A Project Report on

IOT Based Smart Healthcare Monitoring System

Submitted in partial fulfillment of the requirements
for the award of the degree of

Bachelor of Engineering

in

Information Technology

by

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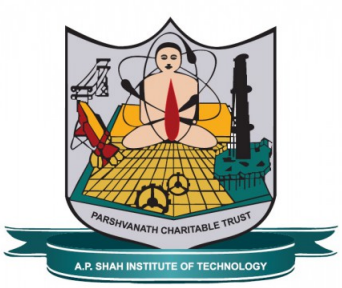
Under the Guidance of

Prof. Sonal Jain



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Approval Sheet

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CERTIFICATE

This is to certify that the project entitled ***"IOT Based Smart Healthcare Monitoring System"*** submitted by ***"Divya Shepal" (19104053)*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Information Technology***,to the University of Mumbai,is a bonafide work carried out during academic year 2022-2023.

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Divya Shepal
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Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

Healthcare is given the extreme importance now a- days by each country with the advent of the novel corona virus. So in this aspect, an IOT based health monitoring system is the best solution for such an epidemic. Internet of Things (IOT) is the new revolution of internet which is the growing research area especially in the health care. With the increase in use of wearable sensors and the smart phones, these remote health care monitoring has evolved in such a pace. IoT monitoring of health helps in preventing the spread of disease as well as to get a proper diagnosis of the state of health, even if the doctor is at far distance. In this project, a portable physiological checking framework is displayed, which can constantly screen the patient's heartbeat, temperature and other basic parameters of the room. We proposed a nonstop checking and control instrument to screen the patient condition and store the patient information's in server utilizing Wi-Fi Module based remote correspondence. A remote health monitoring system using IoT is proposed where the authorized personal can access these data stored using any IoT platform and based on these values received, the diseases are diagnosed by the doctors from a distance.

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IOT:	Internet of Things
WSN:	Wireless Sensor Network
HCMS:	Healthcare Monitoring System
BPM:	Beats Per Minute
SpO2:	Oxygen Saturation
HRV:	Heart Rate Variability
IoT-HCMS :	Internet of Things Healthcare Monitoring System.
Wi-Fi:	Wireless Fidelity

Chapter 1

Introduction

The increased use of mobile technologies and smart devices in the area of health has caused great impact on the world. Health experts are increasingly taking advantage of the benefits these technologies bring, thus generating a significant improvement in health care in clinical settings. Likewise, countless ordinary users are being served from the advantages of the M-Health (Mobile Health) applications and E-Health (health care supported by ICT) to improve, help and assist their health. According to the constitutions of World Health Organization (WHO) the highest attainable standard of health is a fundamental right for an individual. As I are truly inspired by this, I attempt to propose an innovative system that puts forward a smart patient health tracking system that uses sensors to track patient vital parameters and uses internet to update the doctors so that they can help in case of any issues at the earliest preventing death rates.

Patient Health monitoring using IoT is a technology to enable monitoring of patients outside of conventional clinical settings (e.g. in the home), which may increase access to care and decrease healthcare delivery costs. This can significantly improve an individual's quality of life. It allows patients to maintain independence, prevent complications, and minimize personal costs. This system facilitates these goals by delivering care right to the home. In addition, patients and their family members feel comfort knowing that they are being monitored and will be supported if a problem arises. ESP32 is a tool that can be programmed to understand and interact with its environment. It is a good open source a microcontroller platform that allows electronics enthusiasts to build quickly, easily and at low cost with minimal use and monitoring projects. The combination of IoT and esp32 is a new way to introduce the Internet of Things to Health Care Monitor the patient system. The esp32 Board and nodemcu collects data from sensors and transmits wirelessly to the IoT website and on the LCD screen. Communication of medical information, correct decision- making of knowledge collected and knowledge patient could be a difficult task in IoT. For this project, the IoT primarily based Patient Health Monitoring System (PHMS) is being employed esp32 is projected to gather the specified parameters and examine the information obtained from sensory devices. IoT combination with esp32 could be a new thing to introduce net of Things to the Patient Health Care System. esp32 and nodemcu Board collects information from sensors and transmits wirelessly to the IoT web site and on the LCD screen. The projected PHMS system is certainly being tested parameters like pulse rate, temperature, humidity level etc.

Chapter 2

Literature Review

The purpose of literature review is to gain an understanding of the existing research on IOT Based health monitoring system. The literature review helped in selecting appropriate information and suitable feature extraction process for getting efficient results.

- In [1], author has presented "An IOT Based Smart Health care system using Raspberry Pi". They have used an exclusive sensor to monitor a patient's health parameters. Hence author has used platform Raspberry Pi for IoT. The Raspberry Pi is a platform which offers compact platform for a Linux server with a low cost. The combination of Raspberry Pi and IoT is a new changing technology in the healthcare system. Raspberry Pi collects various data from sensors and transfers to database. Cloud computing possess numerous advantages such as flexibility, highly automated, low cost etc. The Cloud's features enable customers to build and deploy their applications on virtual servers. Here the author has concentrated over the idea of separating wireless sensor network and cloud computing. Once sensors are connected to patients' bodies, they start to receive and transmit data to the database sensors like temperature (DS18B20), heartbeat, blood pressure, ECG (AD8232) services available in the cloud are responsible for receiving, storing, and distributing patient's data.

- In [2], author has presented "An Overview on Heart rate Monitoring and Pulse Oximeter System". In this paper a low-cost device is described that measures the heart rate of the patient by placing sensors on the fingers, later the result will be displayed on LCD. The designed system can be used by unprofessional people. The change in heart rate can be displayed by graph using graphical LCD. Over a period of time, maximum and minimum heart rate can be displayed using the designed system. Abnormalities are displayed on LCD indicated by buzzer. In order to send heart rate to PC output should be attached.

