INTELLIGENT BABY INCUBATOR USING LABVIEW

VIDYA DHATRAK, REVATI GHOLAP ,SUPRIYA PATIL, NAGAMA BHALDAR, PROF. MANISHA MHETRE

Vishwakarna Institute of Technology, Pune

Abstract: - In developing countries neonatal death rate is more. One of the leading causes is failure to keep babies warm. Incubators provide warmth and prevent heat loss to significantly improve survival rates. The use of air-heated incubators has been the standard method of providing a stable, individualized thermal environment for the newborn infant at risk.

A Lab view based intelligent baby incubator is designed to give efficient heating control. Many parameters need to be considered for the proper working of the Incubator. Two important parameter interfacing is discussed in this paper. Humidity and Temperature control is considered as a basic.

INTRODUCTION

Proposed system:

This paper presents a system which includes system structure, hardware circuits, control algorithms, and software program of the incubator for premature infant using LabVIEW. The main advantage of this device are that preheating is in less time than others, the capability of meeting of emergency is provided, control track of temperature and humidity are visible, operation is easy to clinical practice, and maintainability is possessed. In this project we have interfaced sensors i.e. LM35, Thermistor for temperature and HIH4000-001 for humidity sensing. Their outputs are signal conditioned using LABVIEW tools and these signals are used for analysis and comparison with the help of which the fan and heater at the output are controlled.

NEED: 98% of reported neonatal deaths occur in the developing world. One of the leading causes is failure to keep babies warm, which leads to increased hypothermia, decreased metabolism and infection.

Temperature regulation is one of the most important factors affecting survival in newborn infants. Infants typically lose heat to their environment in four different ways: through conduction, convection, radiation, and evaporation. Premature infants, as compared to term infants, are at an even greater disadvantage in temperature maintenance, because of the larger skin surface area to body mass ratio, decreased subcutaneous fat, and low supplies of brown fat. Furthermore, the normal surge in metabolic rate that occurs after birth is reduced in preterm infants, resulting in limited heat production. Preterm infants' birth rates are especially high in developing countries. A combination of poor facilities, poor after-birth care, and a lack of knowledge has propelled preterm birth to be one of the leading causes of infant mortality in developing countries. Incubators provide warmth and prevent heat loss to significantly improve survival rates.

Literature survey:

Development of Wireless Monitoring System for Neonatal Intensive Care Unit.[1], N.S. Joshi ,R.K. Kamet , P.K. Gaikwad: The research paper depicts a Development of a Wireless Monitoring System for Neonatal Intensive Care Unit (NICU); which is an isolated room for a premature/weak new-born baby. It provides the environmental condition as its mother's belly. Lack of attention to thermoregulation continues to be a cause of unnecessary deaths in the neonatal population.

Technique: Maintaining a stable body temperature is essential to ensure optimal growth of premature and weak infants. As the temperature and humidity parameters play a vital role during the development of premature weak infants, this research work develops a wireless system which continuously monitors these parameters inside the

NICU. The system deploys a set of suitable sensors for the system development. The analogue signals from sensors are processed using a Peripheral Interface Controller (PIC) microcontroller and further transmitted towards the receiving end with the help of Global System for Mobile Communications (GSM) modem using Application Terminal (AT) commands.

Design and Implementation of a Digital Control Unit for a Oxygenaire Servo Baby Incubator[2] Mahmoud Salim, Mohamed Zahran
A fully digital and programmable temperature system is designed and implemented for the Oxygenaire Servo Baby Incubator. The transmitter circuits is also designed and implemented for all the variables of the incubator that are used as control signals like the air temperature sensor (thermistor), baby skin temperature sensor (probe), humidity sensor and air flow sensor. Two modes of operation are implemented in the control algorithm: air or skin mode.The AVR microcontroller is used as a control device and the control program is developed using ATMEL assembly language programming. The control unit is sensitive to change of $0.1^{o}C$. At startup, based on a unique control strategy, the incubator reaches its steady state in about 14 minutes.

