IoT - BASED INFANT INCUBATOR HEALTH MONITORING SYSTEM

INTRODUCTION TO IoT COURSE PROJECT REPORT

Submitted by

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ABSTRACT

Premature babies, also known as preemies, are those that are born before the mother has reached 37 weeks of gestation.According to the World Health Organization (WHO), 1 million out of 15 million preemies die as a result of their prematurity, making preterm birth the second-highest cause of mortality for children who do not live to complete their fifth year and the top cause of death in the first month following birth.In order to create a similar environment to that of the womb, newborns must be housed in an incubator. The relative humidity and temperature should be strictly maintained at predetermined levels based on the number of incubation days.However for various causes, if the temperature of a neonatal incubator rises rapidly and the doctor is not aware of the condition in the incubator, the premature baby will face numerous difficulties.In the absence of a continuous monitoring system, information about the baby's health is unavailable, which causes difficulties for the medical staff and causes delay in assessment of the situation and consequently, treatment.
In the existing prototypes, only a few parameters are monitored which doesn't serve the complete purpose of an incubator, since in a controlled environment various parameters are important. It also fails to project the potential dangers to the neonate.
Our idea is a smart infant incubator monitoring system that includes numerous elements being tracked and real-time data with the aid of various sensors integrated to the microcontroller.The baby as well as the incubator environment is being constantly monitored.Medical personnel receive information about the patients' conditions via Thingspeak cloud, web server , Pushover app and excel sheets, which they may use to process and analyse the baby's current state. Parents will also be benefitted by being able to monitor their baby remotely.

Keywords: Arduino UNO, ESP8266, Thingspeak, heartbeat monitoring, SpO_2 , ambient temperature and humidity , Body temperature, Neonatal incubator.

INTRODUCTION

An infant incubator is a device that consists of a hard box-like shell that allows an infant to be kept in a controlled environment for medical treatment.Temperature, relative humidity, and oxygen concentration are all maintained at a constant level in a neonatal incubator. Incubators are used in conjunction with other equipment and methods to provide the greatest possible environment and continuous monitoring for babies who require special assistance. It might be helpful to conceive of them as a second womb meant to protect and nurture a newborn. A baby may need to be in an incubator for a variety of reasons including premature birth, breathing issues,infection, jaundice,low birth weight etc.

Generally, in the case of a premature baby,a condition occurs when they stop breathing or their heart rates drop, called Apnea. Our Heart beat monitor is an Infrared sensor which continuously counts the number of pulses per 60 seconds and sends it to controller and then to the cloud.Typically,ECG requires continuous attachment of several electrodes with specific gel, which leads to discomfort, pain and damage of the fragile premature infant's skin.To overcome this, we chose to extract the heart beats by an infrared technology. Also , overuse and under-use of supplemental oxygen can harm preemies,therefore SpO_2 must be monitored and kept within 90 to 93% to avoid diseases.

When infant's body temperatures are not regulated, they are at high risk of hypothermia. Neonatal hypothermia has been reported to raise the risk of complications of preterm birth, coagulation abnormalities, infection etc. According to the American Academy of Pediatrics (AAP) baby body temperature is considered to be normal between 36.1 – 38 °C. Premature newborn babies have high skin permeability, because of this it is vital for keeping the temperatures to a certain level.

The major role of IoT in the project is in Monitoring the vitals of the baby’s and enabling healthcare professionals to be more watchful and connect with neonates proactively. Data collected from IoT devices can help physicians identify the best treatment process for the neonates and reach the expected outcomes,and help them interpret and predict any disease or disorder in preliminary stage itself at a low cost and efficient setup as compared to existing cumbersome methods.Moreover the cloud storage is more reliable and does have minimal chances of data loss.A limited and controlled lowering of body temperature at low environmental temperatures would of course spare some of the new-born baby's limited metabolic energy reserves in the early days of life. The constant visualisations thingspeak provides in a graphical way is a boon for parents, since they can easily keep on their babies’ progress as well as for doctors’ monitoring of the scenario.

It is important to consider not only the baby's temperature, humidity, heart rate etc, but also other issues that may affect the baby's health, such as the factor of skin contact among family members/staff directly contributes to the cause of disease and irregular temperatures in the baby, because the baby's skin is still more sensitive, and it may become infected.So visits to the controlled environment must be reduced, therefore, we need a remote monitoring system to do so.

The goal of utilising an incubator is to produce a highly stable environment in which a newborn with a low body weight can maintain a consistent body temperature. The humidity condition in the chamber must be considered when constructing the incubator, because sensitivity of the chamber temperature is more relative ease, but if the humidity condition is dry, it will have a significant impact on the baby's health.
The transepidermal weight loss (TEWL) of the infant temperature will occur if optimal humidity is not maintained.

This report proposes an effective infant incubator monitoring system. The following are some of the report's major contributions:

1. Increases device safety by making temperature data continuous, accurate, and real-time. In practise, the temperature of the incubator and the temperature of the baby's skin varies, and doctors are more concerned with the body temperature (skin temperature).The real-time central monitoring system for premature babies delivers real-time data on infant skin temperature and box temperature, ensuring the

consistency and quality of recorded temperature data and providing clinical guidance for doctors' diagnosis and treatment.

2. Ensures the normal humidity and temperature in the incubator to provide a proper controlled environment for newborns.

3. Medical personnel can remotely monitor the newborn's physical condition in the baby incubator, lowering the danger of harm caused by the newborn's aberrant physical condition with the help of an efficient LED system, which contains different conditions of alert according to the premature baby and a normal infant.

4. Parents of preterm babies can also view the child's real-time progress remotely from afar,reducing stress, minimising the frequency of trips to the neonatal ICU , and enhancing the ICU's environmental quality.They can access the previous days' records as well as receive alerts in the pushover app.

5. Improve the efficiency of medical personnel's job and lower their error rate. On the central display screen of the nurse station or the central monitoring room, The python based GUI web server can be utilised as the central monitoring system for preterm babies can instantaneously display the newborn's skin temperature, incubator temperature and humidity,SpO_2,and heart rate.

6. All types of graphs,excel sheets and tables required by medical personnel can be automatically evaluated and generated, reducing medical personnel's work intensity, improving nursing efficiency, and lowering error rates.Our project includes a web interface, Thingspeak graphical visualisation as well as an Android app that allows users to interact with the system using a sophisticated user experience.

OBJECTIVES

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1. Accumulating Real Time Data,Sensing multiple health parameters of the baby continuously, Incorporating the LED system for easy assessment of the situation and raid alert in case of emergency.

2. Collecting and Storing the sensed data - It can help in better assessment and analysis of baby's health. Cloud data storage and excel sheet for assessment for future references for doctors, web server for display of instantaneous data, and pushover app

for alert notifications.

3. Providing this data to the parents of the baby - Efficient visual display of thingspeak data is easily accessible by the parents providing real time data about their baby. and enables them to keep track of their baby's health conditions.

PROPOSED METHODOLOGY :

The suggested system's fundamental concept is a continuous infant incubator health monitoring system.

Three key characteristics of our system are :

- Data storage and processing : As is discussed previously, a series of sensor signals are gathered via the arduino uno, including the SpO_2 , heartbeat,ambient temperature, humidity and body temperature. Significant features can be retrieved to detect and identify potential heart disease in the infant and combat various diseases and emergencies that may occur due to any of the parameters fluctuating more drastically than the safe-limit.
    1. The identification and accurate diagnoses of a potential disease and danger often require a certain amount of historical data; therefore, a cloud database is established in the form of Thingspeak Cloud to store the sensor data from the sensor node for each individual user in a graphical manner.
    2. An excel sheet also stores the data during the required time frame.

- Data visualisation :

  A web-server based data visualisation scheme using python is implemented,more specifically a web-based GUI is created for authorised users to access the data, which is real time.Fig. shows an example of the interface that displays real-time heartbeat,SpO_2 ,ambient temperature, humidity and body temperature data. The same data is uploaded to the Thingspeak Cloud and also shown in real time on the webpage , which is backed by the python based tkinter package.

- Disease identification and notification - Our solution seeks to provide a user-friendly interface for data access. The hospital mainserver, doctors or nurses, and family members or associated caretakers are the three user groups targeted by the system.

  Any minor fluctuation in the heart rate, body temperature etc is often life threatening for an infant. The system aims at protecting infants from such conditions, and it is important that the patients’ health conditions can be monitored and understood.