- In [3], author Punit Gupta, Deepika Agrawal, Jasmeet Chhabra, Pulkit Kumar Dhir(2018) proposed the design and implementation of an IoT based monitoring system in Medical sector which can be very useful in many emergency medical services. In the article they talked about supporting the intense medical services like Intensive Care Units(ICU), Critical Care Units(CCU) with the help of INTEL GALILEO 2nd generation development board. In this report the model will be useful in enhancing the services, improving the risks and old traditional way of treating the victims. Use of digital wearables electronics devices are proposed to improve the quality of the services to the patients.

- In [4], author Mustafa Abdullah Azzawi, Rosilah Hassan and Khairul Abu Bakar(2016) proposed the resources in IoT devices and its authentication mechanisms.This paper talks about the IoT devices like sensor, actuators its control centre to send the data over the network. In this article they talked about the ECC algorithm over the CoAP protocol. Researchers have proposed about the wearable sensors, its applications for the remote health monitoring .

- In [5], author Ravi Kishore Kodali, Govinda Swamy and Boppana Lakshmi, proposed the idea of implementation of sensors through microcontrollers and transceivers. They talked about the medical devices with the help of XBee S2 module with LM35 temperature sensor and also Intel Galileo Generation 2 board with another XBee S2 module to act as a gateway .

- In [6], author Vandana Milind Rohokale, Neeli Rashmi Prasad, Ramjee Prasad, proposed the idea of accessing the information of a tagged object or tagged person with the help of internet that corresponds with the active RFID. They intended to increase the Quality of Service(QoS) through wired or wireless communication via cooperation in medical treatments. The researchers suggested to prevent the death rate through quality care and proposed the IoT approach for the regular health parameters like blood pressure, sugar level of the body, haemoglobin among the poor and middle class family.

- In [7], author Abhishek, Gaurav, Sasikumar proposed the implementation of the Raspberry pi (Linux computer) with IoT for the designing and construction of the system in the medical services. The researcher presented the idea of measuring the heartbeat of the patient with the help of sensors. In this system the doctor can monitor the parameters continuously through the gateway in raspberry pi via internet .

- In [8], author Sarfraz Fayaz Khan (2017) proposed the idea of using the RFID and IoT tags in healthcare. The researcher talked about different approaches used in IoT like E healthcare, U-Healthcare, Wireless Monitoring to enhance the robustness in medical sectors. These new technologies and approaches will be very helpful in emergency situations and to change the traditional way of treating the patients with the help of microcontrollers and sensors .

- In [9], author has presented "Survey of IOT Based Patient Health Monitoring System". Here author proposes a smart health care system that includes smart identification tag, server and internet. Physiological conditions are provided by smart identification tag on the basis of medical report of the patient which is diagnosed by doctor via WLAN. The objective of this paper is to monitor the patient often. New technology proposed here is capable of providing a large range of benefits to patients. The author has proposed a mobile physiological monitoring system, which is capable of monitoring the patient's body parameters in the hospital. Sensing, and controlling are the functions of smart system and decision made is based on available data.

- In [10], author presented "IOT Based Patient Monitoring System". It is a mobile physiological monitoring system that is capable of continuously monitoring the patient's heart rate using ECG. Using replaceable electrodes ECG sensor can be attached to the patient's chest. Signals produced during muscle contraction is sensed by the system

and recorded. The signals collected from the body are converted to an electrical signal. This paper shows the use of smart healthcare system. This new technology is capable of offering a large range of benefits to patients through early detection of abnormal conditions.

- In [11], author has presented "Heart rate Monitoring System". This paper explains a unique contribution in identifying all components of an IOT healthcare system. A generic model is proposed that can be applied to IOT based healthcare monitor. It is important and no known end-to-end system is found for remote monitoring of health issues. Here concentration is given more on the sensors to observe the various parameters of the patient body. The contribution is done by concentrating on LPWANs (Wide Area Network), by focusing on their unique suitability for use of IoT systems.

- In [12], author has presented "An IOT Based Health care monitoring system". Constant observation is required in hospitals where the patients are under medical care for a longer period of time. Although the patient is not in a critical situation, the doctors still need confirmation on their health parameters. Now a day, the expenses for hospitalization are high and expensive. So the health policies in various countries have shifted its focus from providing reactive, acute care to provide care outside the hospital. Hence author designs and build the sensing data that conditions the system to display accurate body parameters of the patients. The aim of this paper is to supervise the heart rate, blood pressure, temperature and ECG continuously through respective sensors. The recorded data is sent to the device and if the value exceeds, the alert message will be sent to the doctor.

- In [13], author presented "Simulation of Health care Monitoring System in Internet of Things by Using RFID". Author has designed the effective healthcare monitoring system using the IoT. The health monitoring system plays a vital role with IOT; the RFID tag is used to initialize the bed system as a key. The sensors are used to observe the patient's condition frequently. The information report of patient is transmitted to the website through IOT system so that the doctor the can know about the condition of the patient. The movable bed mechanism is used to adjust the bed according to the patient's condition. The buzzer is to indicate the nearby persons that the patient is in critical situations. In this paper, there is a discussion over the security requirements of authentication. Particularly they have represented a ECC-based RFID authentication in terms of implementation and authentication. Even though most of these cannot satisfy the security requirements and implementation.

- In [14], author presented a "Review on-IOT Based smart healthcare system". Here architecture of Smart Health Care Monitoring and IOT is demonstrated by author. New technologies help in minimizing the better quality as well security concept. ECG signals are obtained by electrodes that are placed on the chest. Later wires are connected to ECG sensor (AD8232).The sensor is used in measuring the electrical activity of the heart. Problems and challenges that could be faced in future are presented by this system. Applications of IOT can be improved using new methodologies and technologies. Sensors like Blood pressure, Temperature, Heart rate, ECG are used in IOT along with Raspberry Pi kit and Wi-Fi module.

