DESIGN AND IMPLEMENTATION OF AN INTELLIGENT HEALTHCARE APPOINTMENT SYSTEM

ABSTRACT

In the rapidly evolving realm of digital healthcare, efficient appointment scheduling and doctor-patient communication are essential. This paper presents a system for scheduling doctor's appointments with the goal of providing a centralized platform for healthcare for admin, physicians, and patients. The admin module can see or remove registered users and doctors, modify the types of doctors, and schedule appointments using the system. Using real-time GPS locations, doctors may securely register, check their availability, and update the status of their bookings. Depending on several criteria, the patient module can register and look for doctors in their area. The machine learning model that uses a random forest regressor makes recommendations for doctors. Additionally, the Google map is integrated into the system for location-based services, enabling patients to view the doctor's location before scheduling an appointment. This is why smart, role-rolling, and location-intersection solutions are used in current health care distribution to raise patient happiness, decrease appointment delays, and improve efficiency.

Keywords: Doctor Appointment System, Random Forest Model, User Role-Based Access, Medical Information System

I.INTRODUCTION

It can be difficult to get timely medical attention in today's fast-paced world, particularly where there are few healthcare providers or overcrowded hospitals. Lines, manual scheduling and outdated information flow for patients undermine both access and satisfaction. In response to these challenges, intelligent healthcare management systems have increasingly been adopted, offering new means for connecting patients and healthcare providers. One such popular solution is called the Doctor Appointment Booking System (DABS), that aims to automate and streamline online appointment booking, real-time tracking of appointments including intelligent recommendations.

The proposed system is designed to reduce the waiting time, enhancing scheduling and communication with patients and physicians by providing distinct access role for admin, doctors, and patients. Admins managing users, doctors, appointments etc… Doctors can set

their schedules and see interaction between them and patients making the management more effectively directed; Patients will able to easily find a doctor based on distance, category or other criteria. Using location-based exploitives such as the Google Maps API gives patients a perspective of where a doctor practices before homing in on appointments, bringing trust and transparency.

A key innovation of this system lies in the use of machine learning—specifically, a Random Forest Regressor model—to recommend doctors to patients based on relevant parameters including geographical proximity, doctor workload, and current availability. This ensures an equitable distribution of appointments while helping patients quickly locate suitable practitioners. Similar intelligent systems have been explored in literature, such as in [2], it enhance clinical decision-making and patient satisfaction. Furthermore, the integration of GPS-enabled healthcare solutions as discussed in [13] demonstrates the effectiveness of location-aware mechanisms in optimizing healthcare accessibility. The current research aligns with previous advancements in doctor recommendation and healthcare optimization. Studies like have already demonstrated how automation and real-time data can transform appointment workflows. Building upon these, the proposed system extends functionality through role-based access control, machine learning integration, and real-time map visualization, ensuring higher system efficiency and user engagement[1]. In this paper illustrates a major stride toward smart healthcare ecosystems, emphasizing automation, transparency, and personalization. Future improvements may include teleconsultation modules, integrated payment gateways, and electronic health record (EHR) linkage. With continuous innovation in artificial intelligence and cloud-driven systems, doctor-patient interaction is evolving into a seamless, data-driven process poised to shape the next generation of healthcare service delivery.

II. RELATED WORK

The study by Mohammed Mehmood Ali (2023) explores how machine learning can be used to improve the scheduling of medical appointments and doctor availability in healthcare systems. It explains that effective scheduling helps reduce operational problems by enabling better planning and forecasting. The research, based on Machine Learning Theory and Formal Learning Theory, uses a qualitative literature review to analyze findings from various journals. The reviewed studies show that machine learning supports smarter use of health data, efficient hospital scheduling, and patient classification. The paper concludes that applying machine

learning can significantly optimize appointment management in hospitals and recommends further study of predictive scheduling techniques to enhance patient and doctor coordination.

