AUTOMATED OUTPATIENT MANAGEMENT USING REINFORCEMENT LEARNING

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report **"AUTOMATED OUTPATIENT MANAGEMENT USING REINFORCEMENT LEARNING**" is the bonafide work of "**MERLINE.P(142220243023), NAVEEN.J(142220243026), RISHITHA.M(142220243032)**" who carried out the project under my Supervision.

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ABSTRACT

The Outpatient Management Application is a cutting-edge digital platform designed to revolutionize the way healthcare providers and patients interact and manage care outside of a traditional hospital setting. This innovative solution leverages the power of technology to streamline appointment scheduling, facilitate secure communication between patients and their healthcare team, and empower individuals to take charge of their health journey. By integrating features such as real-time appointment booking, medication reminders, personalized health education resources, and seamless access to medical records, the application enhances the overall outpatient experience. Furthermore, it prioritizes data security and privacy, ensuring compliance with industry regulations and safeguarding sensitive patient information.

The Outpatient Management Application is not only a tool for optimizing operational efficiency within healthcare institutions but also a catalyst for promoting patient engagement, improving adherence to treatment plans, and ultimately contributing to better health outcomes. Its user-friendly interface and comprehensive functionality make it an indispensable asset for modern healthcare delivery.

KEYWORDS: ***Outpatient Management Application, digital platform, healthcare, patient interaction, care management.***

TABLE OF CONTENTS

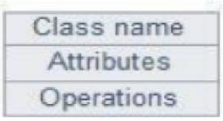
LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVATIONS

ABBREVATIONS	EXPANSIONS
ML	Machine Learning
NLP	Natural Language Processing
RL	Reinforcement Learning
NM	Neural Networks
RAM	Random Access Memory
ROM	Read Only Memory
OS	Operating System
RFID	Radio Frequency Identification
OSI	Open System Inter connection
PEM	Privacy Enhanced Mail
PEMI	Portable electronic Medical Information
MR	Medical Representative

LIST OF SYMBOLS

SYMBOLS	DESCRIPTION
	An entity is a source of data or a destination for data.
	A data flow shows the flow of Information from its source to its destination
	A process shows a transformation or manipulation of data flow within the system.
	Classes are used to represent objects. Objects can be anything having properties and responsibility.
	The start symbol represents the beginning of a process or workflow in an activity diagram.
	The end symbol shown represents the completion of a process or workflow.
	A use case is the specification of a set of actions performed by system, which yields an observable result that is typically of value for one or more actors or other stakeholders of the system.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION:

Introducing the Outpatient Management Application - a ground-breaking, state-of-the-art platform poised to redefine the landscape of outpatient care. This innovative solution represents the pinnacle of healthcare technology, seamlessly integrating the intricate dynamics of patient-provider interactions beyond the confines of traditional hospital environments. By harnessing the power of digital connectivity, this application transcends the ordinary and propels outpatient management into an era of unprecedented convenience, efficiency, and patient empowerment.

Designed with a deep understanding of the evolving needs of modern healthcare, the Outpatient Management Application serves as a beacon of patient-centricity and technological prowess. It not only streamlines administrative processes and communication channels but also fosters a harmonious synergy between patients and their healthcare teams. Through its intuitive interface and comprehensive features, it stands as a testament to the potential of technology to revolutionize the delivery of outpatient care, heralding a new dawn of unparalleled accessibility, security, and personalized support for every individual on their health journey.

Revolutionize outpatient care with our innovative management application. Seamlessly connect patients, healthcare providers, and administrative staff for efficient scheduling, tracking, and communication. Empower users with streamlined access to medical records, appointment reminders, and personalized care plans. Experience the future of outpatient healthcare with our intuitive platform.

1.2 PROBLEM STATEMENT:

The Outpatient Management Application aims to address the critical need for a comprehensive, patient-centric digital platform that streamlines outpatient care processes and enhances patient-provider communication outside traditional hospital settings. However, there is a pressing problem in current outpatient care management, stemming from the lack of centralized and efficient systems for scheduling, communication, and information sharing. This results in disjointed care experiences, poor treatment adherence, and increased risk of medical errors due to miscommunication and data fragmentation. Patients often struggle to effectively manage their care outside of the hospital environment, leading to suboptimal health outcomes and unnecessary healthcare utilization.

Furthermore, healthcare providers face challenges in efficiently coordinating outpatient care, leading to fragmented patient information, scheduling inefficiencies, and communication barriers. This results in reduced productivity, missed opportunities for proactive care interventions, and ultimately compromises the quality of care delivered to outpatients.

Consequently, there is an urgent need for a sophisticated Outpatient Management Application that can seamlessly integrate scheduling, secure communication, and information sharing to improve patient outcomes, increase healthcare efficiency, and enhance the overall outpatient care experience.

1.3 OBJECTIVES

- Transform and optimize the outpatient healthcare experience for patients and healthcare providers
- Improve patient outcomes through enhanced communication and streamlined processes
- Prioritize seamless management of outpatient appointments to reduce wait times and ensure timely access to care
- Facilitate secure and convenient communication channels between patients and healthcare teams
- Empower patients with personalized health education resources, medication reminders, and access to medical records
- Bolster data security measures to ensure strict adherence to privacy regulations and safeguard patients' sensitive information
- Promote treatment adherence and improve patient-provider communication
- Streamline administrative processes to enhance the overall quality of outpatient care

- Implement technologies to monitor, track, and analyze health data for proactive interventions.
- Develop interactive platforms for patients to access information, engage in care plans.
- Utilize automated systems for seamless appointment bookings and optimized resource allocation.
- Implement secure messaging systems to enhance communication among healthcare professionals and patients.
- Integrate administrative processes to reduce redundancies and improve operational efficiency.

1.4 BENEFITS

- **Streamlined Scheduling:** The application allows for efficient scheduling of outpatient appointments, reducing wait times and optimizing the allocation of healthcare resources.
- **Enhanced Communication:** The application facilitates secure and direct communication channels between patients and their healthcare providers. This enables quick exchange of information, clarification of doubts.
- **Improved Resource Utilization**: Healthcare institutions can benefit from improved resource allocation and management due to more organized scheduling and efficient communication.
- **Comprehensive Patient Data Management**: The application supports the management of patient health records and enables healthcare providers to access relevant patient information quickly and securely.
- **Remote Patient Engagement**: The integration of secure messaging and telehealth capabilities in the application allows healthcare professionals to engage with patients remotely.
- **Medication Adherence Support**: The application offers features such as medication reminders and educational resources, which help patients adhere to their prescribed treatment plans.
- **Personalized Health Education:** As part of the application, patients have access to personalized health education resources.
- **User-Friendly Interface**: The application's intuitive design and user-friendly interface enhance the patient experience.
- **Increase Revenue:** By optimizing operations and reducing no-show appointments, outpatient management can lead to increased revenue streams for healthcare facilities.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE REVIEW

1. "The Development of Clinic Management System Mobile Application withIntegrated Appointment, Prescription, and Payment Systems", Rusyaizila Ramli, Kristo Radion Purba, AN Nur Khushairah Mohd Nor Azman Kuzaimi (1), in 23 July 2022

A Clinic Management System (CMAS) mobile application was developed using Agile and Mobile-D approach to address challenges in outpatient clinics, particularly during peak times and pandemics. It offers patient appointment scheduling, prescription management, and cashless payments. User acceptance testing yielded an overall score of 82.7 out of 100, validating its effectiveness.

2. Adaptive Digital Encounters: An approach for reducing digital impact onoutpatient flow, Fahad Ahmed Satti, Taechoong Chung, Sungyoung Lee (2),in 24-27 September 2021

The paper underscores the imperative to enhance user experience in Healthcare Management Information Systems (HMIS). Introducing Adaptive Digital Encounters (ADE) as a solution, it aims to optimize user interactions and system usability. ADE focuses on personalized, adaptive interfaces, ensuring seamless, intuitive, and efficient digital encounters for healthcare professionals and patients within HMIS.

3"A Comprehensive Mobile Tele-Consultation Solution for Tertiary Hospitals in India", Priyesh Ranjan, Rajeev Aravindakshan (3), in 16-18 February 2022

The paper outlines the development of a tele-consultation system for tertiary care hospitals in India, prompted by the COVID-19 pandemic's impact on outpatient services. The system encompasses patient, doctor, and healthcare

worker workflows on web and mobile platforms, facilitating tele-consultation requests, video-calling, and EHR-compliant prescriptions. Pilot deployment at various hospitals demonstrated positive acceptance. Furthermore, it explores integrating emerging technologies like blockchain-based EHR management and cloud-based deployments leveraging 5G advancements for enhanced Quality of Service.

4. "Outpatient regulation system in health management: economic benefits of technological innovations", Alceu Salles Camargo Jr(4), published in 26 August 2020.

The paper evaluates the economic benefits of utilizing technological innovations to manage an outpatient appointments system. Using quantitative methods, it assesses the cost-benefit relationship and payback of this approach. The findings indicate a significant benefit-cost relation of 30.6, demonstrating the economic and social impact of this system. While the study contributes to literature on economic evaluation of outpatient appointments systems.

5. "Technological solution to improve outpatient medical care services usingrouting techniques and medical appointment scheduling", Isaias Chamorro Torres, Jimmy Armas-Aguirre (5),in 16-18 December 2021.

This study presents a technological solution using routing techniques and advanced scheduling to enhance outpatient medical services, improving efficiency and patient access to timely healthcare appointments.