1. Any suspicious and abnormal sensor reading can be identified and notifications can be sent to identified users, such as the family members and doctors using the **pushover application** . Parents can use this information to self-monitor their baby’s health, and clinicians can use it to diagnose probable ailments. If an aberrant state is discovered, an alert will be sent to a specific stakeholder, such as doctors or family members via the app**.**
2. A full fledged LED alert system is integrated for easy understanding of the scenario and accordingly suitable next steps can be taken.

Below is the brief description of our system :

- **SENSORS:**

1. **DHT11 for the suitable environment monitoring for the neonate:** Increase in the temperature of the incubator as well as oxygen consumption of preterm infants takes place because of relatively low humidity.We need to maintain constant temperature in a relatively small area without harming the baby in the incubator.

a. Less humidity causes problems like hypothermia, dehydration in the infants.
b. If the humidity is low it tends to raise the insensible water losses, which in turn increases heat evaporation and moisture loss.
c. Relatively higher levels of humidity is also not suitable for infants as it will increase the possibility for germs and bacteria.

2. **LM35 for body temperature:**

a. Fever is a typical indicator of infections, the common cold, and pneumonia, and temperature monitoring of the infant's body will aid in the detection of many other internal disorders.
b. When an infant's body temperature is not controlled, hypothermia is a serious risk. Preterm delivery problems, coagulation abnormalities, infection, and other issues have all been linked to neonatal hypothermia. As a result, we took sure to keep an eye on the neonate's temperature in a non-invasive manner

3. **MAX30100 HeartRate and SpO_2 sensor:** The heart is one of the most important indicators that may be used to assess a patient's overall health. The number of heartbeats per minute is represented in our system.Electrocardiographs are routinely used to monitor electrical heart signals (ECG). Meanwhile, ECG necessitates the continual application of numerous electrodes with a particular gel, causing discomfort, suffering, and skin damage in the fragile preterm child. It's also difficult to manage.In order to overcome this, we used infrared technology to extract the heartbeats

a. Hypoxemia and apnea can be detected early using Respiration and Blood Oxygenation data.
b. Heart Rate helps to detect any kind of cardiovascular disorder in the infant. It also helps to detect arrhythmia(heart can beat too fast, too slowly, or with an irregular rhythm) or irregular heartbeats and ensures the normal working condition of the cardiac system.

c. The arterial SpO2 plays a major role in infant baby's health.There is a difficult balance between too much and too little supplemental oxygen exposure in premature neonatal care. Because both too much and too little supplemental oxygen can harm preemies, their SpO2 levels must be maintained and regulated between 90 and 93 percent to avoid illnesses.

- **MICROCONTROLLER:** The microcontroller **ARDUINO UNO** receives and collects data from each of the sensors.

- **COMMUNICATION MODULE:** signal transmission is implemented by using WIFI module(ESP8826 -01) and the data is pushed to the cloud storage.

- **CLOUD:** Thingspeak stores data and generates plots that may be seen on a computer or through a mobile application for enhanced data visualisation.

- **WEB SERVER USING PYTHON BASED GUI:** The webpage will contain information of temperature, number of pulses, and all other parameters which are being taken instantaneously in the real time by the sensors.

- **MOBILE APPLICATION:** The pushover app is used to get timely alerts so that any fatalities can be avoided and the treatment is done on a priority.

- **LED SYSTEM :** The data is analysed by the LED system, which involves determining the best safe range of the parameters for determining medical emergencies and predicting possible infections/diseases that may pose a hazard to the infant and thereby alarming the staff in such case, with suitable LED indication, whereas the excel sheet records can be referred while the prescription of medicines and for analysis and assessment by the doctor.

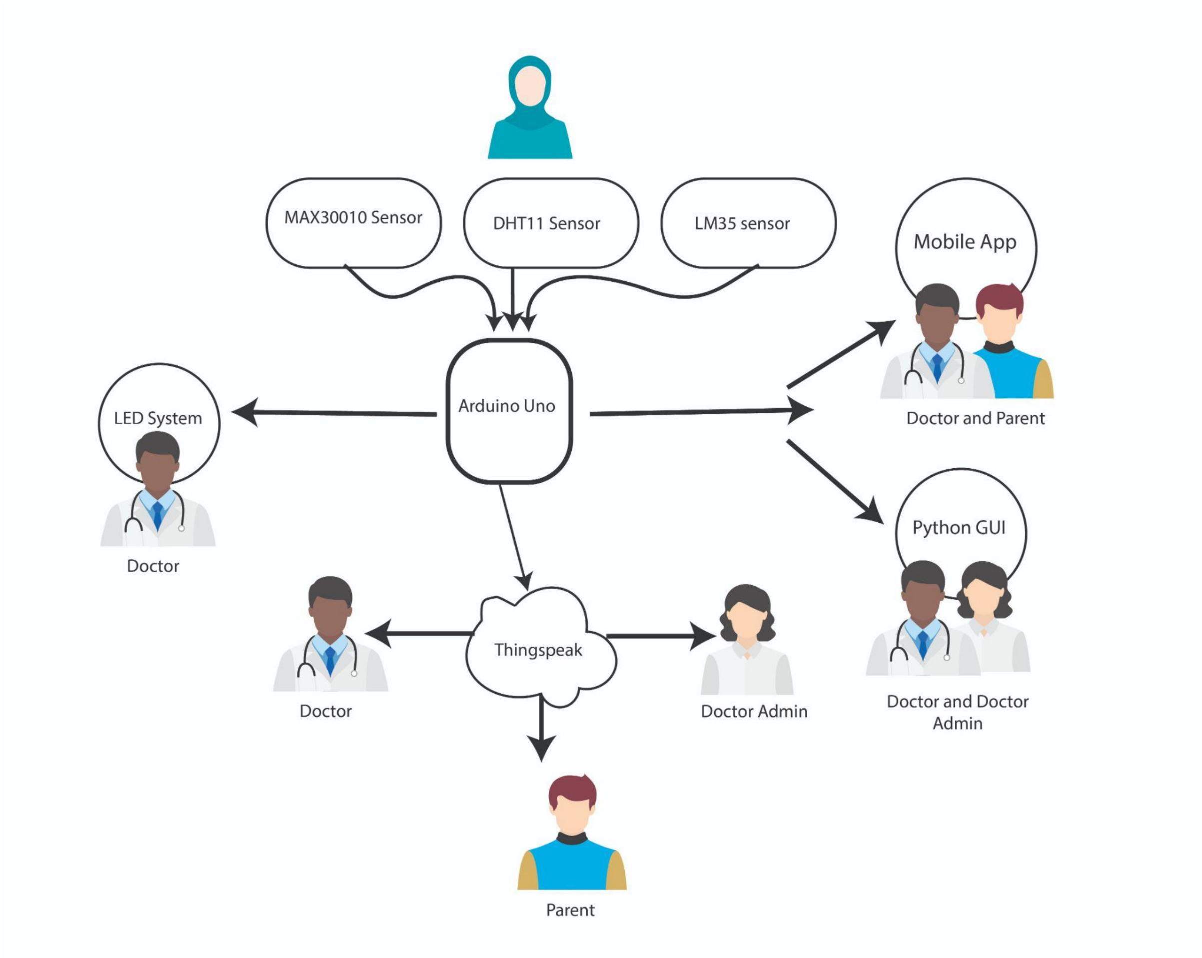


Figure 1: Sensor Node Diagram

A) LIST OF HARDWARE COMPONENTS USED :

S N O .	NAME	PICTURE	DESCRIPTION

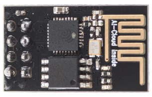
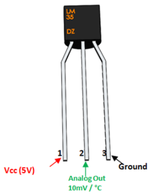
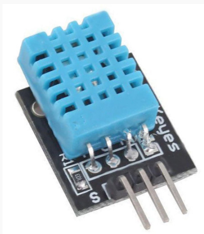
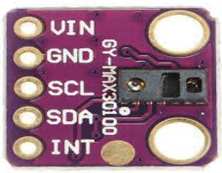
1	**ESP8266 -01 Development Board**		**WiFi Module**
2.	**Arduino UNo**		**Microcontroller.**
3	**LM35 Temperature sensor**		**To measure body temperature.**
4	**DHT11 Digital Humidity and Temperature Sensor**		**For surrounding temperature and humidity**
5	**MAX30100 I2C Pulse Oximeter Sensor**		**Integrated Pulse Oximetry(spo2) and Heart Rate monitor.**
6	**LEDs**		**Red , blue , orange LEDs.**

Table 1

1. A combination of hardware components is used to implement the system. During the implementation step, all of the hardware components are put together. Figure 3 shows the circuit schematic for the created system.Physical pins are used to connect all of the sensors to Arduino. VCC and GND are wired to the Arduino's VCC and GND pins for all sensors.Because it features a built-in Wi-Fi module, the ESP8266-01 is used as a processing device.

