

PID Temperature Controller Infant Incubator Using RTD

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Abstract : The Birth Problems And Premature Birth Can Be Caused By Birth In Early Pregnancy And The Lack Of Pregnancy Nutrition So That The Baby Easily Induces Hypothermia. Therefore, Incubator Is Required For The Babies To Adapt The Outside Temperature And To Help Them Survive. Proposed System Design Considers The Precision Control For Sensitive Application Which Is Achieved Using PWM Calculated With PID Algorithm. Fail Safe Provisions Plays An Important Role In System Design Which Monitors Sensor Probes, External Power And Heating To Be In A Defined Range. Sensors Selected Should Be Stable Over A Long Period Of Time With Precise Variations. RTD PT100 Suits Best For The Given Application Considering The Temperature Range Which Sensor Provides Accuracy And Stability.

Keywords----Incubator; Pulse Width Modulation (PWM); PID Algorithm; RTD PT100

I. INTRODUCTION

Premature Infants Are Born Before The Organs Are Mature Enough To Allow Normal Postnatal Survival. As The Premature Infants Are At Risk To Develop Hypoxia, Hypothermia And Many Other Associated Adverse Conditions, They Need Special Care And Attention. The Temperature Inside The Mother's Womb Is 38°C (100.4°F). Leaving The Warmth Of The Womb At Birth, The Wet New Born Finds Itself In A Much Colder Environment And Immediately Starts Losing Heat. In The First 10-20 Minutes, The New Born Who Is Not Thermally Protected May Lose Enough Heat For The Body Temperature To Fall By 2-4°C (3.6-7.2°F), With Even Greater Falls In The Following Hours If Proper Care Is Not Given. If Heat Loss Is Not Prevented And Is Allowed To Continue, The Baby Will Develop Hypothermia And Is At Increased Risk Of Developing Health Problems And Of Death. Therefore An Infant Incubator Is Necessary Which Attempts To Create The Necessary Environment For The Baby's Survival.

The First Incubator Was Developed In 1857 Named Warmwännaen. In 1833, Pierre-Victor-Adolph Published An Account Of Another Incubator, Developed By Etienne Stephane Tarnier For Use Of Enormous Paris Maternite Named Couveuse. Today Developments Are Still Constantly Underway To Try And Create An Ever More Womb Like Environment; Controlling Oxygen Levels And Other Vital Systems, With An Array Of Sensors, Monitors And Alarms. There Are Different Types Of Incubator Such As Open Box Type Incubator, Close Type Incubator, Manually Controlled Incubator, Servo Controlled Incubator And Transport Incubator. Temperature Regulation Is Of Primary Importance In An Incubator. For Uninterrupted Operations, A Power System Based On Battery Backup May Be Used. For Remote Areas Where Mains Electricity Is Not Available, A Solar Panel May Be Used To Provide Necessary Power. This Is An Important Criterion That Needs To Be Considered For Incubators In Developing Countries Like Ours Where Frequent Failure Of Mains Supply Is A Regular Feature. An Important Integral Part Of A Baby Incubator Is The Temperature Control System. Selection Of An Appropriate Temperature Sensor Is Important For Effective Control Of Temperature In The Incubator. Comparing The Sensitivity And Response Time Of Available Temperature Sensors Like Thermistor, Thermocouple, Rtd In The Range Of Temperature 25-40°C Along With Accuracy, Repeatability, Term Stability, Linearity, Self Heating. If The Temperature Falls Below The Set Value Appropriate Amount Of Heat Energy Needs To Be Supplied In The Incubator To Maintain The Temperature At That Level. This Can Be Done By A Simple Turn On And Off Control System Which Will Turn On The Heater When The Temperature Is Below The Set Level And Turn Off Otherwise.

