IOT BASED PHOTOTHERAPY MACHINE

A PROJECT REPORT

submitted By

NITHIN KRISHNAN P
TVE18MCA039

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in partial fullfilment of the requirements for the award of the degree

of

Master of Computer Applications

Department of Computer Applications
College of Engineering
Trivandrum-695016

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DECLARATION

I undersigned hereby declare that the project report Iot Based Phototherapy Machine, submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mr. Neevan R, Assistant Professor, College of Engineering Trivandrum. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title.

Place: Trivandrum

Date: 08-July-2021   NITHIN KRISHNAN P

DEPARTMENT OF COMPUTER APPLICATIONS

COLLEGE OF ENGINEERING
TRIVANDRUM

CERTIFICATE

This is to certify that the report entitled **IOT BASED PHOTOTHER-APY MACHINE** submitted by **NITHIN KRISHNAN P** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications is a bonafide record of the project work carried out by him under my guidance and supervision. This report in any form has not been submitted to any University or Institute for any purpose.

Internal Supervisor   External Supervisor

Head of the Dept

ACKNOWLEDGEMENT

ABSTRACT

The Phototherapy also called a light therapy is used extensively to reduce the high bilirubin levels of the newborns suffering from jaundice. This therapy consists of exposure to daylight or to specific wavelength of light using light emitting diodes, lasers, flourescent lambs, dichroic lamps or very bright light, full spectrum light. This project is used to solve this condition with the help of Phototherapy Machine. In this project we have implemented a prototype capable of sensing the temperature, control exposure time. Additional Temperature sensor, Weight sensor, heartbeat sensor, Spo2 calculator is also included in the proposed system. All the output data is uploaded to the server and doctor can analyse it using his computer.

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Chapter 1

Introduction

Phototherapy is a technique used to reduce high rate of yellowish colour on newborn babies. The reason for this yellow colour is high bilirubin levels results to jaundice. The only solution to solve this condition is to expose baby to a light. In hospitals baby lies in a cabinet and exposed to a light, and nursed or doctor must monitor frequently or watch the baby. It is much time consuming and not a good practical method. Continues high exposure of light will result in some skin condition to the baby.

I propose the Phototherapy Machine Using IoT and solve this problem. This project is designed to monitor and control the exposure of light automatically using Iot devices. 4 florescent led and 4 UV light is used and the intensity of the light is reduced automatically when yellowish colour is reduced. The machine also included with Heartbeat sensor, Temperature sensor, Weight sensor, Spo2 sensor. All the Datas are uploaded to the server and doctor can view it using the computer or his Smartphone. The proposed system is Cheap and more useful than the existing system.

1.1 Problem Definition

1.1.1 Motivation

Many babies are born everyday and they need continues care. Jaundice is an common condition that arises in newborn babies therefore they need to be solved quickly. currently the existing method is not practical because it needs more time and labour. A nurse need to assigned to every baby. so, the proposed system will help to monitor multiple babies and help to solve the jaundice condition automatically.

1.1.2 Problem definition

The proposed system analyses the baby's skin and check for yellowish colour and automatically adjust the intensity of the light until the yellow colour is completely gone. The project also has a fail safe where if the yellow colour does not reduce the system will automatically shutdown after limited amount of time to save baby from continues exposure to light. The system starts only when it detects the baby and shutdown after the cycle is completed. In next step it reads the temperature and weight of baby and sends data to the server. At the final step the oximeter analyses the heartbeat and spo2 level and take the average and also update the data to the server. While taking the spo2 level it should be done while covering whole finger and it will not get correct reading if exposed under any light.

1.1.3 Objectives And Contributions

The objective is the testing of the system because it can only tested on real life condition. It was a main task to find the yellowish content and use it to check whether the intensity of the light is reduced or not. The next objective is to take average weight value of the baby. The weight sensor takes value in milligram and amplifies it to gram. Finding the temperature is also a task because it was difficult to perform if under a room using prototype devices, The next objective is to find the Heartbeat and spo2 level of the baby. The Heart beat was found using the pulse oximeter and the spo2 value was difficult because of the lighting inside a room. It was difficult to get the correct average sp02 value. The fingered should not be exposed directly under light. The final objective was to upload the output datas to a server. It was impossible to buy a server so I use demo server which shows the output value of the system while connected to same network. The datas are send using that network that has same ip address.

