

EEE 304 (July 2022) C2
Digital Electronics Laboratory

Final Project Report

Health Monitoring System for Infants

Ethics Statement:

IMPORTANT! Please carefully read and sign the Ethics Statement, below. Type the student ID and Write your name in your own handwriting. You will not receive credit for this project unless this statement is signed in the presence of your lab instructor.

<i>"In signing this statement, We hereby certify that the work on this project is our own and that we have not copied the work of any other students (past or present), or copied from internet. We have cited all relevant sources while completing this project. We understand that if we fail to honor this agreement, We will each receive a score of ZERO for this project and be subject to failure of this course."</i>	
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Evaluation Form:

STEP	Assessment Tool	Criteria	CO	PO	MAX	SCORE
1	Peer Assessment	Individual Contribution	CO5	PO9	10	
2		Teamwork	CO5	PO9	10	
3		Ethics	CO4	PO8	10	
4	Viva	Ethics	CO4	PO8	10	
5		Tool Usage	CO2	PO5	10	
6	Report	Technological Limit Evaluation	CO2	PO5	10	
7		Technical Details	CO6	PO10	10	
8		Design Considerations	CO3	PO3	10	
9	Project Demonstration		CO3	PO3	10	
10	Recorded Video Presentation		CO6	PO10	10	
	TOTAL				100	

Course Instructor:

1. Dr. Sajid Muhaimin Choudhury
2. Barproda Halder (PT)

Signature of Evaluator: _____

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1 Abstract

Heart rate (HR) is a vital physiological parameter used to diagnose patients' illnesses and determine the best course of treatment. The goal of this study was to create a model to assess infants' heart rates and compare them to published references. The study also looked at the connection between temperature and heart rate and offered alerts for abnormal temperature readings. The results of the study may have important clinical ramifications for patient care, patient outcomes, and hospital incubated infant care. Clinicians may choose more effective treatments if alerts are given for abnormal temperature values.

2 Introduction

A critical component of neonatal care in the hospital is keeping track of the infants' vital signs while they are in incubators. Clinicians frequently use the heart rate (HR) and temperature of these infants to determine the severity of their illnesses and to guide their treatment plans. Traditional approaches to monitoring these variables, however, can be intrusive, time-consuming, and even dangerous to the baby's health. Our project aims to create a non-invasive method for tracking HR and temperature in incubated infants to address these problems.

We have used digital electronic components in this project to count and gauge the temperature and pulse of incubated infants. Then, in order to determine whether these values are within normal bounds, we have compared them to the thresholds that we have established based on medical literature. By doing this, we hope to give clinicians access to real-time data about the infant's health status, allowing them to make better treatment choices.

The use of digital electronic components and the emphasis on non-invasive monitoring techniques in our project can facilitate quick and precise measurements while lowering the risk of infection and injury to the infant. These elements working together can raise the standard of care provided to hospitalized infants in incubators, ultimately resulting in better health outcomes for these incredibly weak patients.

2.1 Complexity Analysis

For several reasons, it is challenging to create a device that can process temperature and heartbeat simultaneously and provide real-time monitoring of these parameters. To ensure dependable and accurate performance, careful design, testing, and implementation are necessary when integrating multiple sensors and components into a single device. Numerous aspects of the design, including power usage, sensor accuracy, signal conditioning, and data processing algorithms, must be taken into consideration.

To meet clinical needs, it may be necessary to carefully balance competing demands for the device's performance, such as accuracy, reliability, size, and cost. A further layer of complexity is added by the potential need for regulatory compliance before the device can be used in clinical settings.

There might also be several competing solutions to the issue, each with their own benefits and drawbacks. For instance, there might be various sensors and components with varying degrees of accuracy, size, and cost that could be used to monitor temperature and heartbeat. Additionally, various signal processing algorithms, each with their own trade-offs, could be used to extract information from the sensor readings.