This Project Is To Design A Temperature Controller To Be Used To Control Temperature Of A Small Environment Such As An Infant Incubator. Incubators Are Designed To Provide An Optimal Environment For New-Born Babies With Growth Problems (Premature Baby) Or With Illness Problems. Premature Infants Are Unable To Keep Themselves Sufficiently Warm. They Are Also Very Weak And Prone To Infections. An Incubator Is A Special Type Of A Cot Which Provides An Ideal Environment For The Infant. It Tries To Stimulate The Conditions As Inside The Mother's Womb. Current Studies Relate Infant Death In Some Cases While Being Cared In Incubator Due To Suffocation And Malfunction Of An Incubator. This Happen When The Temperature In The Incubator Increases And Causes The Level Of Co2 To Increase Too.

II. RELATED WORK

P. Jagadeesh, G. Karthick Kumar Reddy, S. Venkatramana Reddy In Developed An Inexpensive Temperature Controller For An Infant Incubator In Which ADT7410 Is Configured With One Shot Mode Temperature Conversion, So It Converts At 240 Ms Every Sample. The Sensor Present Conversion Temperature Values Are Compared With The High And Low Temperature Limits, If Found Greater Than The T High & T Cric Limit Then INT, CT Pins In ADT7410 Goes To High State And Relay Position Is Switched To OFF The Radiant Warmer, And Buzzer Beeps Indicate Warning Until It Reach To Low Temperature Limit. If The Present Temperature Is Lesser Than The T Low Limit Then Only INT Pin Go To High State And Relay Position Is Switched To ON The Radiant Warmer And Buzzer Beeps Indicate Warning Until It Reach To High Temperature Limit. Figure 6 Shows The ON-OFF Operation Of Radiant Warmer With ADT7410 Sensor When The Over/Under Temperature Limits Are Reached. The Process Is Continued To Monitor The Infants In Good Environment For Health Recovery [1].

M. Suruthi, S. Suma In Had Designed The Microcontroller Based Baby Incubator Using Sensors 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 Lifesaving 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 Temperature Of The System Can Be Understood. 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 [2].

Dhaval Kothiya, Arjun Chauhan, Twinkle Patel, Khushbu Shah, Shweta Patel, Supriya Singamsetty In Designed The Temperature Controlled In Infant Incubator Which Uses Microprocessor As Main Controller In Digital Signal Processing Combined With Complex Combinational Logic Circuit Are Redundant And Needs To Be Improved In The Sense Of Functionality. Replacement Of Microcontroller With A PIC Controller Is Prudent Action Due To Its Efficiency And Reliability Especially In An Incubator Where The Life Of An Infant Relies On. A PIC Controller Has Least Complex Circuitry Has To Be Designed So That It Saves Space And Be More Reliable For An Incubator. Therefore, It Is Highly Recommended That The PIC Controller Has Reduced Circuit Complexity And Increase The Control System Action Time Response. PIC Controller Is The Solution To All The Problems Since PIC Controller Offers More Efficient, Reliable And Accurate Control [3].

Zain-Aldeen S. A.Rahman, Farahan S. A. Hussain In Developed A Smart Incubator Based On PID Controller Which Was Implemented And Applied To Achieve Smart Incubator. Its Need Low Cost And Power When Compared With Classical Systems. Also The Controller Economical In Power Consumption. This Controller Has This Advantage, The System Motes Need Low Power. Finally, The System Has The Simplicity Using By The Customer [4].

Olson K.R., And Caldwell A.C. In Created The Designing Of An Early Stage Prototype Using Readily Available Material For A Neonatal Incubator For Poor Settings Which Protects And Incubates An Infant While Being Transported To A Hospital. The Device Needs To Be Economical, Robust, And Use Easily Replaceable Parts. The Heating Mechanism Will Use Computer Fans, A Humidifier, And Car Headlights To Provide Heat [5].

III. SYSTEM OVERVIEW

System Overview Contains Block Diagram, Flowchart And Working Of The System.

