TAMILNADU SKILL DEVELOPMENT CORPORATION

NAAN MUDHALVAN NIRAL THIRUVIZHA

CARE CONNECT: INTELLIGENT HEALTHCARE DATA MONITORING AND MANAGEMENT SYSTEM

A PROJECT REPORT

Submitted by

SOWNDARYA K	**420420104047**
VANITHA LAKSHMI G	**420420104056**
VANMATHI S	**420420104057**
YUVASREE C	**420420104061**

in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

ADHIPARASAKTHI ENGINEERING COLLEGE

MELMARUVATHUR

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2024

ACKNOWLEDGEMENT

With the divine blessings of **Goddess Adhiparasakthi**, I express my deep gratitude for the spiritual blessings of His holiness **PADMA SHRI ARULTHIRU AMMA** and the divine guidance of **THIRUMATHI AMMA** that has undoubtedly taken us to path of victory in completing this project.

The infrastructural support with all kinds of lab facilities have been a motivating factor in this completion of project work, all because of our **Correspondent Sakthi Thiru Dr. G. B. SENTHILKUMAR B.E.** with great pleasure we take this opportunity to thank him.

For the academic side the constant support from our honorable **Principal Dr. J. RAJA, Ph.D.,** as encourages us to work hard and attain this goal of completingthe project.

Our sincere thanks to our **Head of the Department Dr. C. DHAYA, Ph.D.,** who has given us both moral and technical support adding experience to the job we have undertaken.

We thank our **Project Coordinator Ms. A. JAYANTHI, M.E.,** who has led from the front questioning as at the right time and encouraging us mostof the time here by extracting quality work from us.

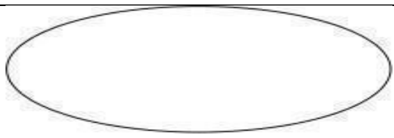
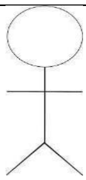
We sincerely thank our **Guide, Dr. C. DHAYA, Ph.D.,** who helped us in crossing in the path to our glory. We also thank other staff members, librarian, and non-teaching staff member of support and motivation in all ourendeavor.

ABSTRACT

In the realm of healthcare, the urgency of prompt patient care is paramount, with delays often leading to severe consequences. This necessity highlights the crucial role of advanced analytics and real-time monitoring systems in optimizing healthcare outcomes. Care Connect emerges as a solution to these challenges, offering an Intelligent Healthcare data monitoring and management system. Care Connect's core objective is to develop a comprehensive platform that continuously monitors patients in real-time, alerts relevant stakeholders, and tracks staff attendance seamlessly. Unlike existing solutions that solely focus on vital sign monitoring and alerts, Care Connect goes further by integrating non-contact attendance tracking for nurses and a robust drug recommendation system. These additional features streamline operations, enhance patient care, and boost overall efficiency within healthcare institutions. Supported by statistics highlighting the consequences of delayed care, Care Connect addresses critical gaps in healthcare delivery. Through its intuitive user interface, the platform provides a holistic view of real-time monitoring, attendance tracking, and drug recommendations. This integration empowers healthcare professionals to make precise and timely treatment decisions, significantly improving patient outcomes and operational effectiveness. Care Connect innovative approach revolutionizes healthcare by enabling proactive interventions, ensuring timely care delivery.

TABLE OF CONTENT

LIST OF SYMBOLS

SYMBOL NAME	NOTATION	DESCRIPTION
Association		Association represents a static relationship betweenclasses.
Use case		A use case is an interaction between the system and other external examination.
Relational		It is used for AdditionalProcess Communication
Control flow		It represents the controlflow between the state
Data process/State		A circle in DFD representthe vertical dimension the object communication
Object lifeline		An object lifeline representsthe vertical dimension then object Communication.
Message		It represents the Message exchanged
Actor		Actors are the user of thesystem and other externalentity that react with the system

LIST OF FIGURES

LIST OF ABBREVIATIONS

EMPL	-	Emergency Medicine Protocol List
RPM	-	Remote Patient Monitoring
ML	-	Machine Learning
IOT	-	Internet of things
ICU	-	Intensive Care Unit
BPM	-	Beats Per Minute
SVM	-	Support vector Machine
HR	-	Heart Rate
API	-	Application Programming Interface
UI	-	User Interface
API	-	Application Programming Interface
UI	-	User Interface
SPO2	-	Saturation of Peripheral Oxygen
MQTT	-	Message Queuing Telemetry Transport

CHAPTER 1

INTRODUCTION

1.1 DOMAIN OVERVIEW

In the healthcare domain, timely responses to critical patient needs are paramount, as delays can lead to severe repercussions. The urgency for advanced analytics and real-time monitoring systems is highlighted, emphasizing the critical role of optimizing healthcare outcomes. The statistics from reputable institutions such as AIIMS and ICMR underscore the significance of addressing delays in seeking care, particularly in cases of cardiac/stroke deaths and maternal mortality. These statistics emphasize the need for innovative solutions like Care Connect, which goes beyond traditional vital sign monitoring to include real-time patient monitoring, staff attendance tracking, and a sophisticated drug recommendation system. Such a comprehensive approach aims to streamline operations, improve patient care, and enhance overall efficiency within healthcare institutions.

1.2 OVERVIEW OF THE PROJECT

To improve patient care and streamline operational efficiency in today's ever-changing healthcare landscape, we aim to develop a cutting-edge analytics platform tailored to the specific needs of healthcare organizations. This platform simultaneously tracks the presence and absence of staff nurse and alert them. In addition to this, it monitors real-time data of patient condition. The key feature of the proposed platform is the incorporation of IoT, a User Interface to view the collected data, and a recommendation system by utilizing IoT sensors, real-time vital signs of patients and other relevant health indicators are collected which ensures timely action. To develop an analytics platform for hospital's healthcare data are gathered from diverse sources through wearable sensors and IoT devices. By implementing IoT sensors, vital signs of patients are monitored at real-time. This system is developed for personalized care, integrating RPM data with analytics platform to monitor patient progress and adjust treatments accordingly.

1.3 OBJECTIVE OF THE PROJECT

The main objective is to create an analytics platform specifically designed for hospitals. This platform will make use of Internet of Things (IoT) sensors to continuously monitor patient vitals and health parameters. Healthcare professionals can give more individualized treatment approaches and enhance patient outcomes and precision health management by examining this data. To improve communication and efficiency within the healthcare system. The Emergency Medicine Protocol List (EMPL) will serve as the guidance for this study, ensuring that drugs are given in compliance with established protocols under the five rights of nursing. Improving the general efficiency and effectiveness of healthcare facilities is the main goal. The project aims to enhance patient care, optimize resource allocation, and streamline operations. The ultimate objective is to develop a flexible and scalable framework that can be applied to many healthcare facilities, encouraging innovation and improvements in the provision of healthcare.

The five rights of nursing are fundamental principles that guide medication administration and patient care. They include ensuring the right patient receives the right medication at the right dose via the correct route and at the right time. Verifying patient identity, medication accuracy, dosage precision, appropriate administration route, and timely delivery are crucial to prevent medication errors and promote patient safety.

The objective of the Care Connect project is to develop an intelligent healthcare data monitoring and management system that integrates advanced analytics, real-time monitoring, and early intervention capabilities to optimize patient outcomes and streamline healthcare operations. This includes developing a comprehensive platform that incorporates continuous real-time patient monitoring, non-contact staff attendance tracking, and a sophisticated drug recommendation system. The goal is to revolutionize healthcare delivery by empowering healthcare professionals with timely and precise information for proactive interventions, ultimately improving patient care and operational efficiency within healthcare institutions.

CHAPTER 2

LITERATURE SURVEY

A Literature review is a text of a scholarly paper, which includes the current knowledge, including substantive findings, as well as theoretical and methodological contributions to a particular topic.

PAPER: 1

Title: LoRa WAN-based Hybrid Internet of Wearable Things System Implementation for Smart Healthcare.

(Elsevier journal publication)**.**

Author: Suliman Abdulmalek, Abdul Nasir, Waheb A. Jabbar.

Year: 2024

Summary: This paper discusses the system that incorporates smart wearable sensing units for real-time, remote monitoring of vital health parameters such as Blood Pressure (BP), Heart Rate (HR), and Body Temperature (BT). The developed IoWT-HHMS shows great promise for efficient and effective real-time remote monitoring of patients' health conditions using an innovative hybrid wireless network communication mechanism.

PAPER: 2

Title: An Automated Chronic Disease Management for Cardiac Arrest Detection and Prevention on Emergency Using Internet of Medical Things (IoMT)

(E3S Web of Conferences 491, 03020).

Author: Dr.Sarumathi, Harshini, Kavin Kumar, Keerthivasan.

Year: 2024

Summary: This paper discusses the suggested method that uses a pulse sensor to automatically monitor heart rate and a MEMS pressure sensor incorporated into IoMT devices to measure blood pressure (BP). If an elderly individual has a cardiac arrest, an automatic call with the exact GPS location is sent to a nearby ambulance service and their caretakers. The benefit of this method is to prevent unexpected death.

PAPER: 3

Title: Design and development of patient health tracking, monitoring, and Big data storage using Internet of Things and real-time cloud computing.

(Elsevier journals. Plos one 19.3 (2024)).

Author: Imran Shafi, Sadia Din, Siddique Farooq, Imran Ashraf.

Year: 2024

Summary: This paper discusses the IoT health monitoring solutions that eliminate the need for regular doctor visits and interactions among patients and medical personnel. Many patients in wards or intensive care units require continuous monitoring of their health. A pulse oximeter is utilized in our system to measure blood oxygen saturation and body temperature, as well as a heart rate monitor to measure pulse rate. A web-based interface is also implemented, allowing healthcare practitioners to access and visualize the collected data in real-time, making remote patient monitoring easier. IoT-based patient health monitoring system represents a significant advancement in remote patient monitoring.

PAPER: 4

Title: Patient health monitoring system using IoT.

(Elsevier journal publication).

Author: Sangeetha Lakshmi K, Preethi Angel S, Preethi U, Pavithra S.

Year: 2023

Summary: This paper discusses the Real-time health monitoring system proposed based on IOT. The main aim is to create a dependable patient management system based on IoT so that healthcare professionals can monitor their patients who are either hospitalized or at home using an IOT-based integrated healthcare system to ensure quality patient care. Sensors are used to track vital parameters, and the data collected by the sensors is sent to the cloud via a Wi-Fi module. A wireless healthcare monitoring system has been created that can provide real-time online information about a patient's condition.