The paper by Bhaskarwar et al. (2025) presents an innovative Doctor Appointment System that leverages AI and machine learning to streamline healthcare access and reduce patient wait times. The system integrates several smart features, including OTP-based authentication for secure logins, a machine learning-based disease prediction module for preliminary symptom analysis, and an AI chatbot that assists users throughout the appointment process. It also includes a Nearby Hospital Locator for city-based searches and an admin-controlled scheduling system that manages appointments according to doctor availability. A feedback module enables users to report issues and suggest improvements. Overall, the system enhances healthcare efficiency by combining secure authentication, intelligent assistance, predictive analytics, and location-based services to create a seamless and organized experience for both patients and healthcare providers

The paper by Mahanthi and Jacob (2023) introduces the Find-My-Doctor system, which aims to simplify and modernize the process of booking medical appointments. It focuses on providing patients with a convenient and user-friendly experience while addressing their queries during consultations. The system operates as a web-based platform that connects patients and doctors through a centralized database storing medical, appointment, and patient records. Unlike traditional methods that are often time-consuming and inefficient, Find-My-Doctor streamlines registration and scheduling across multiple healthcare institutions. Overall, the study highlights how advanced technologies and user-centric design can transform the medical appointment process, making healthcare access faster and more organized.

The paper by Tamizharasi et al. (2024) focuses on improving the efficiency of medical appointment scheduling through a modern web-based system. The authors identify common challenges such as limited appointment options, difficulty finding the right doctor, and outdated system frameworks that hinder smooth data management. To overcome these issues, the proposed Doctor Appointment Booking System is developed using Next.js for the front-end, Strapi API for the backend, MySQL for database management, Kinde Auth for secure authentication, and Hostinger for hosting. The system's main objective is to simplify appointment scheduling, enhance communication between patients and doctors, and reduce missed appointments. Overall, the study demonstrates how modern web technologies can optimize healthcare scheduling and improve the overall patient experience.

The paper by K. T. et al. (2025) introduces the *Smart Health Consulting and Appointment Booking System*, a comprehensive web-based platform aimed at enhancing hospital management through real-time scheduling and patient-doctor communication. The system allows patients to book appointments based on the live availability of doctors, reducing delays and improving accessibility. It supports doctors in managing schedules, viewing patient histories, and maintaining digital medical records, which aids in more informed clinical decisions. The platform provides features like secure online payment, cloud-based data storage, and data encryption for privacy protection. With a structured database and an intuitive user interface, the system simplifies operations and enhances hospital workflow. Additionally, the inclusion of an Android app offers flexibility by allowing patients to manage appointments through mobile devices. Overall, the study demonstrates how integrating automation, security, and mobile access can create an efficient and patient-centric healthcare solution.

The paper by V. M. and E. B. Kumar (2025) presents the Smart Health Consulting System, a mobile application designed to assist users in disease prediction and hospital recommendation through an integrated e-appointment platform. Developed using XML and Java for the front end and SQLite as the backend, the system enables users to register, log in, and input symptoms for automated disease analysis. By classifying symptoms effectively, the system predicts potential illnesses and suggests suitable hospitals or medical services accordingly. This approach helps patients identify possible health conditions early and simplifies the process of booking doctor appointments. Overall, the study highlights how symptom-based prediction and intelligent hospital recommendation can enhance medical accessibility and improve healthcare service delivery.

The paper by S. Agrawal (2022) introduces an Online Healthcare and Doctor Appointment Booking System designed to allow patients to obtain medical prescriptions and advice remotely without visiting hospitals. The web-based application enables users to register using a hospital-issued number and submit prescription or consultation requests directly to their preferred doctors. Guest users can access general health information, doctor availability, and medical guidance. The platform also allows hospitals and individual doctors to register for service access. Administrators can generate statistical reports for managing system data and user activity. Overall, the study highlights how digital healthcare systems can reduce physical visits, improve accessibility, and facilitate efficient communication between patients and doctors through secure online interaction.