Chapter 2

Literature Review

There are many Journals checked for the execution of Phototherapy machine

M. Afnan Nabizath, S.Anshu Soumya, V. Boomitha, C. Meena and P. Sridharan [1] Proposed a paper called "New Design for Phototherapy Device and Skin Colour Analysis" to detect and cure jaundice in new born babies using Light therapy.

Ankan Gupta, Ashok Kumar, and PreetiKhera [2] Proposed a paper on "Jaundice Prediction through NonInvasive Techniques: Issues and Challenges" it talks about the problems rise in using the high intensity light on baby.

FulgencioYonadab Lopez Silva, Suren StolikIsakina, Jose Manuel Rosa Vazquez[3] proposed a paper with title " "Design and Construction of Phototherapy System Temperature Control "used a method that the system control the babys temperature and analyses it

Harel Rosen, Arye Rosen, Danielle Rosen, BanuOnaral, Mark Hiatt[4] proposed a paper with title " "Use of a Light Emitting Diode (LED) Array for Bilirubin Phototransformation" "Develope a server to analyse and monitor the ouput from the devices.

Sri logeshwaran R, sivakumar P, Kuldeep [5] proposed a paper with title "A Novel design of low cost LED phototherapy equipment" which describes the use of phototherapy machine in real life and implementing it everywhere.It propose how to handle it with only low cost than existing system.

Chapter 3

Requirement Analysis

3.1 Purpose

Practically Everyone incline toward mechanization over a manual framework. In the case of Phototherapy machine important time of doctors and nurses are lost while monitoring the baby continuously. Therefore, with the introduction of automation the device will automatically control itself and nurse does not have to watch the baby at frequent times. This will help the nurse monitor more baby's at the same time. And it is very useful at Real life Applications.

3.2 Overall Description

3.2.1 Product Functions

- Senses whether there is baby in the cabinet.

- controls the intensity of the light, senses temperature, weight.

- Senses the Heartbeat and spo2 level of the baby.

- Send the data to the server using NodeMCU.

- Display all data in the server

3.2.2 Hardware Requirements

- Esp32 Micro controller

- LCD Module

- Regulator IC

- Colour Sensor

- Temperature sensor

- Weight sensor

- pulse sensor

- connection wire unit

3.2.3 Software Requirements

- Arduino UI

- Arduino studio IDE

- phpMySql

3.3 Technologies Used

3.3.1 Arduino

Arduino is an open-source devices stage subject to easy to use hardware and programming. Arduino can get details from any sensor, light sensor, a finger , a text message. You can make any program and working on the arduino and send to the micro controller. All of this is make possible using the Arduino programming language and the Arduino Softer (Arduino IDE).

3.3.2 NodeMCU (Esp32)

NodeMCU, here we have taken Esp32 micro controller Which is open source board structure are available everywhere. We have taken the Esp32 because unlike other micro controllers this one has Built-in WiFi and Bluetooth module. It will help to reduce the unwanted connection wires. It has mainly 2 cores named Processor CPU and Application CPU. The processor CPU controls the WiFi, Bluetooth and all peripheral devices While the Application CPU controls the application programming area. It can be connected via USB port. Has 520Kb Ram and works at 3.3V.

3.3.3 LCD Module (16x2)

LCD modules are very commonly used in most embedded Projects Because it is cheap price and availability. It is named 16x2 because it has 16 columns and 2 rows. An Interface IC HD44780 is used to handle everything with the help of MCU. The function of IC is to get Commands and Data from MCU and Display to on the screen. Operating voltage is 4.7v to 5.3v. It can display both Alphabets and numbers.Can work on both 8bit and 4bit.

3.3.4 Regulator IC (7805)

Voltage Regulator are important content in electronic Circuits. They will provide a constant output voltage for a given varies input voltage. The name 7805 means that it has '78' positive voltage regulator and '5V' as output. It can support output current upto 1.5A. The Minimum input voltage is 7V and Maximum input voltage is 25V. It operates at 5mA current. Here internal thermal Overload and Short circuit protection is available.

3.3.5 Temperature sensor

Here we use 1 wire temperature sensor. It requires only one digital pin for two way communication with the microcontroller. The temperature sensor is precise and needs no external components to work. It can measure temperature from 55 degree to +125 degree. The sensor can be powered with 3V to 5.5V power supply and consumes only 1MA current.