Creating a device that processes temperature and heartbeat simultaneously for real-time monitoring is a challenging engineering challenge that necessitates careful consideration of a variety of variables, competing requirements, and potential solutions. It takes a lot of knowledge and experience to create a successful device because the issue is not obvious or easily solved.

3 Technical Details of the Design

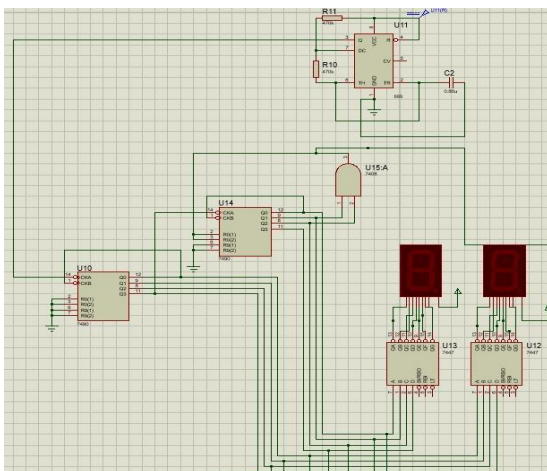
3.1 Design Method

The model is developed using the 74 series IC and relevant sensors. For observing the temperature, thermistor is used. On the other hand, pulse sensor is used for evaluating the heart rate.

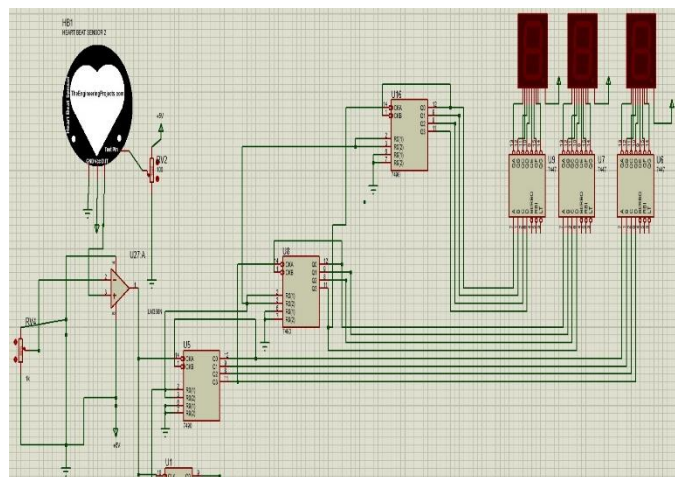
3.2 Novelty Statement

Monitoring device for health care is generally being developed with microcontroller and FPGA. Here our model is designed from the core using the basic IC's. Comparing the efficiency, microcontroller based designs are more acceptable though our model is much cheaper. Again in case of size or space also, our model is inefficient compared to them.