PAPER: 5

Title: A smart healthcare monitoring system for patients using IoT and cloud computing. (AIP Conference, vol. 2603).

Author: A. Muniappan, Praveen Kumar Misra.

Year: 2023

Summary: This paper discusses about health monitoring systems have rapidly grown in recent times; Continuous monitoring of patients is one of the big challenges for hospitals. Smart systems have been established to track the patient's present health status; we focus on monitoring the patient’s blood pressure, body temperature, and Heart rate. This project aims for patients who are in continuous monitoring and are bedridden.

PAPER: 6

Title: The implementation of a real-time early warning system using machine learning in an Australian hospital to improve patient outcomes.

(Elsevier journal publication).

Author: Levi Bassin, Jacques Raubenheimer, David Bell.

Year: 2023

Summary: This paper focuses on data collection from eligible inpatients, aged 16 years and above, who were admitted for at least 24 hours in non-palliative wards. The study included controls from the same hospital during the period of January to December 2019. A Deterioration Index (DI) was incorporated into the electronic medical record system, triggering alerts that were sent directly to senior ward nurses' phones. These alerts not only notified nurses of potential patient deterioration but also included clinical messages aimed at improving communication between nursing and medical staff. This enhanced communication is crucial, as delays in detecting inpatient deterioration often stem from breakdowns in interprofessional communication.

PAPER: 7

Title: IoT-Based Patient Health Monitoring using ESP8266 and Arduino.

(International journal of computer communication and informatics).

Author: Macheso, Paul Stone Brown, and Angel G. Meela

Year: 2021

Summary: IoT Based Patient Health Monitoring using ESP8266 and Arduino" signifies a rising trend in employing IoT technologies for remote health surveillance. Research showcases the efficiency of ESP8266 and Arduino platforms in gathering and relaying critical patient information. Emphasizing real-time monitoring's significance for timely health problem identification, existing studies underscore IoT solutions' potential to enhance patient care and revolutionize healthcare delivery. This advancement not only enables continuous patient monitoring but also facilitates early intervention, leading to improved treatment outcomes and a more proactive approach to healthcare management.

PAPER: 8

Title: A Real-Time Health Monitoring System for Remote Cardiac Patients Using Smartphone and Wearable Sensors.

(International journal of telemedicine and applications)

Author: Kakria.P, Tripathi, N. K, and Kitipawang. P

Year: 2020

Summary: The literature survey indicates a rising trend towards real-time health monitoring systems specifically tailored for remote cardiac patients. These systems utilize smartphone and wearable sensors to offer continuous monitoring, enabling early detection of cardiac abnormalities and ultimately leading to improved patient outcomes. The integration of these technologies not only enhances convenience but also proves to be cost-effective, making personalized healthcare delivery more accessible. Furthermore, such systems empower patients by allowing them to actively engage in monitoring and managing their cardiac health, thereby promoting a proactive approach to cardiac care.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

The existing system in healthcare monitoring primarily relies on traditional wireless technologies, which may not fully address the requirements of energy efficiency, long-range communication, and cost-effectiveness. While some solutions incorporate Bluetooth, they often struggle with limited coverage, higher power consumption, and scalability issues, especially in large-scale deployments. These systems may also lack the ability to dynamically optimize parameters based on changing network conditions, leading to suboptimal performance and potential reliability concerns.

3.1.1 DISADVANTAGES

- Lack of real-time data monitoring.
- Nurse alerting system is not integrated.
- Lack of drug recommendation system
- Adaptability Challenges

3.2 PROPOSED SYSTEM

The proposed system, Care Connect, is an innovative Intelligent Healthcare data monitoring and management platform designed specifically for hospitals and healthcare institutions. It integrates advanced analytics, real-time monitoring, and intelligent alerting systems to optimize patient care, streamline operations, and enhance overall efficiency.

3.2.1 ADVANTAGES

- Streamlined Operations
- Timely Interventions
- Improved Care Experience

3.3 ALGORITHMS

3.3.1 MACHINE LEARNING ALGORITHMS

The drug recommendation system incorporates several machine learning algorithms to enhance its functionality and accuracy. These algorithms work synergistically to analyze patient data, historical medication usage, and medical profiles to provide personalized and effective drug recommendations system.

The ML algorithms used in the drug recommendation system:

1. Support Vector Machines
2. Collaborative Filtering
3. Matrix Factorization
4. Decision Trees
5. Neural Networks
6. Clustering Algorithms
7. Bayesian Networks
8. Random Forest

Once the algorithm gets good at drawing the right conclusions, it applies that knowledge to new sets of data. Machine learning can be grouped into two broad learning tasks: Supervised and Unsupervised. There are many other algorithms.

3.3.2 SUPERVISED LEARNING

An algorithm uses training data and feedback from humans to learn the relationship of given inputs to a given output. For instance, a practitioner can use marketing expense and weather forecast as input data to predict the sales of cans. You can use supervised learning when the output data is known. The algorithm will predictnew data.

There are two categories of supervised learning:

- Classification task
- Regression task

Classification

Imagine you want to predict the gender of a customer for a commercial. You will start gathering data on the height, weight, job, salary, purchasing basket, etc. fromyour customer database. You know the gender of each of your customer, it can only bemale or female. The objective of the classifier will be to assign a probability of being a male or a female (i.e., the label) based on the information (i.e., features you have collected). When the model learned how to recognize male or female, you can use newdata to make a prediction.

Regression

When the output is a continuous value, the task is a regression. For instance,a financial analyst may need to forecast the value of a stock based on a range of feature like equity, previous stock performances, macroeconomics index. The system will be trained to estimate the price of the stocks with the lowest possible error.

Logistic regression

Extension of linear regression that's used for classification tasks. The output variable 3is binary (e.g., only black or white) rather than continuous (e.g., an infinite list of potential colors) Classification.

Decision tree

Highly interpretable classification or regression model that splits data-feature values into branches at decision nodes (e.g., if a feature is a color, each possible color becomesa new branch) until a final decision output is made.

Naive Bayes

The Bayesian method is a classification method that makes use of the Bayesiantheorem. The theorem updates the prior knowledge of an event with the independent probability of each feature that can affect the event. Regression Classification Support vector machine Support Vector Machine, or SVM, is typically used for theclassification task. SVM algorithm finds a hyperplane that optimally divided theclasses. It is best used with a non-linear solver.

Random forest

The algorithm is built upon a decision tree to improve the accuracy drastically. Randomforest generates many times simple decision trees and uses the 'majority vote' method to decide on which label to return. For the classification task, the final prediction will be the one with the most vote; while for the regression task, the average prediction of all the trees is the final prediction.

AdaBoost

Classification or regression technique that uses a multitude of models to come up witha decision but weighs them based on their accuracy in predicting the outcome.

Gradient-boosting trees

It is a state-of-the-art classification/regression technique. It is focusing on the errorcommitted by the previous trees and tries to correct it.

3.3.3. UNSUPERVISED LEARNING

Unsupervised learning is a category of machine learning where algorithms are trained on unlabeled data without specific guidance or supervision. Unlike supervised learning, where the algorithm learns from labeled examples, unsupervised learning focuses on discovering hidden patterns, structures, or relationships within the data itself. In unsupervised learning, an algorithm explores input data without being given an explicit output variable (e.g., explores customer demographic data to identify patterns).

K-means clustering

Puts data into some groups (k) that each contains data with similar characteristics (as determined by the model, not in advance by humans).

Hierarchical clustering

Splits clusters along a hierarchical tree to form a classification system. Can be used forCluster loyalty-card customer. Clustering Recommender system help to define the relevant data for making a recommendation.

CHAPTER 4

SYSTEM SPECIFICATION

Develop a system responsible for data processing, model training, and inference. This could be implemented using frameworks like TensorFlow, PyTorch, orscikit-learn. Design a user-friendly frontend interface for interacting. Functional requirements serve as the foundation for designing and developing software systems by detailing the desired behavior and functionality that users expect from the system.

4.1 FUNCTIONAL REQUIREMENTS

Functional requirements describe the specific functionalities and capabilities that a software system or application must possess to meet user needs and business objectives. These requirements outline what the system should do in terms of inputs, processing, outputs, and interactions with users or other systems.

4.1.1 REAL-TIME MONITORING AND ALERTING SYSTEM

Data collection:

Collect real-time data from various patient monitoring devices (blood pressure monitor, pulse oximeter) Collect data on vital signs (blood pressure, heart rate) Detect anomalies in patient vitals based on pre-defined thresholds.

Alerting system:

Generate real-time alerts for detected vital signs. Allow customization of alert thresholds based on patient needs. Integrate with existing hospital alert systems. Prioritize alerts based on severity

4.1.2 ATTENDANCE TRACKING SYSTEM FOR STAFF NURSE

Tracking system for the presence of nurse:

Track the presence and absence of nurses in the ICU using non-contact methods. Record timestamps for entry and exit.

Alerting system:

Generate alerts when a nurse is absent during a critical patient vital Signs. Integrate with the real-time monitoring and alerting system

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements specify the quality attributes, constraints, and characteristics that a software system must exhibit in terms of performance, usability, reliability, security, scalability, and other aspects. These requirements focus on how the system performs or behaves under different conditions rather than what it does functionally.

Performance

The system should process and display data with minimal latency (delay) to ensure timely response to patient needs. The system should be highly available with minimal downtime to guarantee continuous patient monitoring and timely alerts.

Security

Implement robust security measures to protect sensitive patient data from unauthorized access or breaches. Ensure compliance with relevant data privacy 24 regulations. Safeguard the system against cyberattacks and unauthorized access to maintain system integrity and functionality.

Scalability

The system should be scalable to accommodate a growing number of patients and staff members within the ICU.

Usability

The application interface should be intuitive and easy to use for healthcare staff with varying levels of technical expertise. Provide clear instructions and guidance on using the system effectively.

Reliability

The system should function reliably with minimal errors or malfunctions to ensure consistent and dependable patient care support.

Maintainability

The system should be designed for easy maintenance and updates to ensure ongoing functionality and adaptation to future needs.

4.3 HARDWARE REQUIREMENTS

- OS : Windows 7,8 and 10 (32 and 64 bit)
- RAM : 4 GB
- ESP32 : Microcontrollers with integrated Wi-Fi module.
- MAX30100 : Pulse oximetry monitor reference design board.
- BUZZER : Alerting system.