Novel Tehnique To Control The Premature INFANT INCUBATOR System Using ANN [3] Dr. Ghada M. Amer Dr. Kasim M. Al-In this paper novel technique by using Artificial Neural Network ANN is used in order to simulate the premature infant incubator control system by implementing the back propagation method. Sensors are used to indicate temperature, humidity, and oxygen concentration of the incubator internal environment. Sensors output are entering to the ANN, which identify the corresponding case and decide the suitable reaction upon previous training. The proposed ANN premature incubator control system in all conditions that can occur in the premature infant incubator environment proved right decisionTechnique.The proposed Artificial Neural Network (ANN) based to control the premature infant incubator system is tested with a set of different cases including very extreme cases. The % errors of this system are ranged between 1.6e-2 to 4.6e-2 in controlling the temperature, between 0.1 to 0.12 in controlling the humidity and are between 0.12 to 1.3 in controlling the oxygen concentration.

Smart Jacket Design for Neonatal Monitoring with Wearable Sensors[4] by Sibrecht Bouwstra, Wei Chen, Loe Feijs Sidarto Bambang Oetomo: The smart Jacket aims for providing reliable health monitoring as well as a comfortable clinical environment for neonatal care and parent-child interaction. In this paper explore a new solution for skin-contact challenges that textile electrodes pose. The jacket is expandable with new wearable technologies and has aesthetics that appeal to parents and medical staff.

Technique: 6 different sensors mounted on the baby's body to collect bio signals. These sensors stitched in patches .this patches are mounted on jacket. Whenever smart jacket ware by baby body signal collected and makes signal conditioning.

Design of an Infant Incubator for Cost Reduction and Improved Usability for Indian Health Care Centers[5] By-Sreenath S. N.1, Sudhindra Kumar2, Lohit .

The purpose of this study was to design an infant incubator for improved usability. This study helped to arrive at customer needs which were later converted into technical voice for the development of quality functional deployment (QFD), based on which final design specification (PDS) was listed. Five different concepts were generated. Final concept is selected based on Pugh's method of concept selection. From the study the finalized concept has superior usability features compared to that in the present market.
Reference 6: Neonatal phototherapy today's lights, lamps and devices. By-Stephani D.P.: Neonatal phototherapy is a widely used and accepted form of treatment for neonatal Hyperbilirubin anemia. Effective phototherapy needs to satisfy three important criteria identified in the literature: effective spectrum, sufficiently high irradiance and large effective treatment
area. This article looks at how technology for delivering light therapy varies, considers the Safety aspects and compares the devices available and in use in the NHS today, against the Identified effective criteria

Drawback in the Incubator uptill now:

1) In smart jacket incubator different sensor are mounted on jacket for that jacket babies body must be in contact with this jacket.
2) Some incubators are made from wood during the high humidity it become a spunge & its harmful for babies.

INTELLIGENT BABY INCUBATOR USING LABVIEW:

Proposed System

BLOCK DIAGRAM.

