Arduino Based Baby Incubator Using GSM Technology

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Abstract – *The preterm infant care is one of the most important, delegate and sensitive area in Bio-medical field. Some new-born are at a higher risk of mortality and are called high-risk infants, because the gestational age and their birth weight put them at a higher risk of disease and death. Preterm baby requires surrounding exactly similar as in the womb to cope with the external environment. Some extent, the incubator can serve as this environment. An infant incubator provide stable level of temperature, relative humidity and light condition to an extent in which the preterm have some condition as in the womb. Air temperature, relative humidity and light condition has to be maintained as it requires to preterm baby. Measurements of this parameter can be done and under risk situation conveyed to the parents with alarm system and GSM technology. The main purpose of this project is to design and implement a closed loop control system to regulate the temperature, relative humidity light intensity by using LED's to avoid jaundice condition to inside neonatal incubator. Arduino and PWM used for implementing the hardware.*

Key Words: **Baby Monitoring, Temperature Sensor, Humidity Sensor, GSM Network, LCD, 3*4 Keypad, Arduino, Switching Circuit.**

1. INTRODUCTION

The newborn baby needs time to adjust their condition with the outside world. This is sensitive time to new baby born especially premature babies. Premature babies need special attention to make babies still alive. One of procedures to make premature babies still alive is put them into the incubator, the period premature babies in the incubator according to soundness, durability and system of organs of them. The incubator is one of tools to help premature babies to adjust with the outside world, because condition in the womb is very different with outside world, especially condition of temperature. Temperature in the womb is approximately 36 - 37 0 C but in outside world is approximately 27.0 C – 28. 0 C. Temperature in the incubator is maintained according to age and weight of premature baby, for example; age of baby is days and weight of baby is less than 1500 gram, the temperature in the incubator is maintained of 35 o C and relative humidity is maintained of 50% RH - 75% RH. Using the incubator the premature babies hope will be adjusting their condition with outside world and the babies can survive.

In this study, we design an incubator system prototype can send a warning message via SMS. The incubator system consists of LCD, SHT11 sensor, light bulb, fan, GSM modem, and microcontroller ATmega328 based Adriano Uno open source board. The purpose of this study is to design a system that can send a warning SMS from incubator to mobile phone when the temperature in the incubator is below/ above 35 o C and relative humidity are below 50% RH and above 75% RH. This system can improve the security of the system to errors on baby infant incubator, so as to avoid the occurrence of death in infants due to temperature and humidity are not appropriate in an incubator, so as to create a sense of security and comfort for babies, parents of infants and hospital personnel on when the baby is put into an incubator.

1.1 Principle

The circuit works on the principle of analogue to digital conversion. The temperature is sensed by an analogue temperature sensor and this analogue value is converted to a digital value using as ADC. Digital humidity sensor uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Arduino microcontroller then processes the digital signal to display the temperature sensor in Celsius and digital humidity on the display.

1.2 OBJECTIVE

- The project was aimed as keeping in mind that the demands and need of by large the rural population. We have added controlling mechanism to the existing model.
- By adding GSM alert, doctor can be informed by a message of baby parameters. Main purpose of an incubator is fulfilled which is to maintain an artificial environment for a neonate to survive.
- It was verified, with this, study necessity of use water in the humidity reservoir incubator used in this work, as well as, to maintained humidity controlled.
- The expectation is that the presented will be able to provoke reflection in the professional of the health area in sense of using water in humidity system of the newborn incubator and that the control of this humidity could contribute to the thermo-neutral of the environment and to improve the quality of the life premature newborns.