4.4 SOFTWARE REQUIREMENTS

- IDE : Visual Studio Code
- PL : Python
- MANIPULATION: Pandas
- ML : TensorFlow, PyTorch

4.5 FEASIBILITY STUDY

Care Connect demonstrates strong feasibility across economic, technical, social, and operational dimensions, positioning it as a highly viable and impactful solution for optimizing healthcare delivery and improving patient outcomes.

4.5.1 ECONOMICAL FEASIBILITY

Economic feasibility assesses the financial viability of implementing CareConnect. It involves evaluating the costs associated with development, deployment, and maintenance against the potential benefits and cost savings it offers to healthcare institutions and patients.

Cost of Development:

Initial investment in developing the platform, including software development, hardware integration, and algorithm design.

Operational Costs:

Ongoing expenses such as maintenance, upgrades, and staff training.

Potential Benefits:

Cost savings through improved operational efficiency, reduced medication errors, streamlined workflows, and better resource utilization.

Return on Investment (ROI):

Analysis of the projected ROI based on cost savings, enhanced patient outcomes, and improved healthcare delivery.

4.5.2 TECHNICAL FEASIBILITY

Technical feasibility evaluates whether Care Connect can be successfully developed, implemented, and integrated into existing healthcare systems. It includes considerations such as technology requirements, infrastructure readiness, and scalability.

Technology Stack:

Utilization of advanced analytics, IoT devices, cloud-based data processing, machine learning algorithms, and user-friendly interfaces.

Scalability:

Ability to scale the platform to accommodate increasing data volumes, additional features, and growing user base.

4.5.3 SOCIAL FEASIBILITY

Social feasibility assesses the acceptance and impact of CareConnect on various stakeholders, including healthcare professionals, patients, regulatory bodies, and the community at large. It considers factors such as user acceptance, ethical considerations, and societal benefits.

Stakeholder Acceptance:

Consultation with healthcare professionals, administrators, and patients to gather feedback, address concerns, and ensure user acceptance.

Ethical Considerations:

Adherence to ethical guidelines regarding patient privacy, data security, informed consent, and responsible use of technology in healthcare.

Patient Empowerment:

Empowering patients with access to real-time monitoring, personalized care, and improved treatment outcomes.

Community Impact:

Contributing to improved healthcare services, reduced healthcare disparities, and overall societal well-being.

4.5.4 OPERATIONAL FEASIBILITY

Operational feasibility evaluates the practicality and effectiveness of implementing CareConnect within healthcare institutions. It considers factors such as organizational readiness, workflow integration, training requirements, and potential barriers to adoption.

Organizational Readiness:

Assessment of hospitals' readiness in terms of infrastructure, staff capabilities, leadership support, and change management strategies.

Training and Support:

Provision of comprehensive training programs, user manuals, and technical support to healthcare professionals for efficient usage of Care Connect.

User Feedback:

Continuous feedback mechanisms, user surveys, and performance evaluations to identify areas for improvement and ensure optimal functionality.

CHAPTER 5

SYSTEM DESIGN AND DEVELOPMENT

5.1 INTRODUCTION

The system design and development for CareConnect encompass a holistic approach aimed at revolutionizing healthcare delivery through advanced analytics and real-time monitoring systems. The primary objective is to optimize patient care by enabling timely interventions, personalized medication recommendations, and early detection of health issues. This section outlines the key components of the system design, including file design, input design, and output design, all geared towards enhancing healthcare outcomes and operational efficiency.

5.2 FILE DESIGN

File design within Care Connect is structured to efficiently store and manage various types of data essential for healthcare analytics and monitoring. This includes patient vital signs data, medication records, staff attendance logs, and system configuration settings. The file design ensures secure storage, quick retrieval, and seamless integration with data processing algorithms and machine learning models. By organizing data into structured files, Care Connect facilitates robust analytics, real-time monitoring, and accurate decision-making processes.

5.3 INPUT DESIGN

The input design of Care Connect focuses on seamlessly gathering data from multiple sources, including wearable IoT devices, medical sensors, electronic health records (EHRs), and staff attendance systems. The system integrates data acquisition protocols to collect real-time patient vital signs, medication adherence, and activity levels. Inputs from healthcare professionals, such as diagnostic reports and treatment plans, are also incorporated into the system. The input design ensures data accuracy, completeness, and timeliness, enabling proactive interventions and precise healthcare recommendations.

5.4 OUTPUT DESIGN

CareConnect's output design revolves around delivering actionable insights, alerts, and recommendations to healthcare providers, administrators, and patients. The system generates real-time monitoring dashboards displaying patient vital signs, alerts for critical conditions, and staff attendance status. The output design also includes medication recommendation reports based on machine learning algorithms and clinical protocols. Additionally, CareConnect provides customizable reports, trend analysis charts, and predictive analytics outputs to support informed decision-making and improve patient outcomes.

The system design and development of CareConnect integrate seamlessly to create an intelligent healthcare platform that enhances patient care, streamlines operations, and empowers healthcare professionals with actionable data-driven insights.

5.5 SYSTEM ARCHITECTURE

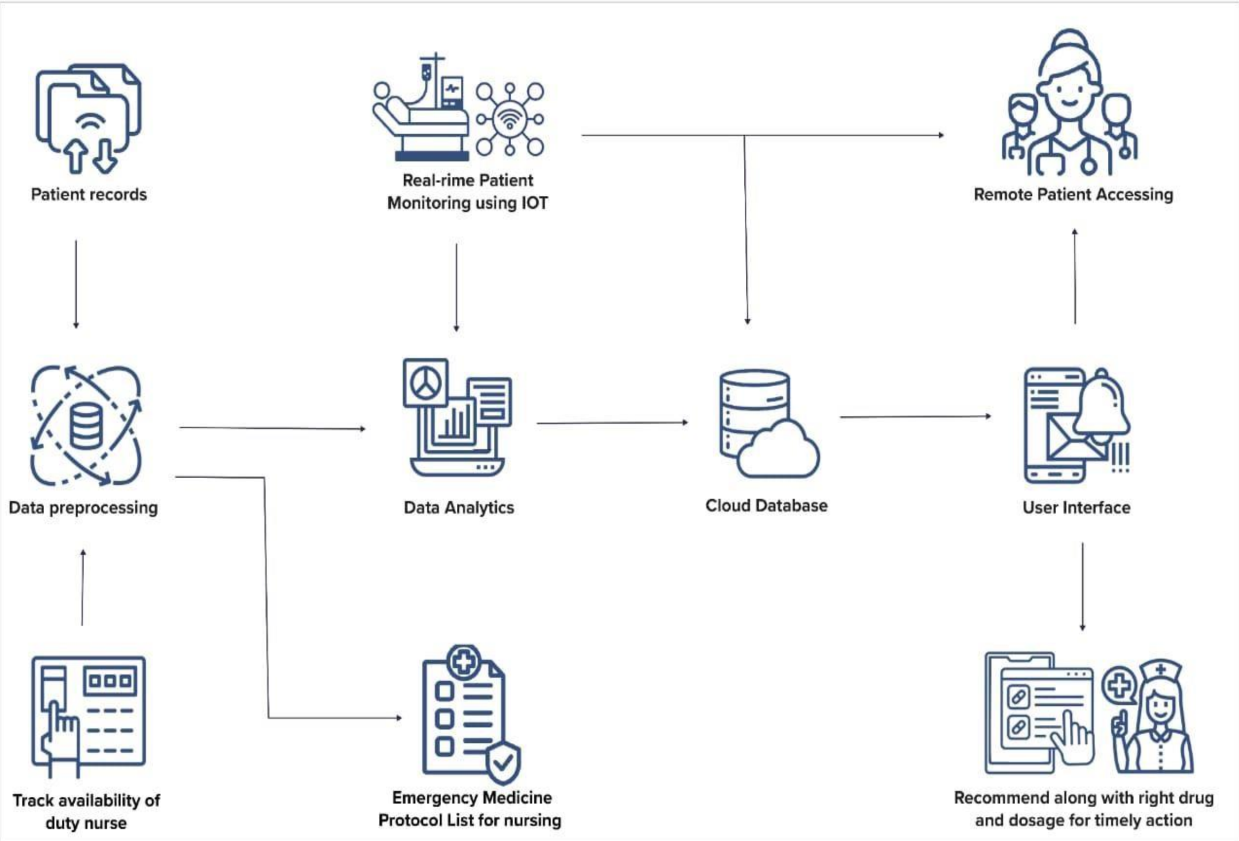


Figure 5.5.1 System Architecture

5.6 USECASE DIAGRAM

A use case diagram is a type of Unified Modelling Language (UML) diagram that is used in system design and software engineering to show how users or other actors interact with a system that is being considered. From the perspective of users or third parties, it offers a high-level overview of the features or services of the system.

The use case diagram helps stakeholders and developers understand the system's needs, functionalities, and how various actors interact with the system to accomplish specific goals or activities.

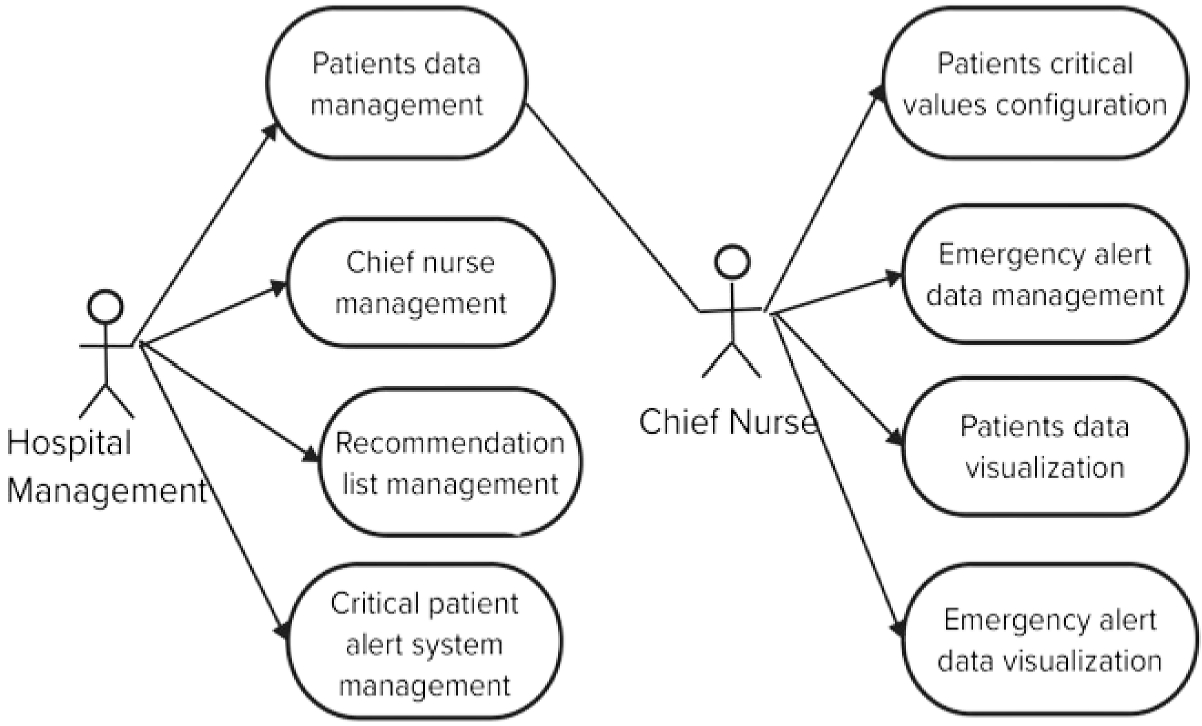


Figure 5.6.1 Use case Diagram

The diagram shows these actors interacting with the use cases. the Chief Nurse linked to "Hospital Management," "Recommendation list," and Emergency Alert Data Management ability to initiate these functionalities.

