

## Infant Monitoring System

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**Abstract:**-In hospital procedures, premature babies will be monitored in the incubator and placed in NICU. However, incubators in rural hospital do not have the ability to provide paediatricians with real-time monitoring. To overcome this, an android application is developed which will help the doctors and nurses to monitor the health conditions of the infant at all the time. This system utilizes humidity sensor, pulse sensor and sound sensor to measure the humidity inside the incubator, pulse rate of the infant and voice of the baby respectively. The data from the sensor are displayed in PC via arduino UNO microcontroller and is stored to the database. The health conditions of the infants are monitored continuously and whenever the any of the sensor data reaches the danger level that can harm babies, an alert will be send the paediatricians via SMS. So, the paediatricians can be able to take relevant actions immediately.

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### Introduction

A premature baby is one who is born too early, before 37 weeks. Premature babies may have more health problems and may need to stay in the hospital longer than babies born later. They also may have long-term health problems that can affect their whole lives. The earlier in pregnancy a baby is born, the more likely he is to have health problems. Some premature babies have to spend time in a hospital's neonatal intensive care unit (also called NICU). This is the part of a hospital that takes care of sick new borns. In hospital procedure, premature babies will be monitored in the incubator and placed in the neonatal intensive care unit(NICU). However, incubators in rural hospitals do not have the ability to provide paediatricians with real-time monitoring.

The incubator system in all hospital's NICU currently require nurses and doctors to monitor fants manually all the time. However, these hospital personnel are also required to do other work at the same time. Thus, motivated by this problem, this project is designed to help them monitor the baby in incubator more efficiently. In this project, an android application based monitoring system which utilizes humidity sensor and pulse rate sensor is developed to measure the humidity in incubator, and baby's heartbeat and sound sensor to measure the voice of the baby respectively. The data collected from the sensors can be viewed on a personal computer (PC) and an alert message will also alert NICU personnel if the data readings reach to certain level that can harm babies. The aim of this project is to provide an effective system for increasing NICU personnel's productivity and efficiency at work.

### Existing System

This system utilizes humidity sensor and pulse rate sensor to detect the humidity of the incubator and heartbeat of the baby respectively. An arduino UNO microcontroller is used to process the sensor data. An LCD display is attached to the incubator which displays the humidity inside the incubator. Further, the humidity level of the incubator and the baby's pulse rate are sent to the PC via

arduino for continuously monitoring the baby incubator. It also have an alarm system that can detect both the parameters are in safety level and will alert the caregivers. If either of the values goes above or below the threshold, an LED will be turned OFF and the buzzer will be turned ON to alert the NICU Personnel[1].

### Proposed System

The proposed system is a mobile application system for monitoring infants that provides all the necessary information with which the user

i.e, caregiver can monitor the baby anywhere, anytime. It utilizes three sensors namely humidity sensor, pulse rate sensor and sound sensor to monitor the humidity of the incubator, pulse rate and audio voice of the infant respectively. In this system, an arduino UNO microcontroller is used to process the data from the sensor and the data is stored to the database. This database is updated as the data from the sensor varies continuously. Meanwhile, an alert message is sent to the person who is using this application i.e, caregivers (doctors, nurses, parents) if the any of the parameters falls in danger situation. Thus, it could help doctors and nurses in monitoring premature infants in hospital. Furthermore, they can also provide fast response if the infants in danger conditions.

### Advantages

This system can help the doctors and nurses to monitor the infants condition anywhere all the time. Most doctors in the hospital have very tight schedule and cannot always be available in the NICU. They also have responsibilities to other patients at the same time. With this application, caregivers will be able to monitor infant environment condition and health situation from mobile phone with much ease. They can also provide fast response in case of emergency.

## Hardware and Software requirements

### Hardware Requirements

Arduino UNO Microcontroller SN-MOD

HMD Humidity Sensor Pulse Rate Sensor

Sound Sensor

### Software Requirements

Android Studio Arduino

1.6.8Xampp

Server(Database

connectivity)

## Tools Description

### Hardware

#### Description:

#### Arduino UNO Microcontroller

The Arduino Uno R3 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. The Uno differs from all preceding boards in that it does not use the FTDI USB- to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter[2].

#### Pulse Rate Sensor

Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game and mobile developers who want to easily incorporate live heart rate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino. It also includes an open-source monitoring app that graphs your pulse in real time[3].

#### Sound Sensor

The sound sensor module provides an easy way to detect sound and is generally used for detecting sound intensity. This module can be used for security, switch, and monitoring applications. Its accuracy can be easily adjusted for the convenience of usage. It uses a microphone which supplies the input to an amplifier, peak detector and buffer. When the sensor detects a sound, it processes an output signal voltage which is sent to a

microcontroller then performs necessary processing[4].

