IOT BASED ADVANCE HEALTH MONITORING SYSTEM

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FINAL YEAR DESIGN PROJECT REPORT

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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15 July, 2024

DECLARATION

I hereby declare that this project has been done by us under the supervision of **Dr. Arif Mahmud, Associate Professor & Program director MIS, Department of Computer Science and Engineering, Daffodil International University**. I also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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APPROVAL

This Project titled "**IOT Based Advance Health Monitoring System**", submitted by **202-15 3828 Jannatul Ferdous Konok** to the Department of Computer Science and Engineering Daffodil International University, has been accepted as satisfactory for the partial fulfillment o the requirements for the degree of B.Sc. in Computer Science and Engineering and approved a to its style and contents. The presentation has been held on 15-07-2024.

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ABSTRACT

The establishment of imaginative and efficient patient monitoring systems has been made conceivable by the Internet of Things (IoT), which has radically altered the healthcare industry. The paper introduces an Internet of Things (IoT)-Based Advance Health Monitoring System which is along with an ESP8266 microcontroller, Blynk platform, and Web Deployment to monitor multiple important metrics utilizing sensors such as DHT11, Max30102, DS1820 Temperature, and ECG. An Emergency Notification System is incorporated in the system to provide prompt notifications during important health incidents. It likewise offers an individually tailored website that doctors and patients may access to view historical trends and real-time health data. Additionally, it also makes it simpler for the family members of the patient to continue to keep an eye on their well-being from far away, thereby fostering awareness as well as involvement in their medical treatment. Individualized availability, web deployment, and the incorporation of several sensors with IoT technologies increase the system's efficacy in managing and continuously monitoring health. Our comprehensive approach not only guarantees prompt interventions but also advances patient-centered healthcare by encouraging cooperation between medical professionals, patients, and their families.

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Introduction

1.1 Overview

The next phase of personalized health care and remote patient monitoring has been ushered in by the convergence of Internet of Things (IoT) technology and healthcare. The research presented here presents a unique IoT-Based Health Monitoring System as a reaction to the rising demand for effective health monitoring solutions [1]. The escalating prevalence of long-term medical conditions and the growing demand for continuous surveillance necessitate the development of solutions capable of smoothly integrating various sensors and communication channels to deliver prompt patient health status updates.

The proposed setup features an ESP8266 microcontroller, Blynk platform, Web Deployment infrastructure, and a variety of sensors, including DHT11, Max30102, DS1820 Temperature, and ECG [4]. The system enables the real-time monitoring of critical health indicators includes blood oxygen levels, heart rate, and temperature by utilizing the capabilities of these components. In spite of enabling proactive intervention and prompt detection of health anomalies, this continuous surveillance improves patient outcomes and reduces the cost of healthcare related to emergency interventions.

In addition, the integration of an emergency alert system guarantees that medical personnel and caregivers are swiftly informed in the event of serious health crises, enabling prompt actions with the possibility of saving lives [3]. Furthermore, the system has a customized web interface that physicians and patients are able to use, making health information simply accessible and encouraging teamwork in healthcare decision-making.

The model emphasizes an integrated approach to healthcare management by enabling patient families to become involved in remote health monitoring [7]. It motivates people to take an active part in their own health and well-being. This introduction lays the groundwork for the paper's evaluation of the IoT-Based Health Monitoring System's operations, technical architecture, and potential to transform patient care and the provision of healthcare

1.2 Background and Present State

Background:

As IOT has advanced, the idea of Advance health monitoring has transformed significantly. In past times, healthcare was primarily focused on adaptive treatment plans and recurrent inspections. However, an evolution toward proactive and ongoing health monitoring has been triggered by the implementation of IoT in healthcare. This change makes it possible to gather and analyze data in instantaneously, which facilitates early detection of possible health problems and prompt intervention. The electrocardiography (ECG) , the maximum30105 , DHT11, also DS18B20 are merely a few of the sensors that the Internet of Things-based Advance Health Monitoring System utilizes to track vital signs and other health metrics. These sensors continuously gather data, which is eventually sent to healthcare providers in order that they may evaluate it and make decisions.

Present:

Healthcare and personal caregiver services are among the healthcare environments where Internet of Things-based health monitoring technologies have been deployed. By offering constant patient monitoring, these devices lessen the need for recurrent hospital stays and enable early abnormality diagnosis. The information gathered is utilized to monitor health trends in patients, control long-term ailments, and notify healthcare providers of crises. As of right now, these systems are demonstrating encouraging progress in terms of bettering patient outcomes, increasing the effectiveness of medical care delivery, and cutting costs. However, challenges including data security, privacy anxiety and the requirement for dependable internet access still need to be resolved.

Additionally, research is being done to investigate the integration of machine learning (ML) and machine learning (AI) technologies in order to improve the system's capacity for tailored treatment plans, predictive analytics, and data analysis. IoT-based health monitoring systems have the potential to completely transform healthcare, and this promise is becoming more and more clear as technology develops.

1.3 Problem Statement

Providing on time, high-quality healthcare continues to be quite challenging, particularly for disadvantaged and rural populations. Traditional healthcare models on occasion rely on recurrent visits to medical institutions, which can cause delays in identification and treatment—particularly for chronic and acute illnesses. The current approach of occasional monitoring falls short of offering the ongoing care required for the successful management of chronic illnesses. In part because of the absence of prompt medical treatment and real-time health data, patients suffer from worse health outcomes, higher costs for healthcare, and a rise in hospital readmissions. Globally, the incidence of chronic illnesses such as cardiovascular disease, type 2 diabetes, and respiratory problems is growing, requiring ongoing monitoring and care. Because of their lack of ability to deliver this kind of ongoing care effectively, traditional healthcare systems manage chronic illnesses less than optimally. The initial signals for complications are typically ignored by patients, which can result in serious health problems and higher death rates. Problems regarding patient confidentiality and safety of information in the current health monitoring systems are critical in combination with problems with accessibility and ongoing monitoring difficulties. Critical health data must be collected, transmitted, and stored with the greatest precautions to avoid breaches and unlawful access. It is imperative to tackle the crucial challenge of securing this data while maintaining the accuracy and dependability of health monitoring systems. Through utilizing advanced sensors and IoT technology, the IOT Based Advance Health Monitoring System attempts to close those cracks and offer continuous, real-time health monitoring. Critical health data is continually gathered by sensors like the electrocardiography (ECG), the MAX30102, DHT11 (temperature and humidity sensor), and DS18B20 (temperature sensor). Medical professionals receive this data so they may evaluate and make decisions in real time, allowing for quick detection of medical issues and immediate action. Nevertheless, putting such an arrangement into place comes with administrative, ethical, and technical difficulties. These include reaching broad acceptance and integration into current healthcare buildings, protecting patient privacy and data security, and providing dependable data transfer. For organizations to take full advantage of the potential of IoT-based health monitoring systems to enhance healthcare outcomes, effectiveness, and accessibility among all communities, it is imperative that we solve these obstacles.

1.4 Motive and Objective

The main goal in front of establishing an IoT-Based Advance Health Monitoring System is to revolutionize patient care by taking advantage of technology to enable continuous, real-time monitoring of vital health parameters. The system aims to close current gaps in healthcare monitoring by integrating IoT devices and communication platforms, ensuring immediate action during crucial health events, and offering patients, caregivers, and medical professionals with access to actionable health data.

- ❖ Provide an integrated IoT-based advance health monitoring system which allows you to monitor vital signs including blood oxygen levels, heart rate, ECG Body temperature and room temperature in real time.
- ❖ Establish reliable channels for communication that allow for smooth flow of data across medical experts, caregivers, and patients.
- ❖ Include an emergency alert system to let caregivers know about serious health issues rapidly in order that they can take appropriate action.

1.5 Scope and Limitations

Scope:

Through continuously and real-time monitoring patients' vital signs and health elements, the Internet of Things-based Advance Health Monitoring System promises to improve the provision of healthcare. This system can be utilized in home care settings, clinics, and healthcare facilities, amongst different types of healthcare. Essential components consist of devices that gather important health data, like the ambient temperature sensor DS18B20, the pulse oximeter, MAX30102, the humidity and temperature sensor DHT11, and an electrocardiogram (ECG). Following that, the data is sent to health care providers, allowing for immediate action and individualized treatment.

The scope of the system includes:

- **Remote Monitoring:** Monitoring remotely makes it accessible to patients particularly those that live in impoverished or remote areasto get ongoing healthcare without needing to make frequent trips to healthcare facilities.

- **Chronic Condition Management:** Providing patients the ability to maintain an eye on their health indicators and notify healthcare providers of any anomalies in order to manage chronic illnesses.

- **Preventive Healthcare:** Preventive medicine aims to reduce the risk of serious complications by enabling early identification of possible illnesses.

- **Information statistical analysis:** the investigation of health data, forecasting of possible problems with health, and personalization of medical services via the use of machine learning and artificial intelligence techniques.

- **Patient Empowerment:** Allowing patients to observe their own health indicators and choose on their own medical care has been referred to to be patient engagement.

Limitations:

IOT Based Advance Health Monitoring System has a number of limitations despite its potential:

- **Data Security and Privacy:** Safeguarding private health information is a top priority. To stop breaches and unwanted access, strong encryption and safe data transfer procedures are required.

- **Technical Difficulties:** Real-time data transmission needs reliable internet access, which may prove difficult for rural or developing whereabouts.

- **Accuracy and Reliability:** If one wants to avoid missed identifications or false alarms, the reliability and precision of sensors and data gathering procedures must be maintained. Sensor calibrating and regular service are required.

- **User Adoption:** Patients as well as healthcare providers may be resistant toward adopting novel technologies. Training and instruction are required for efficient utilization.