2.2 SUMMARY OF LITRATURE SURVEY

S.NO	TITLE	YEAR OF PUBLICATION	AUTHOR NAME	CONCEPT
1.	The Development of Clinic Management System Mobile Application with Integrated Appointment, Prescription, and Payment Systems	23 July 2022	Rusyaizila Ramli, Kristo Radion Purba, AN Nur Khushairah Mohd Nor Azman Kuzaimi (1)	Development of Clinic Management System mobile app for efficient appointment, prescription, and payment management.
2.	Adaptive Digital Encounters: An approach for reducing digital impact on outpatient flow.	24-27 September 2021	Fahad Ahmed Satti, Taechoong Chung, Sungyoung Lee (2)	Adaptive Digital Encounters (ADE) enhance healthcare systems by dynamically generating user interfaces, integrating patient data history, and automating vital sign collection for improved user experience.

3.	A Comprehensive Mobile Tele-Consultation Solution for Tertiary Hospitals in India	16-18 February 2022	Priyesh Ranjan, Rajeev Aravindaksha n (3)	Development of a tele-consultation system for tertiary hospitals in India allows patients to consult with doctors via mobile devices, incorporating EHR, video-calling, and emerging technologies.
4.	Outpatient regulation system in health management: economic benefits of technological innovations	26 August 2020	Alceu Salles Camargo Jr (4)	This study quantitatively assesses the economic impact of technological innovations in outpatient appointment systems, indicating a significant benefit-cost ratio and societal value.

5.	Technological solution to improve outpatient medical care services using routing techniques and medical appointment scheduling.	16-18 December 2021	Isaias Chamorro Torres, Jimmy Armas-Aguirre (5)	The paper outlines a tech solution that significantly cuts patient wait times and scheduling in Peru, using K-means and Ant Colony System algorithms.

Table 2.2: Summary of Literature survey

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM:

The existing outpatient management application is an extraordinary system that seamlessly integrates patient scheduling, electronic health records, and communication tools. It allows healthcare providers to efficiently manage patient appointments, track medical history, and easily communicate with patients. The application offers a user-friendly interface for both patients and medical staff, enabling quick access to appointment schedules, medication alerts, and treatment plans.

Additionally, it includes features such as telemedicine capability, prescription management, and secure messaging for effective patient-provider communication. With robust data security measures and interoperability with other healthcare systems, this outpatient management application streamlines administrative tasks, enhances care coordination, and ultimately improves the overall patient experience.

3.1.1 DISADVANTAGES OF EXISTING SYSYTEM

- **Limited Accessibility**: The existing outpatient management system may suffer from limited accessibility, making it difficult for patients to easily access their medical records, schedule appointments, or communicate with their healthcare providers.
- **Data Security Risks:** The current system might have vulnerabilities that expose patient data to security risks, such as unauthorized access, data breaches, or identity theft.
- **Suboptimal Workflow:** The current system may be plagued by inefficiencies such as long waiting times, redundant paperwork, or disjointed communication channels.

3.2 PROPOSED SYSTEM

The proposed outpatient management application aims to revolutionize the patient experience by leveraging advanced technology for seamless healthcare delivery. Key features include a user-friendly interface for easy appointment scheduling, secure access to personal medical records, and efficient communication with healthcare providers. The system will prioritize data security through robust encryption and access controls to protect patient information. Integration with electronic health records and interoperability with other healthcare systems will ensure comprehensive and accurate data sharing across care settings.

Additionally, the application will incorporate AI-driven capabilities to automate routine administrative tasks, reduce wait times, and improve overall operational efficiency. Ultimately, the proposed system will enhance patient satisfaction, streamline outpatient care processes, and facilitate better collaboration among healthcare professionals for optimized patient outcomes.

3.2.1 ADVANTAGES OF PROPOSED SYSTEM

- **Improved Efficiency**: The proposed Outpatient Management Application streamlines appointment scheduling, patient registration, and medical record-keeping.
- **Enhanced Accessibility**: With electronic health records and remote access capabilities, healthcare providers can quickly access patient information.
- **Increased Patient Satisfaction**: The application facilitates smoother interactions with healthcare systems by providing patients with easy appointment booking, reduced waiting times.

CHAPTER 4 SYSTEM REQUIRMENT

4.1 HARDWARE REQUIREMENTS:

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware. A hardware requirements list is often accompanied by a hardware compatibility list, especially in case of operating systems. The minimal hardware requirements are as follows,

▪ System: Intel Core i3|i5

▪ Hard Disk: 512 GB

▪ RAM: 8 GB

4.2 SOFTWARE REQUIREMENTS

The software requirements are description of features and functionalities of the target system. Requirements convey the expectations of users from the software product. Software requirement definition involves identifying and documenting the user requirements, business needs, and technical specifications of the software. It also involves defining the system architecture, hardware and software components, and testing and validation requirements.

Language: Html, CSS, Python.

IDE: Visual Studio Code.

4.3 TOOLS

- Machine Learning Frameworks: Apache Spark ML lib.
- Data Analysis Libraries: Pandas, Scimodels, NumPy.
- Integrated Development Environments (IDEs): Visual Studio Code.

4.4 LIBRARIES USED:

4.4.1 NUMPY:

NumPy is a fundamental Python library for numerical computing that provides support for multidimensional arrays and matrices. Numpy can be used forsimulating various scenarios in outpatient management, such as predicting patientwait times, optimizing appointment schedules, or simulating the effects of different treatment protocols.

Features of NumPy

- NumPy has various features including these important ones:
- A powerful N-dimensional array object
- Sophisticated (broadcasting) functions
- Tools for integrating C/C++ and Fortran code.
- Useful linear algebra, Fourier transform, and random number capabilities

4.4.2 PANDAS:

Pandas can efficiently import data from various sources such as CSV files, Excel spreadsheets, databases, or web APIs. In an outpatient management application,patient records, appointment schedules, treatment data, and other relevant information can be imported into Pandas DataFrames for further processing.

Features of Pandas:

- Data Frame Object
- Indexing and Selection
- Data Operations and Transformations
- Time Series and Categorical Data Handling

4.4.3 SCI-KIT MODELS:

Scikit-learn can be used to build predictive models for tasks such as patient readmission prediction, appointment no-show prediction, or treatment outcome prediction. By training machine learning models on historical outpatient data, healthcare providers can identify patterns and factors contributing to specific outcomes, enabling them to make informed decisions and interventions.

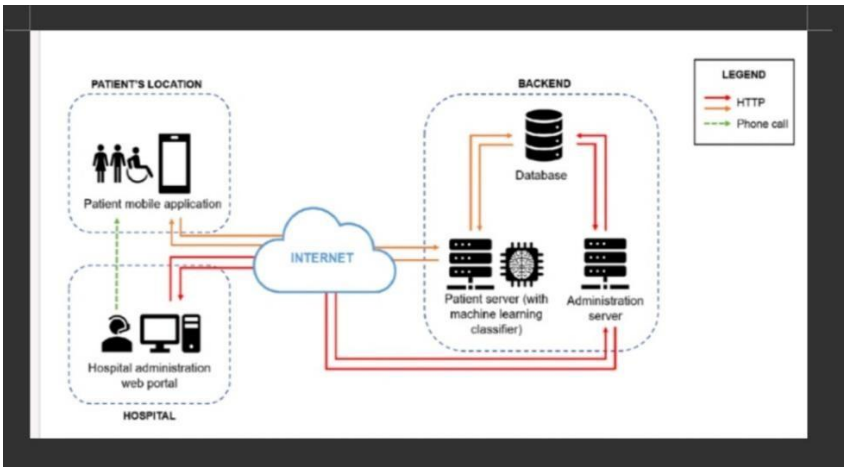
Features of SCI-KIT MODEL:

- Model Evaluation and Selection
- Pre-processing and Feature Engineering
- Integration with NumPy and Pandas
- Active Community and Development
- Open Source and Free

CHAPTER 5

FUNCTIONAL DESIGN

5.1 ARCHITECTURE DIAGRAM WITH EXPLANATION



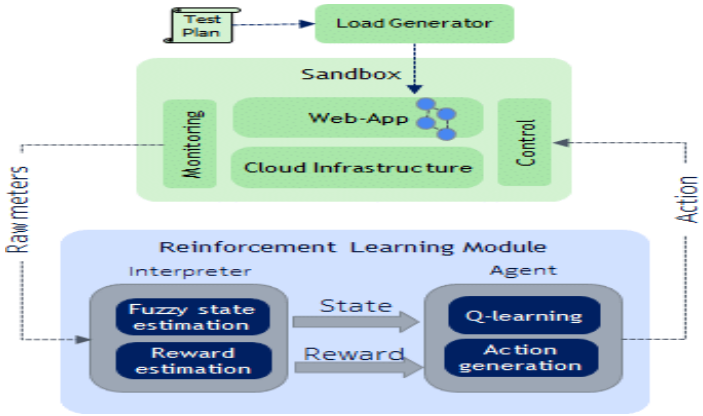


Fig 5.1 : ARCHITECTURE DIAGRAM

- Patients data and hospital data are the main components
- The data will be collected as patient's information, hospital information and send it will be pre-processed.
- After pre-processing the data collected will be stored in the database through internet.
- The data base will segregate the data and sends it to the admin server.
- Further the data will be classified by reinforcement learning algorithm.
- The operation performed in the Backend will be carried out by the training agent, it will detect key points and extracts.
- The data will be classified and stored successfully.

5.2 STEPS OF ARCHITECTURE DIAGRAM

We should dig further into the parts referenced in the design graph breakdown:

5.2.1Patient's Communication:

➢ Patient portable application:

The patient portable application probably incorporates highlights, for example, arrangement planning, admittance to clinical records, secure informing with medical services suppliers, telemedicine capacities, and perhaps wellbeing following functionalities. It might likewise offer administrations like medicine updates, side effect trackers, virtual meetings, and admittance to instructive assets on wellbeing and health.

