An Android Application Based Temperature and Humidity Monitoring and Controlling System for Child Incubators

Md. Mohaiminul Islam, Navila Rahman Nadi

Abstract— Prematurely born infants are usually kept in a distinct form of chambers enclosed with controlled temperature and humidity which are referred to as "incubators". These Advanced incubators are extensively used in developed countries because of its expensive priceing and as an alternate system, human monitoring of premature babies in incubators by nurse is being widely used, which is very much inclined to human blunders. The projected system exhibits a cheap, time saving and easily monitored android application based controlling system of temperature and humidity for incubitors. Although some proposed system are already available with the same goal, but this paper is different in the mean of android based usability where an android application is deployed to display the sensor output results in the users phone.In the field of babycare, this system will aid the doctors and nurses, to monitor atmost ten incubators, through the android application installed in their mobile phones, without even being present in the place where the incubators are being placed. This project can be deployed in needed hospitals and baby care units without including huge cost or manpower overhead.

Index Terms— Baby Incubator, Temperature Sensor, Humidity Sensor, Monitoring System, Andriod, ATmega328, DHT 11.

1 Introduction

A Preterm birth which is also known as premature birth means the birth of the baby at least 37 weeks gestational age. Premature infants are at greater risk for delays in development, hearing problems and problems seeing. These risks are seeing only in the earlier a baby is born. Preterm birth is the most common cause of death among infants worldwide. Almost four million babies die worldwide in the first month of life where as one million die on their first day. [1] Preterm birth is ascribed around 6% to 25% of neonatal deaths across 184 countries according to WHO [1]. Low Birth Weight (LBW) and Mild jaundice is common in most of the premature babies (about 60%). Until the natural process of gaining fat and metabolic rate to staying warm does not build up itself, these premature babies are kept in incubators for treatment.

Incubators concept came into limelight in the mid-nineteenth century when Dr. Stephane Tarnier first took initiative to develop it where hot-water reservios were extensively used. From that concept in 1970s, Neonatal Intensive Care Units (NICUs)was established as a particular section of the hospitals in some developed countries. From that instant, researches and new inventions keep proceeding to find out more efficient infant incubator system. Nowadays, the widely used incubator system comprises a chamber surrounded by a water jacket and insulation with temperature and gas level sensors, a gas injection and separate water jacket and air heaters to keep the infant body warm.

This paper helps to the designing and implementing it to specially in rural areas or developing countries where mostly the manpower is less and they can not provide expensive treatment of such infant incubator system. This Arduino based baby incubator helps to all peoples, the cost this project is very less than today's baby incubator which are used in big hospital. So, everyone which belongs to economical backward also use of it.

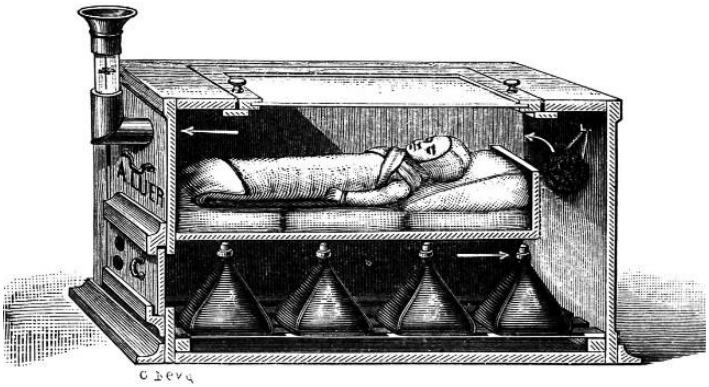

Figure 1: Tarnier's invented Incubator [2]

Moreover, as this project not only used for monitoring and controlling the temperature but also provide number of advantages such as controlling humidity, pressure etc through a mobile phone which is much more convenient to monitor two incubators at a time which saves a lot of energy, manpower and period

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2 Overall Framework of the Incubator System

2.1 Design

The proposed infant incubator system can be divided in three main parts: the terminal device, the network and the baby monitoring and executive system. Currently, through this system temperature and humidity can be monitored from two different incubator using android application. In the hardware section, automatic alarm system for different incubator based on temperature or humidity can be set up as well wirelessly switching ON or OFF the heater can be possible by im menting Android application.