1.6 Report Layout

Creating a comprehensive report style for the "IOT Based Advance Health Monitoring System" requires segmenting the document into multiple sections that emphasize the project's details, features, development stages, and outcomes. Below is a layout outline for the report:

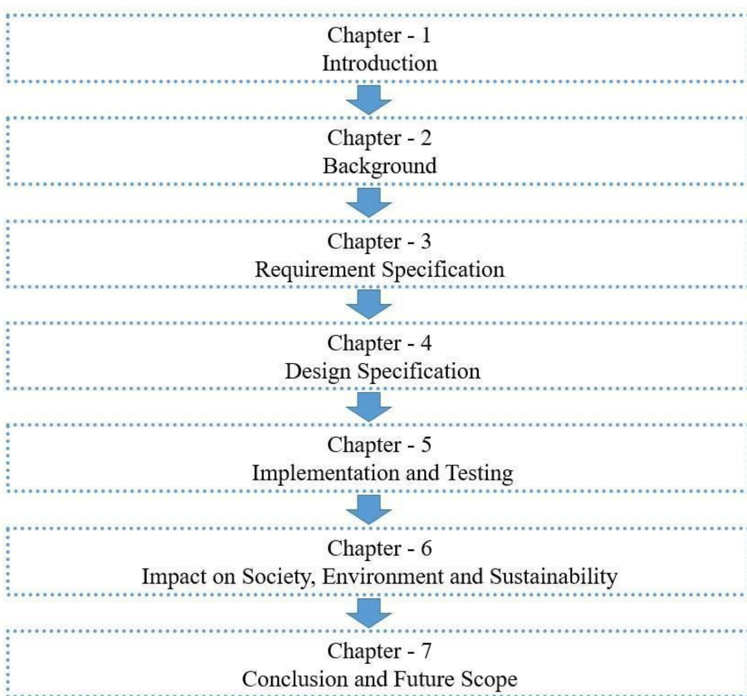

Figure 1.6.1: Report Layout of this Project.

1.7 Summary

Through utilizing modern sensors and Internet of Things technology to continuously and real-time monitor patients' vital signs, the IOT Based Advance Health Monitoring System optimizes healthcare. Although it makes early detection and quick procedures possible, it enhances access to healthcare and administration, especially for distant places. However, there are challenges to be resolved, such as ensuring data security, continuous connectivity, and system integration. Artificial intelligence for prediction, empowering patients, and improved access to implementation. are the main goals. The technology has the ability to greatly enhance medical results as well as effectiveness despite these limitations; but its deployment will need regular attempts to conquer technological in nature, ethical, and logistical issues.

CHAPTER 2

Background

2.1 Overview

This chapter provides a comprehensive review of the existing literature related to IoT-based health monitoring systems. It aims to contextualize the current research landscape, identify gaps, and highlight the advancements in technology and methodologies. The review covers several key areas:

IoT Terminologies:

- **Internet of Things (IoT):** The network of physical objects that include sensors, software, and a connection to gather and share data online is referred to as the World Wide Web of Things (IoT).

- **Sensor:** The sensor is an appliance which measures and observes bodily characteristics like heart rate, humidity, or temperature.
- **Microcontroller/Microprocessor:** The component in responsible for managing interaction with other gadgets or the internet, in addition to handling and analyzing data from sensors.
- **Wireless communication:** Including frequently utilizes use of technologies like Wi-Fi, Bluetooth, or Zigbee, is the exchange of information between machines without the need for conventional wires.
- **Cloud computing:** Offers scalability and remote access for saving and retrieving programs and data over the internet instead of on local hardware.
- **Data Processing:** Processing information is the process of decoding and analyzing processed sensor data with the goal to draw inferences or set off actions.
- **Edge Computing:** Prevents latency and the requirement for constant connection to the internet by processing data locally on the device or close to the data source.
- **Gateway:** A gateway is a device that links Internet of Things (IoT) devices to a network or the internet. It usually gathers data before delivering it to the cloud.

- **Firmware:** The software is programming that has been integrated into hardware gadgets and generally regulates how the device operates and communicates with other parts.

Health Monitoring System Terminologies:

- **Electrocardiogram (ECG) :** An electrocardiogram (ECG) analyses the electrical activity of the heart as time passes in order to identify irregularities in the pace of the heart.
- **Pulse Oximeter:** A pulse oximeter is an instrument used in health monitoring to assess respiratory and heart health. It measures oxygen saturation (SpO2) and pulse rate (PR).
- **Temperature Sensor:** Temperature sensors are essential to determine fever or dehydration as they can measure body or outside temperatures.
- **Humidity Sensor:** A vital instrument to identify environmental factors which could have an effect on health, a humidity sensor detects the amount of humidity in the air.
- **Data logging:** It is the process of storing collected sensor data, either right on the device or remotely in the public internet for additional analysis or reference.
- **Alert System:** A system that, usually based on predefined criteria, notifies users or caregivers of unexpected medical conditions or emergencies
- **User Interface:** the user interface, which could involve web dashboards, mobile apps, or displays, which enables users to interact with the health monitoring system.
- **Remote monitoring** allows caretakers or healthcare practitioners to keep tabs on a patient's condition without having to engage in physical contact with them. It accomplishes this by monitoring health parameters at a distance.
- **Anomaly Detection:** Finding abnormalities in health data that might be related to future difficulties or emergencies is referred to as anomaly detection.

2.2 Related Work

Circuitdigest.com [1] IoT based patient Health Monitoring System using ESP8266 and arduino. (n.d.). This research paper discusses an IoT-based health monitoring system for COVID-19 casualties, focusing on monitoring temperature, humidity, and pulse rate through mobile phones. The system uses a fingertip heartbeat sensor, DHT11 sensor, Node MCU microcontroller, Wi-Fi module, and I2C module to convert data to parallel display on an LCD screen.

IoT Based Emergency Health Monitoring System [2] The "Embedded Based Wireless ICU Monitoring System" is an intelligent system designed to assist in industrial tasks. It consists of sensors like pressure, temperature, ECG, LCD, microcontroller, which work together with a PIC microcontroller. The system monitors bio-potentials and alerts doctors to abnormal conditions, allowing for immediate care.

The paper presents a IoT-based health monitoring system for COVID-19, Security and Communication Networks, 2023[3] high blood pressure, and diabetic patients in Bangladesh. The system measures body temperature, heartbeat, and oxygen saturation levels, sends data to a mobile application, and simplifies medical device usage.

Ruman, M. R., Barua, A., Rahman, W., Jahan, K. R., Jamil Roni, M., & Rahman, M. F. (2020). IoT based emergency health monitoring system[4] This paper presents a 24/7 IoT system for monitoring a patient's body, collecting physiological parameters like pulse, body temperature, and heart rate. The data is sent to an IoT Cloud platform via WIFI-Module, enabling medical specialists to monitor the patient's health and providing suitable health facilities.

Tamilselvi, V., Sribalaji, S., Vigneshwaran, P., Vinu, P., & GeethaRamani, J. (2020). IoT based health monitoring system[5] IoT plays a crucial role in monitoring coma patient health, potentially saving up to 60% of lives. A device uses GSM and IoT to monitor health parameters, including temperature, heartbeat, eye blink, and SPO2. The system uses an ARDUINO-UNO board as a microcontroller and cloud computing, transmitting vital parameters to Advance devices for further evaluation and selection.

Hamim, M., Paul, S., Hoque, S. I., Rahman, M. N., & Baqee, I.-A. (2019). IoT based remote health monitoring system for patients and elderly people[6] The IoT is revolutionizing the health sector by making it more accessible and affordable. A prototype uses three health sensors to monitor patients' health, reducing hospital visits and medical expenses.

Akhila, U. V., Vasavi, Y., Nissie, K., & Venkat Rao, P. (Eds.). (n.d.). An IoT based Patient Health Monitoring System using Arduino.[7] This project proposes an IoT-based Patient Health Monitoring System (PHMS) using Arduino, which collects and evaluates health parameters, provides notifications, and suggests medical care in critical situations, using wireless data transfer to an IoT website.

An IoT based Patient Health Monitoring System D.Shiva Rama Krishnan, 2Subhash Chand Gupta. (n.d.).[8] The healthcare sector is utilizing wireless-sensing node technology to monitor patients' health, especially in old age, by detecting heart problems and enabling timely medical maintenance through a system interfaced with Arduino-uno.

Dohr et al. [12] measured a person's blood pressure using a Keep In Touch device that was connected to an Android-based Smart phone through Near Field Communication. The device transfers all of the data it receives from Keep in Touch to a secure website, where anyone can monitor blood pressure readings.

.Junaid Mohammed et al.[13] used an IOIO-OTG Microcontroller to analyze the patient's ECG and track the readings from anywhere in the world. A monitoring application for Electrocardiogram readings was created for Android Smart phones. Using a USB connection, Bluetooth connection, or near field communication, the IOIO-On the Go microcontroller may send data to an Android handset. Following collection, the data is moved to the smart phone's Android application. where the ECG values can be tracked.

2.3 Comparative Analysis

SL No	Author Name	MAX30102 Blood Pleasure	ECG	DHT11	Body Temperature	Alert System	Patient Maintain	Individual Role Monitor
1.	Circuitdigest [1]	Y	N	Y	N	N	N	N
2.	Yumpu[2]	Y	Y	N	Y	Y	N	Y
3.	Security and Communication Networks [3]	Y	N	Y	Y	N	N	N
4.	Ruman, M. R., Barua [4]	Y	N	N	Y	N	N	N
5.	Tamilselvi [5]	Y	N	Y	Y	N	N	N
6.	Hamim [6]	Y	N	N	Y	N	Y	N
7.	Akhila, U. V [7]	Y	N	N	N	Y	N	N
8.	D.Shiva Rama Krishnan. [8]	Y	N	N	Y	N	N	N
9.	Dohr et. al [12]	Y	N	N	Y	N	N	N
10.	IOT Based Advance Health Monitoring System(My Project)	Y	Y	Y	Y	Y	Y	Y

Table 2.3.1: Comparison between existing works

2.4 Open Issues

Although IoT-based Advance health monitoring systems offer multiple advantages, a number of lingering issues must be resolved prior to they can be utilized widely and efficiently:

1. **Privacy and Data Security:**
    - ❖ Encryption and Secure transfer: In order to protect private medical records from online risks and illegal access, it is essential to use powerful encryption technologies to ensure safe data transmission.

    - ❖ **Observance of Regulations:** Understanding the requirements of HIPAA, GDPR, and other pertinent rules for healthcare data privacy in order to guarantee patient confidentiality and comply with legal requirements.