➢ Phone call:

Direct calls act as an extra correspondence channel for patients to contact the medical clinic for critical issues, arrangement planning, or requests that might require prompt consideration. Call focus agents might deal with these calls, guiding them to the applicable divisions or offering help in light of the idea of the question.

➢ Patient server access:

The patient server probably stores and oversees patient-explicit information safely, guaranteeing consistence with security guidelines like HIPAA or GDPR. It might deal with client validation, information encryption, correspondence with outer frameworks, and access control to safeguard patient data.

5.2.2 Medical clinic Framework:

➢Hospital organization portal:

The organization entryway gives clinic staff instruments to oversee patient confirmations, release processes, staff plans, stock, charging, and other regulatory undertakings. It might incorporate dashboards for constant bits of knowledge, announcing abilities, asset allotment instruments, and correspondence highlights for inward coordination.

➢ Hospital database:

The medical clinic data set fills in as the focal vault for patient records, therapy narratives, test results, solution data, and other basic information. It is critical for keeping up with information respectability, guaranteeing exactness in clinical records, supporting dynamic cycles, and working with consistent data trade among medical care suppliers.

5.2.3 Correspondence and Backend:

➢ Communication services:

These administrations probably envelop informing conventions, email notices, information synchronization instruments, Programming interface reconciliations with outside frameworks, and guaranteeing information consistency across various parts.They assume an essential part in working with correspondence between the patient versatile application, medical clinic framework, and other coordinated administrations, guaranteeing consistent information stream and constant updates.

➢ Machine learning server:

The AI server is liable for handling enormous volumes of information to create experiences, expectations, proposals, or mechanize specific cycles in view of cutting-edge calculations. It very well might be used for errands, for example, customized treatment plans, prescient examination for illness results, abnormality identification in diagnostics, or improving emergency clinic assets proficiently.

➢ Administration classifier:

The organization classifier probably sorts authoritative information into predefined classes or classifications, empowering smoothed out information the executives, search functionalities, and report age. It very well may be utilized to characterize patient records, regulatory archives, monetary information, or functional measurements for simple recovery, examination, and dynamic inside the emergency clinic framework.

5.2.4 In general Framework Mix:

➢ Patient Area Backend:

This part might include following patients inside the medical clinic premises utilizing innovation like RFID labels, guides, or WiFi triangulation for effective asset portion, decreasing stand by times, and upgrading patient experience. It could likewise uphold administrations like wayfinding, crisis reaction coordination, patient stream enhancement, and nearness based notices for medical clinic conveniences.

CHAPTER 6 SYSTEM DESIGN

6.1 UML DIAGRAM

Unified Modelling Language is a visual language for specifying, constructing and documenting the artefacts of systems. The UML defines various UML profiles that specialize subsets of the notation for common subject areas, such as diagramming Enterprise JavaBeans (with the UML EJB profile). The UML is a very important part of developing objects oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

UML diagrams make abstract ideas and software systems easier to understand through visualization. This is beneficial for software engineers who need to collaborate when building software. UML diagrams also make it easier for software engineering teams to communicate with external stakeholders. Software engineers can use the UML model to explain how the system works to non-tech-savvy people.

Types of UML diagrams

There are two subcategories of UML diagrams: structural diagrams and behavioural diagrams.

- Structural diagrams depict the components that make up a system and the relationship between those components. These diagrams show the static aspects of a system.
- Behavioral diagrams represent what happens within a system. They show how all the components interact with each other and with other systems or users.

6.1.1 USE CASE DIAGRAM

Use case is a collection of related success and failure scenarios that describes an actor using a system to support a goal. A use case diagram is a graphical representation of the interactions between actors (users or external systems) and a system under consideration. It provides a high-level view of the system's functionality and the interactions between users and the system. Use case diagrams are typically used during the early stages of software development to capture the system's requirements and to communicate with stakeholders.

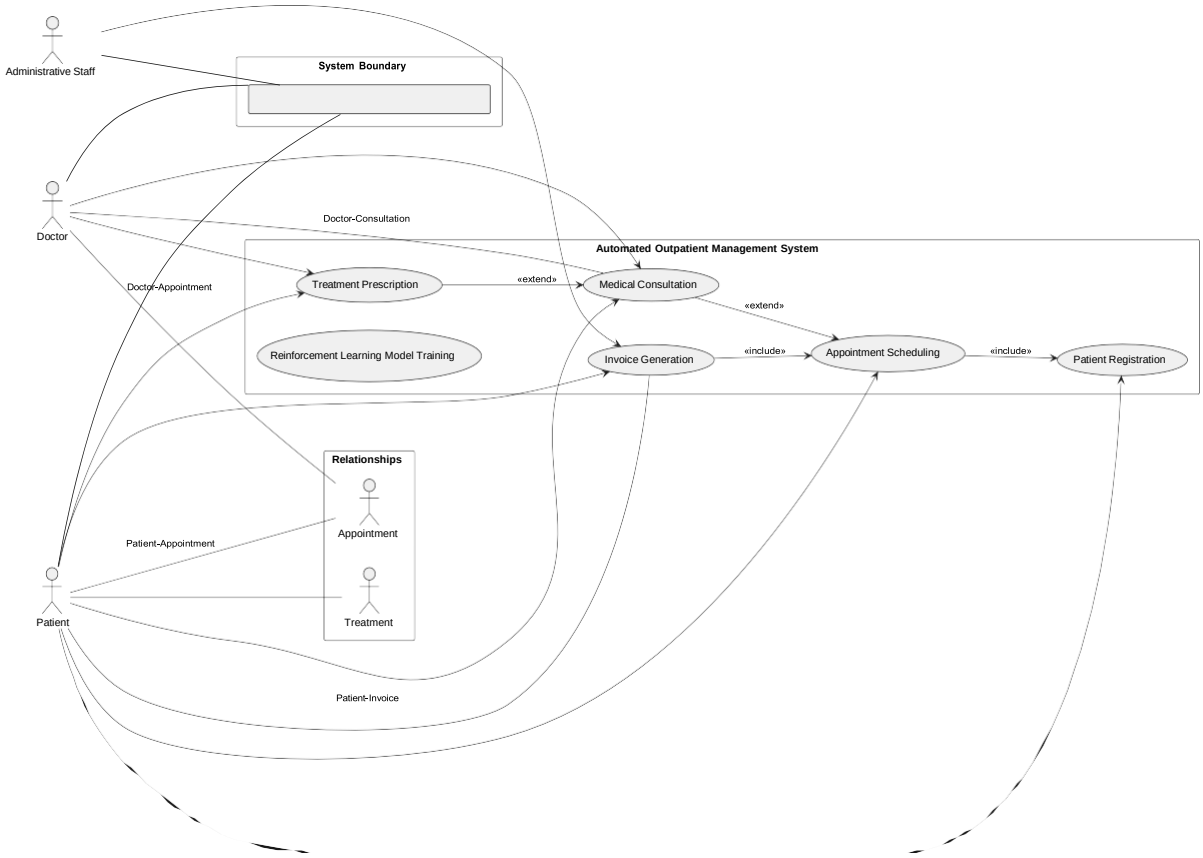


Fig 6.1: USE CASE DIAGRAM

6.1.2 CLASS DIAGRAM

Class diagrams are used to show the different objects in a system, their attributes, operations, and a relationship between them. They are used for static object modelling. In figure.no.6.2 describes class diagram analysing diseases for climatic changes using ontology. It helps in identifying the relationships between objects and provides a clear picture of the overall structure of the system. The class diagram also helps in code generation and provides a blueprint for the software development team.

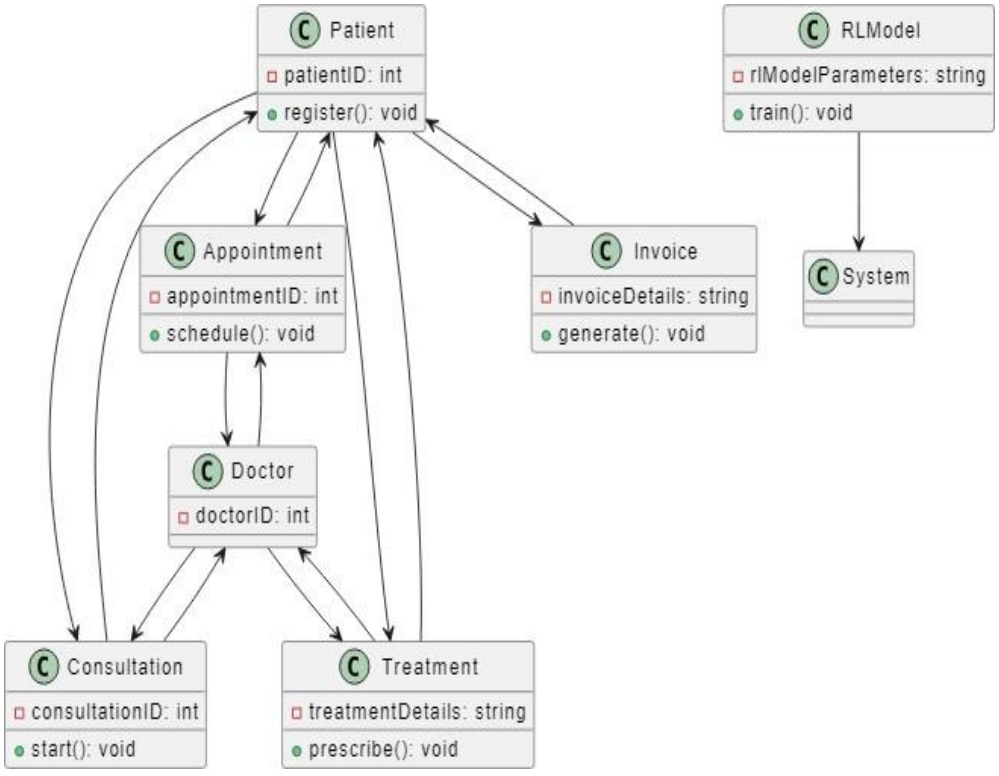


Fig 6.2: CLASS DIAGRAM

6.1.3 STATE CHART DIAGRAM

State chart diagram is used to model the dynamic nature of a system. It illustrates the interesting events and states of an object, the behavior of an objectin an event. Transitions are shown as arrows, labelled with their events. State chart diagrams can be used to model complex systems. They are useful for visualizing and analyzing the behavior of a system, identifying potential problems, and improving system performance and reliability.