ARDUINO PINOUT WITH THE SENSORS

COMPONENT	**PIN**	**VCC**	**GROUND**
LM35	A0	5V	GND
DHT 11	D5	5V	GND
MAX 30100	A4 (SDA) A5 (SCL)	3.3V	GND
ESP-8266-01	RX -- TX TX --RX	3.3V	GND
ORANGE LED	D11		
RED LED	D12		
BLUE LED	D13		
SWITCH	A2	5V	GND

Table 2

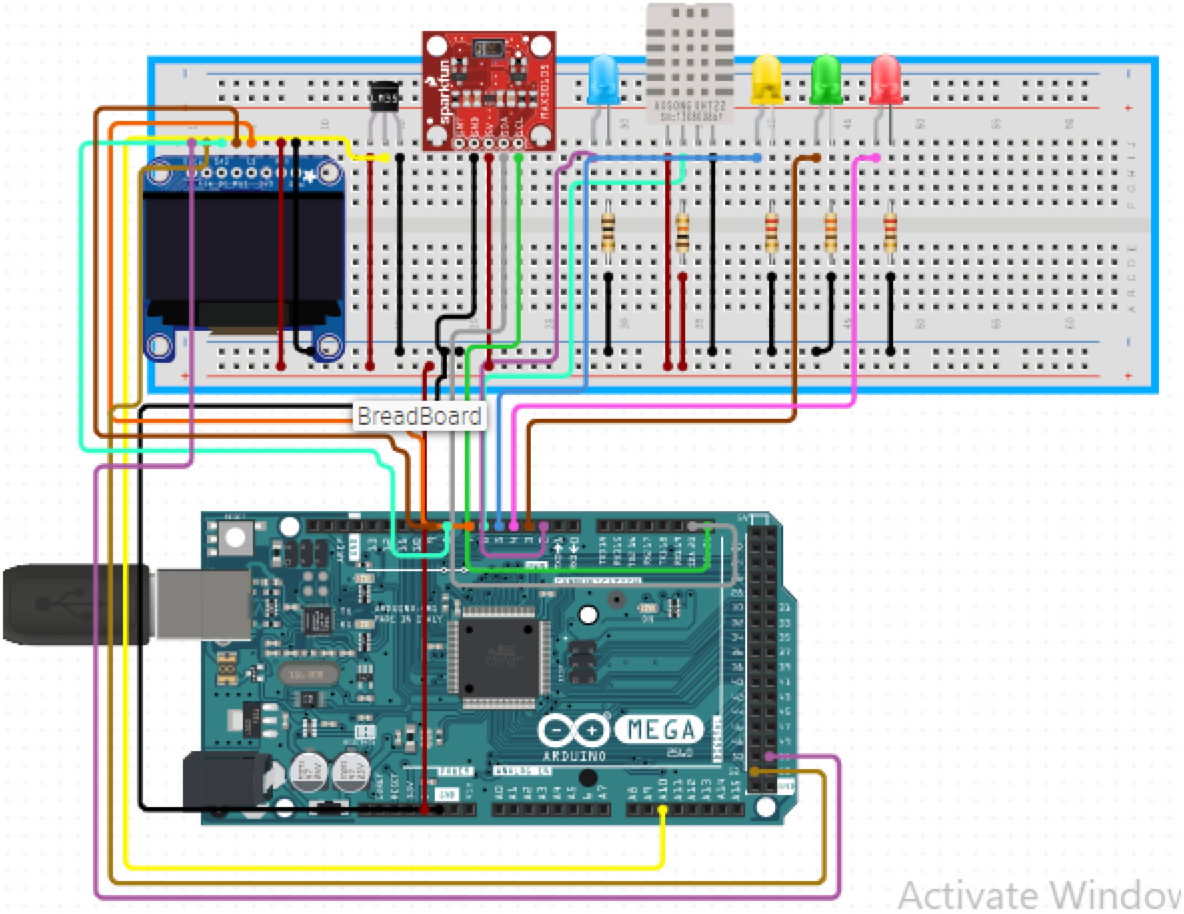


Figure 2 : Circuit diagram

2. After all of the individual electronics were gathered and calibrations were completed, we combined all of the sensors into the Arduino Uno so that it could function as a single system.
3. In terms of sensing, the Arduino Uno detects the values from the sensors and analyses them accordingly, whilst in terms of transmission, the ESP9266 module connected to Arduino receives data from Arduino and transfers it to cloud storage and web server which can be later accessed for further analysis. Further data is stored in the excel sheets for systematic record of the baby's health parameters.