2. **Integration with Existing Healthcare Systems:**
    - ❖ **Interoperability:** The development of standard interface and standards for smooth interaction with current Electronic Health Records (EHR) as well as other medical facilities is known as interoperability.
    - ❖ **Data Consistency:** Ensuring consistent information formats and minimizing disparities among data supplied by Internet of Things devices and traditional health records are essential elements of data consistency.

3. **Technical Difficulties:**
    - ❖ Stable and dependable internet access is a must, particularly in rural and underdeveloped areas where continuous transmission of information is required.
    - ❖ Sustaining excellent sensor accuracy with routine calibration is necessary to prevent counterfeit positives or exclusions in health data.

4. **User Awareness and an adoption:**
    - ❖ **Patient and Provider Education:** Offering patients as well as physicians the necessary guidance and assistance to enable them to use and evaluate data from Internet of Things health tracking devices in an effective way.

- **User-Friendly Interfaces:** Developing user interfaces that are easy to understand and readily available to a wide variety of users, even those without little technical knowledge.

5. **Cost and Accessibility:**
   - **Affordability:** Decreasing the high installation and upkeep costs over time to enable a wider population to take advantage of the technology, especially in environments with limited resources.
   - **Scalability:** The possibility of the infrastructure to grow to meet greater population sizes without compromising information accuracy or efficiency.

6. **Moral Aspects to Take into Account:**
   - **Informed Consent:** Acquiring patients' express assent while making sure they have all the details of the way their data will be used is known as "well-informed consent."
   - **Equity:** Avoiding inequities in the availability and quality of healthcare by ensuring equal utilization to Internet of Things health tracking technologies.

7. **Durability:**

- **Energy Efficiency:** Energy efficiency is the procedure of developing infrastructure and equipment that uses less energy in order to improve systemic sustainability and lessen its negative effects on the environment.
- **Lifecycle Management:** Putting policies in place for the responsible disposal and recycling of Internet of Things electronics in order to minimize waste from electronics.

8. **Integration of AI and Machine Learning:**
   - **Algorithm openness:** In order to maintain trust and encourage medical decision-making, it must be feasible to make sure the explainability and accessibility of AI algorithms utilized for health data analysis.

- **Bias and Fairness:** The purpose is to ensure that every individual receive fair and impartial health projections and suggestions by eliminating any biases in AI algorithms.

The successful deployment, adoption, and long-term viability of IoT-based Advance health monitoring systems depend on resolving these outstanding obstacles. To overcome such barriers and fully accomplish the promise of this revolutionary healthcare technology, stakeholders must work collaboratively and conduct ongoing research and technological advances.

2.5 Summary

The incorporation of IoT technology in healthcare is reviewed in Chapter 2, with a focus on the move toward continuous, real-time monitoring. It focuses into the effects of many different types of sensors on patient care, including ECG, MAX30102, DHT11, and DS18B20. This chapter assesses the benefits and disadvantages of the various IoT health monitoring solutions now in use. Key unresolved obstacles are identified, such as those pertaining to data security, dependable connection, integration difficulties, acceptance by users, cost control, ethical dilemmas, and sustainability. This thorough analysis offers a basis for comprehending the progress, challenges, and potential paths of Internet of Things-based Advance health monitoring systems.

CHAPTER 3

Requirement Specification

3.1 Overview

The design specifications, analysis of requirements, and methodology for an IOT Based Advance Health Monitoring System are presented in this chapter. It offers a thorough foundation for the structure's growth, guaranteeing a methodical approach to accomplishing its goals. With the goal to determine the requirements and expectations of all parties involved—including patients, healthcare providers, and technical teams—the chapter starts with an extensive requirement analysis. The architecture of the overall system is then described in depth, including the hardware and software components, the movement of data, and protocols for communication. The development process, encompassing design concepts, programming techniques, and testing procedures, is covered thoroughly in the approach section. It highlights how crucial consumer input and continual refinement are to the system's ongoing improvement. The elements of user design of the interface, user experience components, and how they interact are all described in detail in the layout specification section. The primary objective of this chapter is to make sure that every facet of the system is well-planned and recorded in order to enable an effortless integration and deployment into the current healthcare infrastructures.

3.2 Proposed Methodology

To guarantee a thorough effective solution, the IOT Based Advance Health Monitoring Systemis developed using a structured and iterative approach. The approach consists of many steps:

1.Analysis of Requirements:

- ❖ **Interviewing Stakeholders:** Talk to patients, medical professionals, and technical teams to learn about their needs and get particular demands.
- ❖ **Use Case Development:** To identify both functional and non-functional needs, define applications and scenarios.

2. Design of System Architecture:

- **High-Level Design:** Explain the general architecture of the system, taking into account the ways in which software, hardware, and methods of communication interact.
- **Detailed Design**: Describe how each element, such as sensor modules, DPUs, and user interfaces, is designed.

3. Selection of Components:

- **Sensor Selection:** Depending on precision, dependability, and reliability, select suitable sensors such as ECG, MAX30102, DHT11, and DS18B20.
- **The Microcontroller and Networking:** To guarantee dependable transmission of information, use microcontrollers and connectivity choices (such as Wi-Fi and Bluetooth).

4. Integration of Systems:

- **Hardware Integration:** Integrate connection modules and microcontrollers with sensors.
- **Software Development:** Create backend systems for data storage and analysis, as well as firmware for sending information and collecting.

5. Testing and Prototyping:

- **Development of Prototypes:** Create prototypes to verify performance and principles of design.
- **Unit testing:** Examine each component individually to make sure it conforms with design requirements.
- **Integration testing**: Ensure that every system part integrate and communicate with one another effectively by testing the entire system.

6. User Input and Revisions:

- **User testing:** To obtain input on interface and performance, test with real users.

❖ **Iterative Improvement:** Modify the system in response to test outcomes and input from users.

3.3 Hardware and Software Requirements

Hardware Requirements:

1. **Sensors:**
   - ❖ **ECG Sensor**: The electrocardiogram, or ECG sensor is essential for tracking the electrical signals of the heart in the medical field. It is able to detecting and recording the electrical impulses produced by contractions of the heart muscle, which makes it possible to monitor heart rate and identify anomalies like arrhythmias. The ECG sensor records these electrical signals and offers vital knowledge that is used to diagnose cardiac conditions, evaluate the health of the heart, and direct medical actions. It is crucial for both normal patient monitoring and situations of emergency, enabling medical personnel to act quickly and accurately based on well-informed information.

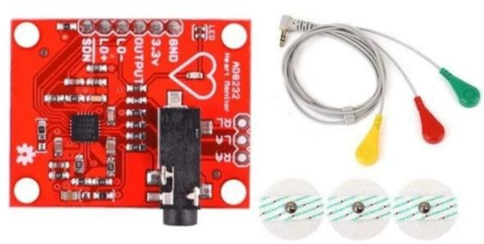

Figure 3.3.1: ECG Sensor

   - ❖ **MAX30102 Sensor:** The MAX 30102 sensor is intended for heart rate and pulse oximetry monitoring. It measures blood oxygen saturation (SpO2) levels and determines heart rate variability using photosynthetic (PPG). The sensor measures oxygen saturation levels in the blood by shining light onto the skin and calculating the quantity of light absorbed. This data is vital for keeping a watch on respiratory disorders and general cardiovascular health.

In environments like intensive care units, sleep monitoring, and physical activity uses, where real-time monitoring of oxygen levels and heart rate variability is crucial, the MAX30102's capacity to deliver continuous, non-invasive measurements makes it a helpful instrument.

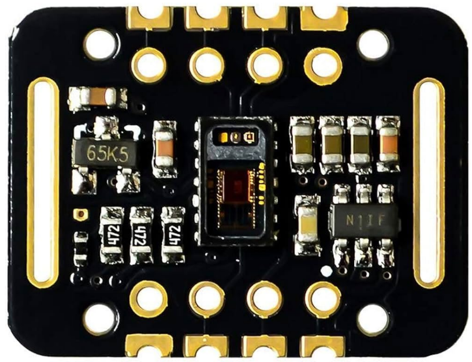

Figure 3.3.2: Max30102 Sensor

❖ **DHT11 Sensor:** The temperature and humidity of the outside atmosphere are measured using the DHT11 sensor. Since it gives accurate measurements of both the surrounding temperature and relative humidity, it may be utilized in situations where keeping an eye on environmental factors is crucial for the well-being and pleasure of patients. The DHT11 sensor renders sure that the humidity and temperature are kept within ideal ranges in hospital wards, healthcare storage facilities, and home healthcare settings. This encourages patient well-being and improves the efficacy of medical treatments by decreasing discomfort and the chance for issues brought on by outside influences.

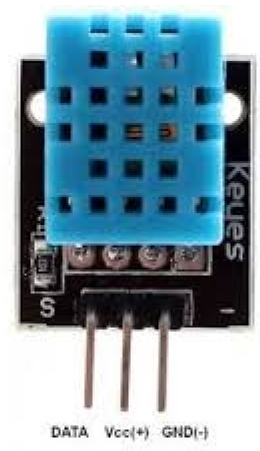

Figure 3.3.3: DHT11 Sensor

- **DS18B20 Sensor:** The precision with which the DS18B20 sensor measures temperature is well known. This functions with a high degree of accuracy while taking temperature readings at certain locations because to its digital interface. This type of sensor is frequently used in healthcare settings where accurate temperature monitoring is crucial, such body temperature monitoring, making sure that healthcare equipment is operating properly, and maintaining stable ambient temperatures in labs and medical facilities. Because of its dependability and precision, the DS18B20 is an invaluable instrument for applications that need precise temperature management and monitoring. These kinds of applications improve patient safety, care quality, and efficiency of operations in healthcare environments.

Figure 3.3.4: DS18B20 Sensor

2. **Microcontroller (ESP8266):**

   A reasonable, Wi-Fi-capable microcontroller perfect for Internet of Things applications is the ESP8266. It features several GPIO ports for sensor and peripheral connections, a robust 32-bit CPU for effective data handling, low power consumption for battery-powered applications, integrated Wi-Fi for monitoring from afar, and a compact form for easy incorporation into small places.