- In [15], author has presented "Heart rate Measurement from the Finger Using a Low

Cost Microcontroller". IOT has a wide range of application. IoT has been developed for Wireless sensor network (WSN). Using IOT, health monitoring designs are presented. There are some problems that are related to health monitoring and IOT. New technologies help to minimize better quality as well as security concept. New technologies and methodologies are used. Aurdino board, Wi-Fi modules, temperature, pulse oximeter, blood pressure, heartbeat rate sensors are used in IoT.

- In [16] author has presented "SInternet of Things as Key Enabler for Sustainable Healthcare Delivery". Here the author considers IOT as a global network infrastructure, linking physical and virtual objects. This architecture consists of existing and evolving internet and network developments. Exclusive object identification, sensor and connection capability are offered. Hence sensors will be characterized by a high degree of data capture. This paper aims to show how radio frequencies are identified and Internet of Things technologies allow patients to access healthcare services.

- In [17], author has presented "Remote Health care Monitoring System using Arduino Board over Distributed Ubiquitous Environment". Here author concentrates on IoT based Smart Healthcare System. The major objective of this designed system is to transfer the patient's health parameters. This paper proposes the efficient system for observing patient pulse rate and temperature. The system uses pulse sensor to keep track of heart rate of the patient. With the use of sensors we can access the various parameters of body. These input data are transmitted to the computer for family and doctor's for reference. Thus in the modern health care system, the usage of IoT technologies have brought many benefits for patients,

- In [18], author has presented, "Heart Attack Detection and Heart Rate Monitoring Using IOT". In this paper with the help of observed heart rate through IOT device, heart attack can be detected. Here the methods used by author includes Arduino board, Wi-Fi module and pulse sensor. Pulse sensor will start sensing the heart rate readings once the system is set and heart rate of the patient will be displayed on LCD screen. Data can be transmitted over internet with the use of Wi-Fi module. By checking a patient's heart rate it can be determined if the patient is healthy or not based on heart rate displayed on the LCD screen. Limits are set to the system, heart rate of the patient is monitored and immediately alert message will be sent by the system if the heart rate goes below or above threshold value. They have implemented an application that will track and monitor heart rate of patient correctly and message will be sent in case of possibilities of heart attack.

Objective

The main objective of the project are:

- To monitor health parameters using the sensors.
- To make a budget friendly health monitoring system.
- To display patient health data on LCD screen and also on the website.
- To record or store the patients health data.

Chapter 3

Project Design

The project's key features, structure, criteria for success, and major deliverables are all planned out in this steps. The aim is to develop design in a way so that it can differ from existing system that can be used to achieve the desired project goals

3.1 Existing System

In the existing system(Figure.3.1), I use active network technology to network few sensors to a single PMS. Patients' various critical parameters are continuously monitored via single PMS and reported to the Doctors in attendance for timely response in case of critical situations. The sensors are attached to the body of the patients without causing any discomfort to them. In this PMS we monitor the important physical parameters like temperature,humidity, heart beat rate and oxygen level using the sensors which are readily available. Thus, the analog values that are sensed by the different sensors are then given to a microcontroller attached to it. The microcontroller processes these analog signal values of health parameters separately and converts it to digital values using ADC converter. Now, the digitalized values from more than one microcontroller are sent to the Central PMS. Each of the sensors attached microcontroller with a transceiver will act as a module which has its own unique ID. Each module transmits the data wirelessly to the gateway attached to the PC of the Central PMS. The gateway is attached to the PC i.e. Central PMS which is situated in the medical center or at home, is capable for selecting different patient IDs and allowing the gateway to receive different physical parameter values the patient specified by the ID. The software designed using Graphical User Interface (GUI) can operate on different physical parameters of each patient, consecutively with a specified time interval for each patient. At any time, any of the doctors or patients can log on the Central PMS and check the history of the observed critical parameters of any of the patient attached to the network.(Figure.3.1)