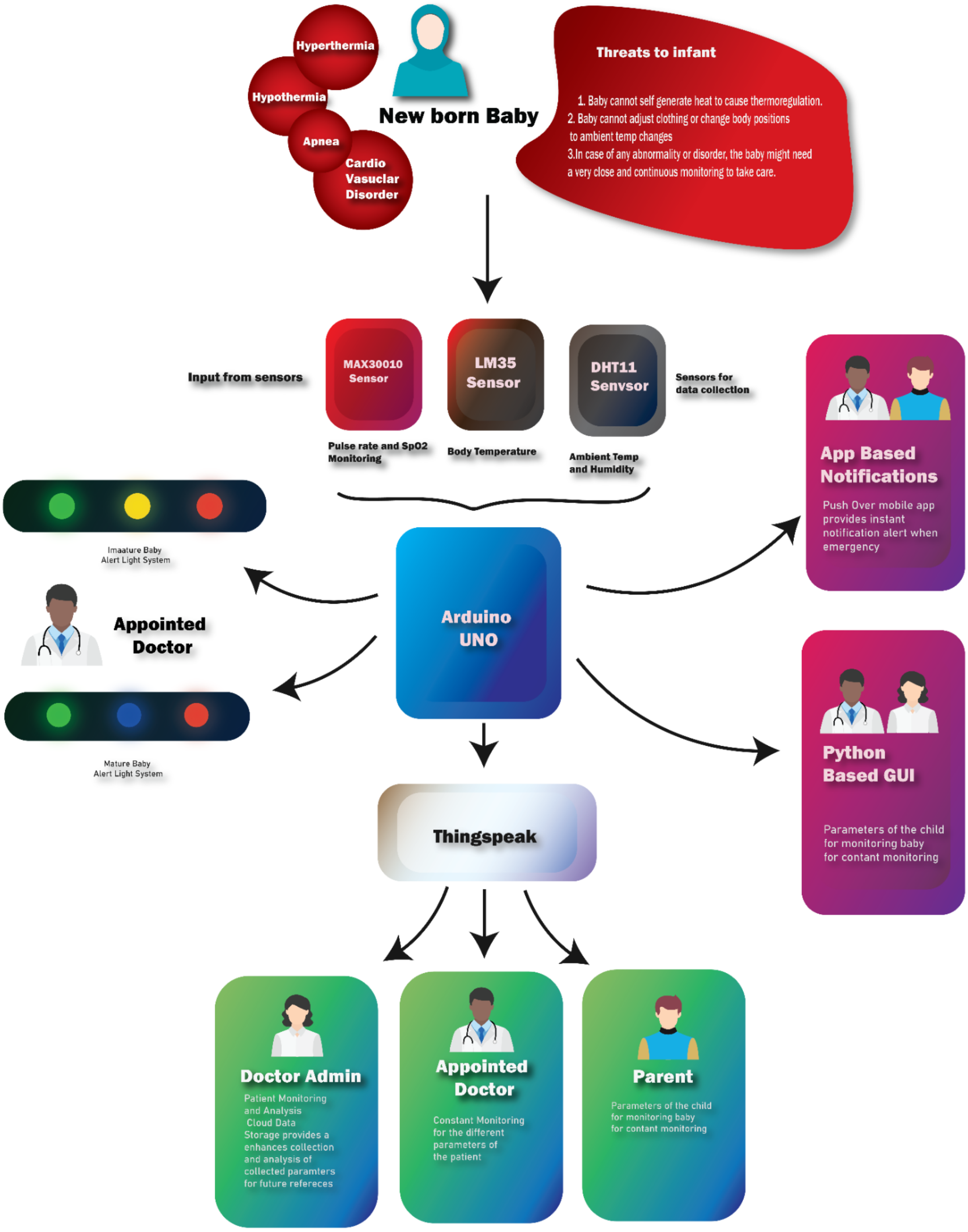


Figure 3 : Block Diagram

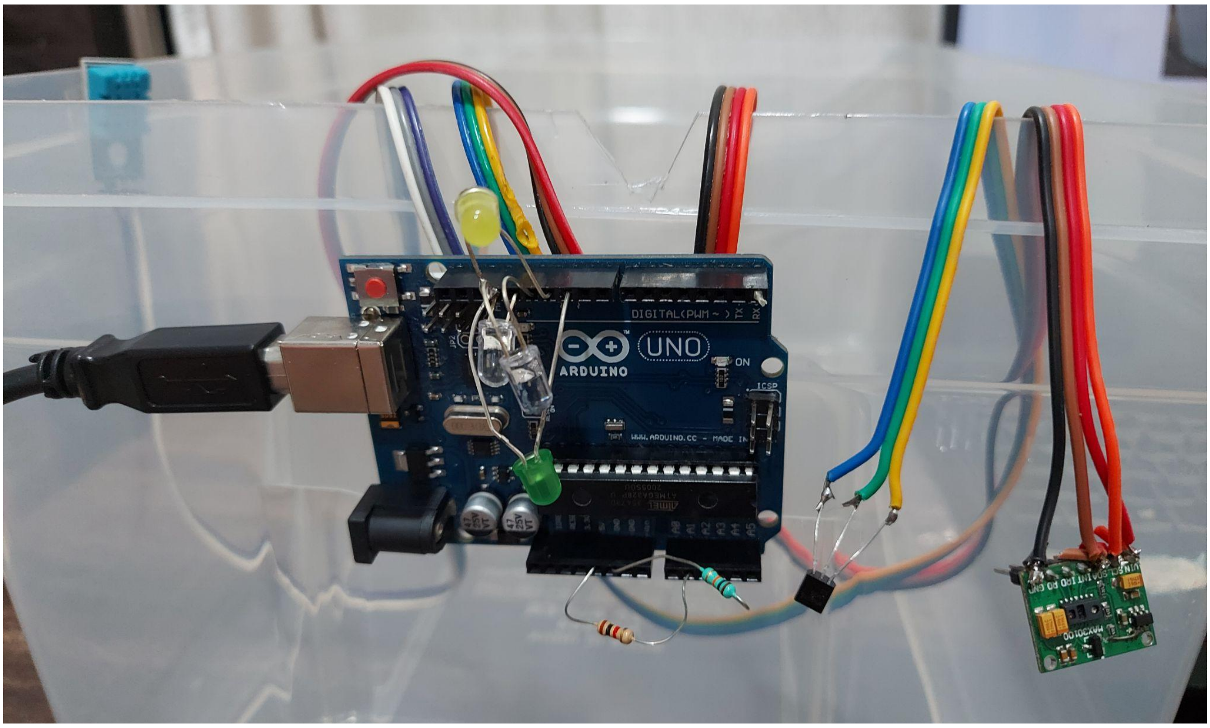


Fig 4 Developed sensor node

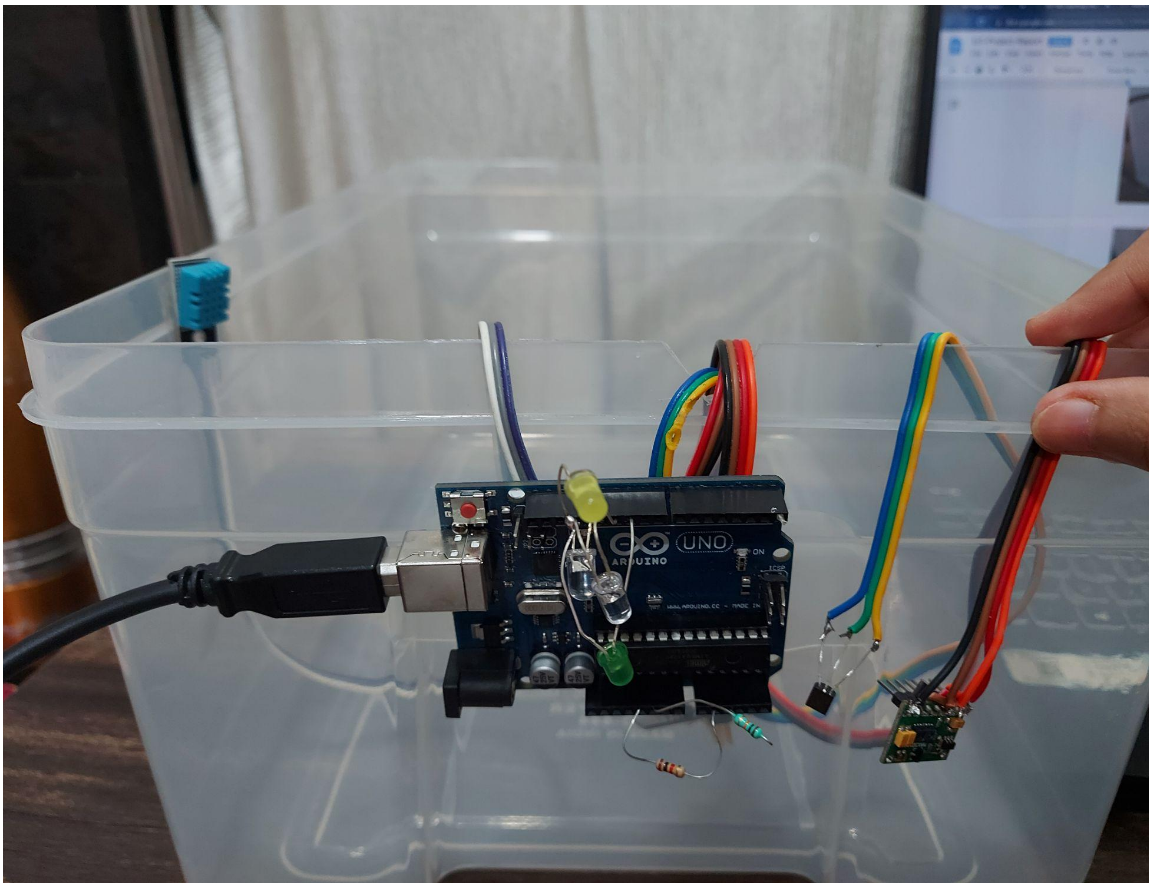


Fig 5 Sensors interfaced in the incubator box

COMPARISON OF OUR SOLUTION WITH THE EXISTING SOLUTIONS

1. **Adding additional sensors amounting to 5 parameters tested and Integration of more than 2 sensors, of kinds - digital and analog** : SpO2 sensor (will sense the oxygen saturation level in the blood) and another temperature sensor (DHT11) which will sense the temperature of the surrounding area and manage the controlled environment.

2. **Using multi-utility sensors** - We are using a single sensor(DHT11) which will both sense the temperature of the surrounding as well as sense the humidity of the surrounding, similarly a single sensor (MAX30100) is used to sense the SpO2 level as well as the pulse rate of the body. Hence decreasing the no. of sensors used, and therefore reducing the complexity and bulkiness.

3. Adding python based **GUI web server** for real time data values as well as quick diagnostics.

4. The web server consists of an 'email' button which sends the whole record of the baby's health parameters in an **excel sheet as an email attachmen**t to the doctor.

5. The **LED system**, which is one of a kind as compared to the previous implementations of the smart incubator,with two different codes for neonatal and infant babies which works according to the baby present in the incubator. It has separate conditions and loops for both mature and premature babies and immediately alarms the medical facilities in case of any danger, when the parameters exceed their usual safe limits. In case of premature babies, the conditions have been made more sensitive as minor aberrations in the parameters may harm the baby and could lead to fatal consequences.

RESULT AND ANALYSIS

Initially, the hardware was implemented for heart rate and spo2 monitoring, body temperature monitoring, and ambient monitoring on an individual basis. The collected results for each bodily health metric were studied by modifying behavioural or environmental conditions to have a better knowledge of how the sensors perform in response to certain changes.

The analysis of the signals acquired and how they were integrated to transfer the data to the cloud storage for graphical representation on the android application is presented in the following sections.