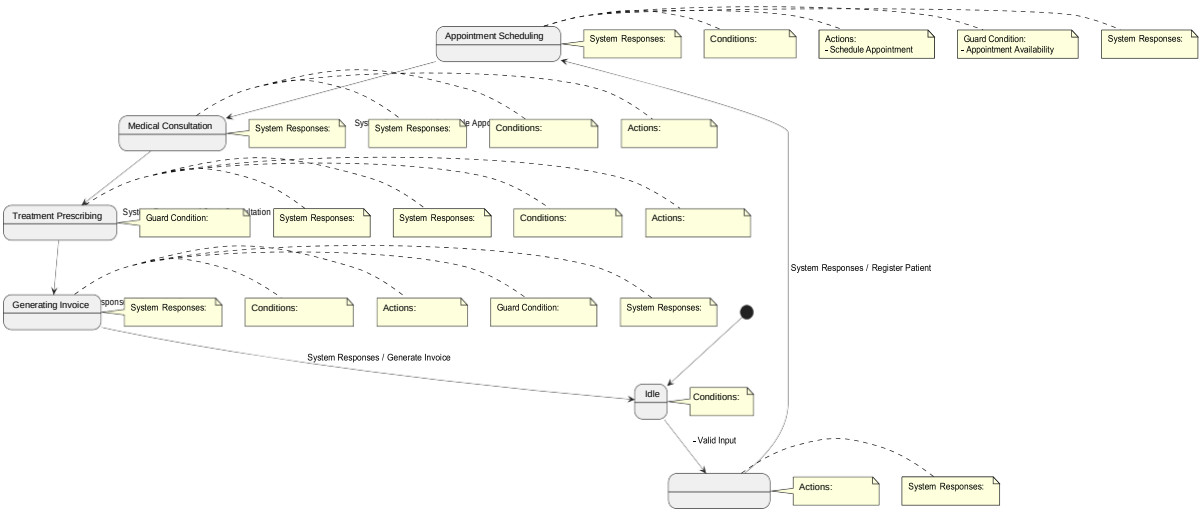


Fig 6.3 : STATE CHART DIAGRAM

CHAPTER 7

METHODOLOGY

7.1 METHODOLOGY

The methodology adopted for **Automated outpatient management using Reinforcement learning**.

7.1.1 REINFORCEMENT LEARNING:

Reinforcement Learning (RL) is a type of machine learning algorithm that focuses on training intelligent agents to make sequences of decisions to achieve to goal.

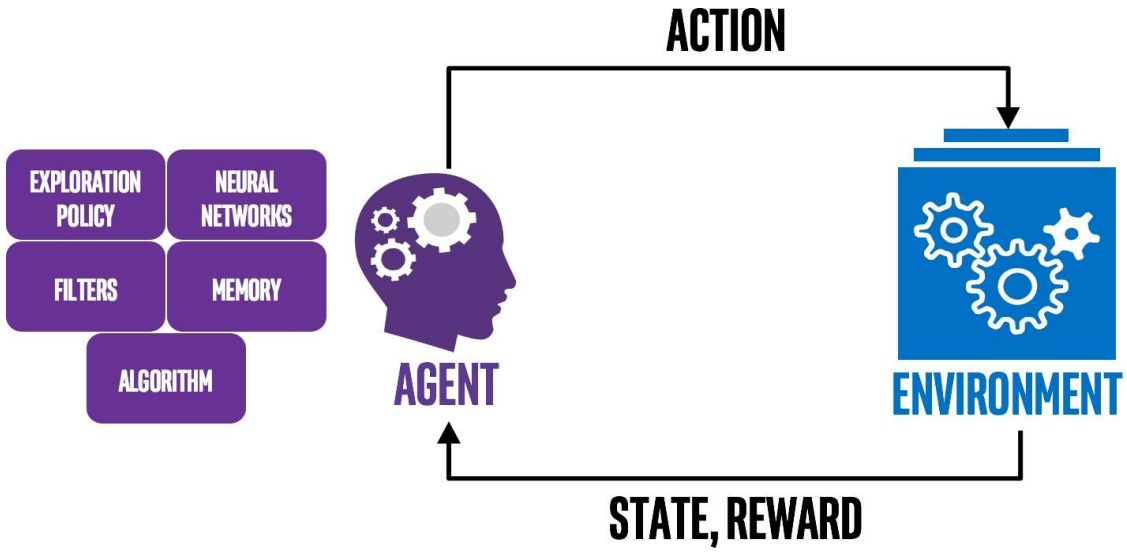


Fig 7.1: Reinforcement Learning

Common usages of reinforcement learning models include the following:

- **Treatment Recommendation**: RL algorithms can learn to recommend personalized treatment plans for individual patients based on their medical history, current condition, and treatment response. The RL agent interacts with the environment (patient's health status) and learns which treatments lead to better outcomes over time.
- **Appointment Scheduling:** RL can optimize appointment scheduling by considering factors such as patient preferences, clinic capacity, and urgency of appointments. The RL agent learns to schedule appointments efficiently to minimize patient wait times and optimize clinic utilization.

7.1.2 NATURAL LANGUAGE PROCESSING ALGORITHM

Natural Language Processing (NLP) is a subfield of machine learning that focuses on the interaction between human language and computers. It involves the use of computational techniques to understand, analyze, and generate human language

Common usages of reinforcement learning models include the following:
Information Extraction: Identifying and extracting specific information from unstructured text, such as extracting names and dates from news articles or medical records.

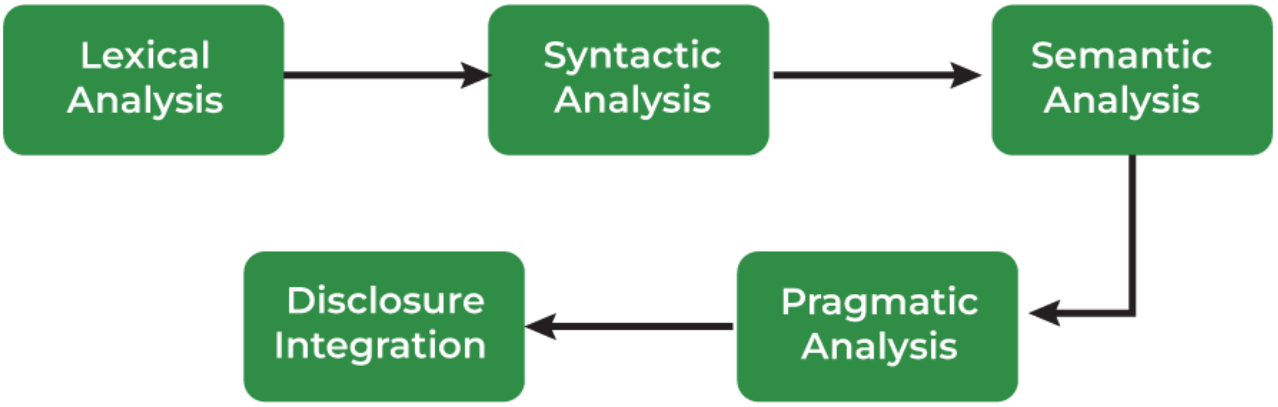


Fig 7.2 : Natural Language Processing

7.1.3 RANDOM FOREST

The substance frames a cross breed approach joining Irregular Timberland and Support Figuring out how to further develop short term administration in medical services. Arbitrary Woodland is utilized to anticipate and pursue choices in light of patient and medical care information, while Support Gaining streamlines framework execution by gaining from past activities. The cycle includes characterizing goals, information assortment and pre-processing, carrying out Arbitrary Backwoods for expectations, coordinating Support Figuring out how to persistently further develop procedures, and use.