3.3.6 Weight Sensor

The load cell is a transducer that transforms force or pressure into electrical output. Load cell has strain gauge which deforms when force applied on it. Electrical signals generated by the load cell are in few milli volts, so they need to be amplified. Hence, HX711 chip is a analog to digital converter used to amplify low electric output to high.

3.3.7 Pulse sensor (MAX30100)

The device has two LED's, one emitting red light, another emitting infrared light. Both the red light and infrared light is used to measure oxygen levels in the blood. It reads the absorption levels for both light sources and stored them in a buffer that can be read via I2C.During a pulse oximeter reading, led Sensor like device is placed on a finger, earlobe, or toe. Small beams of light pass through the blood in the finger, measuring the amount of oxygen. It does this by measuring changes in light absorption in oxygenated or de-oxygenated blood.

3.3.8 Colour sensor

The sensor has 4 different types of diodes. Red, blue, green and white. Each type can be activated using S2, S3 section pins. We can set frequency scaling to all the lights to control its intensity. Input voltage is 2.7V to 5.5V. It can be directly connected to the digital pins of micro controller.

3.4 Functional Requirements

Functional requirements speak to the proposed conduct of the framework. This conduct might be communicated as administrations, errands, or capacities that the predetermined framework is required to perform. The accompanying useful prerequisites have been recognized for this venture.

3.4.1 Testing

The framework should be tested under different ecological conditions like high and low temperature and dampness, changing force of light, etc.. The output from different sensor modules is then sent to server using Micro controller. The testing of temperature sensor and pulse oximeter is done under room temperature to get adequate output.

3.4.2 User Interface

To make the proposed system easy to understand handle by the users,Arduino IDE is utilized to code the sensors. The website will show the correct output results of all the sensors and using MySql the history of database can be viewed.
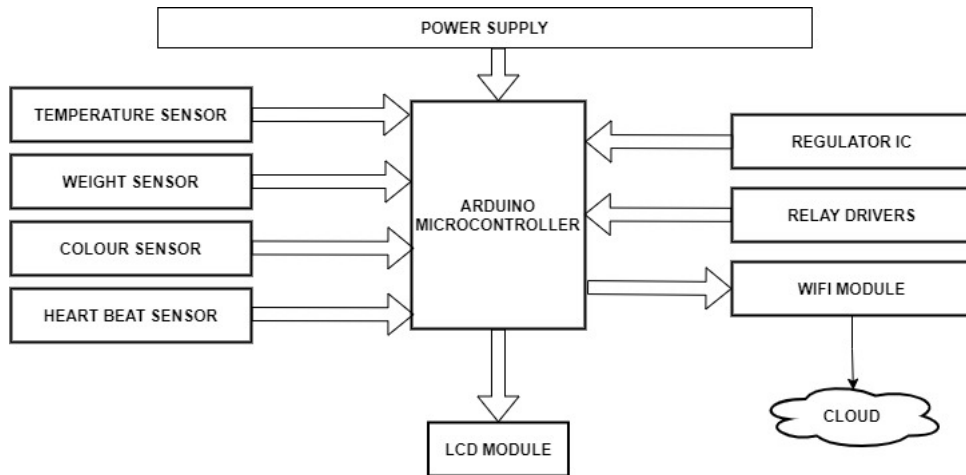

Figure 3.1: Design

Chapter 4

Methodology and System Design

4.1 System Design

The Phototherapy machine is utilizing IoT is a hardware execution with an IoT application. The Sensors detects the baby and gives the weight and body temperature of the baby at first. The light sensor is then activated and detects the yellowish colour on the skin and then adjusts the intensity of the light automatically. The next step is the function of the pulse oximeter the sensor is attached to the baby's finger and it gives the Heartbeat reading and spo2 level. All these datas are uploaded to the server via micro controller (esp32) Doctor or nurse can monitor the status of these sensors datas using a computer or android device.

4.1.1 Overall Design

System is a Hardware model that incorporates IoT. Colour sensor sense the yellow colour on the skin. Temperature sensor finds the body temperature. Weight sensor gives value in gram. Oximeter gives the Heartbeat reading and spo2 levels. All these data are uploaded to server with the help of Micro controller.

