

Sensing and Monitoring Incubator for Infants using IoT

Josephine Selle J^{1*}, M. Jegatheswara^{1,2}, B. Akshy Karthick³, O.M. Gowtham⁴

^{1, 2, 3, 4}Department of Electronics and Communication Engineering,
Kalasalingam Academy of Research and Education, Anand Nagar, Krishnankoil, India.
*josephine@klu.ac.in

ABSTRACT

Infants born before 37 weeks of gestation are known to be born prematurely or prematurely. The preterm baby needs to rotate exactly to the uterus to make with the outside places. The animals that reproduce which has potential to be homoeothermic, eg with about the same body temperature, controlled without natural temperatures. Essential organs or enzymes of premature babies grow to a very low level and therefore require special care to copy the physical appearance of the body such as temperature, humidity, light, and oxygen. The baby has several problems depending on the hot rule. The baby has too much space, too little hot spray, and too little pressure to act as a heat sink. A newborn baby has little ability to retain heat with a change in mood and is unable to cope with the sudden change in situation so that it needs to be kept in a device known as an incubator. A baby incubator is a tool with a solid box-like area where the baby can be kept in a controlled medical care facility. The infant incubator provides stable temperature, humidity relative to oxygen concentration. The relative humidity should follow the set values according to the number of incubation days.

Keywords: IoT for infant monitoring, incubator, sensors, humidity, homoeothermic

Introduction

The "Sensing and Monitoring Incubator Baby using IoT" project, controls the automatic cooling system depending on room temperature. The system is built with Arduino (microcontroller) and Arduino is increasingly used to make control systems. As the system is intended to control the cooling system, it is therefore important to better understand the system controlled by Arduino. Nowadays with the advancement of technology especially in the field of micro-controllers, all activities in our daily lives have become part of information technology and we are gaining control over each application. Therefore, this practice has led to the implementation of a small project [1,2]. The sub-control consists of CPUs, clocks, circuits, ROMs, Ram and I / O circuit in a single integrated circuit package. It is thought that a digital micro-controller chip with sensible software is available for calculations and simulation so that more boring information is left to the micro-controller. The chip is of small control systems. In this project work, this program is written in Arduino IDE and facilitates the display of temperatures by degree centigrade and Fahrenheit. And according to the temperature Arduino provides input to the Relay, thus cooling the system automatically turns on / off depending on the temperature. The most important parameter in the industry is heat. It can be damaged due to temperature differences. The temperature sensor probe can be placed in a specific location where the temperature will be monitored continuously. The exact location of the hearing investigation should be determined in the context of access and the level of accuracy found in each area [3]. The steps that will be taken to ensure accuracy during and after testing are also very important.

Temperature is the most measured environmental value. This is to be expected because most physical, electronic, chemical, mechanical and mechanical systems are affected by heat. Some processes work well within a small temperature range [4]. Certain chemical reactions, biological processes, and even electrical circuits perform very well within moderate temperatures. When these processes need to be improved, control systems that keep the temperature within the set limits or continuous are often used. The process control system has grown rapidly since its

inception in 1959. It has become one of the main areas of chemical engineering. One of the most important processes to control liquid temperature in many chemical engineering plants [5-7]. In short, how to control the temperature of the bath water is one of the industrial problems. Therefore, a suitable temperature controller for temperature control of a water bath is a very common requirement for industry.

Temperature rises because of an increase in the effect of cellular activity on substances in the use of heat, which also indicates an increase in the internal energy of the object. Heat exchange, temperature measurements, safe temperature limits for various machines and the number of other heat-related problems are important for all phases of power generation and process processes. Methods of displaying, recording, and controlling temperatures are essential for the design, formation, operation, and testing of energy efficiency and the use of equipment and related equipment [8]. Proper temperature measurement is very important for the energy and process engineers and great strides have been made in this branch. The main purpose is to measure the temperature accurately and reliably, while at the same time keeping the cost of the equipment low.