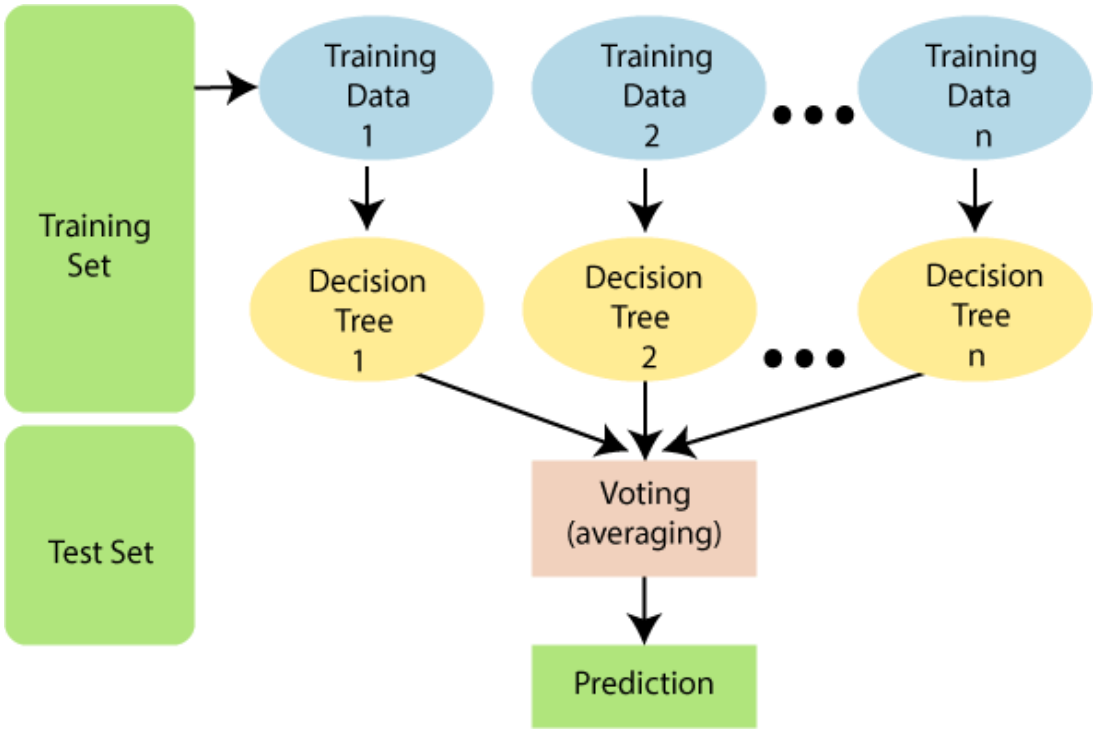


Fig 7.3 : RANDOM FOREST

7.1.4 SVM:

The illustrated framework utilizes a Help Vector Machine (SVM) capability incorporated with support learning for streamlining mechanized short term administration. It starts with gathering broad information, incorporating patient data, functional measurements, and results from past visits. Basic to the framework's prosperity is the course of element designing, where significant properties are chosen and pre-processed to further develop the SVM model's prescient ability. The SVM model, key to this system, is prepared to foresee ideal short term administration choices, utilizing a picked portion in view of information and issue intricacy.

A model SVM pipeline outlines the most common way of preparing the model with patient and functional information, and in this manner, pursuing administration choices for new short term cases in light of the SVM's expectations. Moreover, the joining of a support learning part, depending on a characterized reward framework and a learning calculation, empowers the model to gain from its choices' results. Persistent model assessment and tuning, close by true testing in a medical services setting, are underlined to refine the framework's exhibition.

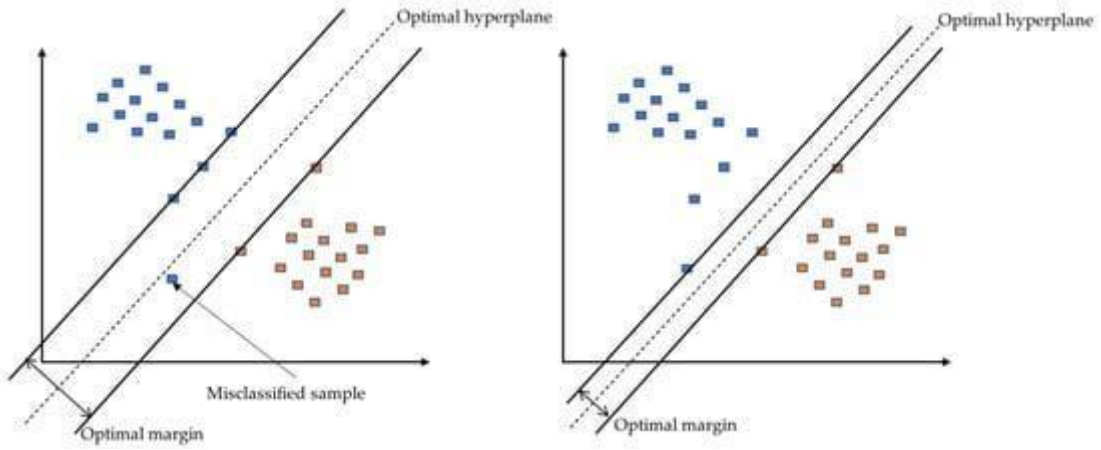


Figure 7.4 : An example of the impact of low C (**left**) and high C (**right**).

SVMs could be applied in various ways:

1. **Classification of Patient Conditions**: SVMs can be used to classify patient conditions based on diagnostic data, symptoms, or other relevant features. For example, SVMs could help in identifying patients with specific medical conditions or predicting the severity of a disease based on patient characteristics.
2. **Risk Prediction and Stratification:** SVMs can be employed to predict the risk of adverse events or complications for outpatient populations. By analysing patient data and medical history, SVMs can stratify patients into different risk categories, allowing healthcare providers to allocate resources more efficiently.
3. **Treatment Response Prediction**: SVMs can help predict how patients will respond to different treatment options. By analysing patient data and treatment outcomes, SVMs can identify patterns and factors associated with treatment success or failure, enabling healthcare providers to personalize treatment plans for individual patients.
4. **Patient Outcome Prediction**: SVMs can be used to predict patient outcomes, such as hospital readmissions, mortality, or disease progression. By analysing longitudinal patient data and clinical variables.
5. **Optimization of Clinical Decision Support Systems:** SVMs can be integrated into clinical decision support systems to assist healthcare providers in making informed decisions about patient care. By analysing large datasets and clinical guidelines, SVMs can help identify the most appropriate diagnostic tests, treatments, or referrals for individual patients.

7.2 MODULE DESCRIPTION

- ❖ Integrated Health Data Platform
- ❖ Care Pathway Optimization Module
- ❖ Transactional Operation Module
- ❖ Collaborative Communication Module
- ❖ Reporting and Inside Hub Module

7.3 MODULE EXPLANATION:

7.3.1 INTEGRATED HEALTH DATA PLATFORM

An “Integrated Health Data Platform” revolutionizes healthcare by aggregating and centralizing patient information, including medical records, test results, and treatment history. This platform facilitates seamless communication between healthcare providers, improves care coordination, enhances data accessibility, and empowers informed decision-making, ultimately optimizing patient outcomes and healthcare delivery efficiency.

Code:

```
<h2>About</h2>
   <p>The Integrated Health Data Platform aggregates and centralizes patient information, improving care coordination and enhancing healthcare delivery efficiency. </p>
  </section>
  <section id="services">
    <h2>Services</h2>
    <ul>
      <li>Medical Records Management</li>
      <li>Care Coordination</li>
    </ul>
  </section>
```

7.3.2 CARE PATHWAY OPTIMIZATION MODULE

"The Care Pathway Optimization Module" enhances healthcare delivery by streamlining patient care journeys. It offers comprehensive tools for optimizing treatment plans, reducing delays, and improving resource allocation. With data-driven insights and streamlined workflows, this module empowers healthcare

Code:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Care Pathway Module</title>
</head>
<body>
  <header>
    <h1>Care Pathway Module</h1>
  </header>
    <section>
```

7.3.3 TRANSACTIONAL OPERATION MODULE

The Transactional Operation Module facilitates seamless transactional processes within systems, ensuring reliability and efficiency. It enables secure handling of data transactions, including financial transactions, order processing, and database operations. With robust error handling and real-time updates, this module ensures smooth and accurate transactional operations across platforms. A transactional operation module typically refers to a software component or system that facilitates the management and processing of transactions within an organization or business.

Code:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Transactional Operation Module</title>
</head>
<body>
  <header>
    <h1>The Transactional Operation Module</h1>
  </header>
```

<section>

7.3.4 COLLABORATIVE COMMUNICATION MODULE

The Collaborative Communication Module fosters efficient and cohesive communication among teams. It integrates messaging, file sharing, and project management tools to facilitate real-time collaboration. With features like threaded discussions, task assignments, and document collaboration.

Code:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>The Collaborative Communication Module</title>
</head>
<body>
```

```
<header>
  <h1>The Collaborative Communication Module</h1>
</header>
  <section>
  <h2>Overview</h2>
  <p>The Collaborative Communication Module fosters efficient teamwork through integrated messaging, file sharing, and project management tools.</p>
</section>
```

.

7.3.5 Reporting and Inside Hub Module

The Reporting and Insight Hub Module empowers data-driven decision-making by providing comprehensive reporting and analytics capabilities. It aggregates and analyses data from various sources, offering actionable insights and customizable reports. With intuitive visualization tools, this module enhances transparency, efficiency, and strategic planning within organizations.

Code:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
```

```
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Reporting and Inside Hub Module</title>
</head>
<body>
  <header>
    <h1>Reporting and Inside Hub Module</h1>
  </header>
```

CHAPTER 8

EXPERIMENTAL ANALYSIS

8.1 EXPERIMENTAL ANALYSIS:

8.1.1 ATTRIBUTE SELECTION FOR REINFORCEMENT LEARNING ALGORITHM:

One of the main contributions of this research is the for mutation of a PEM calculation model to find the overall patient experience. Six attributes (R1, R2, V1, V2, D1, D2) of three stations (Registration, Vitals and Doctor) are considered for this purpose. Calculation of these attributes is shown in Table 2. R-AT is the patient arrival time, R-PS is the process start time and R-PE is the process end time at the registration station. The same attributes are used for Vitals and Doctor's stations. These attributes represent the actual process time a patient spends at each station.

Attribute selection. The attributes which are used to train RL based on the timing information are calculated in the table below. D1 shows that the patient is in the doctor's room, D2 shows that the patient has come out from the doctor's station. Equation (1) and equation (2) are used to compute RPS - RAT, RPE – RPS Process Start Time − Patient Arrival Time=Waiting Time (1) RPS - RAT = R1 RPS is the registration process start time, RAT is the patient arrival time at the registration station. Process End Time−Process Start Time = Actual Process Time (2) RPE – RPS = R2 RPE is the registration process end time and RPS is the registration process start time.