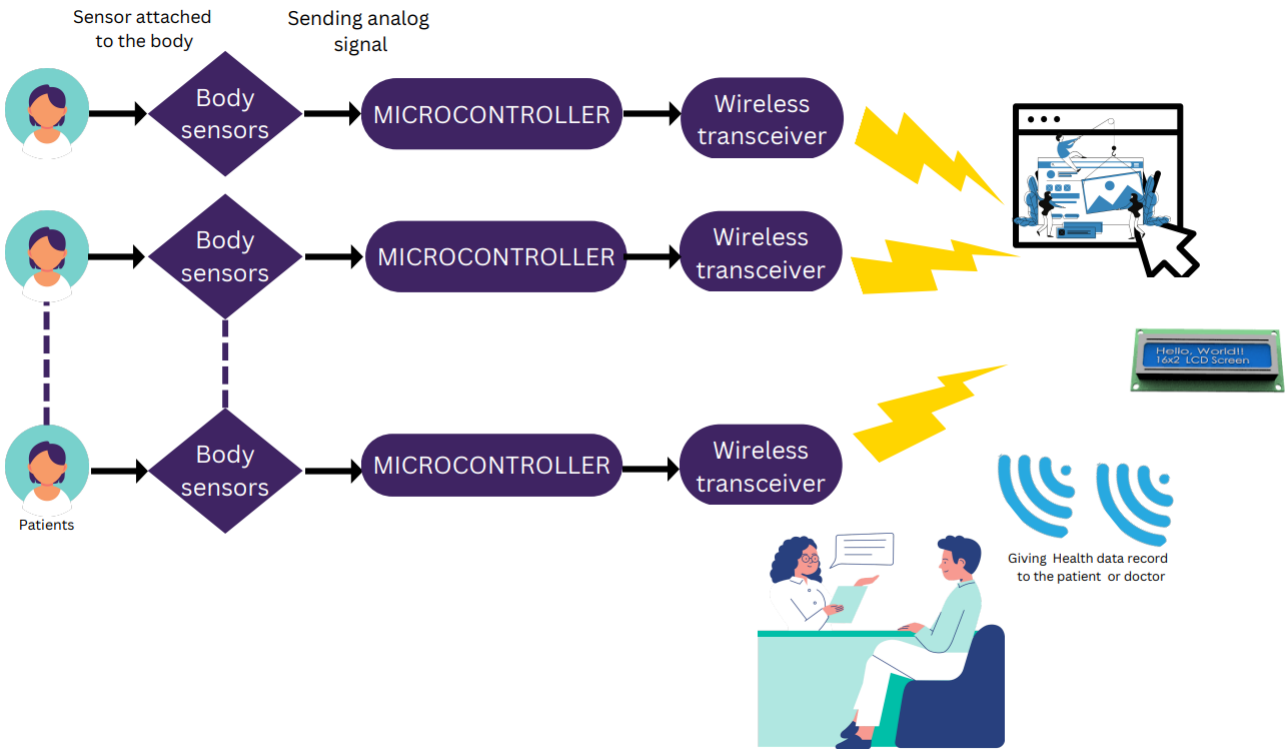

Figure 3.1: Existing System

3.2 Proposed System

The system which I prefer to develop would not only help in monitoring the health of the patient when he is in bed but also when he is out of bed.The main idea of an IoT based healthcare monitoring system will be a promising solution for remote patient monitoring, especially for patients with health issues or conditions. The system will consist of wearable devices and sensors that will continuously monitor the patient's vital signs and environmental factors such as heart rate, SpO2,temperature and humidity. The data will be transmitted to a gateway device, such as an ESP32, which will connect to the internet via Wi-Fi or cellular network and will send the data to a website and LCD screen for storage and analysis. The system will also include a mobile or web application that will allow patients and healthcare providers to access and view the data in real-time. Overall, an IOT based healthcare monitoring system will be able to provide personalized care, early intervention, and improved patient outcomes while reducing healthcare costs. However, there will be challenges and considerations to be addressed, such as data privacy and security, interoperability, and scalability.

3.3 System Diagram

3.3.1 Block Diagram

The system consists of wearable devices and sensors such as Max30100 pulse oximeter sensor and DHT11 sensor that continuously monitor the patient's vital signs such as heart rate , oxygen level and environmental factors such as temperature, humidity.This sensors are connected with microcontoller esp32 which means that the data is transmitted to a gateway device, (ESP32), which connects to the internet via Wi-Fi and sends the data to a website and LCD screen with the help of Nodemcu v3 for storage and analysis. The system also includes a mobile or web application or website dashboard that allows patients and healthcare providers to access and view the data in real-time.(Figure.3.2)

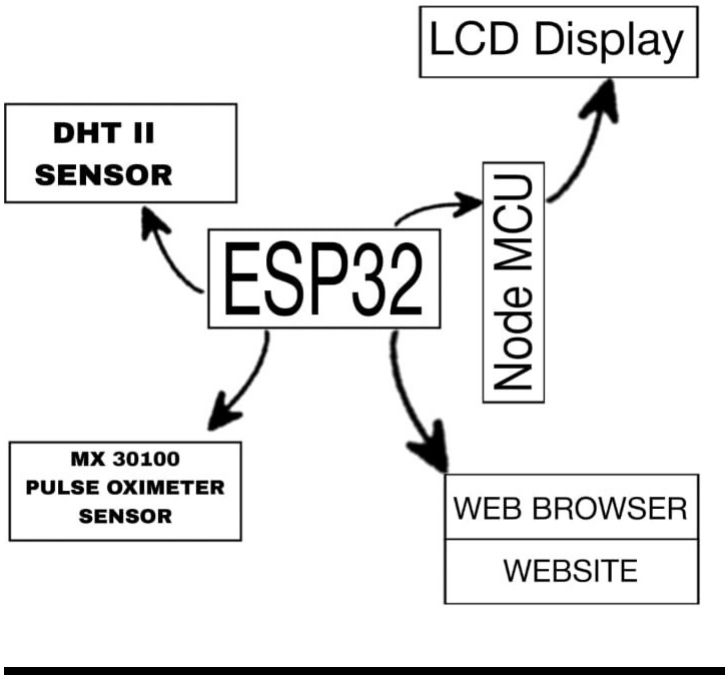

Figure 3.2: Block Diagram of IOT Based Health Monitoring System

3.3.2 Flowchart

The flowchart of the proposed system is shown in Fig.3.3 The system starts by collecting the health data in the ESP32 gateway. The gateway then sends the data to the Nodemcu v3 broker. Then, the broker will process the data received based on the system's program. The health data will be sent to LCD screen , webiste and PHPMyAdmin database for real-time data visualization and storage. The health data collected will be analyzed by the broker.If you are not getting output Then, the whole process will start all over again(Figure.3.3)