### SN-HMD-MOD Humidity Sensor

This humidity sensor module is pre-mounted with SN-HMD-MOD humidity sensor. It can operate in 3.3V to 5VDC. It comes with basic components and it can start measuring humidity by just supplying power to it. HR202 humidity sensor is humidity sensitive resistor made from organic macromolecule materials. It can be used in hospitals, storage room, workshop, production floor, toilet, garden, laboratory and more. Besides the basic operation, the module also have additional voltage comparator circuit which offer adjustable threshold level for humidity sensor to trigger, it becomes a digital output. It can be interface with any microcontroller with digital or analog input such as PIC, SK40C, SK28A, SKds40A, Arduino series for humidity changes detection[5].

### Software Description: Arduino

#### 1.6.8:

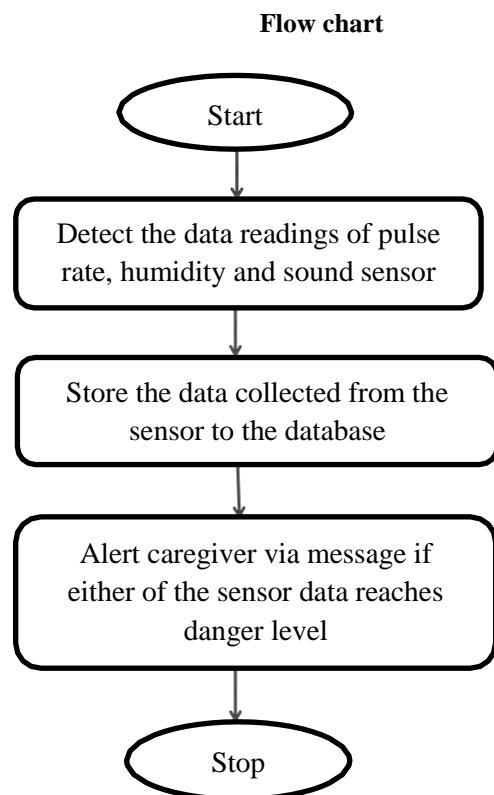
The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board[6].

### Android Studio

Android Studio is Android's official IDE. It is purpose built for Android to accelerate your development and help you build the highest-quality apps for every Android device. It offers tools custom-tailored for Android developers, including rich code editing, debugging, testing, and profiling tools[7].

### XAMPP

XAMPP is a software distribution which provides the Apache web server, MySQL database (actually Maria DB), PHP and Perl (as command-line executable and Apache modules) all in one package. It is available for Windows, MAC and Linux systems. No configuration is necessary to integrate PHP with MySQL. It is a great fit for this course and provides a relatively painless installation and way to manage the configuration changes. Also provided is PhpMyAdmin which gives a GUI tool for managing your MySQL databases[8].



### Experimental Methods

The proposed incubator monitoring system consists of three sensors namely humidity sensor, pulse sensor and sound sensor to measure the humidity inside the incubator, heartbeat of the baby and voice or sound of the baby respectively.

First, sensing the heartbeat of a baby is a little bit different compared to adult. In this work, a pulse oximeter is used to measure baby's pulse rate continuously. Table 1 shows the normal pulse rate for infants and children. In this experiment, the sensor readings were taken from babies from three categories only based on Table 1, which are new born (0 ~ 3 months), infants (3 ~ 6 months) and infants (6 ~ 12 months)[1].

**Table 1. Normal pulse rate for infants and children.**

Age	Pulse Rate Range (bpm)
New born baby (0~3 months)	100 ~ 150
Infants (3 ~ 6 months)	90 ~ 120
Infants (6 ~ 12 months)	80~120
Children (1 ~ 10 year)	70~130
Children 10 years old and above	60~100

Second, the humidity level of the incubator is monitored continuously by placing the humidity sensor inside the incubator. Regarding the information for preparation of incubators, for infants less than 37 weeks gestational age and/or less than 2 kg body weight must be placed in the incubator that can provide humidification within 24-48 hours of life. Humidity values for gestational age infants less than 37 weeks are in the range between 64% to 94%[1].

Then, the sound sensor is used to detect the audio or voice of the baby which is placed inside the incubator. This sensor continuously detects whether the voice of the baby is LOUD or NORMAL. The sensor readings from the three sensors are displayed in the PC via arduino UNO micro controller and are stored into the database.

In this system, an android application is created in which separate login is created for admin, doctor, nurses and the parents. Initially, the admin will record all the information about the doctor, nurses and the infant who is admitted in the NICU. The doctor has given permission to view the health conditions and he/she can modify the health condition of the infants. The nurse can only view the conditions of the infant (particularly, the infant who is assigned to take care of). And, the parents are able to view their own child's health conditions. Furthermore, whenever the sensor readings of any baby seems to reach the danger level, an alert will be sent to the doctor, nurses and the parent via SMS. This system will help the caregivers to monitor the infant anywhere, all the time and also help them to take necessary actions immediately in case of emergency.

### Conclusion

In conclusion, all the sensors sense the data readings continuously which will be viewed by the caregivers through the mobile application. The caregivers will be able to take immediate actions in case of any emergency conditions. This can also help the doctors and nurses to monitor the condition of the infants anywhere at all the time effectively. For further improvement, the data can be transmitted through internet.

### References

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