Likewise, attributes for vitals and doctor's station are selected. R1 and R2 are the attributes of the registration station, V1 and V2 are the attributes from vitals and D1 and D2 are the attributes from the doctor's station. So the R1, R2, V1, V2, D1, D2, therefore represents the six attributes used to train GA.

To build a model, the weights for the attributes are important. These attributes with the weights from the GA generate a PEM model by using equation (3). PEMI_model = (W1 ∗ f1 + W2 ∗ f2 + W3 ∗ f3 + ..W6 ∗ f6) (3) Here [f1-f6]

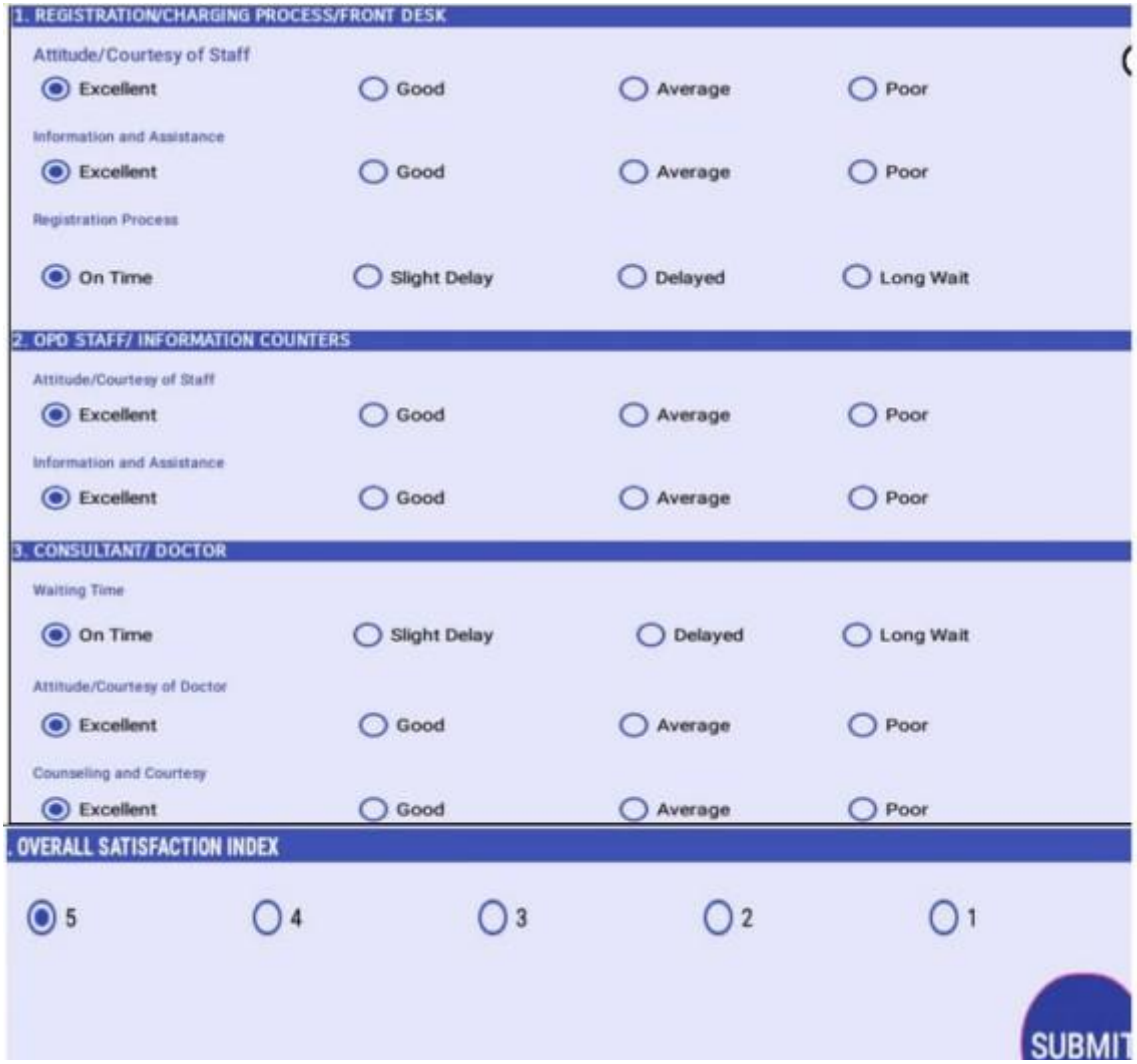


Fig 8.1: ELECTRONIC SURVEY FORM

The above Fig 8.1 shows electronic survey form. The figure shows the details of the questions about each station (3 stations are shown here same questions are asked about laboratory and pharmacy station, questions about environment are related to cleanliness, décor, and temperature). Patient is asked to rank them between 0 to 5 with 0 being worst to 5 as the best.

TABLE 8.1 Attribute selection. The attributes which are used to train GA basedon the timing information are calculated in the table below

Stations	Attributes	
Registration	RPS-RAT=R1	RPE-RPS=R2
Vitals	VPS-VAT=V1	VPE-VPS=V2
Doctor	DPS-DPE-D1	DPE-DPS=D2

Table 8.1: Attribute selection

8.2 DATA NORMALIZATION

Before applying the RL algorithm, the data is normalized in a range from 0 to 5,as the OSI value ranges from 0 to 5.

8.2.1 INITIALIZE POPULATION

In the genetic algorithm, the population consists of different chromosomes and the structure of each chromosome is important. In our framework, each chromosome consists of a 6-dimensional weight vectors W = W1, W2, W3. . .W6. These weights are randomly generated, and all weight vectors are normalized between 0-1. The initial population consists of 50 chromosomes with gene value of 6.

8.2.2 FITNESS FUNCTION:

Fitness function, also known as objective function or cost function, is the mostlyused criterion to increase or decrease the number of iterations based on the result.In our case, fitness function is the difference between PEMI which the model calculates and the actual OSI provided by the patient during the survey process. The objective is to find the optimal weight vector which provides least differencebetween both. Equation 4 is used to calculate the fitness function. Error = abs (PEMI_OSl − PEMI_model).

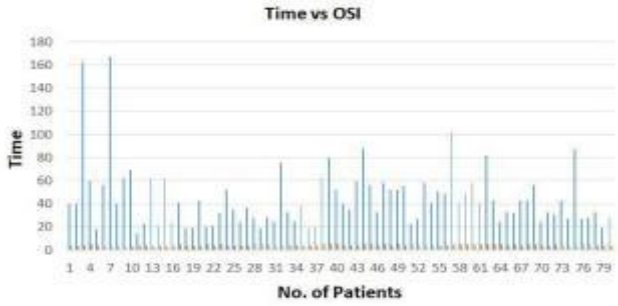


Fig 8.2 : TIME VS OSI

The above FIGURE 8.2 Time vs OSI. The figure shows the time spent by each patient in the hospital and after the treatment the OSI given by him/her based onthe overall experience.

Fig 8.3 : FITNESS VALUE / MEAN FITNESS

The above Fitness Value. The figure shows the fitness value against each chromosome in the population and the mean of all the fitness. The selected chromosome for final PEM has fitness value of 0.008983.

Fig 8.4 : PREDICTED VS ACTUAL OSI

The above FIGURE 8.4 Predicted vs Actual OSI. The figure shows the results ofthe Genetic algorithm. The blue line shows the actual OSI given by the patient and orange line.

8.3 MUTATION:

This is also a genetic operator, it alters the values of two selected parents, i.e. swaps their values. But in our framework, mutation probability is set to 0% which means no change after crossover is performed. Once the cycle is completed a new population is produced by crossover which will again go through the whole process until the optimized weights are produced.

8.4 RESULTS:

The main objective of collecting and then analysing the datasets is to automatically generate a patient experience management system that strongly maps and correlates the OSI given by the patient and the OSI generated through the system.

Two datasets are collected, one is the survey data that gives the OSI, and the other is the RFID dataset that gives the timing information of the patient in the hospital. Both the datasets are used to train RL to find the optimized weights for the final PEMI system.

Fig 8.5: ERROR AND AVG ERROR

The Above FIGURE 8.5 Error and average error. The figure shows the error calculated using actual OSI minus the predicted PEMI. Average error for this dataset is 0.322.

	Training data	Testing Data
Average Error	0.212	0.322
Accuracy	92	80

Then
(True PEMI = true)

Table 8.6: Average error and accuracy on training and testing datasets

Then (True PEMI = true) Table 3 shows the average error and accuracy of both the training data and testing data calculated using the equations 6 and 7 respectively. The accuracy on the training dataset is 92% and the average error is 0.212. When the same optimized weights are applied to the testing data the accuracy is about 80.3% and the average error is 0.322.

The results obtained with the proposed methodology are significant. The proposed work eliminates the use of conventional surveys and reduces the hectic overload of staff working with paper, by using RFID technology. Based on the collected, each patient's satisfaction index is calculated which eliminates the need of conducting independent surveys. In addition, the proposed technique calculates the PEMI in real-time thus enabling the service.

8.5 EXPERIMENTAL RESULTS:

8.5.1 AUTHENTICATION PAGE:

- Users enter their username or email address and password into designated text fields.
- A link or button allows users to reset their password if they forget it. This feature often involves a password recovery process, such as sending a reset link to the user's email.
- Users submit their credentials for authentication by clicking a "Login" or "Sign In" button.
- Both Doctors and Patients can login through our website.
- One need to enter their username and password details correctly.