5.7 CLASS DIAGRAM

The static structure of a system or software program is visually represented by a class diagram, a form of Unified Modelling Language (UML) diagram used in software engineering. It displays the classes in the system along with their interfaces, connections, and relationships. Class diagrams help stakeholders and developers know the architecture of the system, including the classes, together with their methods, attributes, and interactions.

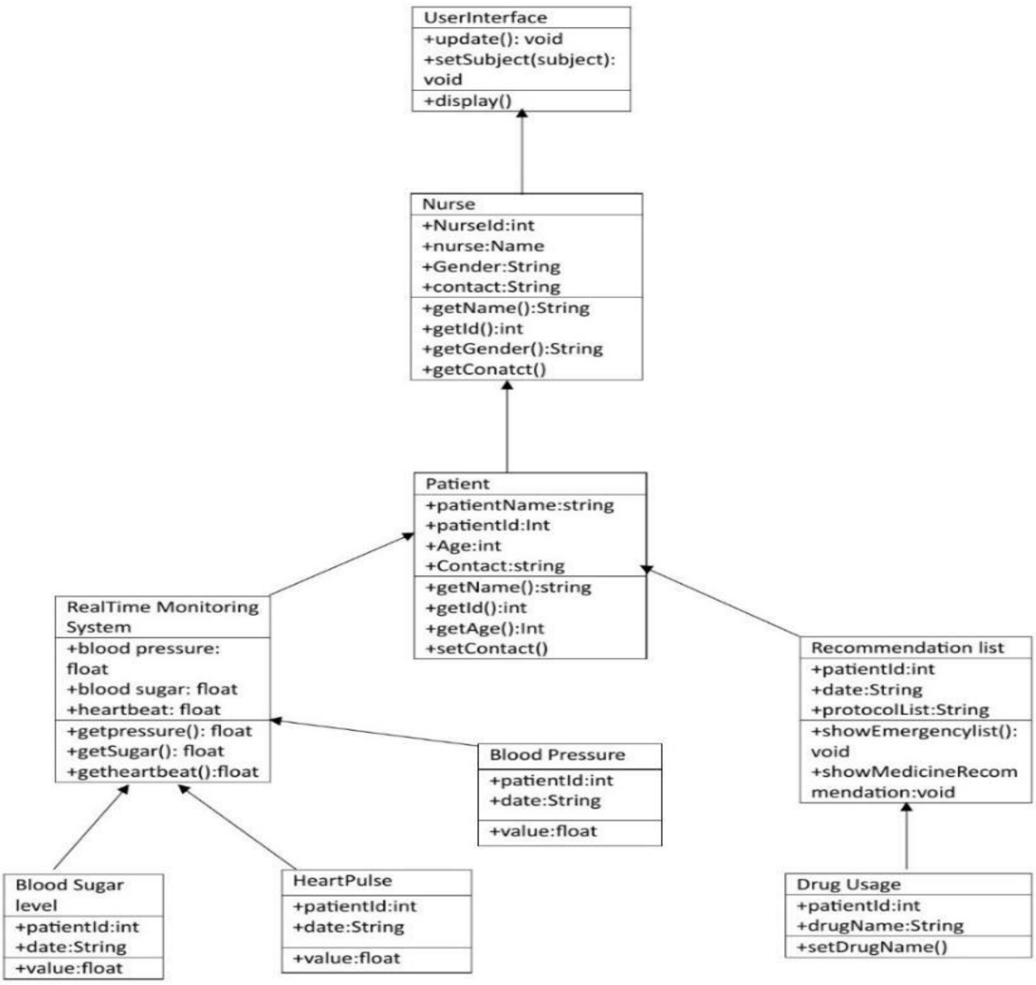


Figure 5.7.1 Class Diagram

5.8 SEQUENCE DIAGRAM

The sequence diagram illustrates the steps or sequence of events that take place in a specific scenario or use case, highlighting the communication flow between objects or actors. Developers and other stakeholders are able to understand a system's control and communication flow, as well as the timing and dependencies of object interactions, by using a sequence diagram.

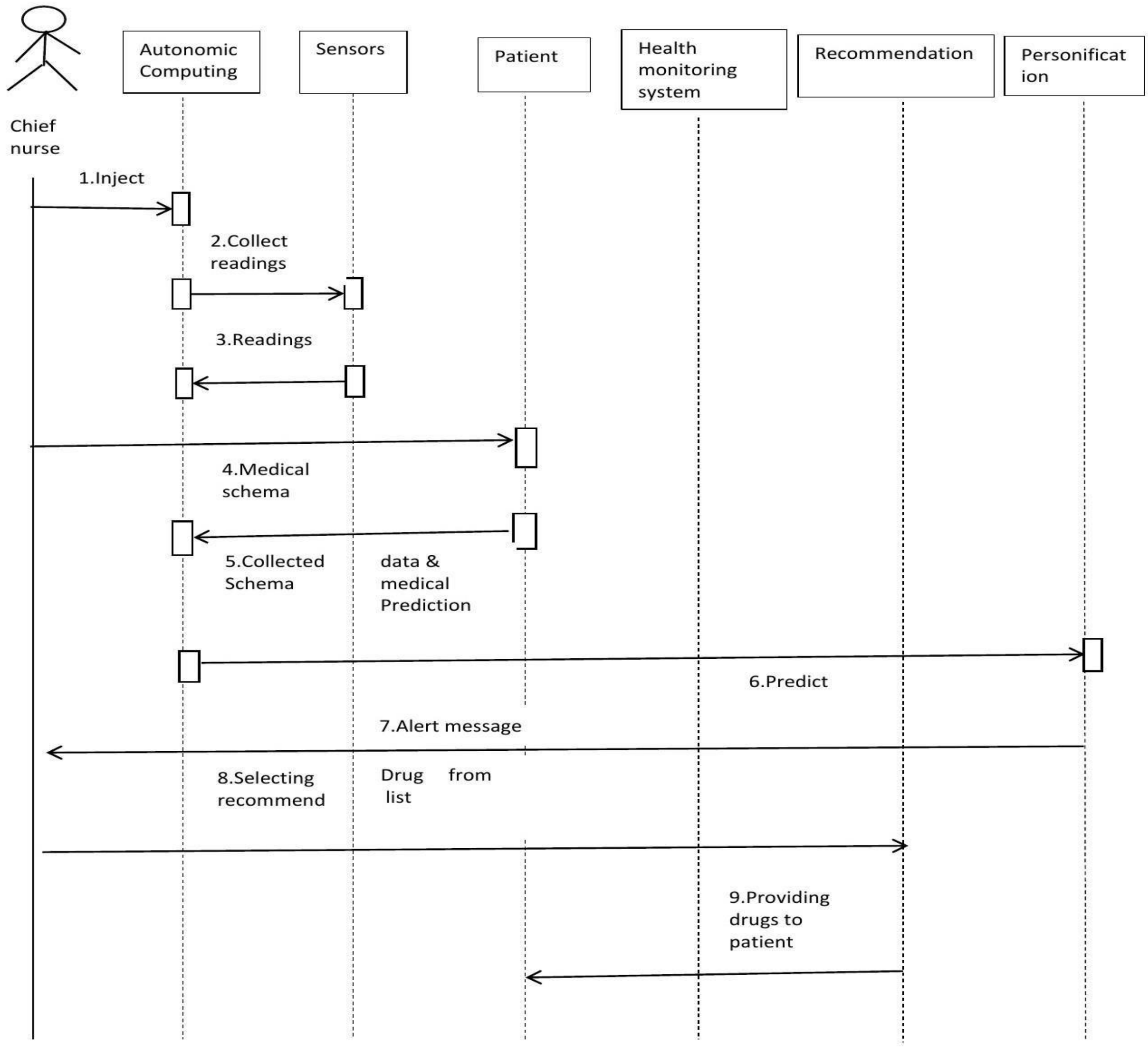


Figure 5.8.1 Sequence Diagram

5.9 ACTIVITY DIAGRAM

The Activity diagrams concentrate on the flow of control or the order in which tasks are completed in a process or workflow. It offers a visual representation of the choices, actions, and stages necessary to finish a job or reach a goal inside a system.