4.1.2 User Interface Design

The principle UI used here is a simple website which shows the datas gives by all the sensors. The website is very user-friendly it gives only required information which anyone can understand quickly.

4.2 Data Flow Diagram

A Data Flow Diagram is an pictorial representation which shows the working and flow of data. DFD can be used to handle the easy handling of data. The DFD gives pictorial representation about the information and commitment of all the components and the methods which can be understood by anyone. When the baby is lied in the bed the weight sensor activates and gives reading of the load sensor to the micro controller. Then next the temperature sensor takes average reading of the baby's body temperature and updates both readings onto the server via micro

controller. The light sensor analyses the baby's skin and detected if yellowish colour is present. If present, it activates the light and controls the intensity of the light according to the level of yellowish colour present. If not, the system will automatically shutdown after limited amount of time. Then the next step is getting status of Heartbeat and spo2.The oximeter is attached to the baby's finger and output of Heartbeat and spo2 reading is uploaded to the server. The user can then monitor the output of all the sensors using a computer or android device.
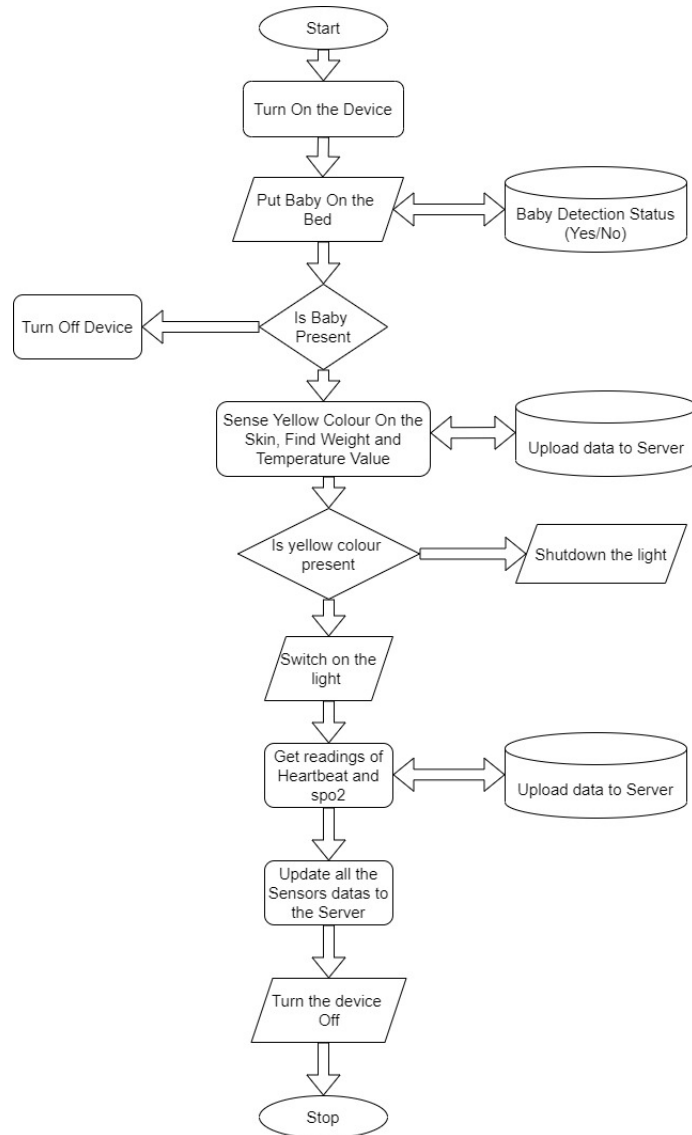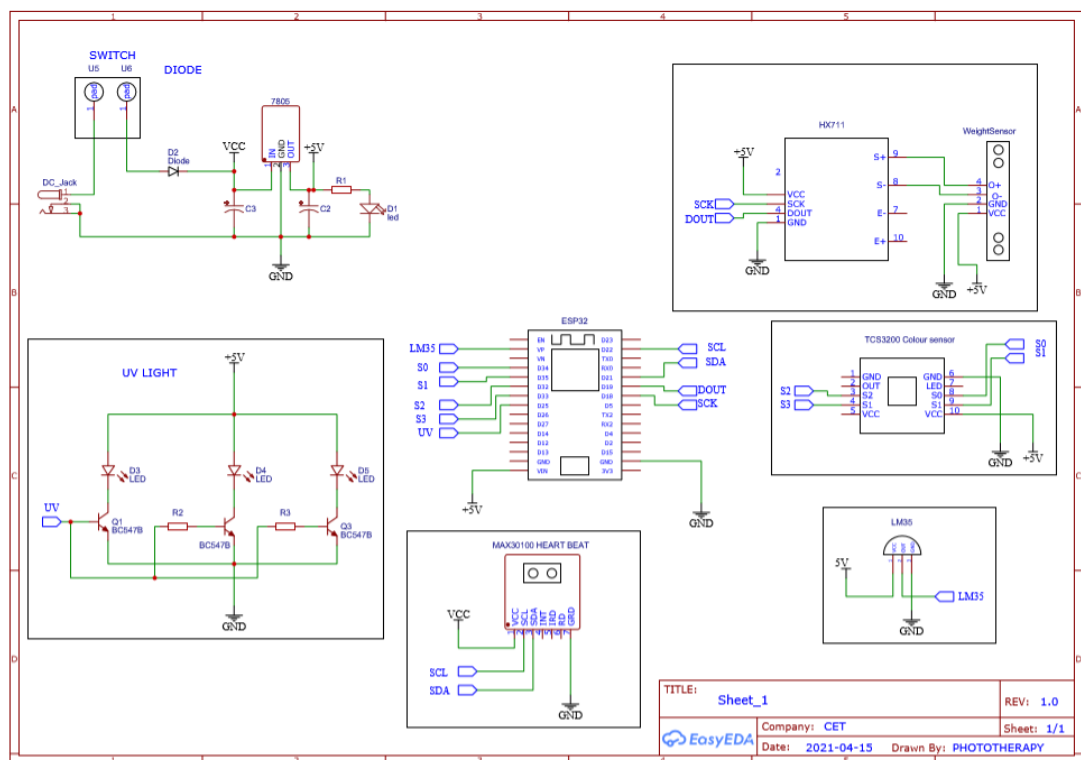