Proposed Methodology

There is many Disadvantages in using the existing ATMEL 89C51 which was seen in section 13, So that we use a high-end Arduino (ATmega8) microcontroller to solve this problem. Digital convertor, analog, a 16 MHz clock, switch Registers are some of built-in components which has many features. This voltage is supplied to Arduino. Some amount of electrical energy is created, and certain temperature is used to display when the system converted into analog to digital signal [9-11]. The centigrade Degree and Fahrenheit degree units to be used in the ambient temperature of the LM35. Immediately also sends the transmission data, when the temperature becomes higher from the set point the switch works and changes to the cooling device as a fan. The monitoring and control of the temperature happens in this way. The system will be automatically controlled by sensors and microcontroller chips placed inside the spray and have a monitoring camera inside the box. For example, an incubator can be started in temperature mode to warm up to a certain point, and then automatically turn off the heater, thus it will the temperature, the controller will be opened to draw hot air into the chamber inside the sprayer to the required level. In addition, the Heart Rate and Humidity device is nearby so that we can monitor the dynamic state of Hamo. We use Wi-Fi as a wireless communication centre and as a controller we use ARDUINO.

Working Model

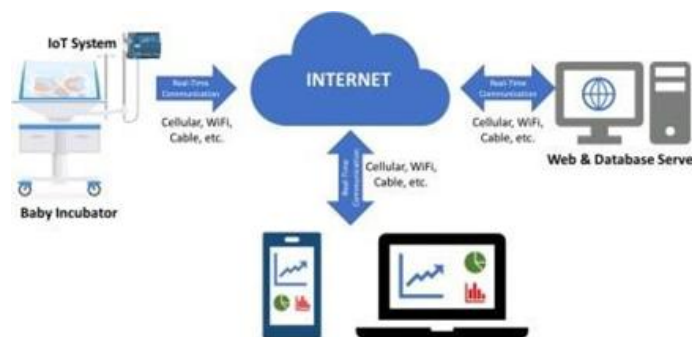


Figure 1 Workflow

In this section we plan to monitor and manage our project. We used the IC LM35 temperature sensor. Throughout the IC the temperature equals to the small amount of voltage which was produced by LM35. They will have the continuous mode in analog.

The Arduino is used as a controller and thus the voltage is supplied to the control unit. In the Arduino UNO the voltage is supplied to analog port 0 (A0). By using the A to D convertor, the analog voltage converts into digital bit this has been happened by Arduino. Between 0 to 1023 it converts the analog voltage level. By a certain value the voltage is converted by the coefficient of 0.488 which doubles the digital data, and this will be supplied by the ATmega328 microcontroller. the controller will be processed by 10 pieces. The temperature of degree centigrade value will be zero. To convert the power level of unit into Fahrenheit unit we should multiply the data by the value of 1.8 and add 32. As A result, 16x2 LCD display data by receiving the Arduino UNO. The digital port (2,3,4,5) receives the data [3,4,12].

For the activation of LCD, The Pin 1 and pin 2 are connected to the ground and Vcc through Arduino. To adjust the brightness of the LCD screen Pin 3 is connected at 10k Ohms. To connect to Arduino pin 11 and pin 12 are connected as RS and enable pin. The temperature will be in both the Celsius and Fahrenheit which will be displayed through LCD. The digital Port 6 will receive the Arduino which has the control bit 0 or 1. There are two bits 0 and 1 in bit 0 it receives 0V from Arduino and in bit 1 it receives 5V from Arduino. To the digital port 6 the circuit is transmitted through transmission. Arduino gives a lower sensitivity if the temperature is lower than the set temperature [13].

The digital pin 6 receives input from the transmitted circuit by the logic level. As a result, the transmission turns on/off when it is connected to the cooling device. the transmission is turned off when the temperature is reduced from the set point. The temperature is therefore monitored and controlled by this project.



Figure 2Arduino Board



Figure 3USB serial cable

Experimental

Results

We set the temperature according to the baby's comfort. Therefore, when the temperature in the incubator drops below the red-led set it changes and the arduino will change the heat and the different color lights and heat switch off. It's the same with the temperature above the set-

point red lead and green lead. In this case the controller immediately commands the heating pad to be turned off. The temperature is therefore controlled in the incubator.