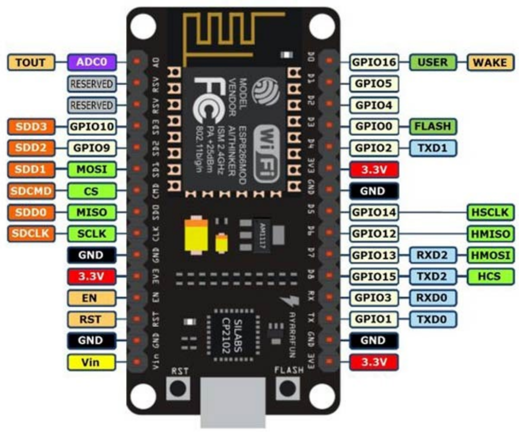

Figure 3.3.5: Microcontroller Esp8266

3. **Power Supply:**

   Ensure a reliable power source compatible with the selected microcontroller and sensors, considering power consumption and operational requirements.

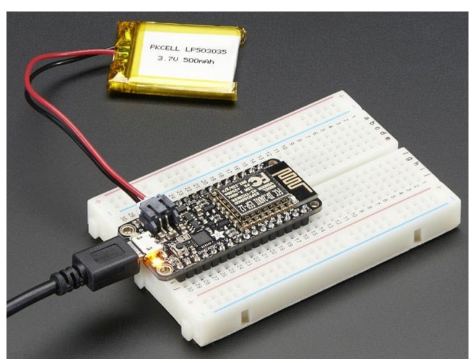

Figure 3.3.6: Power Supply

Software Requirements

❖ **Firmware:**

- Microcontroller code that gathers, processes, and transmits sensor data. Reverse System:

❖ **Database:** MySQL for storing data.

❖ **Server-side Scripting:** Node.js or Python for handling data and APIs.

❖ **Data Analytics:** Machine learning for real-time analysis and anomaly detection is known as data analytics.

❖ **Interface User:**

- For real-time monitoring and warnings, there are online dashboards and mobile apps for iOS and Android.

3.4 Project Management and Financial Analysis

Project Management:

❖ **Team Structure:** Assign roles and duties to team members who will be involved with the project, including designing the hardware and software, testing, and deploying it.

❖ Develop an accurate plan for the project which involves important stages for software development, hardware prototype, testing, and deployment.

❖ **Task Distribution:** Assign responsibilities to team members according to their availability and area of experience to ensure successful cooperation and progress.

❖ **Plan of Communication:** To speak about progress, resolve challenges, and make recommendations rapidly, establish periodic conferences and communication channels.

❖ **Risk Control:** Determine any dangers such as those requiring technology, resources, or regulations, and develop abatement strategies for dealing with them.

❖ **Assurance of Quality:** Incorporate quality control techniques, including comprehensive evaluation and verification methods, to make sure that the structure meets the required standards and specifications.

Finance:

Allocate Funds: Establish the budget needed for programming, hardware components, testing supplies, and other project-related costs.

Estimating Costs: Determine the estimated cost for every part, incorporating sensors, microcontrollers, communication modules, and any supplementary accessories.

Purchasing Resources: Acquire the required supplies and machinery from reliable suppliers, taking time for delivery, the cost, and quality under consideration.

Budgetary Management: Establish an expenditure plan while setting away money for ongoing expenses like upkeep, support, and future improvements.

Sources of Funding: Look into ways that will help the undertaking economically, including donations, advertising, or investments, especially if it will take a large amount of money.

The return on investment: Analyze the project's possible return on investment while taking into consideration factors including better patient outcomes, cost savings, and product demand.

Benefit-Cost Analysis: To determine the project's economic viability along with backing the investment with predicted outcomes and benefits, perform a cost-benefit analysis.

Accounting Reporting: To track budget utilization and ensure transparency, keep complete records of all project costs and financial transactions. I should also generate financial reports on a regular schedule.

<table>
<tr><th>SN</th><th>Components</th><th>Estimated Cost (BDT)</th></tr>
<tr><td>01</td><td>Total Sensor Component in(BDT)
<table>
<tr><td>Max30102</td><td>3200</td></tr>
<tr><td>ECG</td><td>2500</td></tr>
<tr><td>DHT11</td><td>250</td></tr>
<tr><td>DS18B20</td><td>300</td></tr>
</table>
</td><td>5500-6500</td></tr>
</table>

02	Doing market survey	2000-3000
03	Power Supplies and Batteries	500-1000
04	Documentation and Report Writing	500-1000
05	Contingency (10% of total)	1000-1500
	Total Estimated Cost	9,500-13,000

Table 3.4: Financial Analysis

3.5 Process Modeling

This procedure model explains the steps that different kinds of users must take to access a healthcare application. Users start at the Welcome Page, where they have the option to sign up or log in. Depending on their role, they are then sent to one among three dashboards, each with features particular to a position that is the general User Dashboard, the Doctor Dashboard, or the Nurse Panel. The user logs out to complete the transaction. For the purpose of providing various users a clear visual depiction of the system's operation, this model employs prevalent flowchart symbols to symbolize the decisions, actions, and finish points.

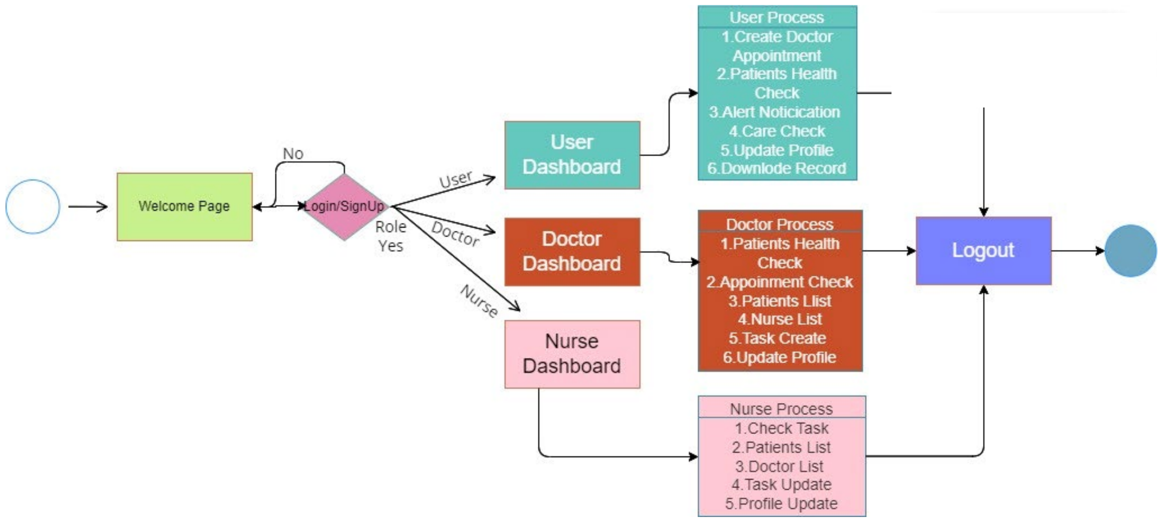

Figure 3.5.1: Process Modeling

3.6 Use Case Modeling and Description

The three primary actors are involved in the IoT-based Advance Health Monitoring System: Users, Physicians, and Nurses. Appointment timing, important alerts, task viewing, health checks, and profile updates are all available to users. Doctors get access to nurse details, manage appointments, make tasks, do health checks, and update their profiles. Nurses have access to lists of doctors and patients, are able to view and modify tasks, and can update their profiles. The system makes it simpler for users, doctors, and nurses to schedule tasks and interact with each other.

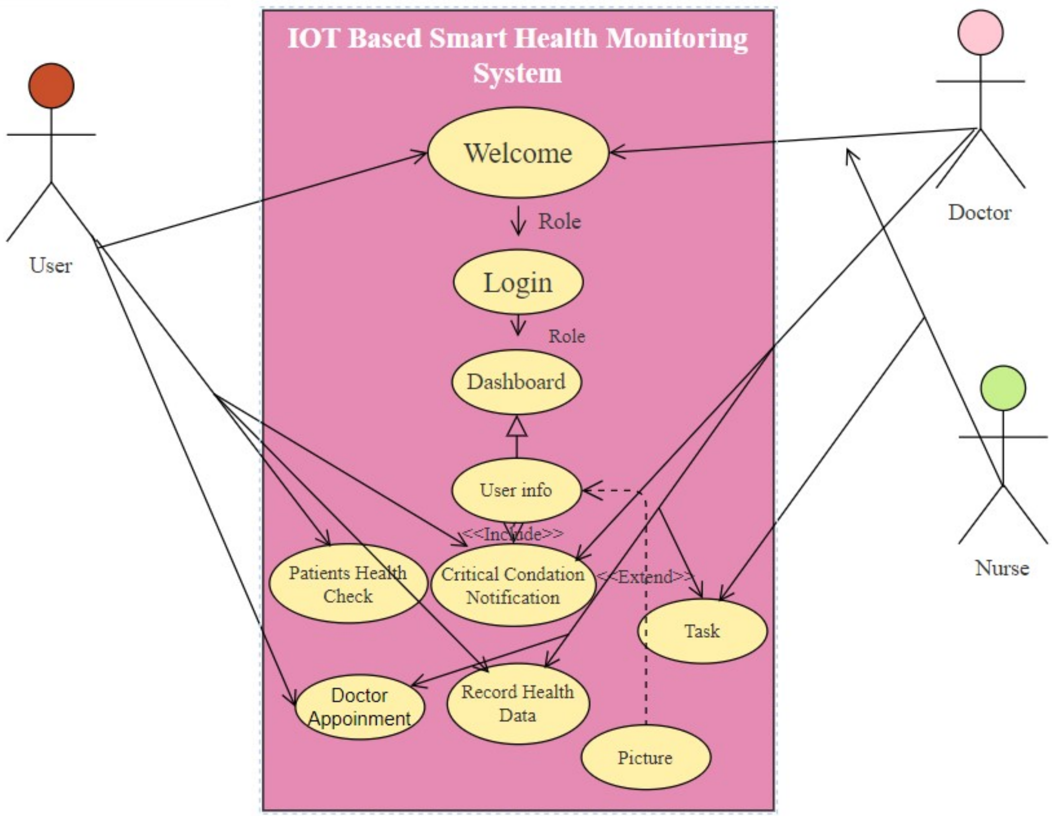

Figure 3.6.1: Use Case Diagram.

