Hasan, N.M.Z. Hashim, N.R. Mohamad, A.S. Rahimi, K.A.M. Anuar. "Temperature Monitoring System for Infant Incubator Using Arduino" International Journal for Advance Research in Engineering and Technology, Volume 3, Issue VI, June 2015
- [5] Ruilan Wang, "The design of temperature and humidity control system in multi incubators based on single-chip microcomputer", School of information and control engineering, Weifang university, Shandong Weifang, China, IEEE 978-1-4577- 05366/11/2011.
- [6] Balraj A, Renuka Devi V, Prof. Amit Patvardhan, Aiswarya R, Prasen V, "Embedded Temperature Monitoring and Control Unit", IEEE International Conference on Recent Trends in Information, Telecommunication and Computing, 2010.
- [7] "Phoenix Medical Systems (P) Ltd." <http://www.phoenixmedicalsystems.com>
- [8] "Perlong Medical Equipment Co., Ltd." <http://perlong.en.madeinchina.com>
- [9] "WIZ110SR User's Manual (Version 2.1.0)" www.rhydolabz.com