In this Microcontroller will read all information from sensors. If there is any problem, it will send message to the operator and then the buzzer will sound. There is a LCD and it will be used for display of sensor information and system running status. There is a Button, and it will be used for changing the set level of Sensing information. There is a Temperature and humidity sensor and it has combined module named DHT22 and it is purely digital. This sensor communicates with MCU by one wire. The sensor will directly give digit data and thus there will be no change in data, we just have to get the data and print the data. There is a Switching Circuit and for that we need connection of computer and GSM modem. The computer and GSM modem needs UART Module to communicate with MCU. The MCU has only one UART Module. Thus, we need connected switching circuit by which we connect both computer and GSM modem. There is a Heartbeat sensor, In the sensor the blood circulation is changed as per our heartbeat. By the IR Light it senses the heartbeat by 12 changing its density. There is a Respiration Sensor It changes its state, The output voltage will be measured if the flex sensor is use.

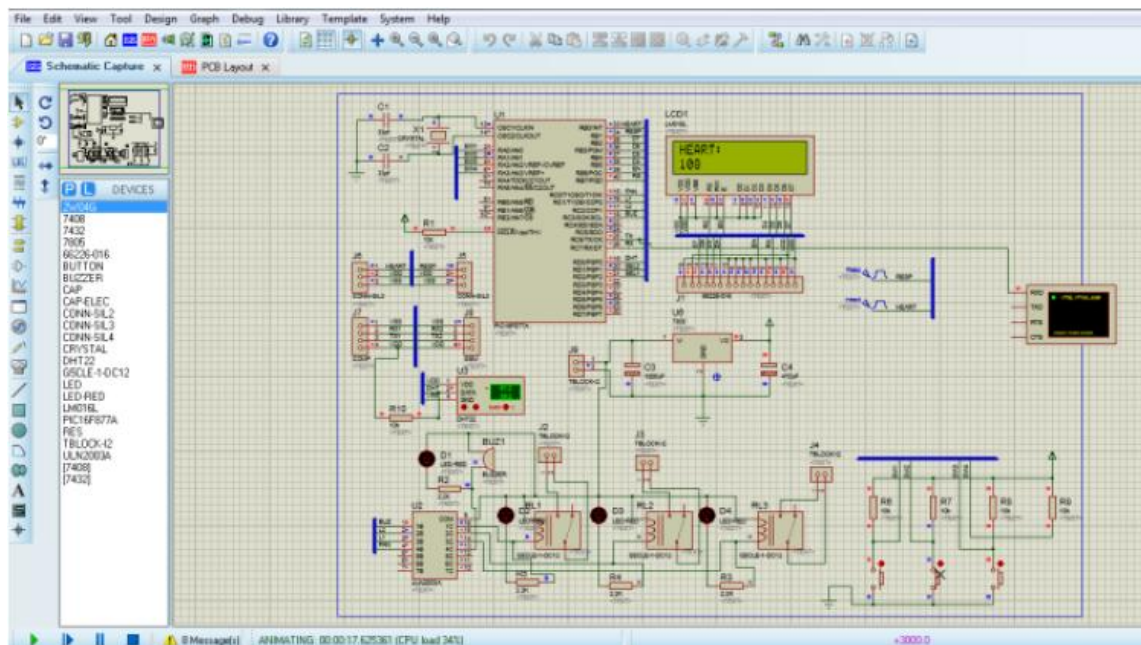


Figure 4Simulation results



Figure 5Model prototype

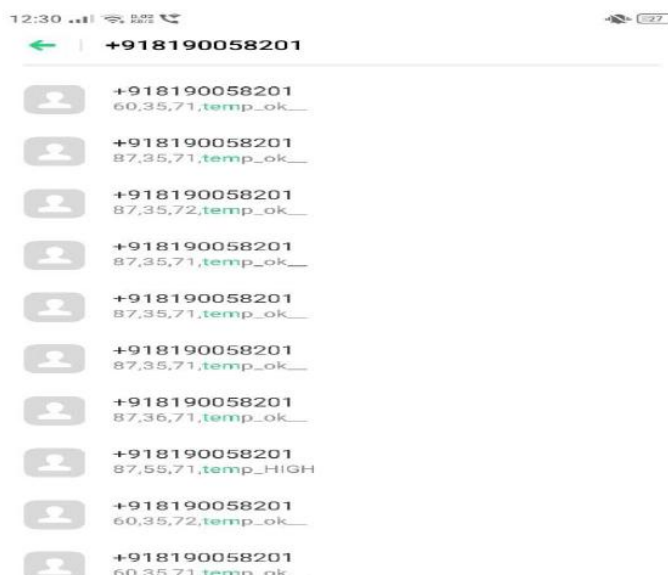


Figure 6 Message received

Conclusion

The proposed system will monitor the infant heartbeat and it also monitors the surrounding humidity and detects problems such as such as infections, common colds, and pneumonia with the same symptoms of fever as body temperature rises significantly. Moisture measurement values also help to diagnose internal problems such as cold, thirst. Continued monitoring of the heartbeat helps to detect any type of heartbeat which is used to find any pre-diseases that the baby has got like arrhythmia turn on automatically, as we did not use this feature. And with constant vigilance there should always be resources for power supply. But in many places, there is still a problem of power outages for about a few hours.

References

- [1] D A Ducker, A J Lyon, R Ross Russel, C A Bass, and N McIntosh, Incubator temperature control: effects on the very low birth weight infant, Department of Child Health, St George's Hospital Medical School, London, 60, 902- 907, 1985.