Figure 4.1: Level 1 DFD

4.3 Circuit Diagram

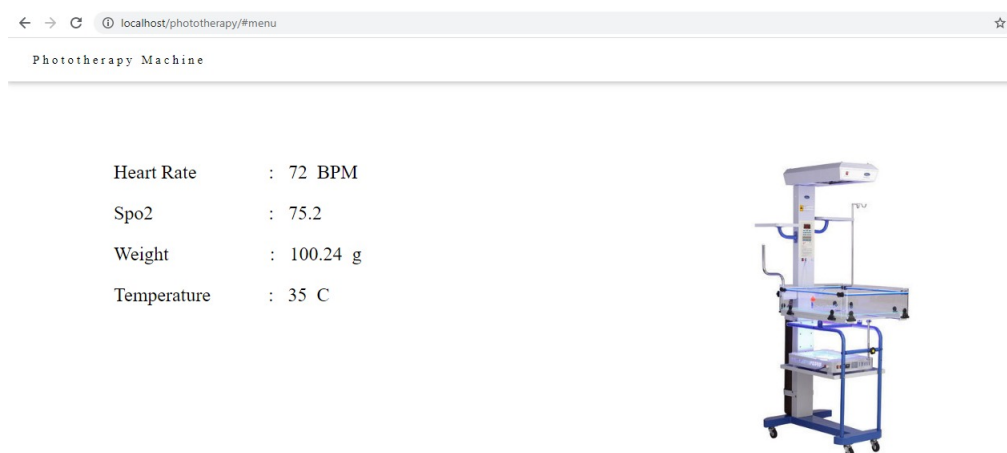
Figure 4.2: Circuit diagram

4.4 Screenshots

Figure 4.3: Website

Figure 4.4: Prototype device

Figure 4.5: empty output

Figure 4.6: Final Result

Chapter 5

Coding, Implementation and Testing

Algorithm 1 Algorithm: Connection of database and upload to server

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1: Start
2: Create a User interface to display the ouput from all the sensors
3: Connect with Sql database to store and get data
4: Create a notification if baby is present or Not
5: Activate all sensors and upload data to the server
6: Check the status of the baby
7: Check the status of all the sensors
8: Notify if any failure occur
9: Stop