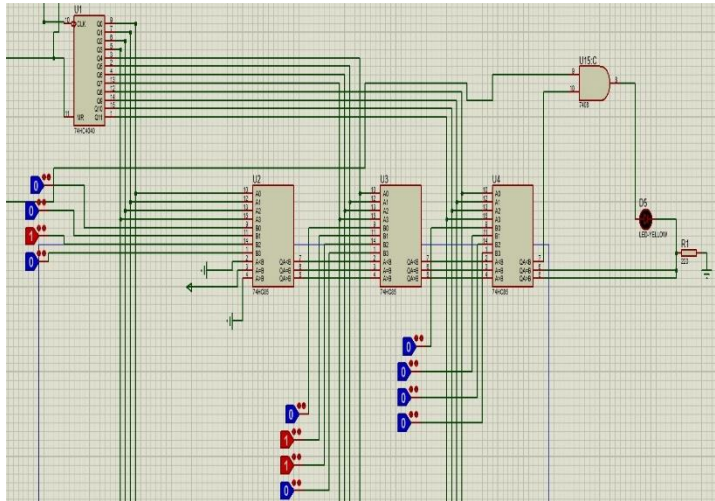
3.3 Circuit Diagram



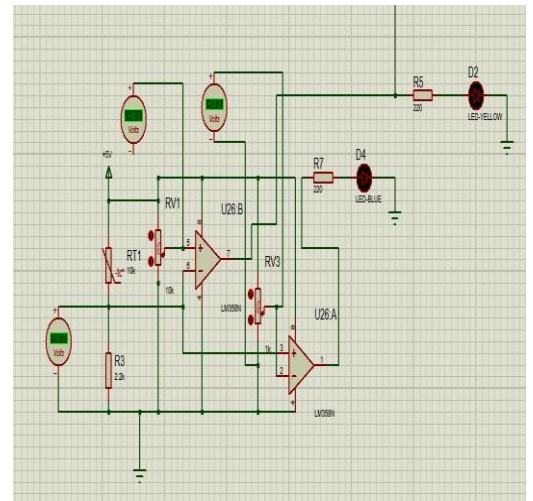
Timer Circuit



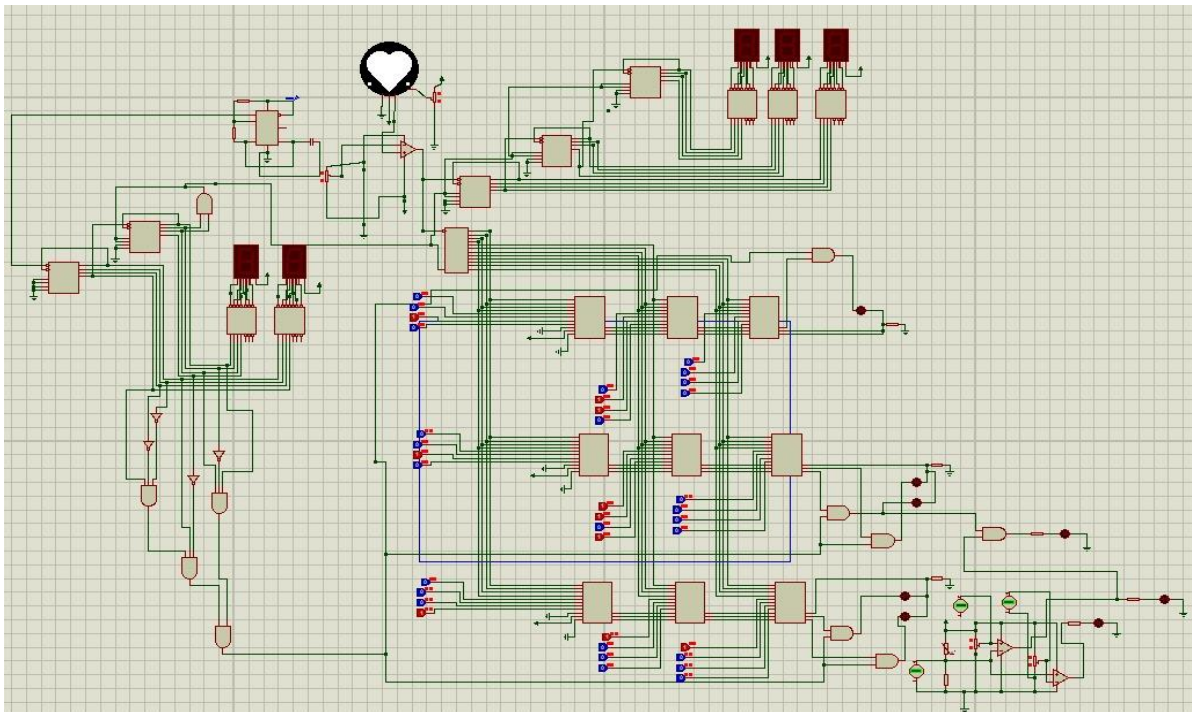
Pulse Sensor Circuit



Comparator Circuit

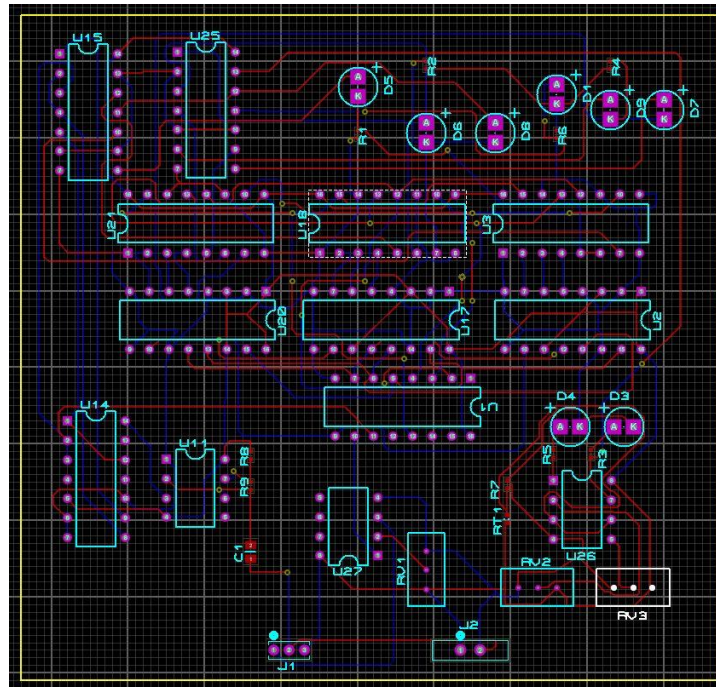


Temperature Sensor



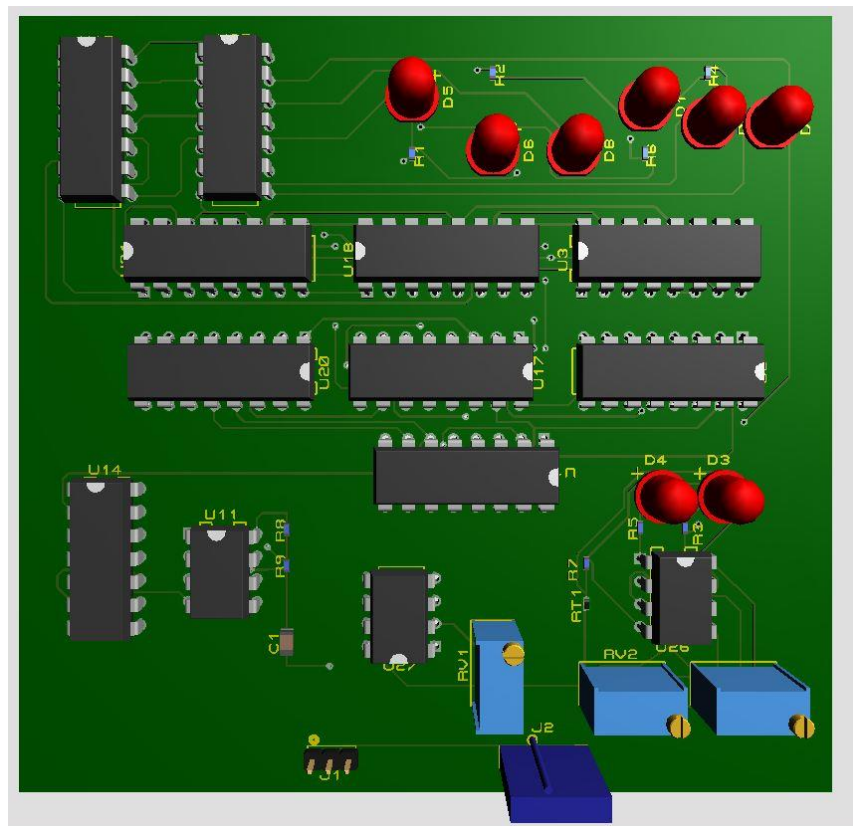
Total Circuit

3.4 Printed Circuit Board Mask Layout



Printed Circuit Board Design

3.5 Pictures of Final Implementation



Implementation of Design(3D rendering)

3.6 YouTube Link

YouTube link for the demonstration video: <https://youtu.be/AKDAN-S1Rdo>

4 Practical Design Considerations

4.1 Considerations to Public Health and Safety

The reason to focus on infant healthcare is to ensure infants' survival and to grow up into healthy adults. Health promotion, disease prevention, and treatment of common childhood illnesses are essential if children are to thrive as well as survive.