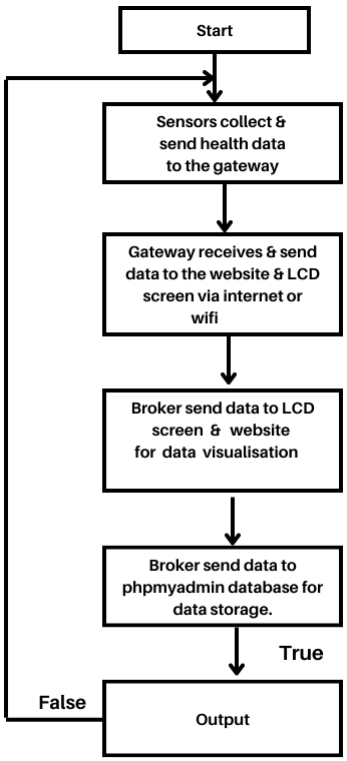

Figure 3.3: Flowchart of IOT Based Health Monitoring System

3.3.3 Sequence Diagram

Sequence diagrams model the flow of logic within your system in a visual manner, enabling you both to document and validate your logic, and are commonly used for both analysis and design purposes.(Figure.3.4)

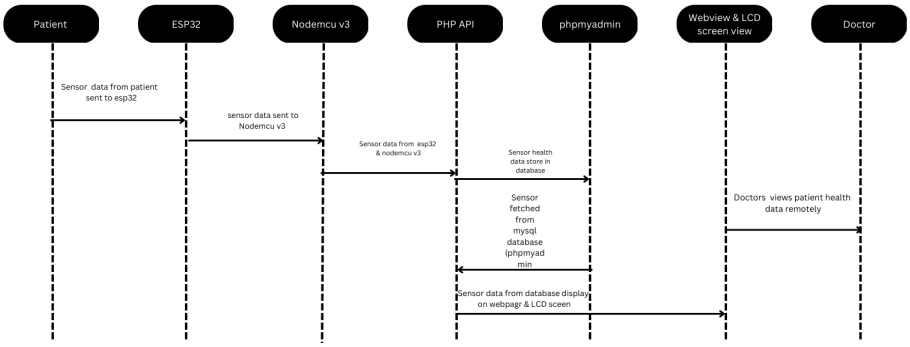

Figure 3.4: Sequence Diagram of IOT Based Health Monitoring System

3.3.4 Hardware Design

This health monitoring system consists of sensors and a microcontroller. We used the ESP32 Nodemcu v3 as the microcontroller, and the sensors are MAX30100 (pulse rate and SPo2 measurement sensor) and DHT11 (temperature Humidity measurement sensor).

Given figure is the circuit diagram for the system. An ESP32 Nodemcu v3 microcontroller, two sensors (MAX30100 and DHT11), a 16×2 I2C LCD display, and a wifi module make up the circuit. The whole system is powered by 5V. The microcontroller (ESP32) is connected to the computer using a USB (Universal Serial Bus) that sends commands to the device via internet.(Figure.3.5)

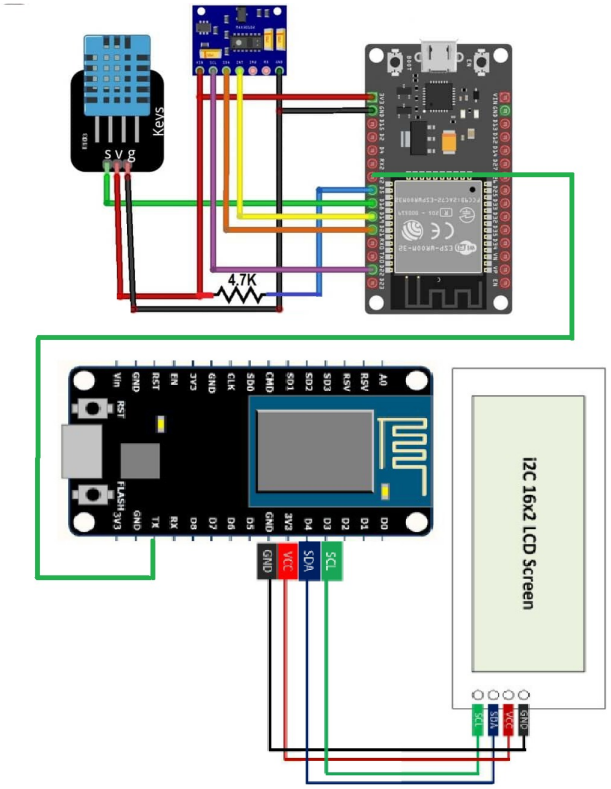

Figure 3.5: Circuit Diagram of IOT Based Health Monitoring System

Chapter 4

Project Implementation

This project has been developed with ESP32 , Nodemcu microcontroller connected with sensors which are attached to the patient. All the sensors sent from microcontroller to MySQL database . A doctor or guardian can log in to web portal to monitor patient's data at any point in time. And at any point of time either a doctor or guardian can log into web portal with patient unique credentials and can check patient's health data and which would help them to monitoring it.

The login form has two input fields, one for the username and one for the password, and a submit button labeled "Log In". The body section contains a login form with two input fields for the username and password and a login button.(Figure 4.1)

```
  <br>
<div class="login-box">
  <div class="white-box">

    <form class="form-horizontal form-material" id="loginform" action="login_back.php" method="POST">
      <h3 class="box-title m-b-20">Sign In</h3>
      <div class="form-group ">
        <div class="col-xs-12">
          <input class="form-control" type="text" placeholder="Username" name="username" required >
        </div>
      </div>
      <div class="form-group">
        <div class="col-xs-12">
          <input class="form-control" type="password" placeholder="Password" name="password" required>
        </div>
      </div>

      <div class="form-group text-center m-t-20">
        <div class="col-xs-12">
          <button class="btn btn-info btn-lg btn-block text-uppercase waves-effect waves-light" name="login" type="submit">Log In</button>
        </div>
      </div>

      <div class="row">

      </div>
```