3.7 Logical Data Model

Several entities are included in the logical data model of the "IOT Based Advance Health Monitoring System": Individual Dashboard, Appointment, Medicine task, and Alert Notification. Users map itineraries, create their own preferences, and make reservations associated with certain destinations; these linkages define interactions. Entity attributes gather pertinent information and lay the groundwork for effective travel planning and user interaction on the platform.

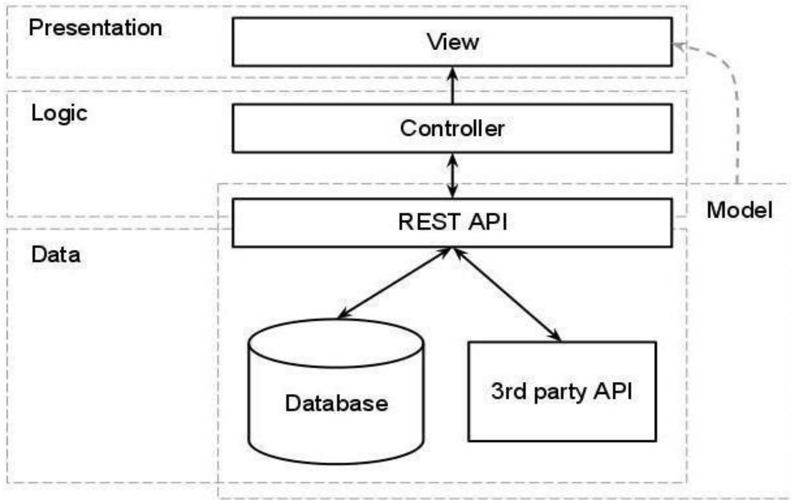

Figure 3.7.1: Logical Data Modeling.

3.8 E-R Diagram

The following tables, which make up the database ER diagram, depict a health management system:

Appointments: Documents including the patient's information, date, time, status, and doctor's ID.

Physicians: Provides contact information, specialty, email address, and name of the physician.

Health Data: Consists of measurements of a patient's temperature, humidity, ECG, blood pressure, heart rate, and timestamp.

Nurses: Personal details such as name, email, and phone number for nurses.

Patients: Patient records with address, phone number, and email addresses.

Picture: Saves picture paths from the patients table that are connected to the user_id.

tasks: Keeps track of the tasks given to nurses, along with the medication, patient and nurse IDs, and task information.

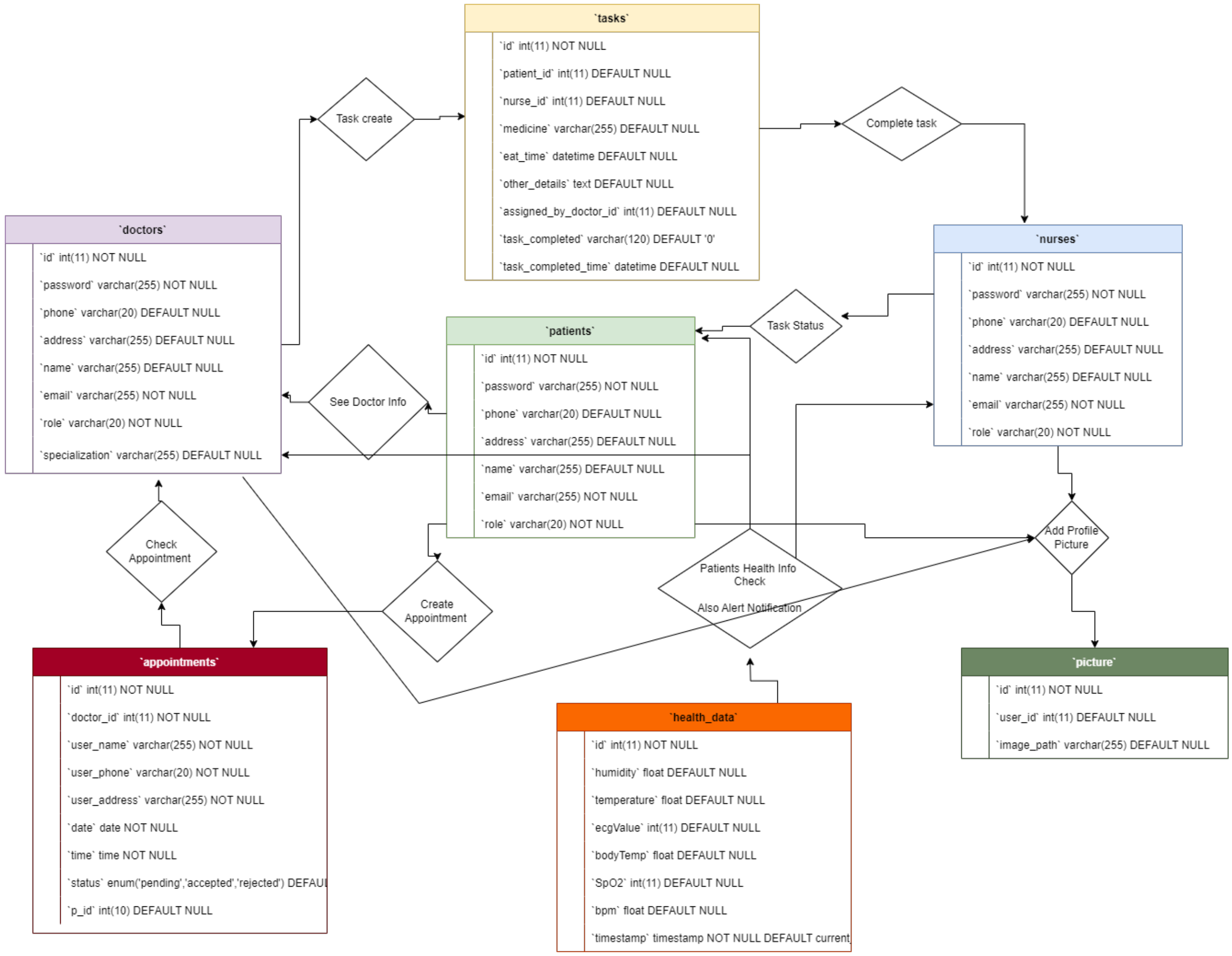

Figure 3.8.1: E-R Diagram.

3.9 Summary

The IOT Based Advance Health Monitoring System report's third chapter provides a thorough summary of the project's requirements and design guidelines. It starts with a thorough examination of the demands of the stakeholders, stressing the value of user feedback and iterative system improvement. The suggested approach provides an organized process to acquire requirements, connecting the system, and testing it. The specifications for both software and hardware are clarified in great depth, emphasizing necessary parts such as the ESP8266 microprocessor, DHT11, MAX30102, ECG, and DS18B20 sensors. Financial analysis, thorough process model, and management of projects variables are also covered in this chapter. The term logical data model and an ER diagram illustrating the database structure of the system round up the section.

CHAPTER 4

IMPLEMENTATION

4.1 Overview

Simple access is made possible by the user-friendly interface of the front-end design. Through social media, phone, or email, users are able to sign in. The dashboard uses graphical representations for displaying tasks, appointments, and health data. In addition to handling duties, users may arrange appointments and monitor real-time health data. Editing private details and medical history is possible with profile management. Users get notifications regarding crucial issues and appointments. The responsive design emphasizes security through using data encryption and safe authentication. For help, there's also a section specialized for suggestions and support.A PHP framework, HTML for structure, CSS for styling, and JavaScript for interactivity make up the back-end design. Users' authentication, processing of information, and database interactions are all managed by PHP. The website's layout, forms, and content are all organized using HTML. The HTML elements are styled by CSS, which ensures an aesthetic and consistent appearance on all devices. JavaScript includes dynamic features including interactive parts, asynchronous data loading, and form validation. The integration of these technologies results in a web application for the Advance health monitoring system that is reliable, responsive, and simple to use.

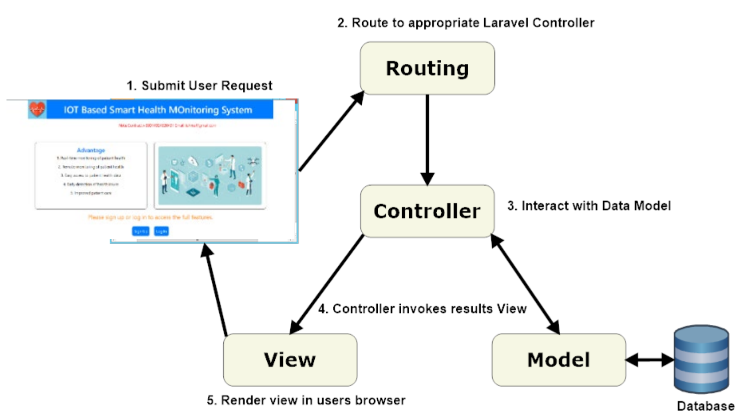

Figure 4.1.1: MVC Architecture.

PHP Artisan, the command-line interface for Laravel, boosts the efficiency of developers by automation time-consuming tasks like component development, database displacements, and seedings. It offers user-friendly environments for testing, simplifies database administration, and allows for effective code scaffolding. Thanks to Laravel's ORM and its ecosystem of libraries and tools, the "IOT Based Health Monitoring System" benefits from simplified development, efficient database handling, secure authorization, and robust testing capabilities, all of which help with the creation of a reliable, scalable, and maintainable web-based travel management system.

4.2 Train Model/ Prototype Design

The training and prototype design for the IOT Based Advance Health Monitoring System involve several key steps. Beginning with rigorous requirement analysis through stakeholder interviews and use case development, the process proceeds to high-level and detailed system architecture design, selecting suitable components like sensors (ECG, MAX30102, DHT11, DS18B20) and microcontrollers (ESP8266). Integration and testing phases ensure hardware and software components work seamlessly together, followed by iterative improvements based on user feedback. Effective project management ensures team coordination and financial planning, culminating in a functional prototype that validates system functionalities and prepares for future deployment and scalability.