The paper by S, R., Shadheem et al,. presents the Doctor Appointment System (DAS) provides a straightforward and efficient way for patients to book appointments with doctors online. Its user-friendly web interface allows patients to check doctor availability and book slots in real time, which makes the whole process faster and more convenient. The system not only sends automated reminders to help users keep track of their appointments but also ensures patient data is secure. Integration with Electronic Health Records keeps the appointment and doctor information up to date, improving both accuracy and the patient experience. Overall, DAS offers a practical and safe solution for managing medical appointments, making life easier for both patients and healthcare providers.

The paper by A. Ahmed, M. T et al,. describes the creation and implementation of an online healthcare platform that provides medical information through both a website and a mobile application. The platform is designed as a web-based system to capture and share comprehensive details about hospitals and their services, making it easier for people seeking medical help to access relevant information. By enabling digital access to hospital data, the system ensures that patients can conveniently obtain the services they need without high costs. The research highlights that both the mobile and web applications are made to be straightforward and effective, giving users a practical way to stay informed about healthcare options. Overall, this system is an affordable and efficient solution that improves access to hospital information for patients, supporting better, more streamlined healthcare experiences.

The paper by N. Manasa et al,. Health Care Management System (HCMS) offers numerous benefits by simplifying and improving healthcare services. It enables quick and easy appointment booking, medicine orders, and lab test scheduling, giving users the flexibility to choose their preferred doctors or get matched with relevant specialists based on their concerns. The system streamlines hospital operations, reduces administrative tasks, and improves patient care through efficient resource management. Built on modern web and mobile technologies like NEXT JS and React Native, it provides a flexible, user-friendly interface connected to backend systems such as MongoDB. HCMS covers key healthcare modules such as patient registration, billing, prescriptions, and laboratory management, facilitating comprehensive care delivery. Overall, the system aims to improve accessibility, reduce costs, and enhance the efficiency of healthcare services, making it beneficial for both hospitals and patients.

III. PROPOSED SYSTEM AND METHODOLOGY

The Doctor Appointment System (DAS) integrates modern technology to improve the management of healthcare by streamlining hospital operations and effectiveness, ease of access, and standard of care. The three main modules of the system are Admin, Doctor, and Patient.

System Architecture

The system architecture of the doctor appointment booking system is made up of three main layers: the data layer, the application layer, and the user interface layer. The presentation layer's intuitive online and mobile interfaces allow patients, doctors, and administrators to perform their respective tasks, such as monitoring timetables, arranging appointments, and keeping an eye on databases. Essential features including scheduling, encrypted user communication, real-time GPS position monitoring, and Random Forest model-based medical recommendations are all managed by the application layer. By keeping user profiles, doctor information, appointment information, and system logs in a secure database, the data layer guarantees reliable, orderly, and secure data management.