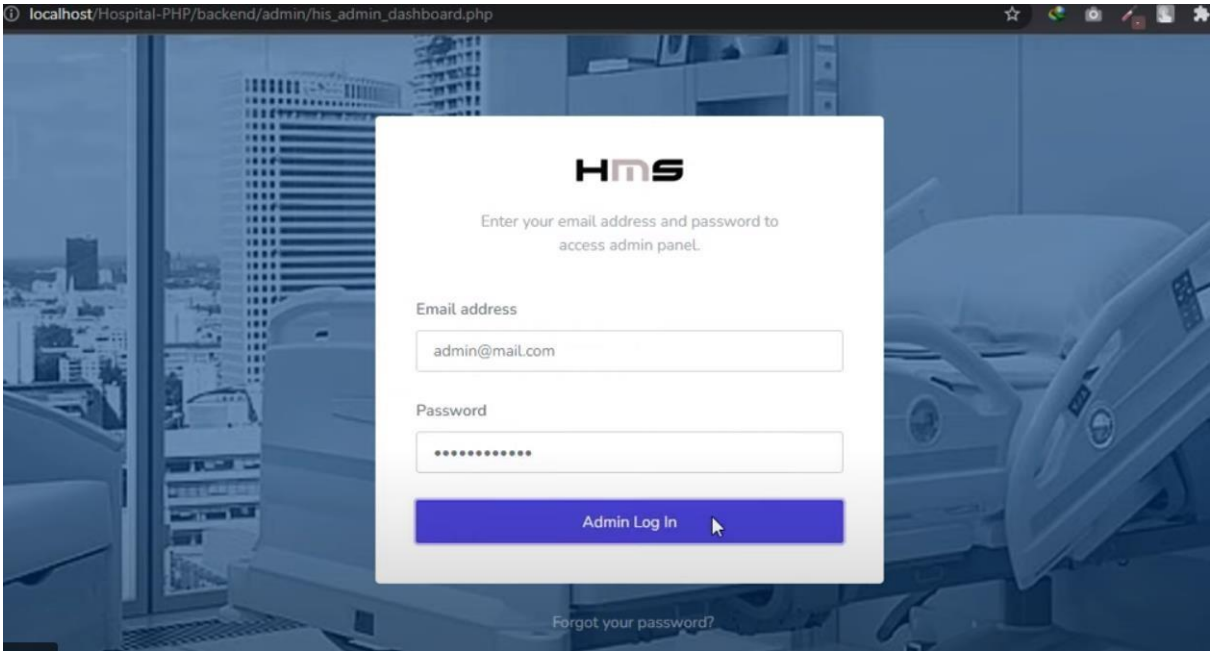


Fig 8.6 : Authentication page

8.5.2 PATIENTS OUTLOOK:

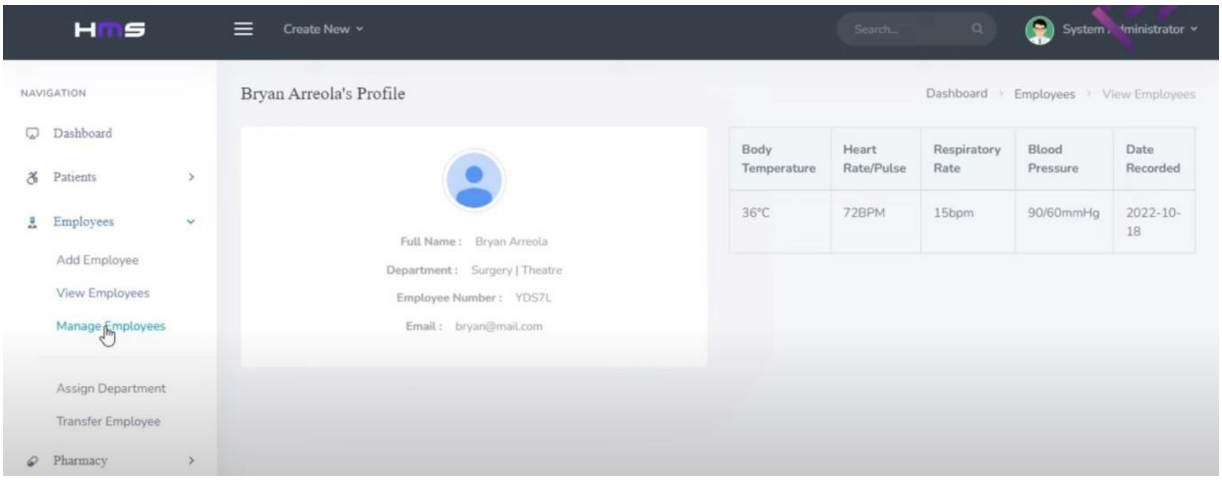


Fig 8.7: Patients outlook

PATIENTS USAGE:

- Patients can view their status how many patients are waiting for the appointment etc.
- Employees and staffs details will also be available for the patients to monitor their visits and they can manage the employee's status.
- Patients can provide feedback on their healthcare experiences and satisfaction with the services received through the application. Healthcare providers can use this feedback to improve the quality of care and enhance the patient experience.
- Pharmaceutical access involves ensuring that a wide range of medications, including essential drugs and treatments for various medical conditions, are available and accessible to individuals in need. This includes both generic and brand-name medications.

8.5.3 DOCTORS OUTLOOK:

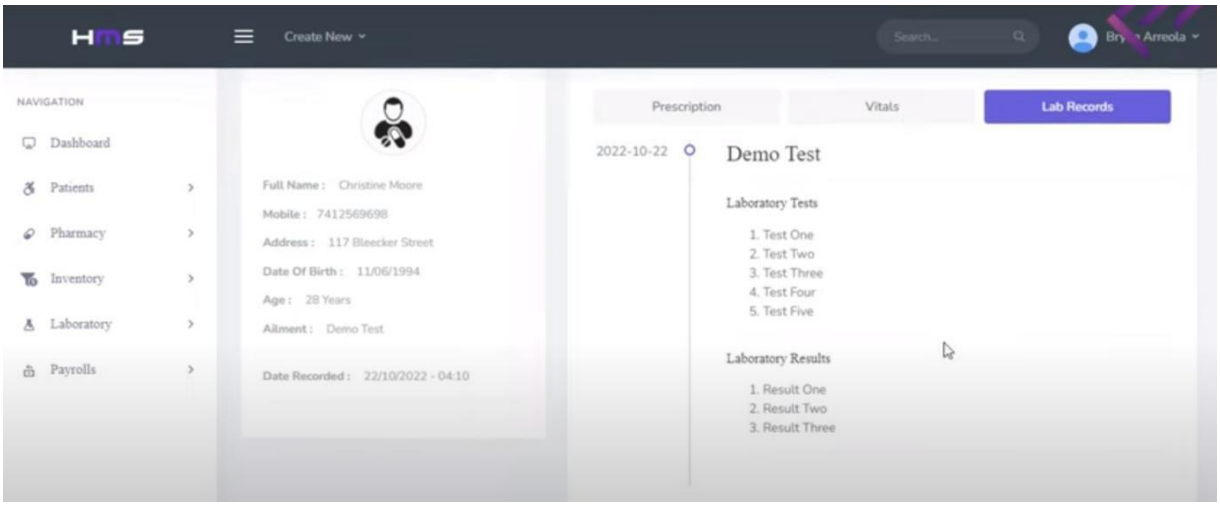


Fig 8.7: Doctors outlook

DOCTORS USAGE:

- This could mean that each time a doctor performs a specific action or task within the system, they earn 5 points. These actions could include conducting consultation prescribing treatments, scheduling appointments, etc.
- The points could be used to evaluate the performance or productivity of doctors within the system. Doctors who accumulate more points might be considered more active or efficient.
- Points could be part of an incentive system where doctors are rewarded based on their usage or activity level within the system. Higher point earners might be eligible for rewards or recognition.
- Points might be used to allocate resources within the system. For example, doctors with higher usage points might be given priority for scheduling appointments or accessing certain features.

CHAPTER 9

CONCLUSION

9.1 CONCLUSION:

The incorporation of reinforcement learning into automated outpatient management systems offers transformative potential in healthcare. Through continuous learning and adaptation, these systems can provide personalized care, optimize resource allocation, improve decision-making, enhance patient experience, and ultimately, reduce costs. By harnessing the power of data-driven insights and adaptive algorithms, healthcare providers can deliver more efficient, effective, and patient-centred care, marking a significant advancement in outpatient healthcare delivery.

9.2 FUTURE SCOPE:

- These systems can leverage historical data and real-time patientinformation to predict disease progression, anticipate healthcare needs, andproactively intervene to prevent adverse health outcomes.
- Integration with remote monitoring devices and telehealth platforms will enable seamless virtual consultations, remote patient monitoring, and remote treatment adjustments, expanding access to healthcare services and improving patient convenience.
- These systems can support research efforts by analysing large-scale healthcare data to identify patterns, trends, and correlations, leading to new insights into disease management, treatment effectiveness, and healthcare delivery optimization.
- As reinforcement learning algorithms continue to evolve, they will enable healthcare providers to offer highly personalized treatment plans tailored to individual patient needs, preferences, and medical histories.