The LM35 output voltage is linearly proportional to the Celsius (Centigrade) temperature.

We set the calibration in the programme since the sensor has a linear + 10.0 mV/°C scale factor.

Vref = 5V

Analog to Digital Converter Count for 1°C = 10m/(5/1024) = 2.048

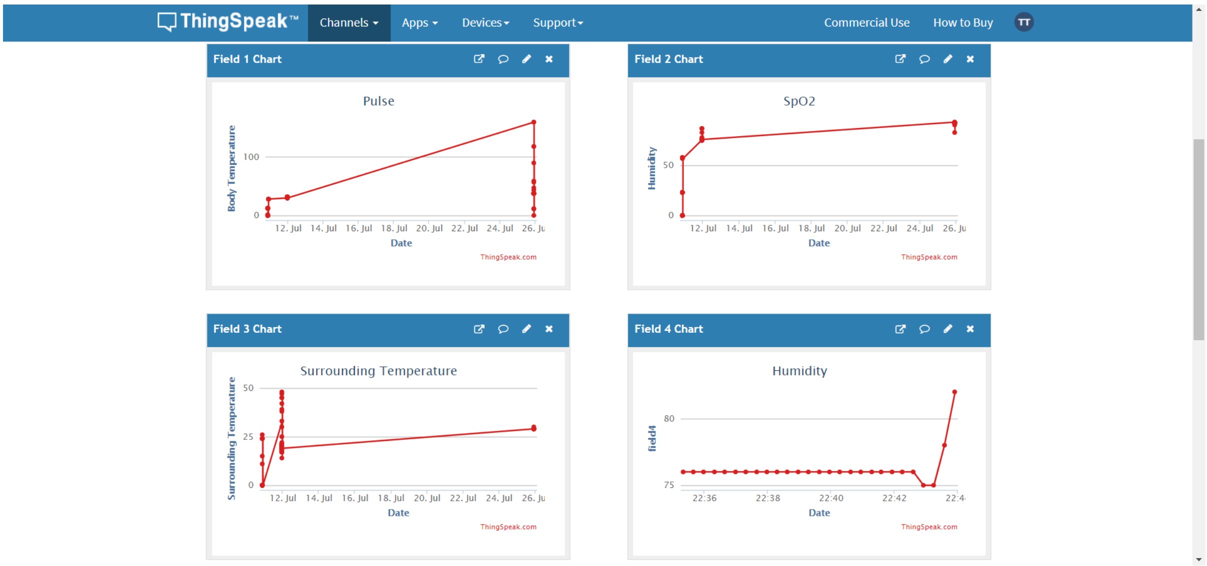
We Convert the analog reading (which goes from 0 - 1023) to a Temperature in centigrades.

Temperature = ADC Count/2.048

THINGSPEAK:

We use ThinkSpeak with the purpose of being able to see any sudden changes in the patient's health status quickly and graphically. It allows only authorised persons to access data about infants. As a result, data is secure and cannot be lost because it is constantly updated to a cloud where analysis can be performed.

The graphical representation of the information of the patient–l, i.e. body temperature, heartbeat, body position, ECG, SP02, and EMG, is shown in figure , which can be viewed by logging onto the Thingspeak server using a personal computer, with Date on the x-axis and the parameter on the y-axis.



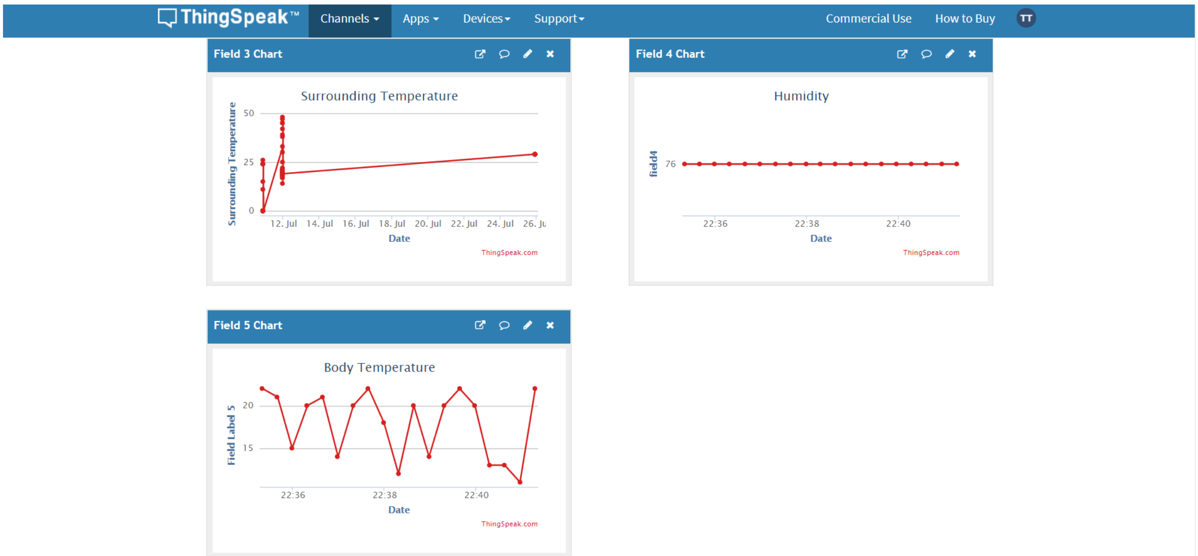


Fig 5 A snapshot of Thinspeak channel for data visualization: a. Heart rate (pulse) b.SpO_2 c. Ambient temperature d. Ambient humidity e.body temperature

Figure shows a screenshot of the continually acquired data in the ThingSpeak. Any medical staff member with an internet connection can simply monitor a specific patient as well as the ambient state in which the infant is now present.The patient data is secure since accessing it requires passing via a password-protected system, which means that only authorised personnel and parents may monitor it. A doctor can readily decide from a remote place by examining data. There is a precise level of threshold for these metrics in a smart health setting. When the data reaches a certain threshold, medical personnel must intervene.

PUSHOVER ANDROID APPLICATION :

The Pushover application was employed, which provided a very simple user interface enabling easy understanding of the application and alerts that could be received in real time on the medical personnel's smartphones.It includes features for monitoring a baby's health statistics , and sending alerts therefore allowing employees to keep a check on the baby from a distance.