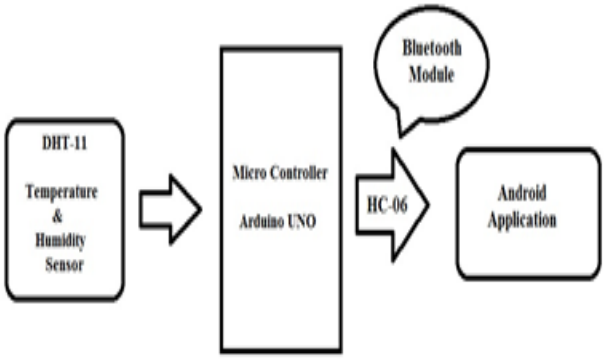


Figure 2: The block diagram of transmission sensor information to Android Application.

The transmission part we have Arduino Uno Board as a Mi controller which based on ATmega 328. DHT-11 the tempe ture and humidity sensor, two relays for switching the hea ON or OFF and HC-06 Bluetooth module to transfer the ser information to the receiver via android application.

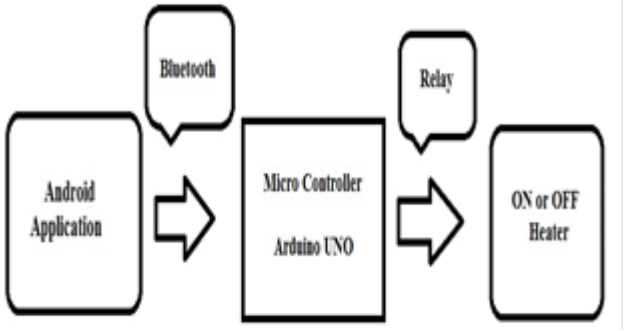


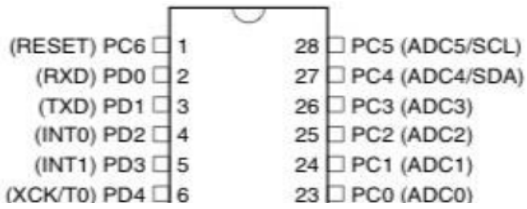
Figure 3: The block diagram of switching incubator.

2.2 Circuitry

For the hardware sections the apparuses were used for making the circuitry which has been described hereby:

2.1.1 Control Unit:
As a control unit Arduino UNO has been used which controlled all the units that were connected to it to give out a desired output. Arduino Uno is a microcontroller board named by ATmega328. It comprises 14 Digital I/O pins of which 6 provide PWM output and 6 Analog input pins.
Figure 3.4: ATMEGA328 (Control Unit) [2]

2.1.2 Humidity and Temperature Sensor:
To choose a proper sensor to measure the temperature of baby in a microcontroller based infant incubator and humidity of baby chamber is very important as well as bit complicaret. For this reason DHT-11, a Small sized, low power consumption, low cost digital temperature & humidity sensor has been chosen for this project. The Humidity measuring accuracy: 5.0% RH and Temperature measurement accuracy: 2.0 C for this sensor.



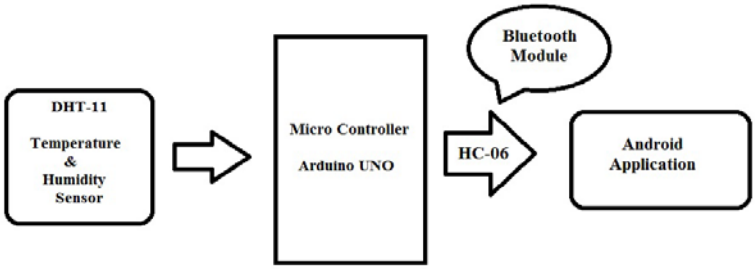


Figure 4: Pins of ATmega 328. [3]

Table1: Designing Apparatus [4]

Apparatus Name	Description
Arduino UNO	Arduino Uno is a microcontroller board integraded with ATmega328. It comprises 14 Digital I/O pins of which 6 provide PWM output and 6 Analog input pins. It consists of 16 MHz clock speed, 32 KB flash memory. The operating voltage , operating voltage is 5V and input voltage is 7-12V(recommended) and 6-20V is limit, DC Current per I/O pin is 20mA and for 3.3V pin DC current is 50mA.
DHT-11	Humidity measuring range: 20% ~ 9 0% RH (0-50 temperature compensation), Temperature measuring range: 0 ~ +50 degree C, Humidity measuring accuracy: 5.0% RH, Temperature measurement accuracy: 2.0 C.
Relay	5V DC Relay, control power is 10A 250V AC and 10A 30V DC.
HC-06	Low cost, low power consumption, it has high-performance wireless transceiver system, Sensitivity (Bit error rate) can reach -80dBm. It's range is approximately 10 Meters (30 feet).

2.1.3 Switching Relay

The switching relay is a necessary part of this designing as it is used to control the heat controller socket. It is extensively used to switch OFF the heat controller socket when the temperature/ humidity within the incubator is higher than the ex pected value while ON when the temperature is lower than the expected value.