- [2] Djaaffar Bouattoura, Pierre Villon, and Gilbert Farges, Dynamic Programming Approach for Newborn's Incubator Humidity Control IEEE Transactions on Biomedical Engineering, VOL. 45, NO. 1, January 1998.
- [3] Henry, C., Shipley, L., Ward, C., Mirahmadi, S., Liu, C., Morgan, S., ... & Sharkey, D. (2021). Accurate neonatal heart rate monitoring using a new wireless, cap mounted device. *Acta Paediatrica*, 110(1), 72-78.
- [4] Yeri, V., & Shubhangi, D. C. (2020, July). IoT based Real Time Health Monitoring. In 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA) (pp. 980-984). IEEE.
- [5] Patrizia, M., Erik, G., Alessandro, P., & Alessia, R. (2007). Supporting inspection strategies through palpable assemblies. In Workshop at Pervasive, Toronto, Canada.

- [6] Kolla, K., Rakesha, R., Tejus, S., Kumar, N. G., & Abraham, A. (2012). Real Time Incubator Monitoring System Using Wireless Sensor Network. In Proceedings of the International Conference on Wireless Networks (ICWN) (p. 1). The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp).
- [7] Mittal, H., Mathew, L., & Gupta, A. (2015). Design and development of an infant incubator for controlling multiple parameters. International Journal of emerging trends in electrical and electronics, 11(5), 65-72.
- [8] Chung, H. U., Rwei, A. Y., Hourlier-Fargette, A., Xu, S., Lee, K., Dunne, E. C., & Rogers, J. A. (2020). Skin-interfaced biosensors for advanced wireless physiological monitoring in neonatal and pediatric intensive-care units. Nature medicine, 26(3), 418-429.
- [9] Sapkota, A., Reddy, D., & Lama, P. A ZigBee Network based Heart Rate Monitoring System for Pre-Mature babies.
- [10] Magadum, A. (2020). Analysis of the IoT Based Wearable s Impact on Individual s Health Consciousness.
- [11] PhondPhunchongharn and Ekram Hossain et. al, A Cognitive Radio for E-Health Applications in A Hospital Environment University of Manitoba Dusit Niyato, Nanyang Technological University Sergio Camorlinga, UNIVERSITY OF MANITOBA AND Trlabs IEEE Communications, February 2010.
- [12] Harvey, S., & Zalud, I. (2020). Obstetric hospital preparedness for a pandemic: an obstetric critical care perspective in response to COVID-19. Journal of Perinatal Medicine, 48(9), 874-882.