A .Block Diagram

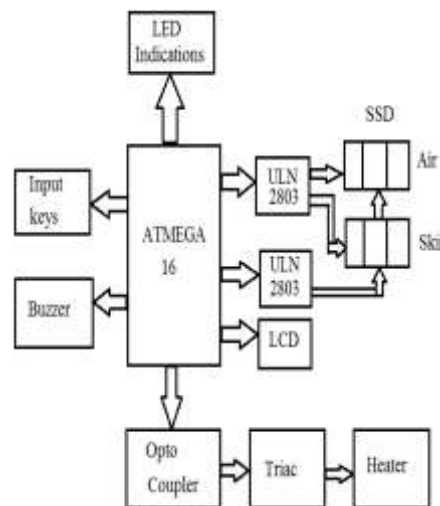


Fig 1. Block Diagram Of System

This System Is Designed Using Atmega 16 Microprocessor. Optocoupler Will Convert Voltage From Microprocessor Into Current For Heater. Triac Is A 3 Terminal Semiconductor Device Used For Controlling Currents. SSD Amplifier ULN2803 Is A Darlington Transition Array Used To Draw High Power Loads.

B. Working

Infants Have Very Low Thermal Regulation, Hence Not Possible For Body To Cope With Thermal Loss. Hence, The Body To Be Kept In Moist Condition. Therefore Temperature Is Maintained With Minimum Variations. Air Or Skin Temperature Will Be Taken As Reference. The Threshold Temperature Is Between 35°C To 37°C. Heat Increases Due To Manual Set Temperature After Turned Off. Here, It Is Controlled By Temperature Sensors And Adjusted According To Threshold. Air Temperature Is Monitored By Temperature Sensors And Is Adjusted By Controlling The Current To Heater. If Temperature Increases Above Threshold, Alarm Beeps To Maintain Temperature. Seven Segment Display Is Used For Skin And Air Temperature. LCD Is Used For Setting Parameters. If The Probe Fails, Alarm Will Beep And Is Called Fail Safe Alert.

C. Flowchart

Flow Chart Of The System Is As Given In Fig 2.

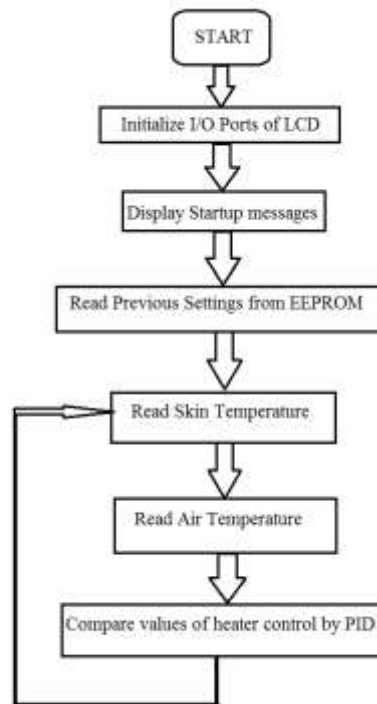


Fig 2.Flow Chart

IV. EXPECTED RESULT

Parameters	Results
Temperature Rise Time 30°C To 37°C	60 Secs
Temperature Reading Accuracy	± 0.1°C
Temperature Overshooting & Undershooting	± 1°C
PID Control	Yes
Fail Safe Alert	Temperature Probe Disconnect Alert & Auto Off Heater
Power Fail	Power Fail Indication & Alert

V. FUTURE ENHANCEMENT

Testing And Verification Of The Design Of An Incubator System Is To Simulate Its Function And Provide Data To For Comparing Measured Values. The Average Power Consumption Of The Device Will Be Measured During Testing And Will Provide Better Information For Battery Selection. This Will Be Important When Selecting The Battery, Which Will Be One Of The Most Costly And Heavy Components In The Device. A Thermal Verification Device That Models The Volume, Surface Area, And Approximate Shape Of An Infant Will Be Utilized To Predict The Degree Of Heat Conduction Within The Incubator. The Device Must First Be Evaluated For Accuracy As A Model Infant. Following The Testing Protocol, The Verification Device Will Determine The Need For Any Changes To The Heating Mechanism.

VI. CONCLUSION

This Hardware Along With The Software Can Prove To Be An Effective System To Make The Life Of An Infant. The Project Is Designed Keeping In Mind The Medical Conditions. It Is Efficient In Maintaining The Temperature Of An Infant. The Aim Of This System Is To Contribute To The Society In A Small Way By Setting Out An Idea For A System Which Could Actually Better The Lives Of Millions Of Infants Across The Globe.

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