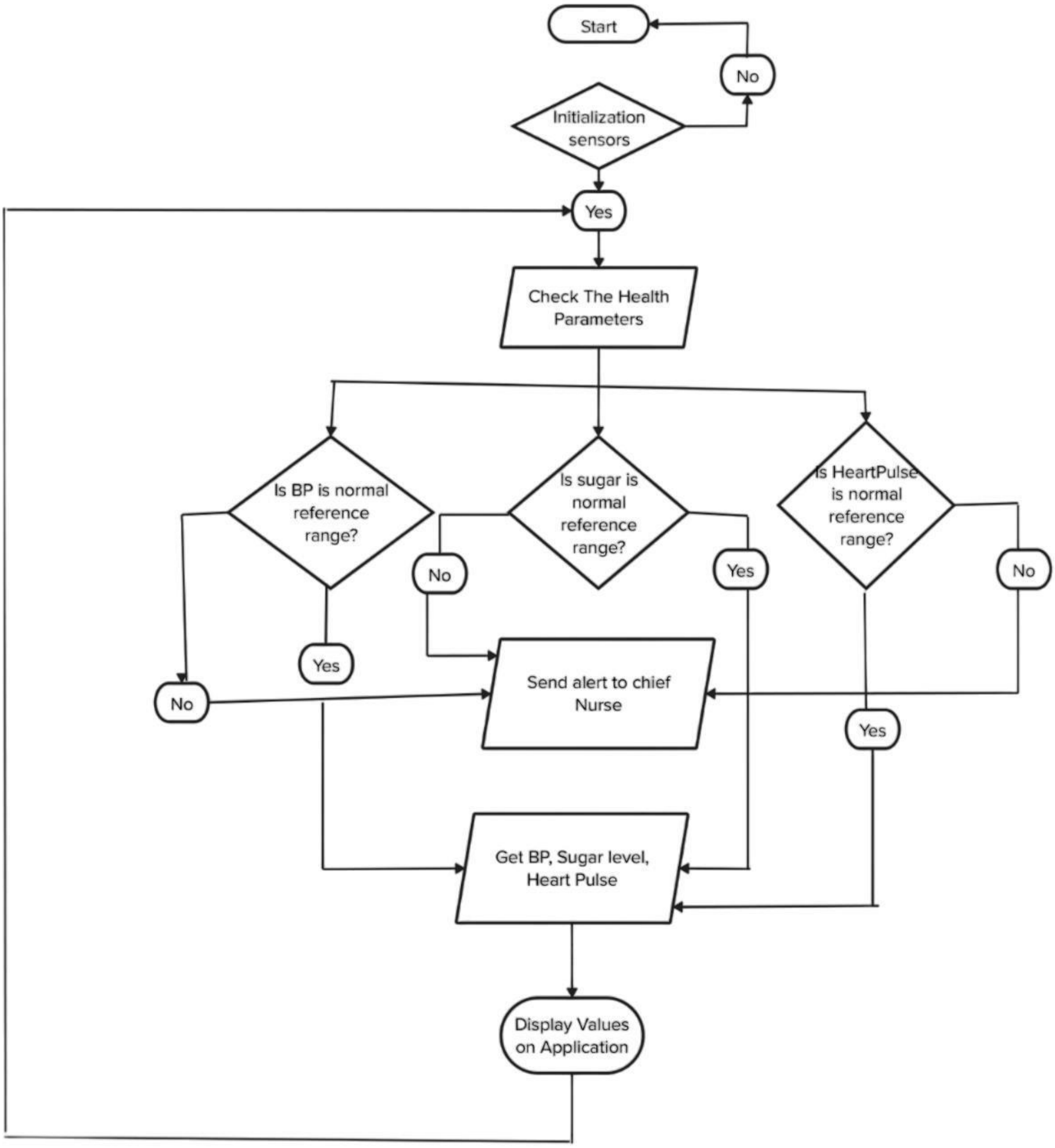


Figure 5.9.1 Activity Diagram

5.10 DEPLOYMENT DIAGRAM

In the deployment diagram the files, libraries, and other resources that are utilized or generated by software components are represented by artifacts in deployment diagrams. A system's physical deployment architecture, which includes its hardware components, software, dependencies, and means of communication, can be visualized and understood with the use of deployment diagrams.

By offering insights on the deployment and interaction of software components within the broader system environment, they support system design, planning, and optimization.

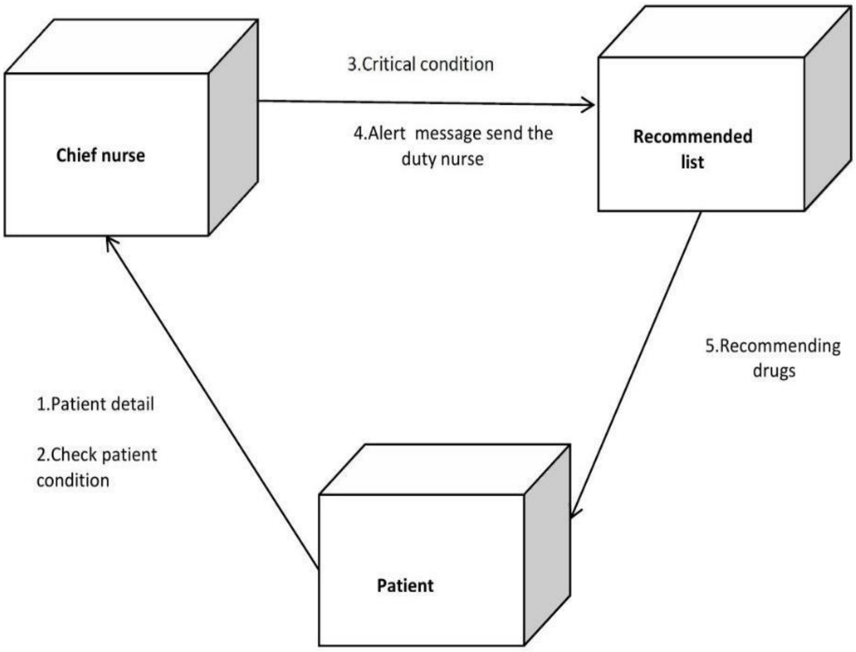


Figure 5.10.1 Deployment Diagram

CHAPTER 6

TECHNOLOGY USED

6.1 INTERNET OF THINGS

Care Connect leverages IoT devices such as wearables and sensors to collect real-time patient data, including vital signs, medication adherence, and activity levels. These devices are integrated into medical equipment, enabling seamless data collection and transmission to the platform. IoT technology ensures continuous monitoring of patients, early detection of health anomalies, and personalized care interventions.

6.2 MACHINE LEARNING

Machine Learning algorithms are utilized within CareConnect to power its sophisticated drug recommendation system. ML models, such as Support Vector Machines (SVM), analyze patient vital signs and EMPL (Emergency Medicine Protocol List) data to predict the most suitable medications and dosages. ML algorithms enable precise treatment recommendations, reducing medication errors, and improving overall treatment accuracy.

6.3 ARDUINO IDE

Arduino IDE is employed in the development and integration of hardware components within CareConnect's sensor systems. This platform facilitates the programming of IoT devices, sensors, and wearable technology, ensuring seamless data communication and functionality. Arduino IDE plays a vital role in optimizing the performance of IoT devices, enhancing data accuracy, and supporting real-time monitoring capabilities within the healthcare environment.

Overall, the combination of IoT, Machine Learning, and Arduino IDE technologies in CareConnect enables comprehensive patient monitoring, precise medication recommendations, and streamlined healthcare operations, ultimately leading to improved patient outcomes and operational efficiency.

CHAPTER 7

MODULES

7.1 MODULE DESCRIPTION

The Care Connect platform encompasses three key modules that collectively enhance healthcare outcomes and operational efficiency.

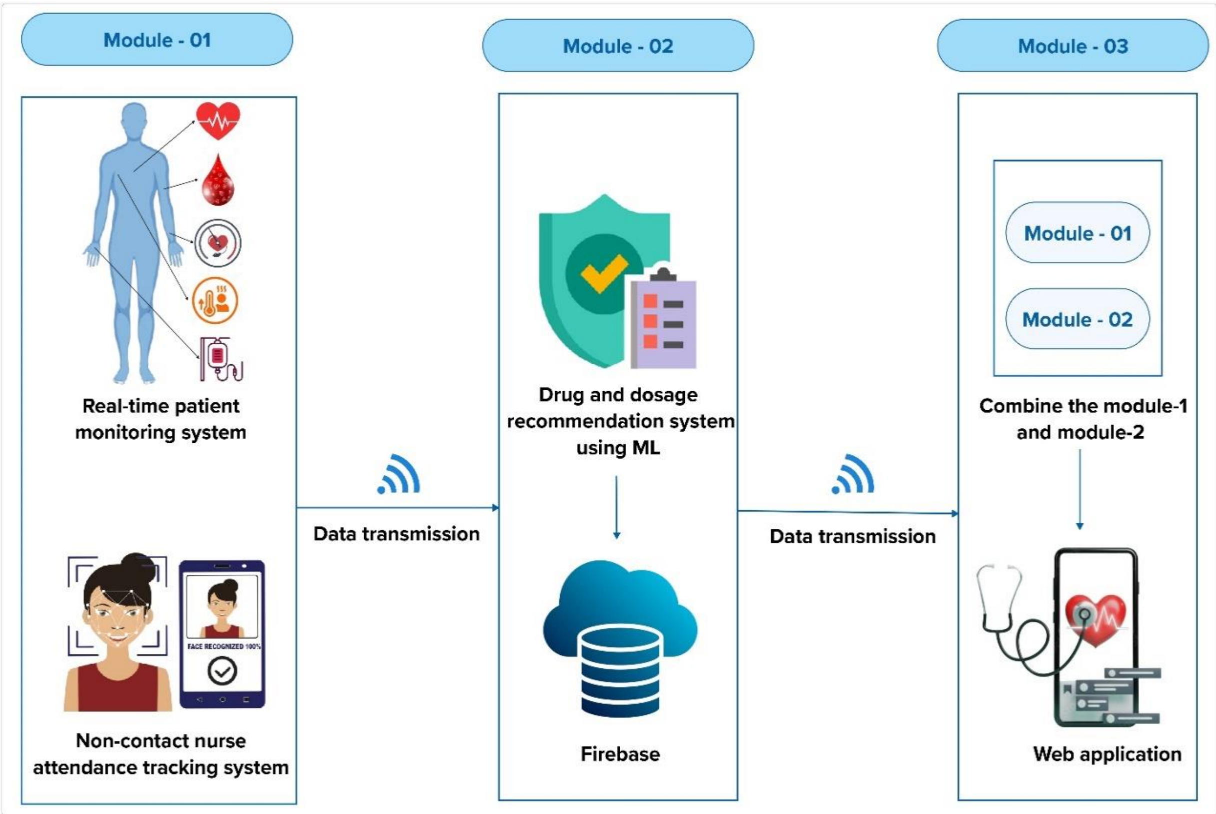


Figure 7.1.1 Proposed Architecture

7.1 REAL-TIME MONITORING AND ALERTING SYSTEM

The Real-Time Monitoring and Alerting System continuously monitors patient data, leveraging wearable IoT devices and advanced ML algorithms. This system ensures early identification of critical conditions, enabling timely interventions and improving overall care outcomes. Through seamless integration with cloud-based data processing, multi-modal data sources such as physiological measurements and clinical variables are aggregated and analyzed in real time, providing healthcare professionals with actionable insights for proactive care delivery.

7.2 DRUG RECOMMENDATION SYSTEM

The Drug Recommendation System utilizes Support Vector Machine (SVM) algorithms to analyze patient vital signs and Emergency Medicine Protocol Lists (EMPL). By correlating this data, the system recommends the most suitable medication, dosage, and timing for each patient, thereby reducing medication errors, enhancing treatment accuracy, and improving patient safety.