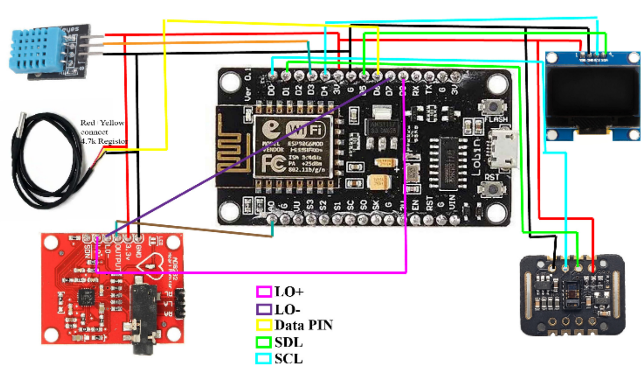

Figure 4.2.1: Circuit Diagram

4.3 System Testing/ Model Evaluation

Important phases in the creation of the Internet of Things-based Advance health monitoring system include system testing and model evaluation. A thorough inspection is done at this step to make sure all the parts are in working order and satisfy the standards. Unit testing is the first step in the process, wherein distinct components, including sensors, microcontrollers, and software modules, are tested separately to ensure proper operation. Following that, integration testing makes sure that all of these parts work together as a whole. Testing for performance is done on the system to assess its capacity, responsiveness, and dependability in different scenarios. Actual users participate in testing for user acceptance (UAT) to provide feedback on the usability, interface, and overall satisfaction of the system. The iterative adjustments are made with regard to the findings to address any problems or potential improvement areas.

4.4 Summary

In order to be ensuring the IOT Based Advance Health Monitoring System is reliable and functional, system testing and model inspection are essential. The following section describes the methodical methodology used, which begins with unit testing for individual components and proceeds to tests for integration to guarantee seamless software and hardware connection. Performance evaluations evaluate how well the system works in real-world scenarios, while user adoption testing collects important input from real users. The experimental findings inform the continuous refinement process, which makes sure the system satisfies all criteria and is prepared to be implemented in healthcare settings.

CHAPTER 5

Implementation and Testing

5.1 Overview

The primary component of an IOT Based Advance Health Monitoring System is a device that measures vital signs such temperature, humidity, heart rate, ECG, and SpO2. It ensures precise monitoring and fast updates by logging real-time data into the health data table. The database and this gadget work together to give healthcare workers easy access to, storage of, and analysis of patient data.

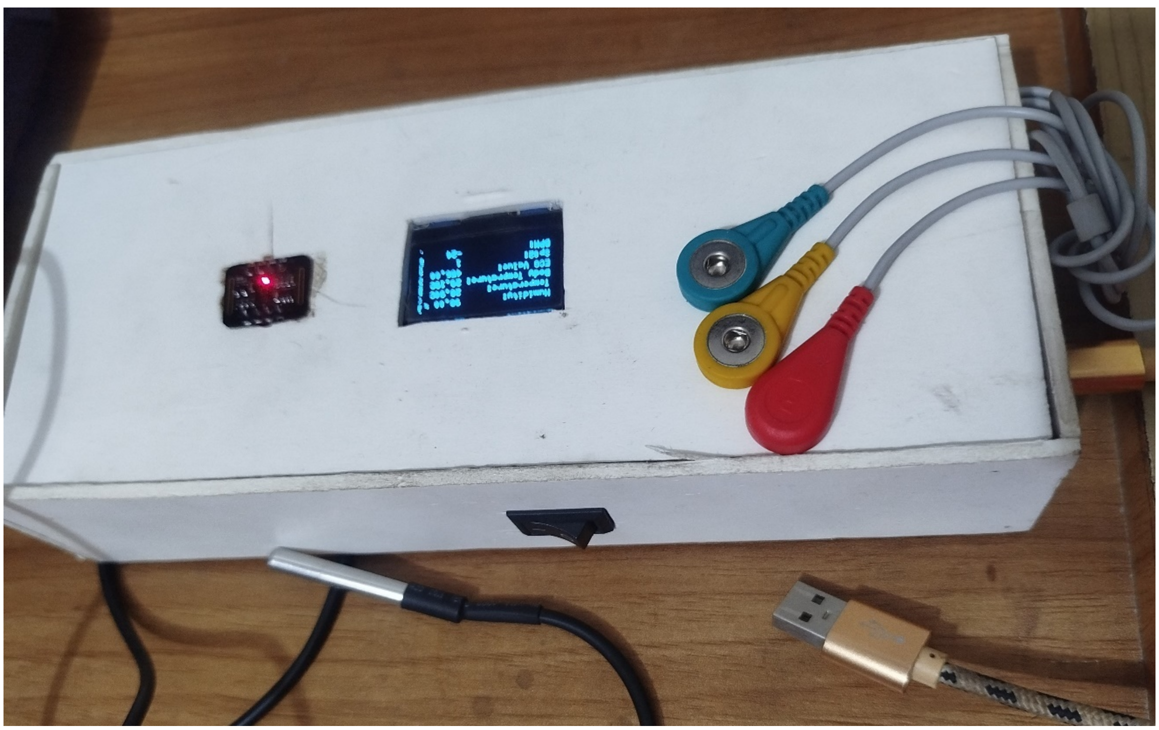

Figure 5.1.1: Main Device

5.2 Experimental Result

For these An Internet of Things (IoT)-based Advance health monitoring system's database includes tables for patients, physicians, nurses, appointments, medical information, and photographs. A few examples of sensors that are useful for patient monitoring are temperature, pulse oximeter, and ECG. Using foreign keys, each table establishes interactions with the others while storing relevant data.

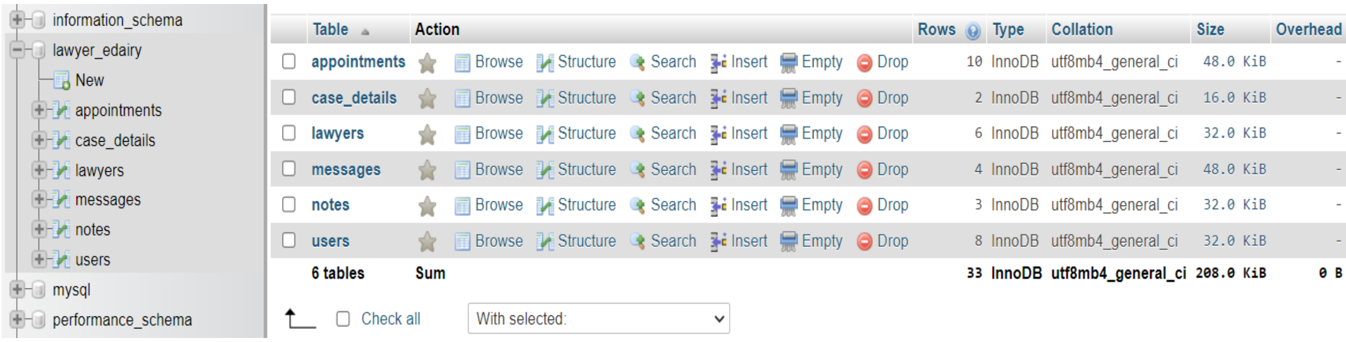

Table	Action						Rows	Type	Collation	Size	Overhead
appointments	Browse	Structure	Search	Insert	Empty	Drop	10	InnoDB	utf8mb4_general_ci	48.0 KiB	-
case_details	Browse	Structure	Search	Insert	Empty	Drop	2	InnoDB	utf8mb4_general_ci	16.0 KiB	-
lawyers	Browse	Structure	Search	Insert	Empty	Drop	6	InnoDB	utf8mb4_general_ci	32.0 KiB	-
messages	Browse	Structure	Search	Insert	Empty	Drop	4	InnoDB	utf8mb4_general_ci	48.0 KiB	-
notes	Browse	Structure	Search	Insert	Empty	Drop	3	InnoDB	utf8mb4_general_ci	32.0 KiB	-
users	Browse	Structure	Search	Insert	Empty	Drop	8	InnoDB	utf8mb4_general_ci	32.0 KiB	-
6 tables	Sum						33	InnoDB	utf8mb4_general_ci	208.0 KiB	0 B

Figure 5.2.1: Database Architecture.

Implementation of Front-end Design

An IoT-based Advance health monitoring system's front-end design uses HTML, CSS, JavaScript, and PHP to generate a user interface that is simple to use. It provides real-time sensor data display, appointment scheduling, health record management, and profile management on dashboards for doctors, nurses, and patients, all of which serve to a responsive and easy-to-use user experience.

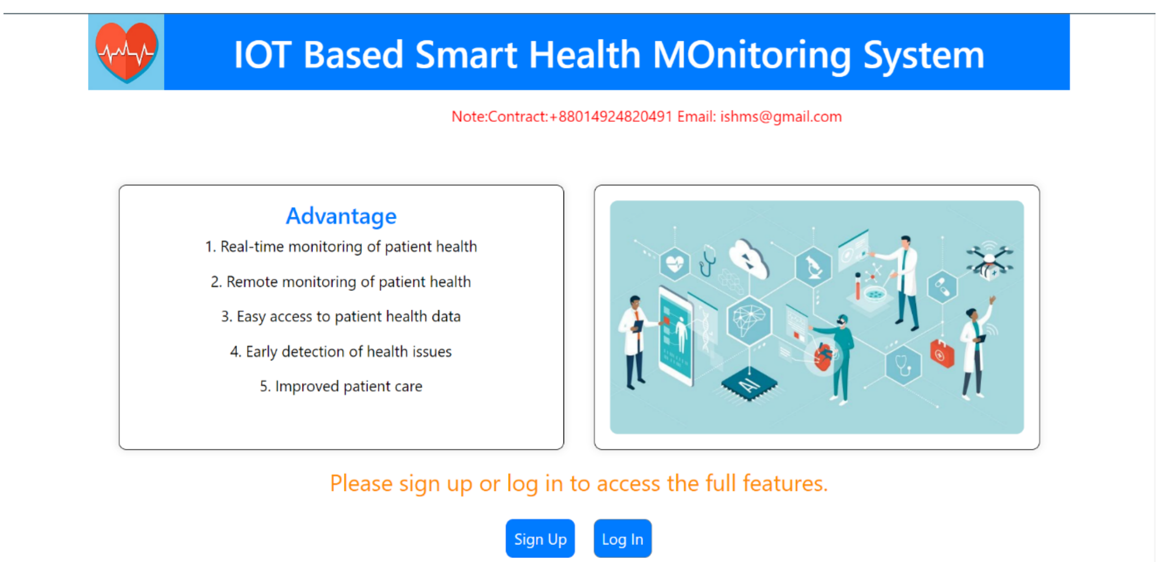

Figure 5.2.2: Landing Page Design.