Algorithm 2 Algorithm: Arduino microcontroller

1: Start
2: Turn on the light sensor if baby present
3: Activate Temperature sensor and weight sensor
4: Display the status in LED module and website
5: Activate Pulse sensor and initialize connection
6: Display readings in LED module and Upload to server
7: Send all the data from sensors and the Relay to Sql database using Esp32
8: Stop

5.1 Testing methods done for the project

System testing is a project testing method which is used for checking whether there is any faults or errors occurring when the project is run. Testing checks for errors and failure and checks if all the system works perfectly with the environment. There are three types of testing which is handles here. First one is the unit testing which test small piece of code. Here the individual components or devices are tested one at a time.Next one is integration testing, the modules that are tested previously are combined together and tested once more. System testing is the final testing process. It checks whether the project that is proposed her meet its specified requirements else the testing procedure will be a failure. The testing methods will test for limitation and failure in the whole system which results in stop working of the system. Main task of a testing process is to check whether the project can be implemented on real life without any Error or Failure. And decides that it will run successfully on the current environment. This test approach record depicts the best possible strategies, technologies, and framework used to working, form, execute and monitor the testing of the assignment "IoT based photo therapy Machine".

5.2   Unit Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Senses the Baby	Baby is detected and UV light turned ON	Same as expected	Pass
2	Weight and Temperature sensor activated	Detects the weight and body temperature of the baby	Same as expected	Pass
3	Heartbeat sensor and pulse sensor activated	Takes Heartbeat reading and spo2 levels	Same as expected	Pass

Table 5.1: Unit test cases and results

5.2.1 Integration Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Integrate the NodeMCU and MySql to store data	NodeMCU and Mysql database integrated	Same as expected	Pass
2	Integrate php and Webserver to retrieve data	Server Integrated with database	Same as expected	Pass

Table 5.2: Integration cases and result-1

5.2.2 System Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Detects the baby	Baby detected and UV light activated automatically	Same as expected	Pass
2	Sensors Activated	Weight sensor,Temperature Sensor,Pulse sensor gives status update	Same as expected	Pass
3	Shows the solution	With the given sensors data the solution is provided to the user	Same as expected	Pass

Table 5.3: System test cases and results

Chapter 6

Results and Discussion

The phototherapy machine is a medical field related IoT project. It is put forward to reduce the working hours of doctors and nurses by the introduction of automated machines. The existing system is not at all practical to the current environment. This project helps to solve the jaundice condition in new born babies by dealing with the problem using IoT devices, and all the mechanism working is done automatically and results is uploaded to server and monitored via android device or computer.

6.1 Discussion

Here the proposed system has further advantages than the existing system. The proposed system is very less cost compared to existing system.It is also very user friendly. Like any new systems this project also have few limitations.

6.1.1 Advantages

- High data accuracy

- reduces manual data entry

- User friendly

- Less time consuming

- Less labour hours

6.1.2 Limitations

- Frequent light exposure may affect some babies

- Readings of sensors vary with room temperatures.

- Readings should be taken carefully

Chapter 7

Conclusion and Future Work

Here the Proposed system is an Phototherapy machine using IoT devices. It was brought about a new prototype which overcomes the drawbacks of the existing devices. Firstly, all the working of the devices is controlled automatically and results are uploaded to server at frequent times. Phototherapy is a machine used for reducing the high rate of bilirubin levels in newborn babies which causes the condition Jaundice. The project is introduced to solve this problem with the help of IoT devices The machine first detects if a baby is present in the bed. If present it then automatically activates the UV light and starts adjusting the intensity of the light according to level of yellowish colour. Next the Temperature sensor and weight sensor finds the body temperature and weight of baby in gram and upload the data to the server. Last step is the heartbeat reading and spo2 level reading which is achieved with the help of pulse oximeter. All the datas from the servers are instantly uploaded onto the server which can be monitored via a Android device or Computer. Overall the result achieved are satisfying and accurate.And we can conclude that the project was successful.

7.1   Future Works

- Making a Cheat phototherapy Machine

- Introducing a mobile application that control all the sensors

- Getting results form more than one baby at the same time

- Doctor will have authority to control the whole device

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