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IoT Based Neonate Incubator

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Abstract - *The neonatal incubator is an apparatus that provides a closed and controlled environment for the sustenance of premature babies. But recently, many premature babies have lost their lives due to lack of proper monitoring of the incubator that leads to accidents. This project deals with the design of an embedded device that monitors certain parameters such as pulse rate of the baby, temperature, humidity and crying of the baby inside the incubator. The details are updated on an app through IOT and a buzzer alert system is also provided at the nursing station, so that proper actions can be taken in advance, to maintain the environment inside the incubator and ensure safety to the infant's life. So, the objective of this project is to overcome the above-mentioned drawbacks and provide a safe and affordable mechanism for monitoring the incubator.*

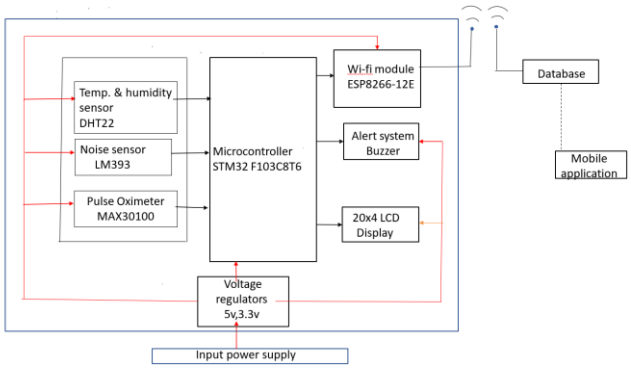
1.INTRODUCTION

Neonatal Intensive Care Unit (NICU) gives special medical attention to newborn babies in needs. The babies who admitted to the NICU are mostly premature. Premature babies are infants who are born before 37 weeks of pregnancy and have low birth weight (less than 2.495 kg) or have any medical condition which needs special attention. [1] Over a decade ago, there are more than 130 million babies are born annually, and nearly 8 million of them die before their first birthday because of prematurity complications. [2] Recently, NICU is equipped with sophisticated instruments to monitor the vital signs of the infants, such as body temperature, blood pressure, pulse rate, and respiratory rate. [1] The advancement of the Internet-of-Things enables medical professionals to monitor these parameters remotely. There are myriads of research about IoT based baby incubator monitoring systems. Some of them are focused on solely monitoring aspects [3] [4] [5] [6] while the others were also embedded controlling aspects [7] [8] [9] [2] [10] into their system. Almost all those works were using incubator temperature and humidity as the main parameters. Reference [4] used humidity and pulse rate sensor as parameters to be monitored, while [3] only monitored the incubator temperature.

1.1Proposed System

Our system monitors temperature, humidity and noise inside the incubator. Here we use sensors and data transfer devices which stores the data and transfers it to the cloud storage. The medical data can be viewed from mobile phones and computer systems from the place where they are and from they can take actions. If there is any problem with the medical data the device gives an alarm signal. So they can prevent the baby affecting from problems.

1.2Block Diagram of Proposed System



Our device monitors the temperature, humidity, and noise inside the incubator and also pulse rate and SpO2 from the neonate. Here we use sensors and data transfer devices that store the data and transfers it to the cloud storage. Our device has 3 sensors that will provide the heartbeat and Spo2 of the neonate. Temperature, humidity, and noise inside the incubator. Data collected from all the sensors is stored temporarily in the microcontroller, displayed on the LCD display, and transmitted to the IoT dashboard over a wireless channel using a wi-fi module for analysis. Our system ensures proper monitoring of the infants and alerts staff/nurses in case of emergencies. The medical data of neonate and incubator parameters can be viewed from mobile phones and computer systems from a re□mote place. If there are any variations/abnormalities with the neonate's medical data/ preset conditions in the incubator our device gives an alarm signal using the buzzer.

2. COMPONENTS

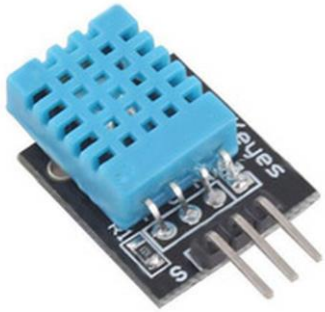
2.1Microcontroller Unit (MCU)

The STM32F103xx medium-density performance line family incorporates the high-performance ARM®Cortex®-M3 32-bit RISC core operating at a 72 MHz frequency, high-speed embedded memories (Flash memory up to 128 Kbytes and SRAM up to 20 Kbytes), and an extensive range of enhanced I/O s and peripherals connected to two APB buses. All devices offer two 12-bit ADCs, three general purpose 16-bit timers plus one PWM timer, as well as standard and

advanced communication interfaces: up to two I2Cs and SPIs, three USARTs, an USB and a CAN. The devices operate from a 2.0 to 3.6 V power supply. They are available in both the –40 to +85 °C temperature range and the –40 to +105 °C extended temperature range.