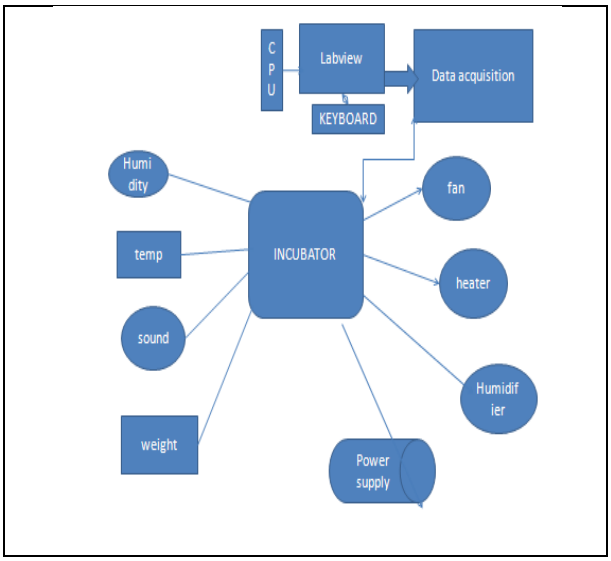

Figure 1: Block diagram of the system

Description: Fig 1 shows propsed system of our .In this different parameters like weigth, Temperature, Humidity,air force sound,CO2 is measured and monitored. In that all parameters are interfaced to Labview using relative sensors & o/p of these sensors is giving (analog i/p) to DAQ(Data acquisition card) & o/p of particular sensor is see on Labview front panel with program control. Base on the signal received by the Lab view, programming control gives out digital output for controlling the output devices like Fan, Motor, Heater using another DAQ card which convert digital signal into analog output. This paper presents measure & control the following parameters:

Humidity: Humidity is a measure of the moisture content of the Air and can be measured as absolute humidity or relative humidity. Relative humidity is Highly dependent upon air temperature as the higher the temperature the greater the Capacity of the air to hold water vapor. It is this value which is of most clinical significance to the preterm infant.

Temperature: Control of environmental temperature is important for the survival of very low birth weight infants. The preterm infant has difficulty maintaining temperature due to a combination of large surface area and very thin epidermal barrier. Heat is lost by evaporation, radiation, convection, and conduction.

Sensor Used for above parameter.

HUMIDITY SENSOR (HIH-4000 SERIES).The HIH-4000 series delivers instrumentation-quality RH (Relative humidity).The RH sensor is a laser trimmed, thermoset polymer capacitive sensing element with on chip integrated signal conditioning. Direct input to a controller or other device is made possible by this sensor‘s near linear voltage output With typical current draw of only 200UA, settling time 70 ms & operating humidity 0 to 100% at -40 to 80 degree celcius operating temperature.Humidity sensor is used for controlling internal humidity of Incubator

TEMPERATURE SENSOR (LM 35 and Thermistor) :

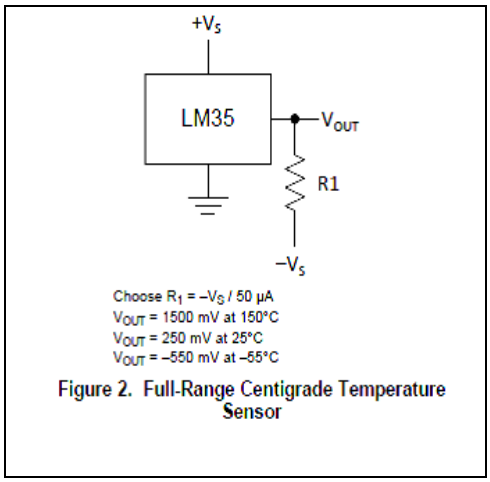

Figure 2. Full-Range Centigrade Temperature Sensor

Figure:2 Temperature sensor interfacing

The LM35(Fig 2) series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature Sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. TheLM35 does not require any external calibration or Trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to +150°C temperature range.

LM 35 is used for measuring Incubators internal Temperature.

Thermistor is used for measuring Baby’s Body temperature.

Hardware of incubator: Construction: The chamber of the infant incubator is transparent. The chamber has two compartments a larger and smaller compartment. The smaller compartment (compartment A) consist of the temperature controlling unit and the larger compartment (compartment B) consist of the mattress where the infant is kept. The chamber is constructed in such a way that the baby is kept away from the temperature controlling part so the baby is assured to be safe. The entire chamber is

constructed using Acrylic sheets. Acrylic is chosen because it is more advantageous over Glass and Plastic.

Figure:3 Construction of Baby Incubator

Aacrylic sheet:

Cast acrylic sheet is a material with unique physical properties and performance
characteristics. It weighs half as much as the finest optical glass yet is equal to it in clarity and is up to 17 times m25 colocolors, in thicknesses from .030" to 4.25". Cast acrylic sheet is made in over 25colocolors, in thicknesses from .030" to 4.25" violet light or filter it out.

Within this construction, two variables are the most important ones: temperature and humidity.Temperature and humidity are measured by sensors positioned on the dome. Figure 2 shows a schematic diagram of the overall operation of a neonatal incubator.