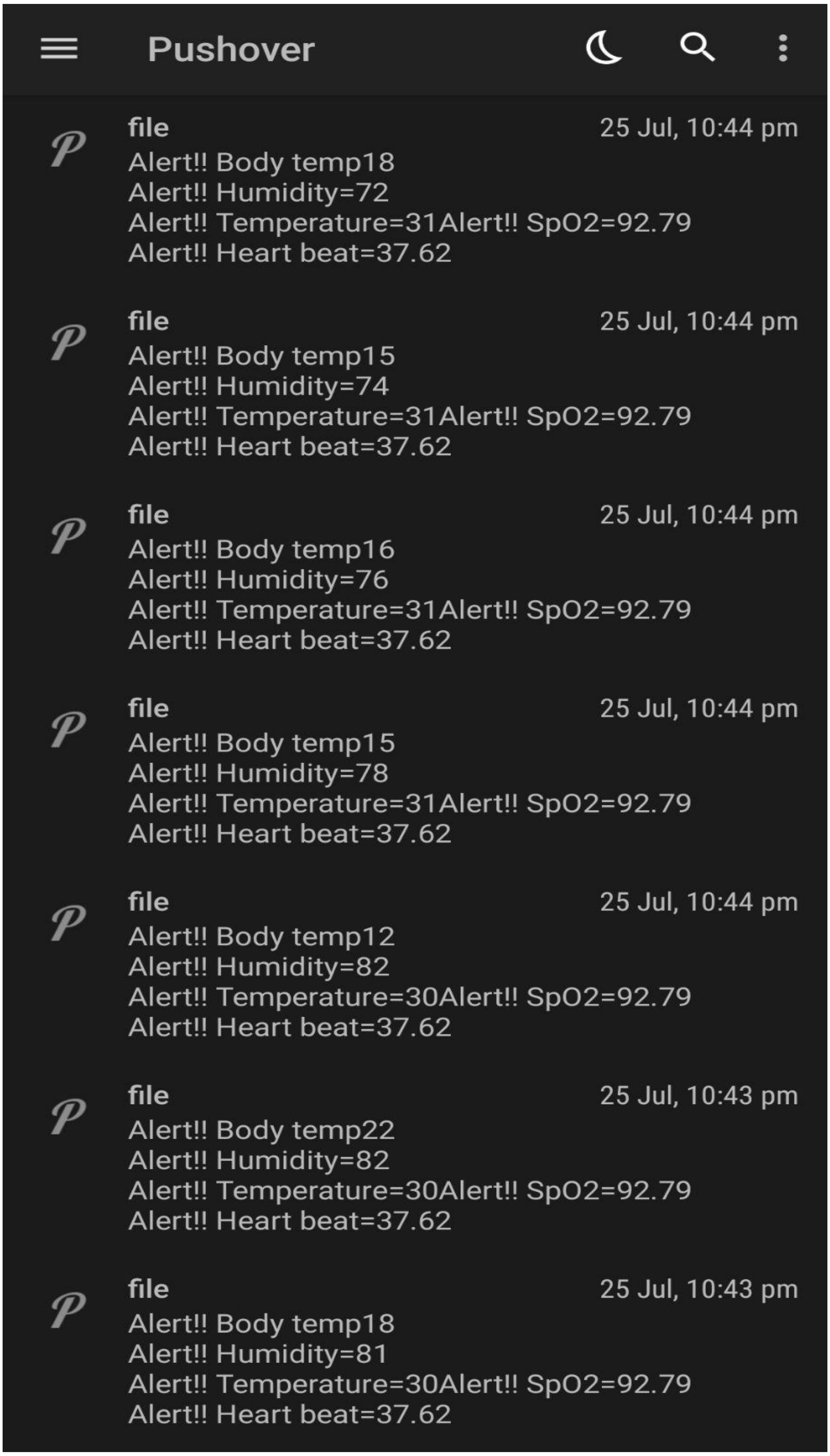


Figure 6 depicts the patient's information as seen through a flexible android application, which provides additional point-by-point data by displaying all variables, including timestamps.

WEB SERVER USING PYTHON BASED GUI:

We used a python package named tkinter to create a web server which displays the instantaneous data of each parameter, on a real time basis.This web server contains the 'email' button which sends an excel sheet of the stored data to the desired personnel for further analysis

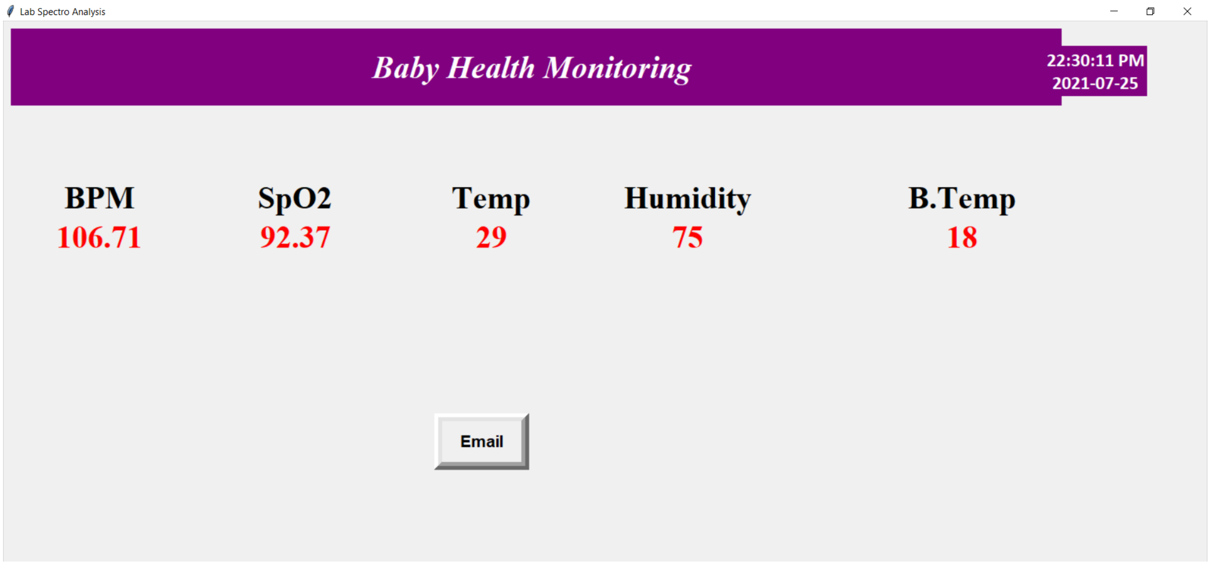


Fig 7 Python Based GUI which makes real time updates

EXCEL SHEET:

As demonstrated in the accompanying figure, an excel sheet includes real-time data of body temperature, ambient temperature and humidity, heart rate, and spo2. Furthermore, doctors can prescribe for a patient by easily monitoring his health status trends and evaluating past-present recordings.This is a one-of-a-kind function that allows the doctor to keep track of the baby's progress and assess it over a set period of time.

LED SYSTEM :

The system has two modes, one for a premature baby and other for a normal baby.A switch has been provided which when removed from pin A12 shifts the system to case 1(conditions for mature), whereas when the resistor (switch) is plugged in the system case 2 (conditions for premature)

Case 1 For Mature Baby :

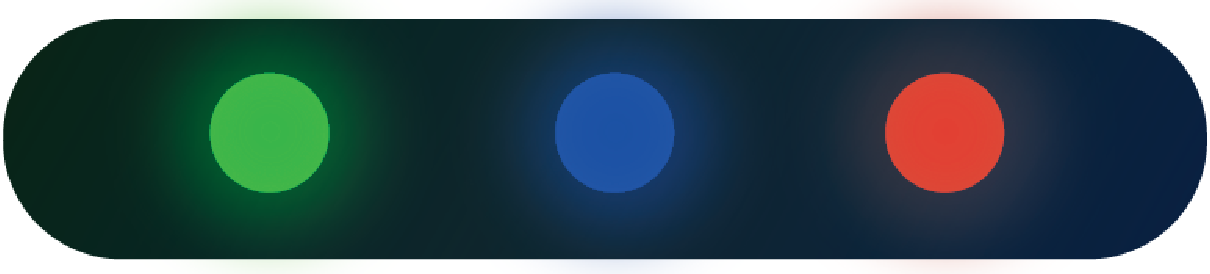


Fig 8 LED System Mature Baby

Condition 1 : Green Light Zero Risk - Condition parameters are within safe threshold

Condition 2 : Blue Intermediate Risk -If the body temp is lesser than 35 C or greater than 38 C

Condition 3 : Red Severe Risk - Need immediate attention if the heart bpm is greater than 150 or less than 80, or if the humidity is greater than 90%, or if the SpO2 level is less than 90, or if the ambient temp is greater than 38, or if the body temperature is greater than 38 or less than 35