- In children with a lung, heart, or brain disorder, fever may cause problems because it increases demands on the body (for example, by increasing the heart rate). So lowering the temperature in such children is important. Moreover, preterm infants frequently have hypothermia when they are admitted to the NICU.

Our project focuses on the detection of health complications fatal to newborn children. Thus it accelerates the treatment process and increases the chances of infants' survival.

- The monitoring removes any human error from the measurement process. Thus it increases the accuracy of diagnosis.

The monitoring system was designed to be nonintrusive so as not to harm the newborn child.

4.2 Considerations to Environment

Digital electronics have some adverse side effects on the environment.

- As we have used ICs and sensors to build the monitoring system, it contributes to the preexisting cycle of environmental threats. But does not pose any new significant negative effects.
- Using the PCB design will reduce power consumption, thus slightly reducing the negative impact on the environment.

4.3 Considerations to Cultural, and Societal Needs

In the Bangladeshi community, infant mortality still poses a threat to public health.

- The monitoring device that we have designed, if made accessible, can help decrease the mortality rate significantly in the rural parts of Bangladesh.
- The PCB design is such that, combined with the right sensors, it can even be installed at homes for patients outside the predetermined age group. Some further improvements to the design need to be made before releasing it to the public to make it user-friendly.

5 Reflection on Individual and Team work

5.1 Individual Contribution of Each Member

1806188 (Md Fadel Faruk) - Sourcing the parts for the design, Hardware implementation (soldering, assist. in connections), Presentation, and Report Writing (main contributor)

1806189 (Himadri Panthadas) - Researching the compatibility and availability of the sensors needed for the design, Sourcing the parts for the design, Hardware implementation (power supply, assist. in connections), PCB design (main contributor)

1806191 (Sumaiya Salekin) - Simulation design in Proteus (main contributor), Hardware implementation (Datasheet and pinout diagram analysis, assist. in connections), Presentation, and Report Writing (assist.)

1806195 (Aye Thein Maung) - Simulation design in Proteus (co-contributor), Hardware Design (main contributor, monitoring and building the circuit, troubleshooting, error analysis, power solving supply problems)

5.2 Mode of TeamWork

- An offline meeting was held to select a suitable problem to solve.
- Individuals were tasked to do research on specific sides and start the basic design of the project.
- When all necessary parts were available, partners teamed up in twos to work on different parts of the system.
- After facing any errors, a meeting was scheduled before which necessary solutions were to be researched by the teammates.

5.3 Diversity Statement of Team

Team members of the group were diverse in terms of gender, religion, and most important in the ways of problem-solving and handling.

6 References and Acknowledgement

6.1 Acknowledgement

Dr.Sajid Muhaimin Choudhury

Assistant Professor

Department of EEE,BUET

6.2 References

- ✓ [How much tachycardia in infants can be attributed to fever? -PubMed \(nih.gov\)](#)
- ✓ [Heart rates in hospitalized children by age and body temperature -PubMed \(nih.gov\)](#)
- ✓ Mank, A., Meyer, M. P., Pauws, S., & Lopriore, E. (2016). Hypothermia in Preterm Infants in the First Hours after Birth: Occurrence, Course and Risk Factors. PLoS ONE, 11(11). <https://doi.org/10.1371/journal.pone.0164817>
- ✓ <https://www.hpe.com/us/en/insights/articles/top-6-environmental-threats-caused-by-digital-electronics-1901.html>