2.2DHT11(Temperature and Humidity sensor module)

The neonatal incubator should be maintained at appropriate temperature and humidity levels. These two parameters can be sensed by using DHT22 sensor. The DHT22 Temperature and Humidity sensor features a temperature and humidity sensor complex with a calibrated digital signal output.



2.3 Heartbeatsensor(MAX30100)

The MAX30100 is an integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

2.4 LM393 MIC Sensor

The microphone sound senso module will detect any audio signals and convert them to either analog output or digital output to any microcontroller we connect it to.

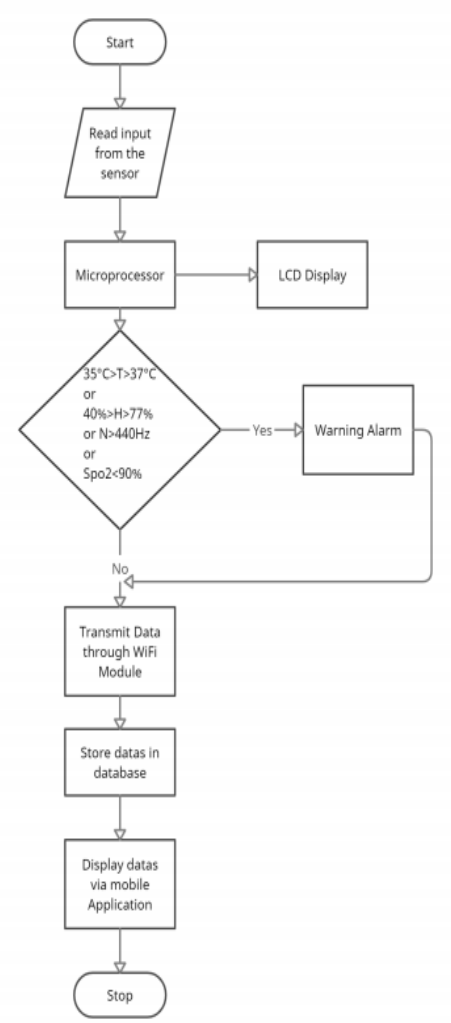
2.5ESP8266-12E Wi-fi Module

The ESP8266 WIFI Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WIFI network. The ESP8266 is capable of either hosting an application or offloading all WIFI networking functions from another application processor.

2.6Buzzer

A buzzer is an audio signalling device. The buzzer consists of an outside case with two pins to attach it to power and ground. When current is applied to the buzzer it causes the ceramic disk to contract or expand. Changing the This then causes the surrounding disc to vibrate. That's the sound that we hear.

3. SYSTEM FLOWCHART



4. ALGORITHM

Step1: Start

Step2: Read input values from the sensors.

Step3: The data from sensors are passed to the microcontroller.

Step4: Display the processed data from microcontroller on LCD.

Step5: Transmit the processed data to the database through wi-fi module.

Step6: Display the data via a mobile application.

Step7: If the temperature value is below 35°C or above 37°C, go to step 8.

Step8: Give a warning alarm.

Step9: If the Humidity level is below 40% or above 77%, go to step8.

Step10: If the noise level is above 440Hz, go to step8.

Step11: If the oxygen saturation level falls below 90%, go to step 8.

Step12: End

5. CONCLUSION

According to experts, by 2023 about 4 million patients around the world will be remotely monitoring their health through IoT. WHO expects that within the next 20 years, more than 2 billion population will be more than 65 years of age expanding space for growth in the healthcare IoT ecosystem. We are still on the runway and are yet to experience a lot of advancements in the healthcare industry. Our proposed system has achieved monitoring of pulse oximetry and heartbeat of the neonate and temperature, humidity inside the incubator. Temperature monitoring is done in order to keep a suitable pre-set environment for the neonate. Also, it helps in monitoring and detects many other internal diseases like infections, common cold, and pneumonia, as they have a common symptom of fever as the body temperature goes high. Humidity measured values also help in preventing having internal problems like cold, dehydration. Continuous heartbeat monitoring helps to detect any kind of cardiovascular disorder in the infant. It also helps to detect arrhythmia or irregular heartbeats. SpO2 monitoring helps in keeping account of blood oxygen saturation and determine any cases of anemia. Thus our device has successfully achieved the design objectives, of the system can acquire the data from various sensors, send those data to an IoT dashboard, simple UI, alert, and a display.

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