APPENDIX:

```
<?php include 'header.php';?>

<!-- Content -->

<div id="content">

    <!-- Intro -->

    <section class="p-t-b-150">

        <div class="container">

            <div class="intro-main">

                <div class="row">


                    <!-- Intro Detail -->

                    <div class="col-md-7">

                        <div class="text-sec padding-right-0">

                            <h5>Health Check Ups</h5>

                            <p>It has survived not only five centuries, but also the leap into electronic typesetting,

                                remaining essentially unchanged. It was popularised in the 1960s with the release of

                                Letraset sheets containing Lorem Ipsum passages, and more with desktop publishing

                                software like Aldus PageMaker including versions of Lorem Ipsum.</p>

                            <ul class="row">

                                <li class="col-sm-6">

                                    <h6> <i class="lnr lnr-checkmark-circle"></i> EMERGENCY CASE</h6>

                                    <p>Excepteur sint occaecat cupidatat non roident,
```

```
                        sunt in culpa qui officia deserunt mollit </p>

                    </li>

                    <li class="col-sm-6">

                        <h6> <i class="lnr lnr-checkmark-circle"></i>
QUALIFIED DOCTORS</h6>

                        <p>Excepteur sint occaecat cupidatat non roident,

                            sunt in culpa qui officia deserunt mollit </p>

                    </li>

                    <li class="col-sm-6">

                        <h6> <i class="lnr lnr-checkmark-circle"></i> ONLINE
APPOINTMENT</h6>

                        <p>Excepteur sint occaecat cupidatat non roident,

                            sunt in culpa qui officia deserunt mollit </p>

                    </li>

                    <li class="col-sm-6">

                        <h6> <i class="lnr lnr-checkmark-circle"></i> FREE
MEDICAL COUNSELING</h6>

                        <p>Excepteur sint occaecat cupidatat non roident,

                            sunt in culpa qui officia deserunt mollit </p>

                    </li>

                </ul>

            </div>

        </div>


        <!-- Intro Timing -->
```

```
                <div class="col-md-5"> <img class="img-responsive intro-img" src="images/intro-img.jpg" alt="">
                </div>
            </div>
        </div>
    </section>

</div>

<!-- Footer -->
<!--======== FOOTER ==========-->

<?php include 'footer.php';?>
<?php
session_start();

?>
<?php
error_reporting(0);
include("dbconnection.php");
$dt = date("Y-m-d");
$tim = date("H:i:s");
?>
<!-- header section -->
```

```
<!DOCTYPE html>

<html>

<head>

<meta charset="UTF-8">

<meta http-equiv="X-UA-Compatible" content="IE=Edge">

<meta content="width=device-width, initial-scale=1, maximum-scale=1, user-scalable=no" name="viewport">

<title>Hospital Admin</title>

<link href="assets/plugins/bootstrap/css/bootstrap.min.css" rel="stylesheet" />

<link href="https://fonts.googleapis.com/icon?family=Material+Icons" rel="stylesheet" type="text/css">

<link rel="icon" href="favicon.ico" type="image/x-icon">

<!-- Custom Css -->

<link href="assets/css/main.css" rel="stylesheet">

<link href="assets/css/login.css" rel="stylesheet">


<!-- Swift Themes. You can choose a theme from css/themes instead of get all themes -->

<link href="assets/css/themes/all-themes.css" rel="stylesheet" />

</head>

<body class="theme-cyan login-page authentication">

<!-- header section -->


<?php

if(isset($_SESSION[adminid]))

{
```

```
    echo "<script>window.location='adminaccount.php';</script>";
}
$err='';
if(isset($_POST[submit]))

{
    $sql = "SELECT * FROM admin WHERE loginid='$_POST[loginid]' AND password='$_POST[password]' AND status='Active'";
    $qsql = mysqli_query($con,$sql);
    if(mysqli_num_rows($qsql) == 1)
    {
        $rslogin = mysqli_fetch_array($qsql);
        $_SESSION[adminid]= $rslogin[adminid] ;
        echo "<script>window.location='adminaccount.php';</script>";
    }
    else
    {
        $err = "<div class='alert alert-danger'>
        <strong>Oh !</strong> Change a few things up and try submitting again.
    </div>";
    }
}

?>
```

```
<div class="container">

   <div id = "err"><?php echo $err;


?></div>

   <div class="card-top"></div>

   <div class="card">

      <h1 class="title"><span>Hospital Management System</span>Login <span class="msg">Sign in to start your session</span></h1>

       <div class="col-md-12">


      <form method="post" action="" name="frmadminlogin" id="sign_in" onSubmit="return validateform()">

   <div class="input-group"> <span class="input-group-addon"> <i class="zmdi zmdi-account"></i> </span>

                <div class="form-line">

              <input type="text" name="loginid" id="loginid" class="form-control" placeholder="Username" /></div>

            </div>

                 <div class="input-group"> <span class="input-group-addon"> <i class="zmdi zmdi-lock"></i> </span>

                <div class="form-line">

                        <input type="password" name="password"  id="password" class="form-control"  placeholder="Password" /> </div>

            </div>

            <div>

               <div class="">

                  <input type="checkbox" name="rememberme" id="rememberme" class="filled-in chk-col-pink">
```

```
                    <label for="rememberme">Remember Me</label>

                </div>

                <div class="text-center">

                    <input type="submit" name="submit" id="submit" value="Login" class="btn btn-raised waves-effect g-bg-cyan" /></div>

                    <div class="text-center"> <a href="forgot-password.html">Forgot Password?</a></div>

                </div>

            </form>

        </div>

    </div>

</div>

 <div class="clear"></div>

 <div class="theme-bg"></div>

  </div>

</div>

<!-- Jquery Core Js -->

<script src="assets/bundles/libscripts.bundle.js"></script> <!-- Lib Scripts Plugin Js -->

<script src="assets/bundles/vendorscripts.bundle.js"></script> <!-- Lib Scripts Plugin Js -->


<script src="assets/bundles/mainscripts.bundle.js"></script><!-- Custom Js -->

</body>

</html>

<script type="application/javascript">
```

```
var alphaExp = /^[a-zA-Z]+$/; //Variable to validate only alphabets

var alphaspaceExp = /^[a-zA-Z\s]+$/; //Variable to validate only alphabets and space

var numericExpression = /^[0-9]+$/; //Variable to validate only numbers

var alphanumericExp = /^[0-9a-zA-Z]+$/; //Variable to validate numbers and alphabets

var emailExp = /^[\w\-\.\+]+\@[a-zA-Z0-9\.\-]+\.[a-zA-z0-9]{2,4}$/; //Variable to validate Email ID


function validateform()

{

   if(document.frmadminlogin.loginid.value == "")

   {

        document.getElementById("err").innerHTML ="<div class='alert alert-info'><strong>Heads up!</strong> Please enter Password</div>";

      document.frmadminlogin.loginid.focus();

      return false;

   }

   else if(!document.frmadminlogin.loginid.value.match(alphanumericExp))

   {

        document.getElementById("err").innerHTML ="<div class='alert alert-Warning'><strong>Heads up!</strong> Invalid Password</div>";

      document.frmadminlogin.loginid.focus();

      return false;

   }

   else if(document.frmadminlogin.password.value == "")

   {
```

```
        document.getElementById("err").innerHTML ="<div class='alert alert-info'><strong>Heads up!</strong> Should not be empty</div>";
        document.frmadminlogin.password.focus();
        return false;
    }
    else if(document.frmadminlogin.password.value.length < 8)
    {
        document.getElementById("err").innerHTML ="<div class='alert alert-info'><strong>Heads up!</strong> Length should be 8</div>";
        document.frmadminlogin.password.focus();
        return false;
    }
    else
    {
        return true;
    }
}
</script>
<?php
session_start();
error_reporting(0);
include("dbconnection.php");
$dt = date("Y-m-d");
$tim = date("H:i:s");
```

```
include("dbconnection.php");
if(isset($_SESSION[doctorid]))
{
   echo "<script>window.location='doctoraccount.php';</script>";
}
$err='';
if(isset($_POST[submit]))
{
   $sql = "SELECT * FROM doctor WHERE loginid='$_POST[loginid]' AND password='$_POST[password]' AND status='Active'";
   $qsql = mysqli_query($con,$sql);
   if(mysqli_num_rows($qsql) == 1)
   {
      $rslogin = mysqli_fetch_array($qsql);
      $_SESSION[doctorid]= $rslogin[doctorid] ;
      echo "<script>window.location='doctoraccount.php';</script>";
   }
   else
   {
      $err = "<div class='alert alert-danger'>
      <strong>Oh !</strong> Change a few things up and try submitting again.
   </div>";
   }
}
?>
```

CERTIFICATES:

SIMATS ENGINEERING

Approved By AICTE | IET-UK Accreditation

NATIONAL CONFERENCE ON RECENT TRENDS IN ANALYTICS AND COMPUTING TECHNOLOGIES (RTACT 2024)

CERTIFICATE

This is to certify that Mr / Ms MERLINE.P has presented a paper titled "OUTPATIENT MANAGEMENT APPLICATION USING INTEGRATED ML SYSTEM" from SRM VALLIAMMAI ENGINEERING COLLEGE in the "National Conference On Recent Trends In Analytics And Computing Technologies (RTACT 2024) held on 15th March 2024" Organized by Department of AR and VR, Institute of CSE, SIMATS Engineering, SIMATS, Chennai - 602105.

Convenor
Dr. M. Gunasekaran

Principal
Dr. B. Ramesh

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CERTIFICATE

This is to certify that Mr / Ms **NAVEEN J** has presented a paper titled **"OUTPATIENT MANAGEMENT APPLICATION USING INTEGRATED SYSTEM "** from **SRM VALLIAMMAI ENGINEERING COLLEGE** in the **"National Conference On Recent Trends In Analytics And Computing Technologies (RTACT 2024) held on 15th March 2024"** Organized by Department of AR and VR, Institute of CSE, SIMATS Engineering, SIMATS, Chennai - 602105.

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has presented a paper titled

"OUTPATIENT MANAGEMENT APPLICATION USING INTEGRATED ML SYSTEM"

from **SRM VALLIAMMAI ENGINEERING COLLEGE**

in the **"National Conference On Recent Trends In Analytics And Computing Technologies (RTACT 2024) held on 15th March 2024"** Organized by Department of AR and VR, Institute of CSE, SIMATS Engineering, SIMATS, Chennai - 602105.

Convenor
Dr. M. Gunasekaran

Principal
Dr. B. Ramesh

REFERENCE:

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