2. MAIN SYSTEM CIRCUIT DIAGRAM

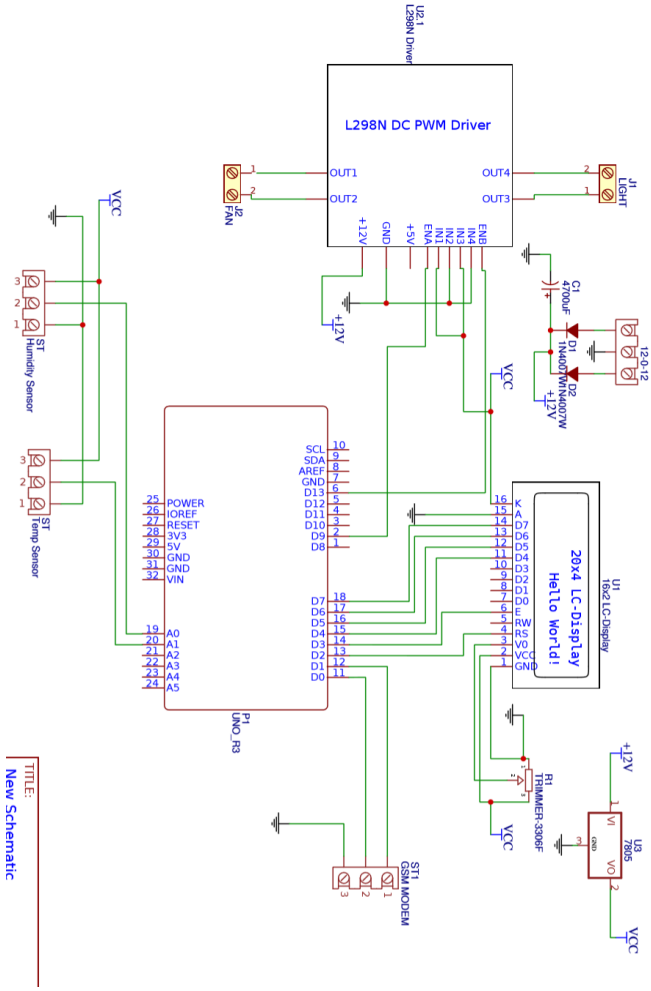

Fig-2.1: Circuit diagram of incubator

3. BLOCK DIAGRAM

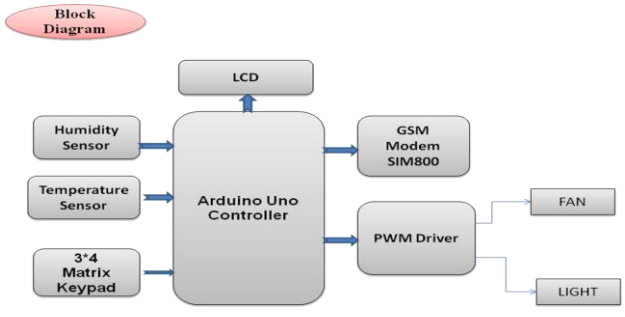

Fig3.1:-Block Diagram of Incubator

4. COMPONENTS

4.1 Arduino

4.1.1What is Arduino ?

Arduino is a set of development boards that come with pre-tested hardware and software libraries. It means, you can by an arduino board and start developing your project instantly. The boards are built around the AVR microcontroller as the base. Software libraries to run on the board are written and made available for free.

4.1.2 Arduino board

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Fig-4.1 Arduino board

Now, if you have noticed, you will find out that the above chip is the same chip that is attached to the base of the arduino. So the basic difference is that the above chip is the microcontroller and the arduino is a board or a breakout that provides base to the microcontroller chip for an easy access to input/output and analog pins and easy burning/uploading of a program. Another thing to be noted is that the arduino is usually meant for people from non-technical background i.e. people from designing and several artists who are arduino inthusiast. But when thinking of a core subject then microcontroller comes to play, it is one of the major subjects is electronics engineering.

4.2. LM35 Temperature Sensor:-

The LM35 device 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. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy).

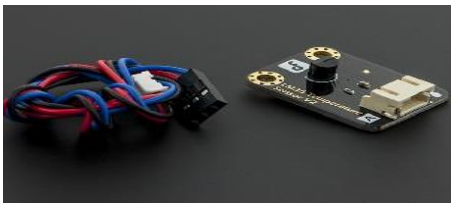

Fig:-4.2.1 Temperature sensor

4.3. DHT11 Humidity Sensor

The DHT11 is a basic, ultra low-cost digital humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