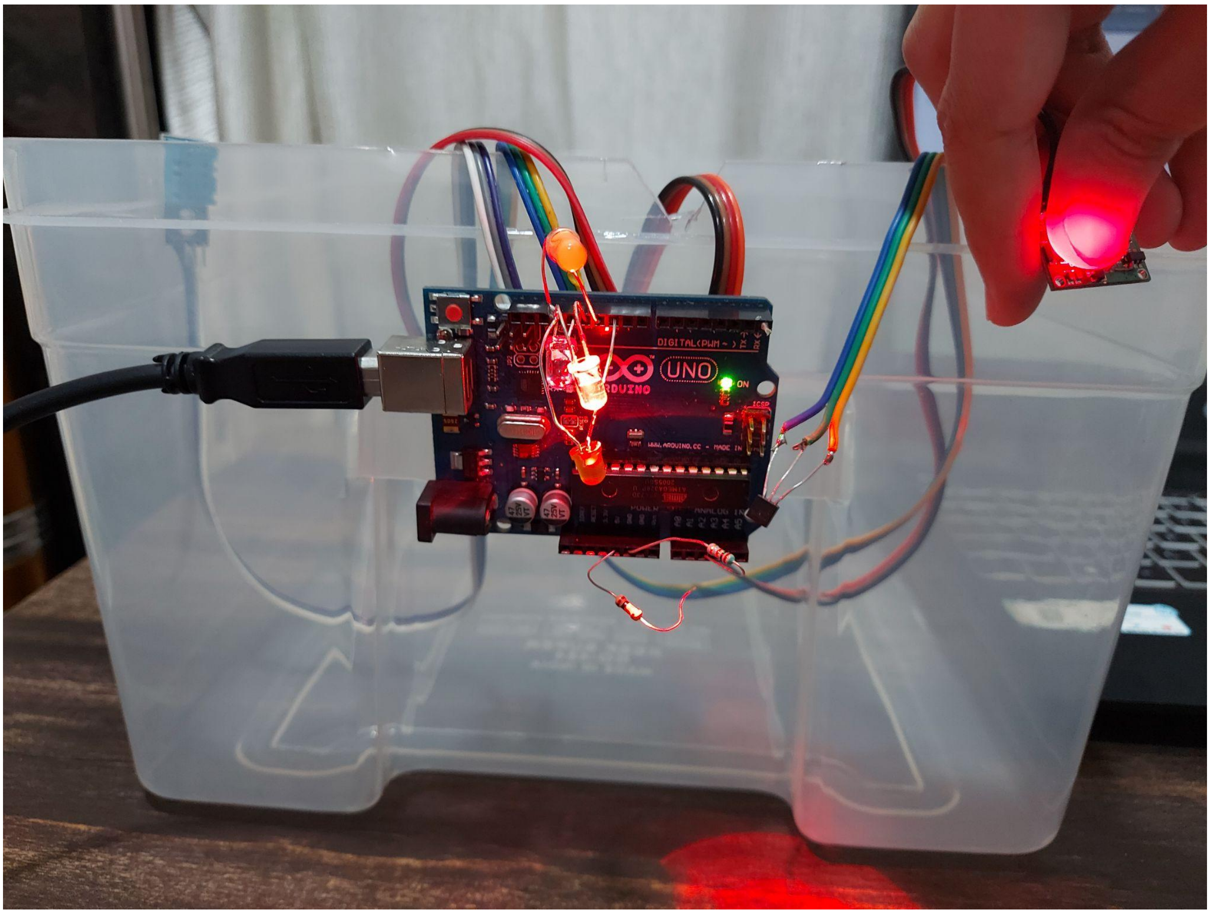


Fig 9 LED System for mature baby indicating emergency

Case 2 For Premature baby :

Fig 10 LED System Premature Baby

Glowing of an orange LED continuously indicates the presence of an premature baby in the incubator

Condition 1 : Green Light Zero - Risk Condition parameters are within safe threshold

Condition 2 : Red Severe Risk - Need immediate attention For a premature baby any significant change from normal health conditions can be fatal, therefore we have removed the intermediate level of alert and added only a second emergency level, The threshold therefore for this is narrower than Mature Baby (if the heart bpm is greater than 150 or less than 80, or if the humidity is greater than 90%, or if the SpO2 level is less than 90, or if the ambient temp is greater than 38 degree celsius, , or if the body temperature is greater than 38 or less than 35 degree C)

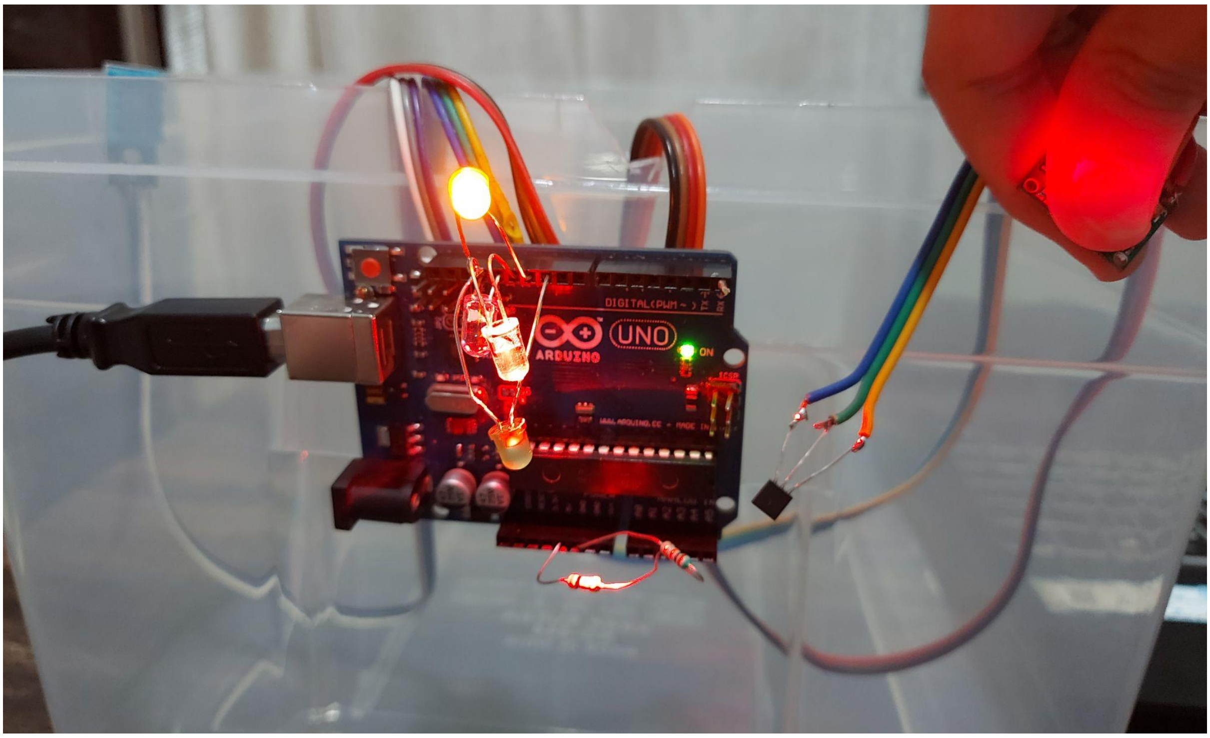


Fig 11 LED System for premature baby indicating emergency

CONCLUSION

By monitoring vital signs and intervening early, infant and newborn mortality can be reduced significantly. For a sick baby who has to be focused on treatment and requires a lot of attention to detect any symptoms or signs of infant ailments, real-time care is critical.
The proposed system keeps track of the infant's heart rate as well as the temperature and humidity of the environment. Temperature monitoring is carried out to ensure that the neonate's surroundings are appropriate. As the body temperature rises, temperature monitoring of the infant's body will aid in the detection of many other internal disorders such as infections, the common cold, and pneumonia, which all have a similar sign of fever. Humidity measurement levels can also aid in the detection of interior issues such as a cold or dehydration. Continuous heart rate monitoring in infants aids in the detection of any type of cardiovascular problem. It also aids in the detection of arrhythmias (irregular heartbeats). The system combines numerous functions into a single device, analyses data from sensors, and interacts with the device according to circumstances specified by conventional clinical research. The system is also simple to use. It can also aid parents, especially those in rural areas, by reducing their number of visits to the hospital and stress by being timely updated with their child's health progress.

LEARNING OUTCOMES:

1. Understand the significance of the Internet of Things in the healthcare domain.
2. Planning and discussion of the architecture, operation, and practicality and scalability of an IoT solution
3. Interfacing various analog and digital sensors with arduino uno and getting familiar with the arduino IDE.
4. Setting up thingspeak channels and retrieving sensor data in the cloud as well as webs browser.