LM 35 ,Thermistor sensors are interfaced to the Labview using NI 9201 card which is 8 channel Analog input DAQ card. Labview programs and result are shown in the following figure.

RESULT

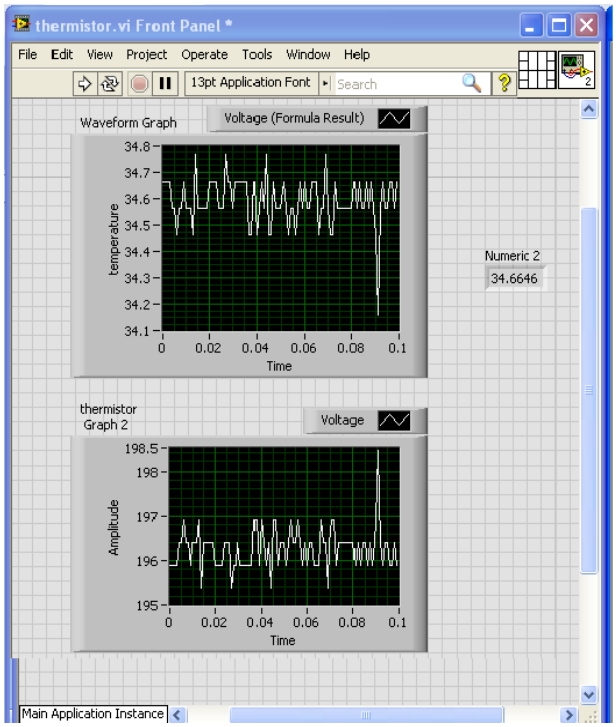

Figure 6. Thermistor Graph interfaced with Labview

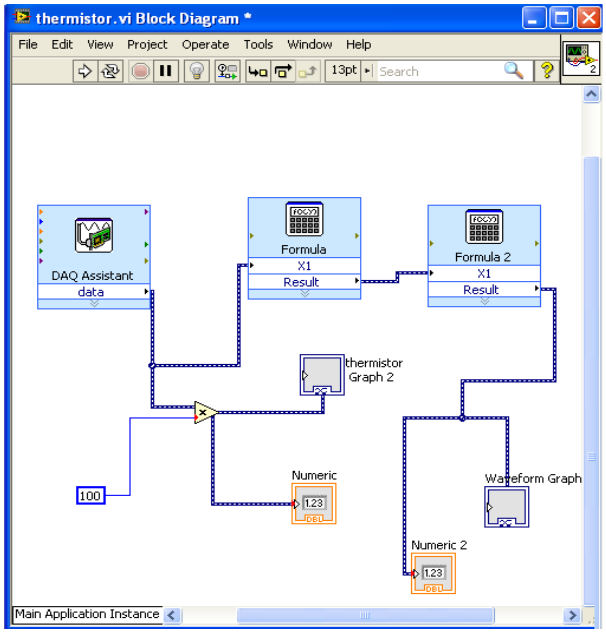

Fig 7.Labview program for Thermistor Interfacing

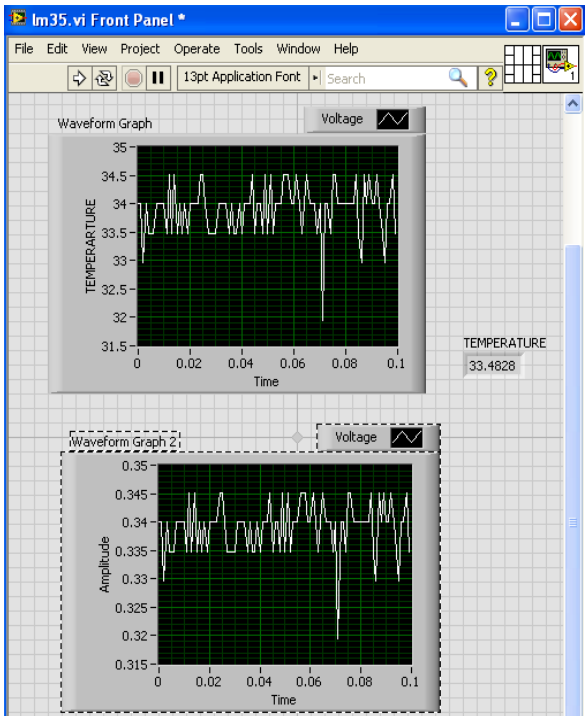

Fig 8: Graph showing Temperature variations using LM 35

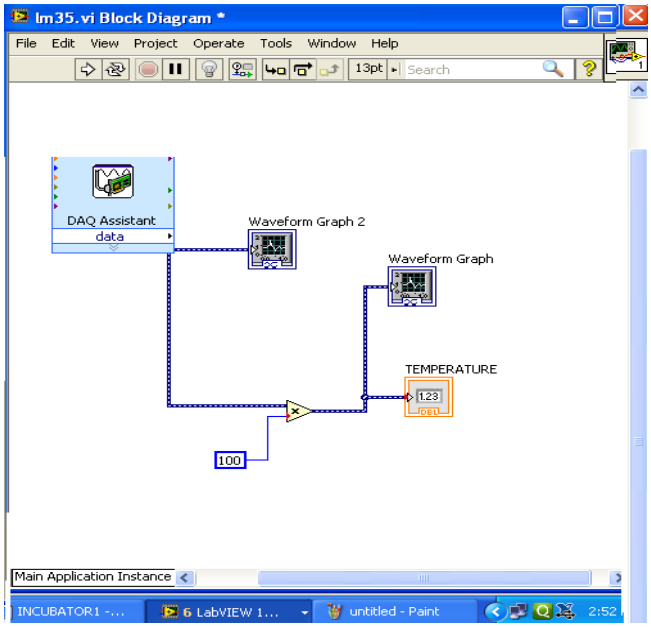

Figure 7. Labview Program of LM35 interfacing.

Proper calibration is carried out for the LM 35,Thermistor and Humidity sensor.

CONCLUSION:

The project is designed keeping in mind the medical conditions available in rural areas. This Equipment can be effectively used by technicians in a small health care centre. It can be a life saving machine for low birth weight infants. The components can be easily fixed. The chamber is sufficient enough to accommodate the baby comfortably. As the electronic part is separated from the Baby's compartment baby can be assured safe. The lab view used here is efficient in controlling the temperature of the system. The temperature of the system can be understood from readings in the lab view. This project is simple and efficient in maintaining the temperature of the chamber irrespective of the outside temperature and is designed at a low cost.