7.3 DEVELOPMENT OF USER INTERFACE

The Development of User Interface focuses on creating a user-friendly application that facilitates real-time monitoring, alerts, and medication recommendations. This interface empowers healthcare providers with intuitive tools for efficient decision-making, ultimately enhancing the overall patient care experience.

The Care Connect platform comprises three essential modules designed to collectively improve healthcare outcomes and operational efficiency. The Real-Time Monitoring and Alerting System utilize wearable IoT devices and advanced ML algorithms to continuously monitor patient data, enabling early identification of critical conditions and timely interventions. Integration with cloud-based data processing ensures real-time analysis of multi-modal data, providing healthcare professionals with actionable insights for proactive care delivery.

The Drug Recommendation System utilizes SVM algorithms to recommend medication based on patient vital signs and EMPL, reducing errors and enhancing treatment accuracy.

The Development of User Interface focuses on creating a user-friendly application for real-time monitoring, alerts, and medication recommendations, empowering healthcare providers with efficient decision-making tools and enhancing the overall patient care experience.

CHAPTER 8
CODING
8.1 CODE FOR RECOMMENDATION SYSTEM
Training the model:

```
# Importing necessary libraries
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, LabelEncoder
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
import joblib
data = pd.read_csv('Heartbeat.csv')
data
X=data[['BPM','Age']]
X
Y=data[['Medication']]
Y
# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.2,
random_state=42)
# Standardize the features
sc = StandardScaler()
X_train_std = sc.fit_transform(X_train)
X_test_std = sc.transform(X_test)
# Initialize the LabelEncoder
label_encoder = LabelEncoder()
# Encode the target variable
```

```
y_train_encoded = label_encoder.fit_transform(y_train)
y_test_encoded = label_encoder.transform(y_test)
import pickle
# Save the StandardScaler object
with open('Heartbeatscaler.pkl', 'wb') as file:
    pickle.dump(sc, file)
# Save the LabelEncoder object
with open('Heartbeat_label_encoder.pkl', 'wb') as file:
    pickle.dump(label_encoder, file)
# Initialize the SVM classifier
svm = SVC(kernel='linear', C=1.0, random_state=42)
# Train the SVM classifier
svm.fit(X_train_std, y_train_encoded)
# Predict the labels of the test set
y_pred_encoded = svm.predict(X_test_std)
# Calculate accuracy
accuracy = accuracy_score(y_test_encoded, y_pred_encoded)
print("Accuracy:", accuracy)
y_pred_encoded
predicted_class_decoded = label_encoder.inverse_transform(y_pred_encoded)
predicted_class_decoded
# Print out the unique encoded values of the target variable
print("Encoded classes:", np.unique(y_train_encoded))
# View the encoded classes
encoded_classes = label_encoder.classes_
print("Encoded classes:", encoded_classes)
with open('Heart_Beat_Classification.pkl', 'wb') as file:
    pickle.dump(svm,file)
```

Custom Model:

```
import numpy as np
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
from sklearn.preprocessing import LabelEncoder

# Load the pre-trained SVM model
import pickle

with open('Heart_beat_Classification.pkl', 'rb') as file:
    svm_model = pickle.load(file)

# Assuming 'sc' is the StandardScaler object used for standardization
# Load the StandardScaler object used for standardization
with open('Heartbeatscaler.pkl', 'rb') as file:
    sc = pickle.load(file)

# Assuming 'label_encoder' is the LabelEncoder object used for encoding class labels
# Load the LabelEncoder object
with open('Heartbeat_label_encoder.pkl', 'rb') as file:
    label_encoder = pickle.load(file)

# Custom input
c = [[108, 53]]
c = np.array(c)

# Standardize the custom input using the loaded scaler object
c_std = sc.transform(c)
```

```
# Predict the class using the pre-trained SVM model
predicted_class = svm_model.predict(c_std)

# Decode the predicted class using the loaded label encoder
predicted_class_decoded = label_encoder.inverse_transform(predicted_class)

# Join the predicted class values into a string
arr_str_flat = ', '.join(predicted_class_decoded.flatten())

# Print the recommended medicine based on the predicted class
print("Recommended Medicine:", arr_str_flat)

# Determine the recommended dosage level based on the predicted class
if predicted_class==0:
    print('Recommended Dosage Level: 0.6mg')
elif predicted_class==1:
    print('The Patient has Ideal Heart Beat Rate')
else:
    print('Recommended Dosage Level: 25mg')
    print('Check for Contra Indication-Asthma')
    print('If Asthma present' )
    print("Recommended Medicine: Atenolol")
    print('Recommended Dosage Level: 100mg')
```

App Generation:

```
import streamlit as st
import pandas as pd
import numpy as np
import pickle
```

```
# Load SVM model
with open('Heart_Beat_Classification.pkl', 'rb') as file:
    model = pickle.load(file)

with open('Heartbeatscaler.pkl', 'rb') as file:
    sc = pickle.load(file)

with open('Heartbeat_label_encoder.pkl', 'rb') as file:
    label_encoder = pickle.load(file)

# Function to predict using the SVM model
def predict(features):

    features = np.array(features).reshape(1, -1)
    c_std = sc.transform(features)
    # Predict the class using the pre-trained SVM model
    predicted_class = model.predict(c_std)

    return predicted_class

# Streamlit UI
def main():
    st.title('MEDICINE RECOMMENDATION FOR BPM')

    # Input features
    feature1 = st.number_input('BPM')
    feature2 = st.number_input('Age')
```

```
    # Predict button
    if st.button('Predict'):
        features =[feature1, feature2]

        prediction = predict(features)

        predicted_class_decoded = label_encoder.inverse_transform(prediction)

        # Join the predicted class values into a string
        arr_str_flat = ', '.join(predicted_class_decoded.flatten())

        # Print the recommended medicine based on the predicted class
        st.write("Recommended Medicine:", arr_str_flat)
        if prediction==0:
            st.write('Recommended Dosage Level: 0.6mg')
        elif prediction==1:
            st.write('The Patient has Ideal Heart Beat Rate')
        else:
            st.write('Recommended Dosage Level: 25mg')
            st.write('Check for Contra Indication-Asthma')
            st.write('If Asthma present' )
            st.write("Recommended Medicine: Atenolol")
            st.write('Recommended Dosage Level: 100mg')

if __name__ == '__main__':
    main()
```

CHAPTER 9

OUTPUT SCREENSHOTS

The output of this integrated system includes real-time monitoring and alerts for abnormal patient conditions. A user-friendly application interface for efficient healthcare management and improved patient care outcomes

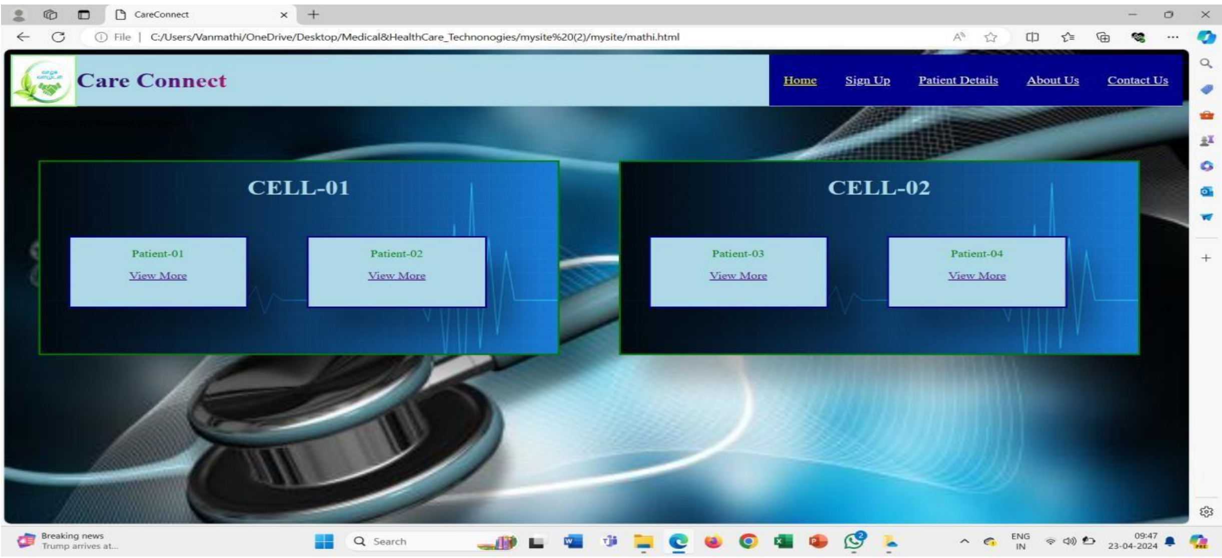


Figure 9.1 User Interface – Home Page

A user-friendly application interface for efficient healthcare management and improved patient care outcomes

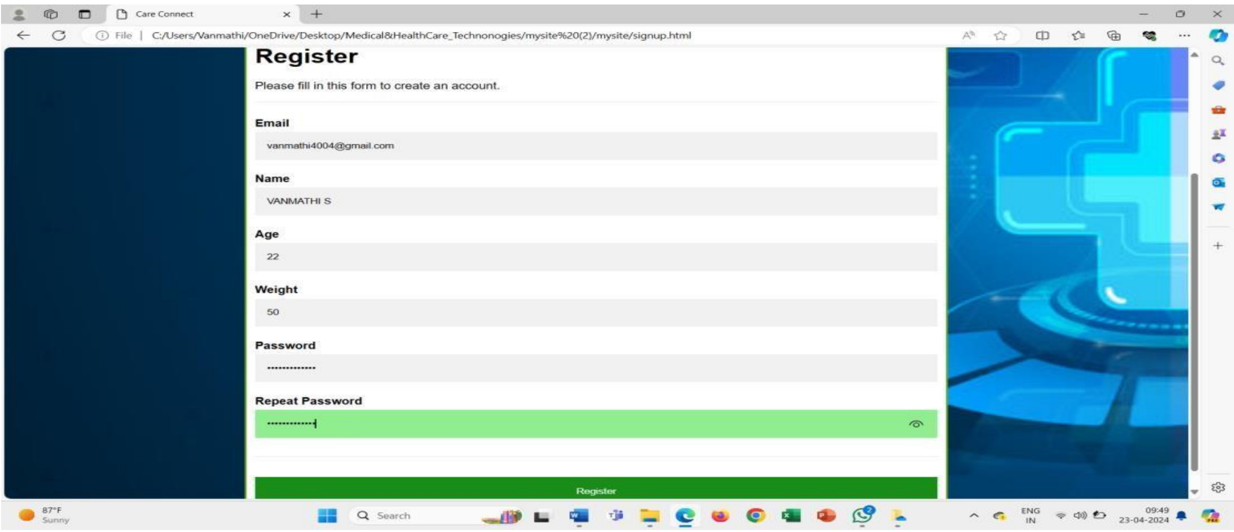


Figure 9.2 User Interface – Registration Page

Registration forms are created on websites to collect information from users who want to create an account.