Figure 4.1: Login Page: To login to the system

This is a PHP script that displays a list of patient data fetched from a database using MySQL. The patient data is displayed in a table with columns for name, date of birth, email, address, and options. The options column includes two links: one for deleting a patient record and one for viewing the details of a patient record.(Figure 4.2;Figure 4.3)

```
        <!-- Nav tabs -->

        <!-- Tab panes -->
        <div class="tab-content">
          <div role="tabpanel" class="tab-pane active" id="home">
            <div class="col-md-12">

              <div id="responsive-modal" class="modal fade" tabindex="-1" role="dialog" aria-labelledby="myModalLabel" aria-hidden="true" style="display: none;">
            <div class="modal-dialog">
              <div class="modal-content">
                <div class="modal-header">
                  <button type="button" class="close" data-dismiss="modal" aria-hidden="true">×</button>
                  <h4 class="modal-title">Patient List</h4>
                </div>
  <div class="fetched-data"></div>

              </div>
            </div>
          </div>

    <div class="row">
      <div class="col-sm-12">
        <div class="white-box">

          <div class="table-responsive" style="overflow-x: hidden;">
          <table id="myTable" class="table table-striped">
            <thead>
              <tr>
                <th>Name</th>
                <th>DOB</th>
                <th>Email</th>
                <th>Address</th>
                <th>Options</th>
              </tr>
            </thead>
```

Figure 4.2: Dashboard(1):To view the patients list

```
    $query = "SELECT * FROM `p_data` WHERE 1";
    $result = mysqli_query($link,$query);

              while( $row3 = mysqli_fetch_assoc( $result ) )
                  {

                  $name = $row3['name'];
                  $DOB = $row3['date'];
                  $Email = $row3['email'];
                  $address = $row3['address'];
                  $id = $row3['id'];

                    echo"<tr><td>{$name}</td>";
                    echo"<td>{$DOB}</td>";
                    echo"<td>{$Email}</td>";
                    echo"<td>{$address}</td>";




                  ?>


     <td>


<div class="btn-group m-r-12">
  <button aria-expanded="false" data-toggle="dropdown" class="btn btn-info dropdown-toggle waves-effect waves-light" type="button">Options <span class="caret"></span></button>

    <ul role="menu" class="dropdown-menu">

     <li><a href="delete.php?id=<?php echo $row3['id'];?>">Delete</a>
     <li><a href="details.php?id=<?php echo $row3['id'];?>">View</a>


    </ul>
</div>
```

Figure 4.3: Dashboard(2):To view health data or delete a patient from the patients list

Overall, this code seems to be part of a larger web application that displays real-time data related to heart rate, SpO2, and humidity. The page refreshes automatically every 10 seconds to show any new data that might have been added. The clear button might be used to clear the table and remove any previously displayed data. The logout button allows users to log out of the application.(Figure 4.4)

```
            <tr>
              <th>Heart Rate</th>
              <th>SpO2</th>
              <th>Humidity(%)</th>
              <th>Temprature(D.C.)</th>
              <th>Time</th>

            </tr>
          <thead>

<tbody>

<?php
include "connection.php";

$select_path="SELECT * FROM `sensordata` WHERE 1";

$var=mysqli_query($link,$select_path);

while($row=mysqli_fetch_array($var))
{
 $m=$row['data1'];
 $t=$row['data2'];
 $h=$row['data3'];
 $x=$row['data4'];
 $time=$row["time"];


?>
    <tr>
    <td><p><?php echo $m; ?></p></td>
    <td><p><?php echo $t; ?></p></td>
    <td><p><?php echo $h; ?></p></td>
    <td><p><?php echo $x; ?></p></td>
    <td><p><?php echo $time; ?></p></td>
    </tr>
    <?php
```

Figure 4.4: To view the patients health data or status

The system's admin can easily export the data stored in the database through the php-MyAdmin database(Figure 4.5)

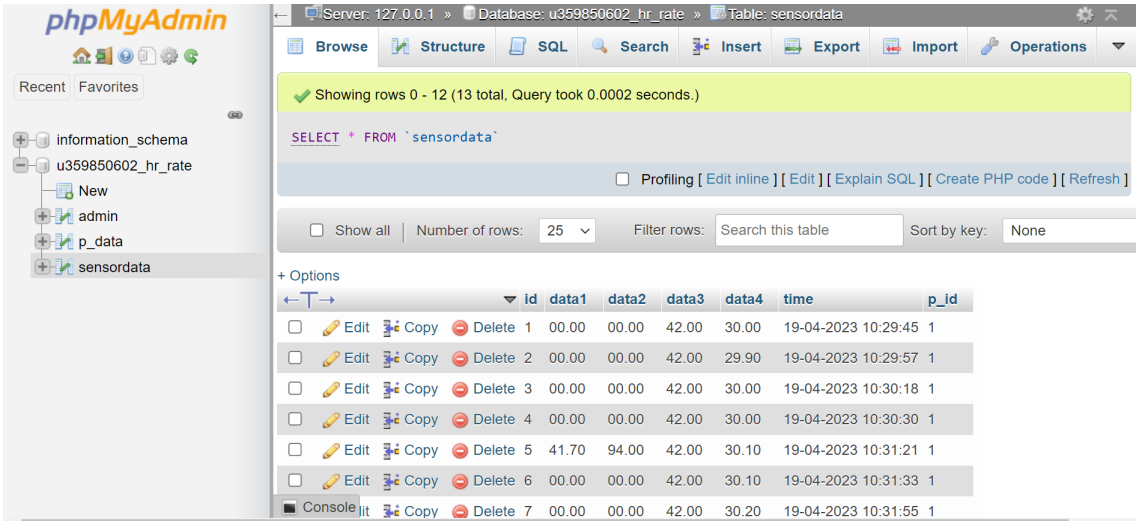

Figure 4.5: phpMyAdmin local database with the patients health data stored in SQL format

Chapter 5

Testing

Testing is an organized summary of testing objectives, activities, and results. It is created and used to help stakeholders (product manager, analysts, testing team, and developers) understand product quality and decide whether a product, feature, or a defect resolution is on track for release. Test documentation includes all files that contain information on the testing team's strategy, progress, metrics, and achieved results. The combination of all available data serves to measure the testing effort, control test coverage, and track future project requirements.