ACKNOWLEDGEMENT

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SOURCE CODE

Arduino IDE :

```
#include "DHT.h"

#define DHTPIN 5

#define DHTTYPE DHT11
```

```
int h,t;int body;
DHT dht(DHTPIN, DHTTYPE);
#include <Arduino.h>
#include <math.h>
#include <Wire.h>
float bpm=0,so=0;
#include "MAX30100.h"

MAX30100* pulseOxymeter;

void setup() {
  Wire.begin();
  Serial.begin(9600);

  dht.begin();
  //pulseOxymeter = new MAX30100(
DEFAULT_OPERATING_MODE, DEFAULT_SAMPLING_RATE,
DEFAULT_LED_PULSE_WIDTH, DEFAULT_IR_LED_CURRENT,
true, true );
  pulseOxymeter = new MAX30100();
  pinMode(13, OUTPUT);pinMode(12,
OUTPUT);pinMode(11, OUTPUT),pinMode(10, OUTPUT);
pinMode(A2, INPUT);
  //pulseOxymeter->printRegisters();
}

void loop() {
  //return;
```

```
  //You have to call update with frequency at least 37Hz. But the closer you call it to 100Hz the better, the filter will work.
  for(int i=0;i<5;i++)
  {
    for(int j=0;j<=100;j++)
  {
  pulseoxymeter_t result = pulseOxymeter->update();
  if( result.pulseDetected == true )
  {bpm=result.heartBPM;
   so= result.SaO2;delay(10);}


   h = dht.readHumidity();
   t = dht.readTemperature();
  body = analogRead(A0);
  body= body*(5000/1023);
  body= body/10;


  if(digitalRead(A2)==HIGH)
  {

digitalWrite(11,HIGH);digitalWrite(13,LOW);digitalWrite(10,HIGH);
  if (bpm<120 || bpm>160)
  {digitalWrite(12,HIGH);digitalWrite(10,LOW);}
  else if (so<85 || so>93)
  {digitalWrite(12,HIGH);digitalWrite(10,LOW);}
  else if (h>70 || h<60)
  {digitalWrite(12,HIGH);digitalWrite(10,LOW);}
```

```
 else if (t>22)
{digitalWrite(12,HIGH);digitalWrite(10,LOW);}
 else if (body>37.4 || body<35)
{digitalWrite(12,HIGH);digitalWrite(10,LOW);}
else
{digitalWrite(12,LOW);}
}
else
{digitalWrite(11,LOW);digitalWrite(10,HIGH);
if (bpm<80 || bpm>140)

{digitalWrite(12,HIGH);digitalWrite(13,LOW);digitalW
rite(10,LOW);}
  else if (so<93 || so>97)

{digitalWrite(12,HIGH);digitalWrite(13,LOW);digitalW
rite(10,LOW);}
  else if (h>60 || h<40)

{digitalWrite(12,HIGH);digitalWrite(13,LOW);digitalW
rite(10,LOW);}
   else if (t>=23)

{digitalWrite(12,HIGH);digitalWrite(13,LOW);digitalW
rite(10,LOW);}
   else if (body>=38)

{digitalWrite(12,HIGH);digitalWrite(13,LOW);digitalW
rite(10,LOW);}
    else if (t<=20 || t>22)
```

```
{digitalWrite(12,LOW);digitalWrite(13,HIGH);digitalW
rite(10,LOW);}
   else if (body>38||body<35)

{digitalWrite(12,LOW);digitalWrite(13,HIGH);digitalW
rite(10,LOW);}
  else
  {digitalWrite(12,LOW);}


    }
  delay(10);
  }


  }
 Serial.print( bpm); Serial.print(" ");
    Serial.print( so ); Serial.print("
");Serial.print(t);Serial.print("
");Serial.print(h);Serial.print("
");Serial.print(body);Serial.println(" ");
}
```

main.py -

```python
def print_hi(name):
   # Use a breakpoint in the code line below to debug your
script.
   print(f'Hi, {name}')  # Press Ctrl+F8 to toggle the
breakpoint.
# Press the green button in the gutter to run the script.
```

```python
if __name__ == '__main__':
    print_hi('PyCharm')
```

sweet.py -

```python
from time import sleep
import tkinter as tk
from tkinter import Message, Text
from tkinter import font as tkFont
import serial
import yagmail
from time import strftime
from datetime import date
import datetime
import urllib.request
import csv
global pieces
global count
count=0
import http.client, urllib
pieces=['0','0','0','0','0']
myAPI = 'DUQS4ORSTCH9C8HU'
ser = serial.Serial('COM5',baudrate=9600)
fields = 'Date'+','+ 'Time'+',' +'Heart rate'+',' +'SpO2'+','
+'Temp'+','+ 'Humidity'+','+'Body temp'
filename = "university_records.csv"
baseURL = 'https://api.thingspeak.com/update?api_key='+myAPI
file = open(filename, "a")
print("Created file")
file = open(filename, "a")
file.write(fields+'\n')
file.close()
```

```
window = tk.Tk()
window.title("Lab Spectro Analysis")
message = tk.Label(window, text="Baby Health Monitoring ",
bg="purple", fg="White", width=58, height=2,
              font=('times', 30, 'italic bold'))
message.place(x=10, y=10)

data1 = tk.Label(window, text="", fg="black", width=10,
height=1, font=('times', 30, 'bold'))
data1.place(x=0, y=200)
datas1 = tk.Label(window, text="", fg="Red", width=10,
height=1, font=('times', 30, 'bold'))
datas1.place(x=0, y=250)
data2 = tk.Label(window, text="", fg="black", width=10,
height=1, font=('times', 30, 'bold'))
data2.place(x=250, y=200)
datas2 = tk.Label(window, text="", fg="Red", width=10,
height=1, font=('times', 30, 'bold'))
datas2.place(x=250, y=250)
data3 = tk.Label(window, text="", fg="black", width=10,
height=1, font=('times', 30, 'bold'))
data3.place(x=500, y=200)
datas3 = tk.Label(window, text="", fg="Red", width=10,
height=1, font=('times', 30, 'bold'))
datas3.place(x=500, y=250)
data4 = tk.Label(window, text="", fg="black", width=10,
height=1, font=('times', 30, 'bold'))
data4.place(x=750, y=200)
datas4 = tk.Label(window, text="", fg="Red", width=10,
height=1, font=('times', 30, 'bold'))
datas4.place(x=750, y=250)
data5 = tk.Label(window, text="", fg="black", width=10,
height=1, font=('times', 30, 'bold'))
data5.place(x=1100, y=200)
```

```
datas5 = tk.Label(window, text=pieces[4], fg="Red", width=10,
height=1, font=('times', 30, 'bold'))

datas5.place(x=1100, y=250)

def sendpush(condition):

  conn = http.client.HTTPSConnection("api.pushover.net:443")

  conn.request("POST", "/1/messages.json",

               urllib.parse.urlencode({

                  "token": "aumn1tzk7jq9m17sz8uqcizwgwq9bk",

                  "user": "uchoxvtez72q7aa85dm3tpc19ytkv2",

                  "message": condition,


               }), {"Content-type":
"application/x-www-form-urlencoded"})

  conn.getresponse()


def email():

  sub = "Daily Report for " + str(date.today())

  # mail information

  yag = yagmail.SMTP(user="i4usmriti@gmail.com", password='')

  body = "kindly Find Attachment"

  # sent the mail

  yag.send(

     to="i4usmriti@gmail.com",

     subject=sub,  # email subject

     contents=body,  # email body

     attachments=filename  # file attached

  )

def time1():

  global pretime

  global pieces

  global count
```

```
  date1 = date.today()
  string12 = strftime('%H:%M:%S %p')
  string = string12 + '\n' + str(date1)
  while ser.in_waiting>0:
     data = ser.readline().decode()
     pieces = data.split(" ")
     datafile = str(date1)+','+string12+',' +pieces[0] + ',' +
pieces[1] + ',' + pieces[2] + ',' + pieces[3] + ',' +
pieces[4]
     file = open(filename, "a")
     file.write(datafile)
     file.write('\n')
     file.close()
     conn = urllib.request.urlopen(
        baseURL + '&field1=' + str(pieces[0]) + '&field2=' +
str(pieces[1]) + '&field3=' + str(
           pieces[2]) + '&field4=' + str(pieces[3]) +
'&field5=' + str(pieces[4]))
     # Closing the connection
     conn.close()


     if float(pieces[4])>30 or float(pieces[0])<90 or
float(pieces[2])>=37.8:
        condition ="Alert!! Body temp"+
str(pieces[4])+'\n'+"Alert!! Humidity="+
str(pieces[3])+'\n'+"Alert!! Temperature="+
str(pieces[2])+"Alert!! SpO2=" + str(pieces[1])+'\n'+"Alert!!
Heart beat="+ str(pieces[0])
        sendpush(condition)
     break


  lbl.config(text=string)
```

```python
  data1.config(text="BPM")
  data2.config(text="SpO2")
  data3.config(text="Temp")
  data4.config(text="Humidity")
  data5.config(text="B.Temp")
  datas1.config(text=pieces[0])
  datas2.config(text=pieces[1])
  datas3.config(text=pieces[2])
  datas4.config(text=pieces[3])
  datas5.config(text=pieces[4])
  lbl.after(1, time1)


lbl = tk.Label(window, font=('calibri', 18, 'bold'),
           background='purple',
           foreground='white')

# Placing clock at the centre
# of the tkinter window
lbl.place(relx=0.95,
       rely=0.04,
       anchor='ne')

btnExit = tk.Button(window, padx=16, pady=8, bd=10,
                fg="black", font=('arial', 16, 'bold'),
                width=5, text="Email",
                command=email)
btnExit.place(x=550, y=500)
time1()
window.mainloop()
```