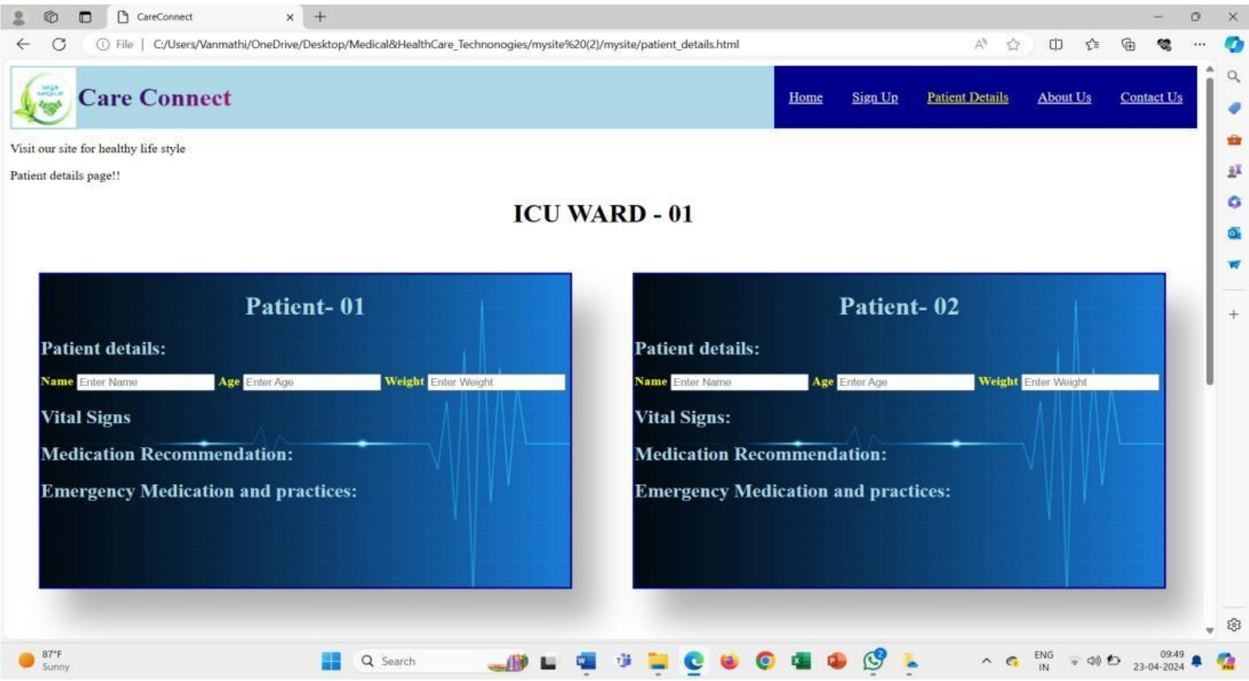


Figure 9.3 User Interface – Patient Details Page

This figure displays the patient details page within the application. It would typically show comprehensive information about a specific patient, including demographics, medical history, vital signs, medications, and any relevant notes or observations by healthcare providers.

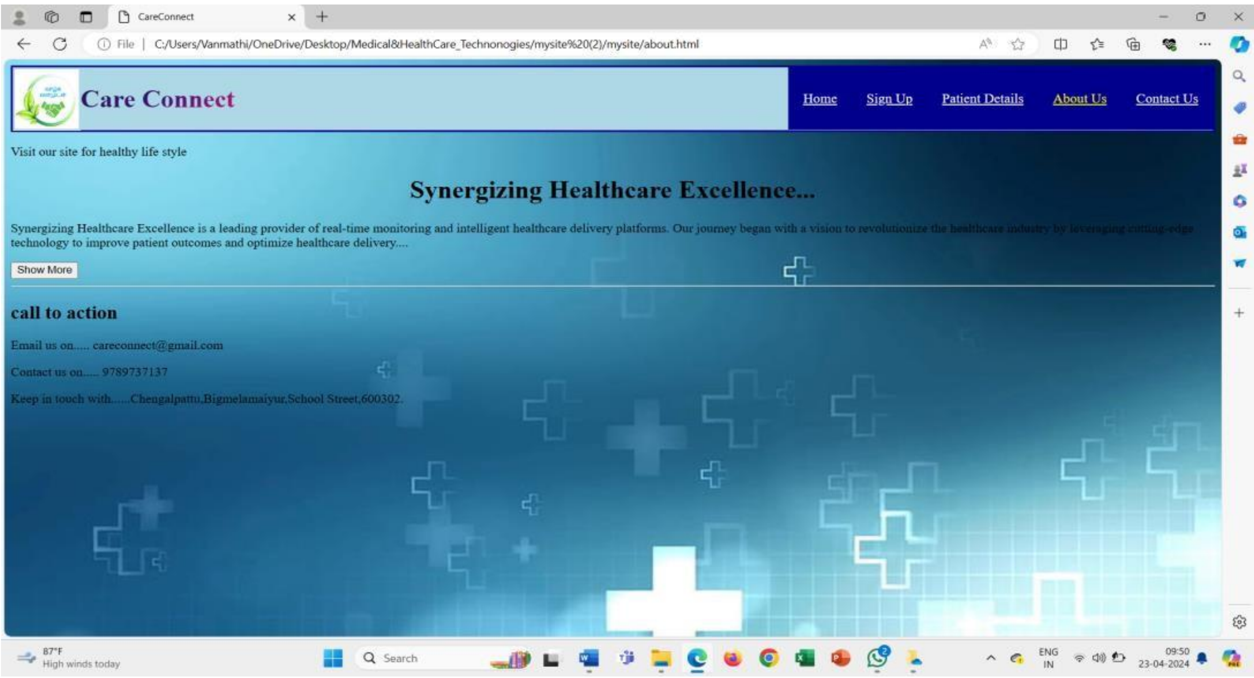


Figure 9.4 User Interface – About Page

The About page provides background information about the Care Connect platform, its purpose, features, and possibly details about the development team or organization behind it. It serves as a resource for users to understand the platform better.

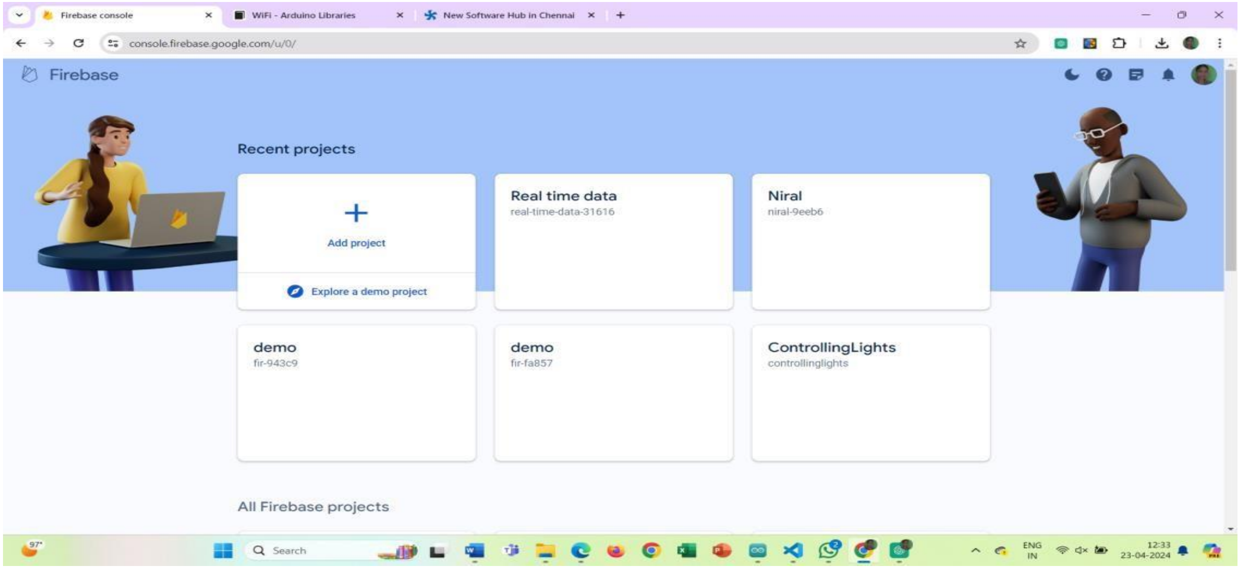


Figure 9.5 Data Processing-Firebase

This figure likely illustrates the integration or utilization of Firebase for data processing within the Care Connect platform. Firebase is a platform developed by Google for creating mobile and web applications. In this context, it may be used for real-time data syncing, database management, and other backend tasks.

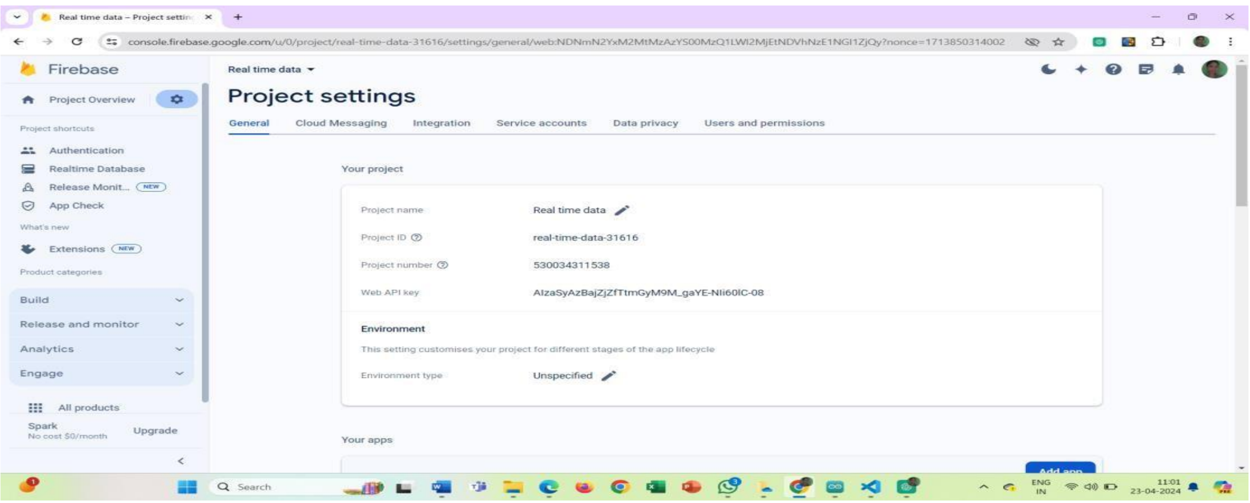


Figure 9.6 Generation of API Key

This figure represents the process of generating an API key, which is a unique identifier used to authenticate and access APIs (Application Programming Interfaces).