The IOT Based Advance Health Monitoring System homepage is located here. Here are some options, including Notice, Some Details, and Login.

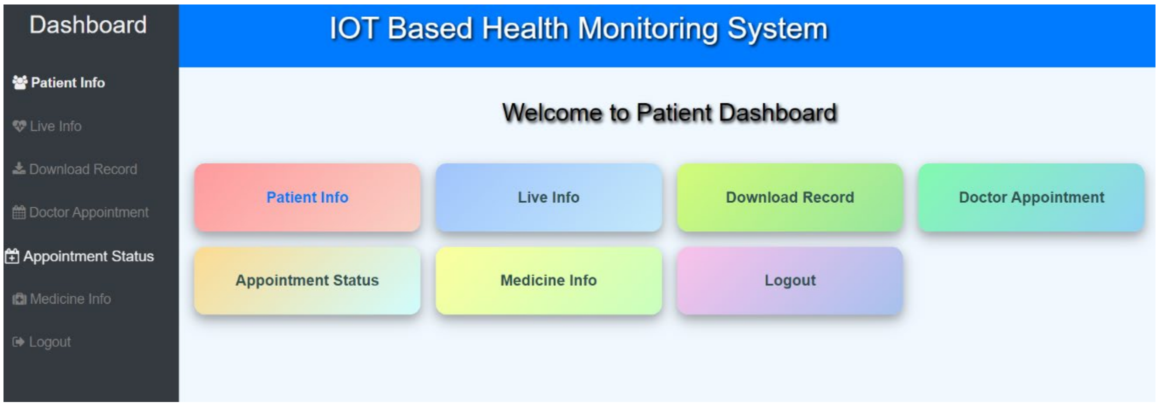

Figure 5.2.3: Patients Dashboard Design.

Greetings aboard the Patient Dashboard! Complete health information, real-time monitoring data, medical record downloads, appointment scheduling, appointment status examinations, and medication information are all available here. Easily use the user-friendly the user interface designed for offering the best possible healthcare management experience. Keep yourself informed and easily maintain your health.

.

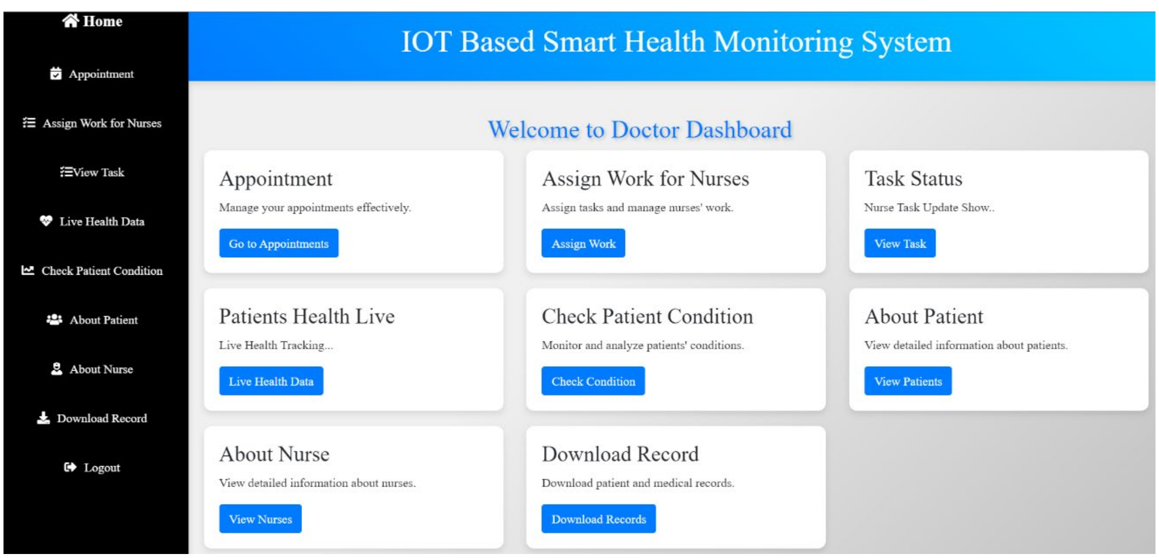

Figure 5.2.4: Doctor Dashboard Design.

Greetings from the Doctor Dashboard! Task management, real-time health monitoring, appointment scheduling, and patient information are all simple to access from this portal. Doctors are competent at managing appointments, updating treatment plans, reviewing medical histories, and monitoring patient progress. The user-friendly design ensures easy navigation and optimized healthcare provision, increasing patient care and clinical effectiveness.

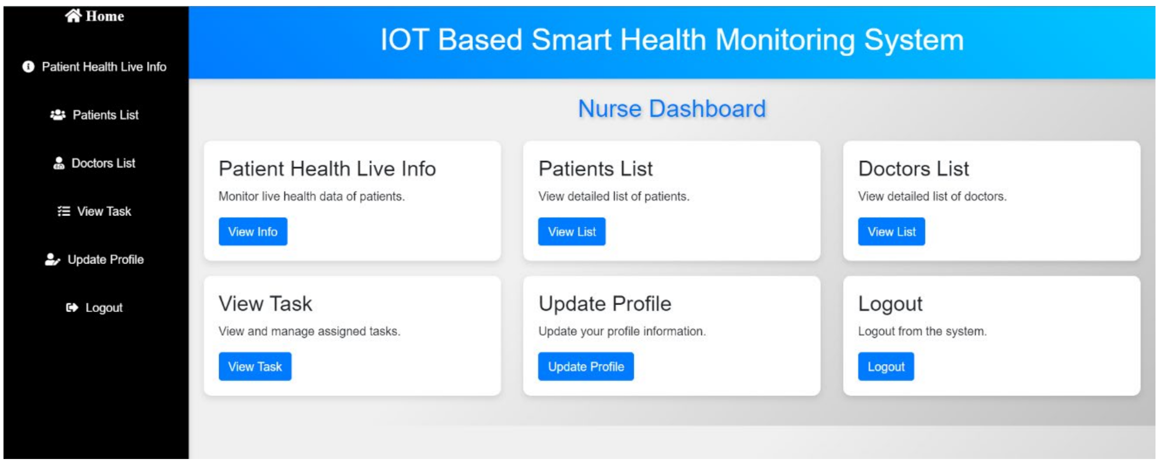

Figure 5.2.5: Nurse Dashboard Design.

The Nurse Dashboard provides a centralized hub for nurses, offering easy access to work assignments, updates, and real-time patient monitoring, enhancing workflow and ensuring efficient patient care execution.

5.3 Performance Analysis

A systematic testing method is necessary to guarantee the IoT-based Advance Health Monitoring System's reliable performance, security, usability, and efficacy. Here's how testing is carried out:

Types of Testing:

- ❖ Unit testing: Verifies that separate parts (sensors, data processing units) are operating as intended.
- ❖ Testing for integration makes ensuring that sensors, data storage, and backend systems

all work together seamlessly.

- ❖ System testing: Checks the general functionality and behavior of the system against established requirements.
- ❖ User Acceptance Testing (UAT): The purpose of User Acceptance Testing (UAT) is to assess user needs and usability through involving stakeholders in scenario-based testing.
- ❖ Security testing: Performs evaluations to find and fix security holes in data storage and transmission.
- ❖ Performance testing: Assesses the stability and efficiency of the equipment under different circumstances and data loads.

Methods of Testing:

- ❖ Test Case Development: Develops thorough test cases that address all user scenarios, edge cases, and system functionalities.
- ❖ Execution and Reporting: Test scenarios are carried out methodically, results are tracked, and reports including test findings are produced.
- ❖ Bug tracking: This method assigns aims, keeps track of fixes, and logs and monitors bugs found using tracking tools.
- ❖ Regression testing: ensures that upgrades have no unintentional effects by validating current functionalities.
- ❖ User input Incorporation: Optimizes system speed and enhances user experience by incorporating input from consumers in tests.

Testing Conditions:

- ❖ Development Environment: Local environments of developers are used to test specific components and capabilities.
- ❖ Staging Environment: An environment which is similar to production settings is used to test integration of systems and functionality in general.

- ❖ User Testing Environment: For the purpose of UAT, real users and/or stakeholders are invited in under monitored circumstances.

Automated:

- ❖ Automated Testing: Regression and repetitious testing are carried out automatically by using frameworks such as PHP Unit for backend testing and Selenium for user interface testing.
- ❖ CI/CD Integration: For smooth testing and deployment processes, automated evaluation can be incorporated into CI/CD pipelines.

Customers benefit by ensuring before deployment that functionality, security, dependability, and user satisfaction

.

5.4 Summary

The Internet of Things-based Advance Health Monitoring System has undergone rigorous testing, ensuring efficiency and safety. Unit testing confirmed sensor accuracy, integration tested components, and system compliance. User Acceptance Testing confirmed user satisfaction, security testing identified vulnerabilities, and performance tests confirmed system responsiveness. Continuous monitoring will enhance system reliability.

CHAPTER 6

Impact on Society, Environment, and Sustainability

6.1 Impact on Life

Through providing precise, real-time health monitoring, the IOT Based Advance Health Monitoring System greatly enhances patient outcomes and healthcare delivery. It gives people the ability to take charge of their health, and encourages early diagnosis and treatment of illnesses. Patients with persistent illnesses or those who live in rural places can benefit greatly from continuous and remote monitoring made available by this technology that connects patients and healthcare professionals. Patients and health care providers save time and money when fewer hospital visits are necessary. In addition, the system's data-driven insights improve overall health management and enable customized treatment programs, which raise the lifespan and improve quality of life.