5.1 Functional Testing

5.1.1 Unit Testing

Unit testing is the first level of testing, which is typically performed by the developers themselves. It helped us understand the desired output of each module, which we had broken down into separate units and in classifying the cry categories on the basis of algorithm that we have used.

Test case No.	Test Condition	Test Steps/ Procedure	Test Data	Expected Result	Actual Result	Pass/Fail
1	View Screen (dashboard. php)	If path is "/" Then dashboard.php is viewed.	View Screen	Systen needs to show the home page to the user	Home page run on the user screen	Pass
2	Capturing sensor health data	Using iot equipment such as sensors , micro controller detect or sens the patients health data.	Patient health data	Sensors should be able to sens the health data accurately.	Sesnsors captured or sens the health data successfully.	Pass
3	View Patient health data record . (details.php)	After clicking on "view" button data stored in database is retrieved	Details	Display patients health data records stored in database.	System shows patients health data records stored in database.	Pass

Table 5.1: Testcases

Chapter 6

Result

The system created for this project study is shown in this section, along with the results obtained by the system. The completed system consists of the pulse rate and SpO2 sensors and the temperature and humididty sensor connected to an Esp32. The ESP32 is connected to a device with the help of a USB, which will help power up the system. When we upload data to the ESP32 Nodemcu v3, the system starts working, and the measurement data will be shown in the Liquid Crystal Display (LCD) display, and the data will also be shown in a web application with the help of a wifi module.
The full system diagram is shown in Figure 6.1, including the measurements of the pulse rate, SpO2, temperature and humidity shown in the LCD Screen and in the web application.The data value is taken from the sensors MAX30100 and DHT11.

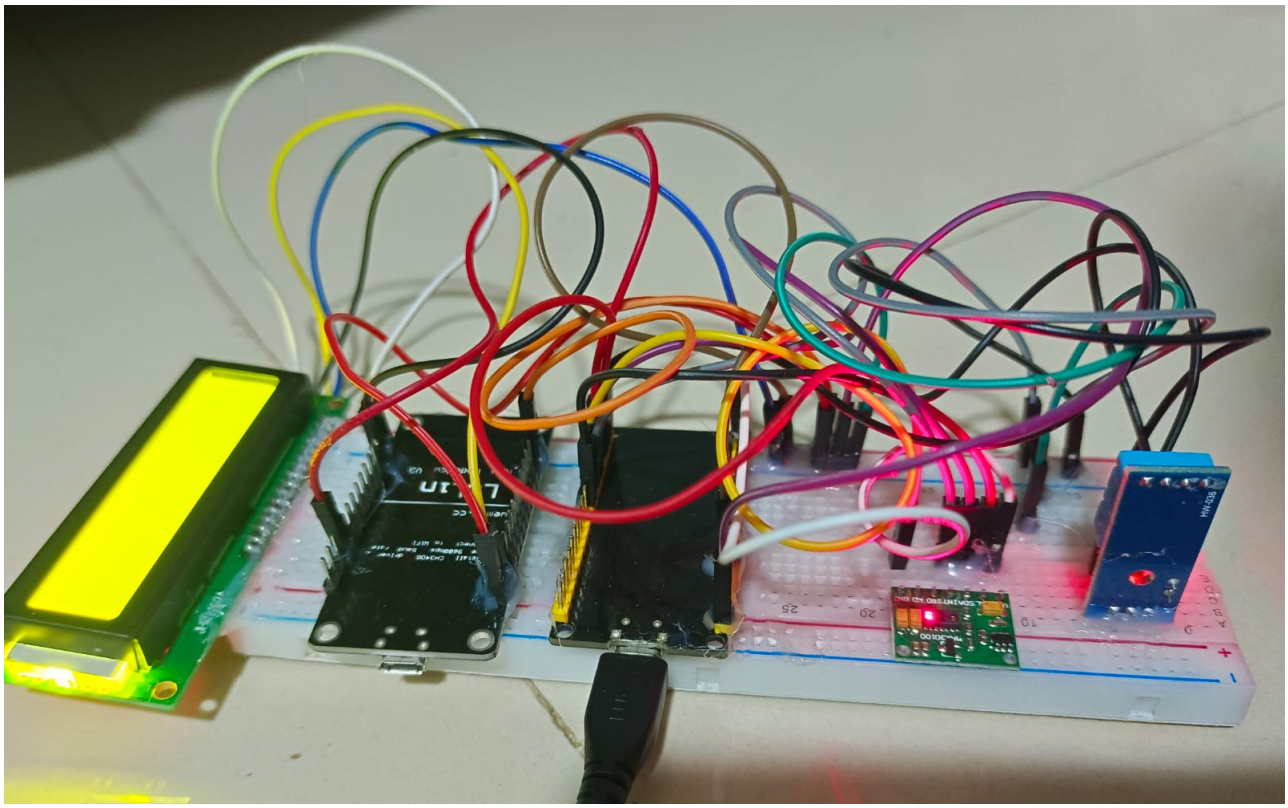

Figure 6.1: Hardware Setup

Figure 6.2 shows the Website or dashboard of the system which mainly include Pateint login doctors login. By using right credentials pateint and doctors can logged into the system.