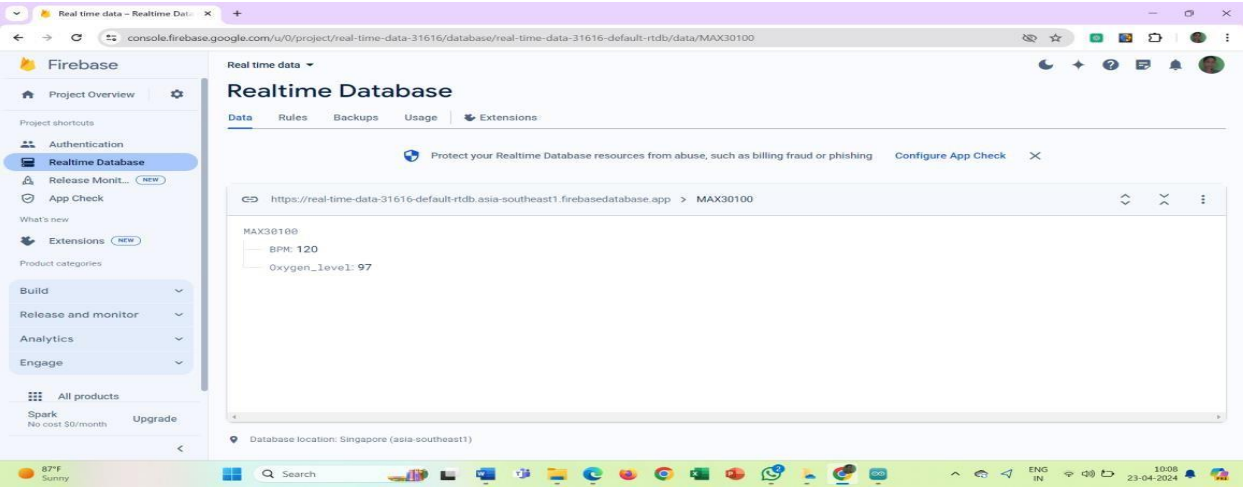


Figure 9.7 Real-time Data Gathering

It serves as the bridge between the complex data collected from various sources, such as IoT sensors and wearable devices, and the healthcare professionals who need to interpret and act upon this data

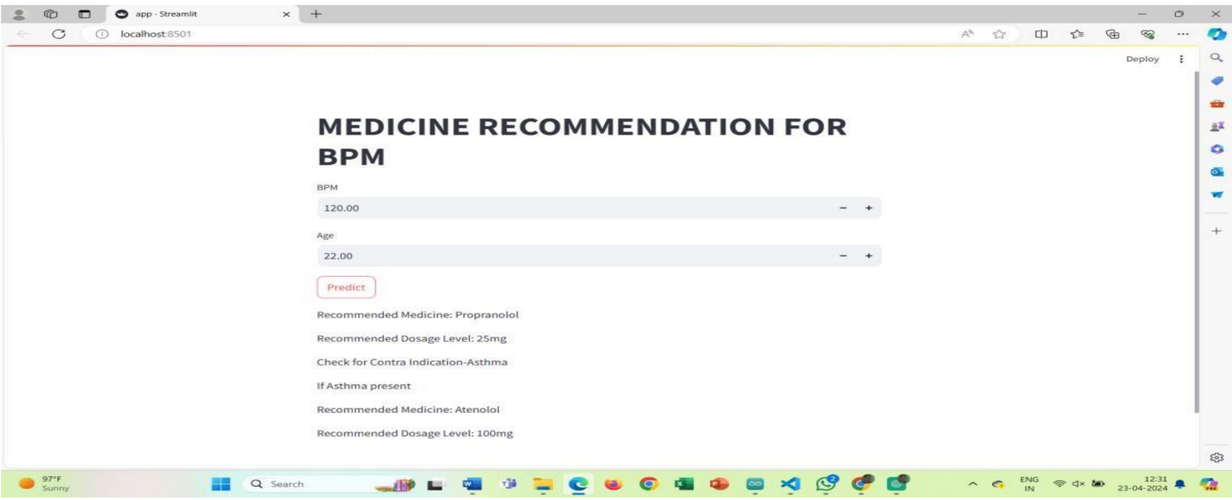


Figure 9.8 Recommendation System

This figure represents the recommendation system within the platform, specifically related to medication recommendations based on patient data and EMPL.

CHAPTER 10

CONCLUSION & FUTURE ENHANCEMENT

10.1 CONCLUSION

In conclusion, Care Connect represents a groundbreaking solution in healthcare management, addressing critical needs for timely interventions, accurate medication recommendations, and streamlined operations. By integrating real-time patient monitoring, non-contact staff attendance tracking, and a sophisticated drug recommendation system, Care Connect revolutionizes healthcare delivery. The platform's user-friendly interface empowers healthcare professionals to make informed decisions swiftly, leading to improved patient outcomes, enhanced care experiences, and overall operational efficiency within healthcare institutions. With a clear motive to benefit both healthcare providers and patients, Care Connect sets a new standard in proactive healthcare, leveraging advanced analytics and real-time monitoring to optimize data utilization and drive positive change in the healthcare industry.

10.2 FUTURE ENHANCEMENT

Future enhancements aim to revolutionize healthcare delivery by leveraging advanced technologies to make healthcare more accessible, personalized, and secure.

1. Integrating Telemedicine Features: Adding telemedicine functionalities to enable remote consultations, virtual visits, and telemonitoring, enhancing accessibility and convenience for patients and healthcare providers.
2. Expanding Data Sources: Integrating additional data sources such as genomics, wearable biometric data, and social determinants of health to provide a more comprehensive view of patient health and wellness.
3. Implementing Blockchain Technology: Utilizing blockchain technology to enhance data security, transparency, and interoperability, addressing concerns related to data integrity and trust.

REFERENCES

[1] S. Abdulmalek et al."LoRaWAN-based hybrid internet of wearable things system implementation for smart healthcare."Internet of Things 25 (2024) 10112

[2] Macheso et. al. "IoT Based Patient Health Monitoring using ESP8266 and Arduino." International journal of computer communication and informatics 3, no. 2 (2021): 75-83.

[3] R.Keerthivasan ."An Automated Chronic Disease Management for Cardiac Arrest Detection and Prevention on Emergency using Internet of Medical Things (IoMT) ".E3S Web of Conferences 49103020(2024)ICECS'24

[4] Praveen Kumar Misra."A smart healthcare monitoring system for patients using IoT and cloud computing".Volume 2603, Issue 1,25 April 2023

[5] Preethi U."Patient health monitoring system using IoT."Volume 80, Part 3, 2023.

[6] Imran Shafi "Design and development of patient health tracking, monitoring and big data storage using Internet of Things and real time cloud computing" journal. pone.0298582 March 11, 2024

[7] David Bell."The implementation of a real time early warning system using machine learning in an Australian hospital to improve patient outcomes". RESUSCITATION 188 (2023) 109821

[8] L. Srinivasan et al."IoT-Based Solution for Paraplegic Sufferer to Send Signals to Physician via Internet". International journal 10(1), 41-52, 2023.

[9] N. I. Ismail."Development of an IoT Based Domestic Monitoring and Alerting System for Paralysed Patients". Journal of engineering and technology.

[10] N. K. Tripathi." A Real-Time Health Monitoring System for Remote Cardiac Patients Using Smartphone and Wearable Sensors"International Journal of Telemedicine and Application

[11] Ahmed, Salman, Saad Irfan, Nasira Kiran, Nayyer Masood, Nadeem Anjum, and Naeem Ramzan. "Remote Health Monitoring Systems for Elderly People: A Survey." Sensors 23, no. 16 (2023): 7095.

[12] Lin, Qi, and Qiuhong Zhao. "IoT Applications in Healthcare." Internet of Things: Cases and Studies (2021): 115-133.

[13] Christopoulou, Stella C. "Machine Learning Models and Technologies for Evidence-Based Telehealth and Smart Care: A Review." BioMed Informatics 4, no. 1 (2024): 754-779.

[14] McBeath, K. C. C., C. E. Angermann, and M. R. Cowie. "Digital technologies to support better outcome and experience of care in patients with heart failure." *Current* Heart Failure Reports 19, no. 3 (2022): 75-108.

[15] Ruiz Díaz, Miguel A., Marta Egea García, Roberto Muñoz Aguilera, Xavier Viñolas Prat, Jorge Silvestre García, María Álvarez Orozco, José Martínez Ferrer, and VALIOSA study group Socorro Sorbet Julia Díaz Celia Hijosa Carmen Varela Francisco Méndez Olga Calvo Omar Al-Rizzo. "Patient satisfaction with remote monitoring of cardiac implantable electronic devices: the V aliosa questionnaire." BMC health services research 20 (2020): 1-9.

[16] Alami, Sarah, Laurène Courouve, Guila Lancman, Pierrette Gomis, Gisele Al-Hamoud, Corinne Laurelli, Hélène Pasche et al. "Organisational Impact of a Remote Patient Monitoring System for Heart Failure Management: The Experience of 29 Cardiology Departments in France." International Journal of Environmental Research and Public Health 20, no. 5 (2023): 4366.

[17] Bedekar, Himani, Gahangir Hossain, and Ayush Goyal. "Medical Analytics Based on Artificial Neural Networks Using Cognitive Internet of Things." Fog Data Analytics for IoT Applications: Next Generation Process Model with State of the Art Technologies (2020): 199-262.

[18] Bedekar, Himani, Gahangir Hossain, and Ayush Goyal. "Medical Analytics Based on Artificial Neural Networks Using Cognitive Internet of Things." Fog Data Analytics for IoT Applications: Next Generation Process Model with State of the Art Technologies (2020): 199-262.