6.2 Impact on Society & Environment

Through improved accessibility and quality of care, the Internet of Things-connected Advance Health Monitoring System revolutionized the way that healthcare is provided to patients. The technology makes remote monitoring possible, ensuring that people, especially those living in disadvantaged or remote areas, have access to prompt medical care and interventions. By providing individuals the tools to take control of their health, promote early detection of health issues, and reduce the need for frequent trips to the hospital, this technology empowers patients. It significantly contributes to the well-being of society through enhancing individual quality of life and overall health outcomes through ongoing monitoring and tailored treatment. The innovation lessens the ecological impact associated with healthcare, thereby encouraging environmental sustainability. It eliminates the need for patients make trips to healthcare facilities for regular check-ups or consultations through the utilization of online tracking capabilities, which lowers emissions associated with transportation. In addition to relieving congestion caused by traffic, the reduction in travel improves the quality of the air in cities. It contributes to preserve the environment by optimizing resource utilization while promoting efficient medical practices, so coordinating the provision of healthcare with sustainable development goals.

6.3 Impact on Sustainability:

The Advance Health Monitoring System, which is based on the Internet of Everything, has a beneficial effect on sustainability through guaranteeing the long-term viability of healthcare systems. By reducing problems through early detection and treatment, it lowers healthcare costs by facilitating more effective resource allocation. Utilizing technology for offering adaptable and adaptable medical services increases reactivity and resilience in the provision of healthcare, especially during emergencies or pandemics. This ability to deliver high-quality care remotely addresses major obstacles to the viability of global health through encouraging fair availability of health and guaranteeing service continuity.

6.4 Ethical Aspects

The Internet of Things (IoT)-based Advance Health Monitoring System faces multiple ethical issues to face, such as protecting patient privacy, getting informed approval for data usage, ensuring data veracity, promoting equity regarding medical access, and upholding responsibility and openness in system operations. For doctors to handle moral dilemmas, protect patient rights, and maintain confidence in medical technology, ongoing observation and assessment are necessary.

6.5 Sustainability Plan

The IOT Based Advance Health Monitoring System has a sustainability plan that emphasizes longevity and careful resource management:

- ❖ Resource Efficiency: To reduce energy consumption and lessen environmental effect, optimize sensor and information processing technology.
- ❖ Scalable Infrastructure: Develop an architecture that is simultaneously scalable and adaptable to future development and advances in technology without compromising functionality.
- ❖ Lifecycle Management: In order to minimize the amount of electronic debris generated, put procedures in place for the ethical disposal and reuse of hardware

components.

- ❖ Community Engagement: To promote sustainability medical procedures and fulfill regional medical requirements, cultivate alliances with legislators, communities, and medical professionals.
- ❖ Continuous Improvement: To enhance environmental standards over time, evaluate system performance, user input, and advances in technology on a regular basis.

6.6 Summary

The positive impacts of the IOT Based Advance Health Monitoring System for life, society, the environment, and sustainability are covered in Chapter 6. Through early illness diagnosis and real-time health monitoring, the system enhances patient outcomes and healthcare delivery, especially for people with chronic ailments or living in distant places. It promotes the effective use of resources and lessens the impact on the environment by reducing the need for frequent hospital visits, which saves money and time. By ensuring fair access and efficient healthcare service, even in times of emergency, the system encourages sustainability. In order to maintain trust, ethical issues like informed consent and patient privacy have been taken care of. A approach to sustainability that emphasizes resource conservation, scalable infrastructure, ethical hardware leadership, community involvement, and continual improvement closes the chapter.

CHAPTER 7
Conclusion and Future Work

7.1 Conclusion

By providing remote monitoring, especially to disadvantaged and remote regions, the IOT Based Advance Health Monitoring System dramatically improves healthcare by enabling immediate action and enabling people to take charge of their own health. By cutting down on unnecessary hospital stays and simplifying patient care, it maximizes resource use. Informed consent, data security, and patient privacy are the three primary areas of ethical concern. Equality and trust in the provision of healthcare are guaranteed by transparent data consumption and equitable access. By doing the use of energy-efficient technology and meticulous hardware management, the system also places a high priority on sustainability. The beneficial impacts will be enhanced by continual improvement and involvement from stakeholders, guaranteeing long-term efficiency, moral participation, and impact on society.

7.2 Further Suggested Works

Considerable potential exists for the IoT-based Advance Health Monitoring System's eventual growth and expansion:

- ❖ Improved Sensor Technology: Establish higher-quality sensors that track more health indicators and with greater accuracy than the ones that are now available, such as pulse oximetry and ECG.
- ❖ Integrate AI and machine learning: Utilize AI algorithms to evaluate enormous volumes of medical data in order to offer personalized treatment recommendations and forecasting.
- ❖ Integration of Telemedicine: To expand the quantity of opportunities for remote medical care and to enable real-time video consultations, integrate telemedicine structures.
- ❖ IoMT Ecosystem Expansion: To promote comprehensive health monitoring, involve Advance watches and Advance healthcare products into the Internet of Medical Things (IoMT) ecosystem.
- ❖ Blockchain for Data Security: Investigate whether blockchain technology could

enhance security of information, transparency, and interoperability between and within healthcare networks.

7.3 Limitations/ Conflict of Interests

Some of the constraints of the Internet of Things (IoT)-Based Advance Health Tracking System include its need on a constant internet and power supply, privacy and security of data issues, potential errors in the sensors, and user compliance requirements. Developers' financial objectives, system users' biases in healthcare delivery, and disagreements among patients, providers, and developers over data ownership may all contribute to conflicts of interest. The organization's potential to improve patient outcomes and healthcare delivery—especially for those who reside in rural areas—underlines its importance despite all of these challenges, highlighting the need for continued development and ethical issues.

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Appendix A

Complex Engineering Problems (EP) and Complex Engineering Activities (EA) Analysis

Title: IOT Based Advance Health Monitoring System.

Students ID: 202-15-3828

CO Description for FYDP-Phase-I

CO	CO Descriptions	PO
CO1	Integrating knowledge to identify problems	**PO1**
CO2	Analyzing different aspects of designing solutions	**PO2**
CO3	Exploring problems through literature review	**PO4**
CO4	Performing economic evaluation and project management	**PO11**

CO Description for FYDP-Phase-II

CO	CO Descriptions	PO
CO5	Creating and designing solutions that take safety into account and satisfy requirements	PO3
CO6	Applying appropriate techniques and technologies to address challenging issues	PO5
CO7	Considering into account elements of society, health, safety, law, and culture	PO6
CO8	Assessing the efficacy and long-term effects of solutions	PO7
CO9	Integrating professional standards and ethical guidelines into practice	PO8
CO10	Performing both independently and collaboratively with effectiveness	PO9
CO11	Effectively communicating with peers and society	PO10
CO12	Taking up lifelong learning	PO12

Addressing CO (1 to 8), Knowledge Profile (K), and Attainment of Complex Engineering Problems (EP):

SN	EP Definition	Attainment	CO	Justification	References
1	EP1: Depth of Knowledge required	Yes	CO1, CO2, CO3, CO5, CO6, CO7, CO8	The project covers the fundamentals of engineering and ensures strong design and implementation by utilizing IoT technology for health monitoring.	Page no: [01-14, 17-24], Section: [3.1, 3.3, 3.4, 4.1, 4.2]
2	EP2: Range of Conflicting Requirements	Yes	CO2, CO7	Addressing issues including conforming to standards and creating a balance between security and functionality. .	Page no: [02-14], Section: [2.4, 2.5]
3	EP3: Depth of analysis required	Yes	CO2, CO6	providing solutions for improved platform accessibility and user experience top priority.	Page no: [6-13, 17-20], Section: [4.2, 4.3, 4.4]
4	EP4: Familiarity of Issues	Yes	CO8	Process optimization, data security, and integration of health monitoring analytics.	Page no: [8-11], Section: [2.2, 2.4]
5	EP6: Extent of stakeholders involved and conflicting requirements	Yes	CO8	working together with medical experts to guarantee that the system satisfies requirements.	Page no: [13-14], Section: [14]
6	EP7: Interdependence	Yes	CO5	Testing to ensure performance, security, and integrity of data.	Page no: [14-15, 21-23], Section: [5.1, 5.2]
7	EP8: Financial Analysis	Yes	CO4	Creating a budget to assess and project expenses.	Page no: [15-16]

Addressing CO11 with Complex Engineering Activities (EA):

SN	EA Definition	Attainment	CO	Justification	References
1	EA1: Range of resources	Yes	CO11	using a knowledgeable workforce, funding, and a range of instruments to facilitate efficient growth.	Page no: [20], Section: [4.4]
2	EA2: Level of interaction	No	N/A	N/A	N/A
3	EA3: Innovation	Yes	C06	Providing Best Communication Platform with Alert Notification	Page: [14-20] Section: [3.1-3.4]
4	EA4: Consequences for society and the environment	Yes	CO8	Maintaining a focus on sustainability and social impact while maintaining moral standards for things like privacy and security.	Page no: [26-31], Section: [6.1, 6.2, 6.4]
5	EA5: Familiarity	Yes	CO11	Analyzing rivals in the market to improve competitiveness and guide strategic decisions .	Page no: [7-10], Section: [2.1, 2.3]

Addressing CO (4, 9, 10, and 12):

SN	CO	Attainment	Justification	References
1	CO4	Yes	Implementing resource allocation and budgeting techniques into financial management procedures.	Page no: [4-5], Section: [1.5]
2	CO9	Yes	supporting moral standards by putting user privacy first and encouraging accessibility.	Page no: [28], Section: [6.3]
3	CO10	No	N/A	N/A
4	CO12	Yes	Implementing a focus on testing and ongoing improvement to promote lifelong learning.	Page no: [21-25], Section: [5.1, 5.4]

HEALTH MONITORING SYSTEM

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