2.1.4 Bluetooth

For android based application we have used blutooth HC-06 which is a high performance wireless transceiver system with sensitivity of 80dBm. The range it can cover is around 10 meters which makes it more effective for the project.

2.2 SOFTWARE

An android application was created by using MIT App Inventor for the projected circuitry. This Application can be monitored through any cell phone and it displays the sensor output result and two load or incubator switching buttons for switching the heater ON of OFF. MIT App Inventor is an intuitive, visual programming environment that allows everyone to jbuild fully functional apps for smartphones and tablets.

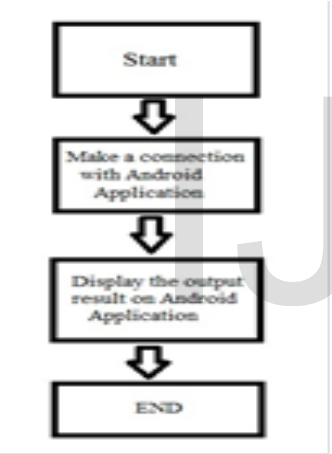


Figure 5: Flowchart of Software implementation

Figure 6: Projected Andriod Based Application for Infant Incubator showing Device connectivity

Using this software, data acquisition, analysis, and logical operations can be tied together. As from the figure 6, it can be seen that the the software showing the Incubator 1 and Incubator 2 accordingly in a name as Load No: 1 and Load No:2. Also, it is representing, whether the incubator is switched on or off.

Figure 6: Projected Andriod Based Application for Infant Incubator showing temperature and humidity of the incubators.

2.2 OPERATING PRINCIPLE

Arduino Uno Board was integrated to ATmega328 circuitry. Arduino IDE software is used to program on the UNO board. To compile the circuit a Bread Board was used where all the equipments were connected with each other through connecting wires. A 5V power supply was connected with the Arduino Uno Board. Our Temperature & Humidity sensor DHT11, Bluetooth module HC-06 and all other equipment were powered up.

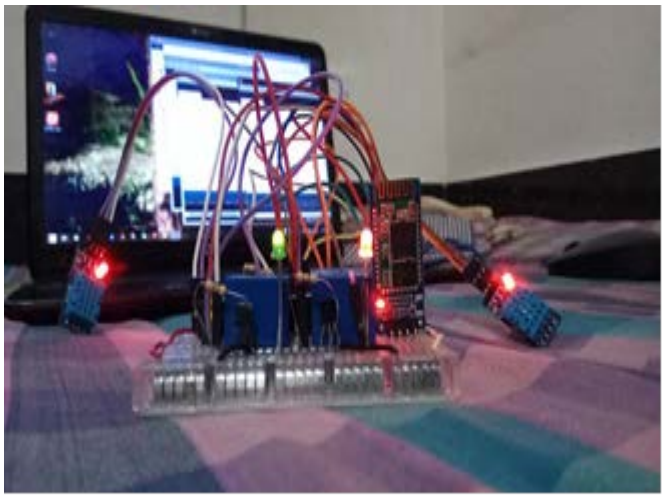


Figure 6: Hardware Circuitry for Infant Incubator system.

After connecting the device with the android application two different Temperature & Humidity sensor output will be seen in on our

android application. The output result monitoring is done in every second and it sends the output result in the android application. Any of the incubators which will increase than the preset temperature value, the bazer will alarm up and notify the user through the application. Then the system will be automatically switched off or also can be mechanically switched off the by the user himself.

3 Result And Discussion

This paper presents a solution of wirelessly monitoring different child incubators at a time. Currently two incubators has been testified but ten incubators can be testified through this application system. The parameter values represent the actual and realtime conditions without human error. From our perspect, we assume that this sensor gives more accurate values than using specific measure devices which can be predicted from the below table of experimented between datasets.

Table 2: Comparison between datasets of sensor and measuring devices

Incubator Number	Temperature (°C)		Humidity (% RH)	
	Thermometer	DHT 11	Hygrometer	DHT 11
1	28.9	30	49	50
2	29	31	51.8	48

4 Conclusion

This paper represents the development of a android based integrated monitoring system for child incubator which can be implemented in rural hospitals. The main benefit of this system is that through this project wirelessly different incubators can be monitored based on the output results that will be displayed into the user's smartphone or tablet. One does not need to stay physically close to the incubators for monitoring. The nurses or administrative bodies of the hospital can be able to monitor from far from the incubator and make decisions and also can controll the heater implemented into the system.

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