AKNOWLEDGMENT:

This work is carried out in the Instrumentation Lab of VIT, Pune

REFRACES:

1) "Development of Wireless Monitoring System for Neonatal Intensive Care Unit", N.S. Joshi ,R.K. Kamet , P.K. Gaikwad. nternational Journal of Advanced Computer Research (ISSN (print): 2249-7277,ISSN (online): 2277-7970) Volume-3 Number-3 Issue-11 September-2013

2) Design and Implementation of a Digital Control Unit for a Oxygenaire Servo Baby Incubator. By, Mahmoud Salim , JPE, Vol. 8, No. 2, April 2008

3)"Novel Technique To Control The Premature infant incubator System Using ANN", Dr. Ghada M.Amer, Kasid Aubidy, Third International Conference on Systems, Signals & Devices, March 21-24, 2005 – Sousse, Tunisia, Systems Analysis & Automatic Control, Volume I.

4)"Smart Jacket Design for Neonatal Monitoring with Wearable Sensors"
Sibrecht Bouwstra, Wei Chen, Loe Feijs, Proceedings of the sixth International Workshop on Wearable and Implantable Body Sensor Networks 2009, (pp. 162-167). *IEEE.*

5) "Design of an Infant Incubator for Cost Reduction and Improved Usability for Indian Health Care", Sreenath Sudhindra Kumar2, Lohit H.S, SASTECH Journal, Volume 11, Issue 2, Sep 2012