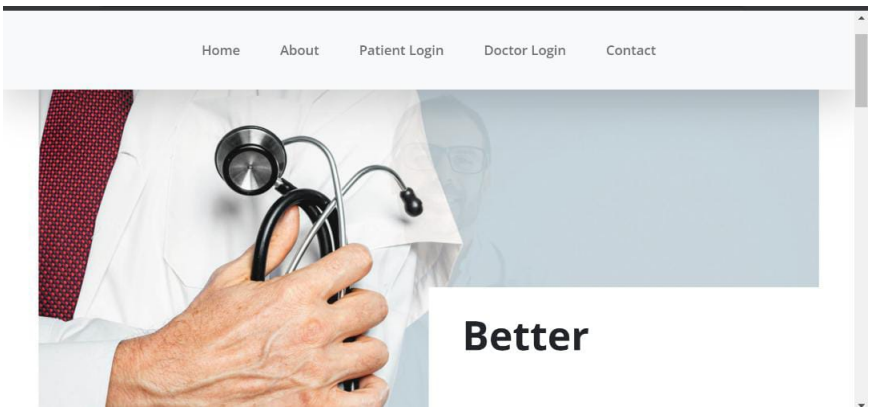

Figure 6.2: Login page

Figure 6.3 shows the dashboard of the system where the list of patients can be seen and after clicking on the option buttton we can view the patient's health data or delete the patient's name from the patient list.

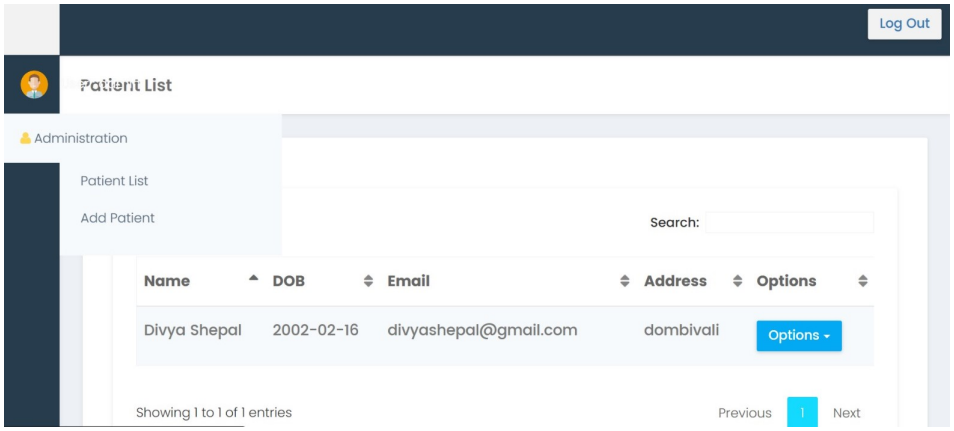

Figure 6.3: Dashboard

Figure 6.4 shows the patient's health data record. Including, heart rate, spo2, humidity, temperature and time and if user wants to clear data then user can do that too.

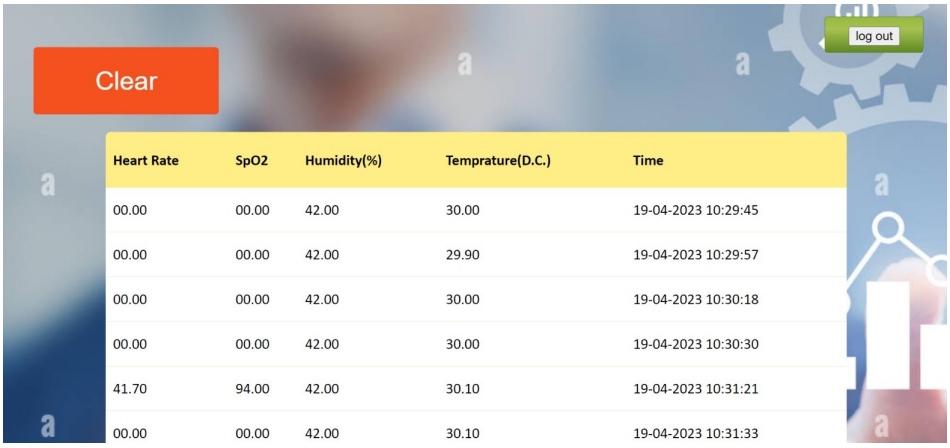

Figure 6.4: Patients health data record

Chapter 7

Conclusion

With the wide use of internet, this work is concentrated to execute the internet technology to establish a system which would communicate through internet for better health. Internet of Things rules the whole world in various fields, mainly in health care sectors. Hence the present work is done to design an Internet of Things based smart patient health tracking system using an Arduino microcontroller. In this, pulse rate sensor is used to detect the heart beat and temperature sensor to read the temperature and sends the data to the cloud using internet. This information is also sent to the LCD display, so patient can easily know their health status. The doctor can view the sent data by logging the specific website. Hence continuous patient monitoring system is designed.

Future scope

The future work of the project is very essential in order to make the design system more advanced. In the designed system the enhancement would be connecting more sensors which measures various health parameters. Besides, other medical sensors such as ECG sensors and blood pressure sensors can be added into the system to improve the functionality of the system. The users will be able to track their health conditions better if the system is capable of tracking more other health data accurately.

- IoT based Remote Patient Monitoring System can be enhanced to detect and collect data of several anomalies for monitoring purpose .
- More research on problems associated with having data online, data privacy as IoT is managed and run by multiple technologies and multiple vendors are involved in it. Security algorithms and certain precautions by the users will help avoid any security related threats in IoT network.
- The interface can be designed to control which sensors can be used by consumers according to their needs.
- Web UI can be enhanced to perform several activities which include controlling the hardware, real-time graphs, history and analysis graphs to observe anomalies etc.

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