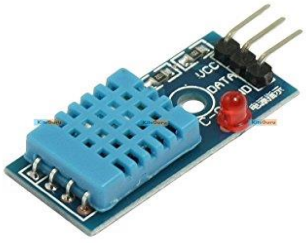

Fig4.3.1:- DHT11 Humidity Sensor

4.4 L298 PWM Driver:-

The L298 is an integrated monolithic circuit in a 15-lead Multi watt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

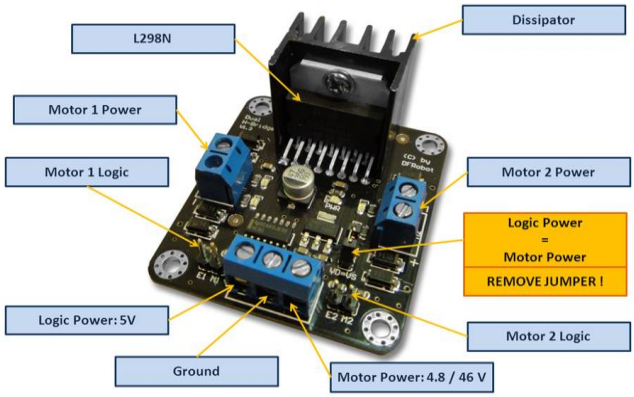

Fig4.4.1:- L298 PWM Driver

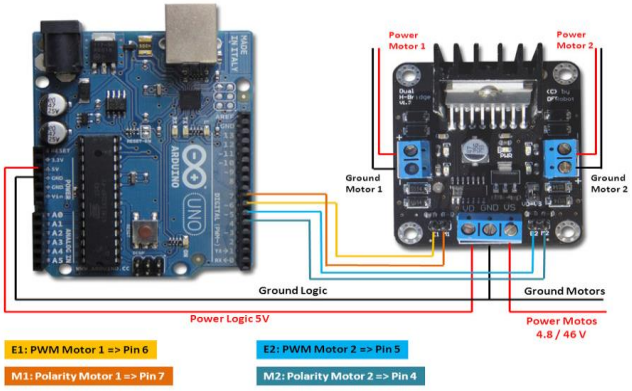

Fig4.4.2:-Arduino and PWM Connection

4.5 20*4 LCD

20x4 LCD is named so because; it has 20 Columns and 4 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. But the most used one is the 16*2 LCD, hence we are using it here.

All the above mentioned LCD display will have 16 Pins and the programming approach is also the same and hence the choice is left to you. Below is the Pinout 16x2 LCD Module:

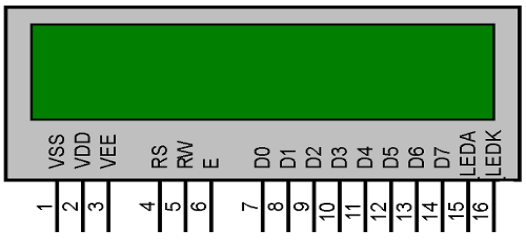

Fig4.5.1:- PINOUT Diagram of LCD Module

Fig4.5.2:- LCD Display

5. APPLICATION

SMS based Baby Incubator using GSM technology has main application in Hospitals

- In Hospital: wud require less attendant time of doctors.
- As it is temperature controller, it can be used in domestic purpose.
- In Industry: The principle of this project can be used in industries like plastic, chemical and process

Various application involved using SIM SMS MODERM

- SMS based remote control and alerts.
- Security application.
- Sensor monitoring.
- GPRS mode remote data logging.

An infant may require an incubator for the following reason:

- When they are not maintaining their own temperature wrapping.
- When they are acutely unwell and closed observation is required

6. ADVANTAGE

- Easy to implement because there are less components.
- Compact in size.

7. CONCLUSIONS

Arduino Based Baby Incubator Using GSM Technology is an inexpensive and simple to use, which can improve the quality of infant-parents with the feeling of assurance. This system expressively provides the parents with the feeling of assurance. The constant capturing of multiple biological parameters of the baby and analysis of the overall health helps mother to understand the internal status of the baby. Time is considerably saved by this temperature controlled system as temperature is compared with set point. As GSM technology is used which makes the users to communicate for distances. This is a convenient system to monitor the baby's health condition from any distance.

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