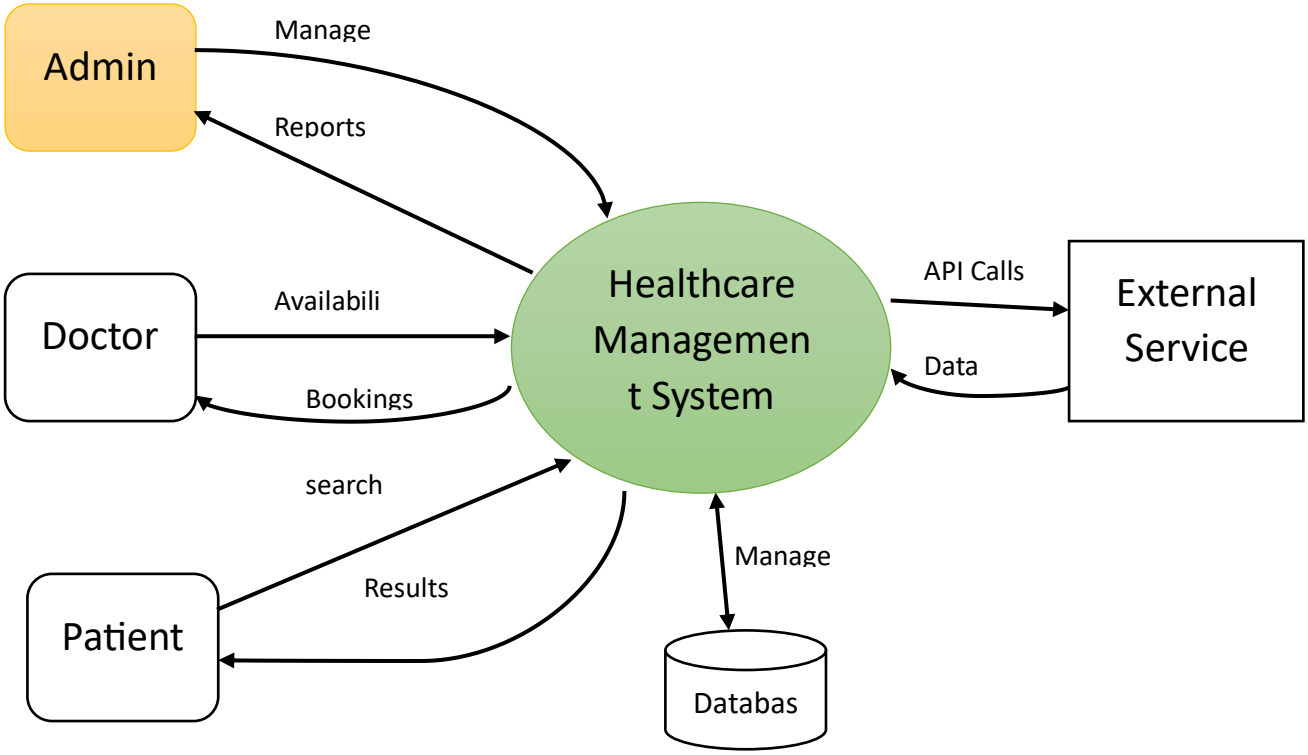

Figure1 System Architecture Diagram

The platform's fig(1), shows that architecture diagram and maintains high security and data integrity while facilitating smooth, role-based access, guaranteeing effective operation, and

offering flexibility for future integration of cutting-edge technologies like telemedicine and payment systems.

Functionalities

Admin module:

The admin module's role is to manage the system overall and ensure that it runs well. The administrator has total control over the list of doctors, including the option to add or remove various doctor types such as dermatologists, cardiologists, and general practitioners. By classifying doctors based on their specialties, this makes user searching easier. The administrator also has access to a list of all registered doctors and users, along with their personal data. Any profiles that include erroneous or questionable information may be deleted by the administrator. Additionally, the administrator has the ability to monitor every appointment that is set up in the system and remove any that are no longer legitimate or required. This module ensures the integrity of the platform and proper regulation.

Doctor Module

The Doctor module makes it easier for healthcare providers to manage their profiles and availability. Medical practitioners register by providing their name, contact details, and login credentials. After signing in, users can create booking windows by entering the consultation location's GPS coordinates, available days, and times. Doctors are also free to choose their own availability by marking themselves as available or unavailable for any given appointment. When needed, they can eliminate previously created spaces and use Google Maps to view the pertinent area for more accuracy. Physicians can also change the status of patient appointments, such as confirming, completing, or canceling them, and they have access to a list of these appointments. This allows doctors to efficiently schedule their appointments and availability.

Patient Module

The Patient module aims to provide a seamless and user-friendly experience for patients seeking medical consultations. To register on the site, patients can enter their personal information and create a secure login profile. After logging in, they can search for physicians by specialization and availability. The Random Forest Regressor machine learning algorithm, which is one of the key components of this module, provides doctor suggestions by looking at

the patient's location, the doctor's proximity, and the patient load at that moment. Patients can use Google Maps to view the doctors' profiles, available times, and real-time location before scheduling an appointment. Clients can track the status of their appointments after placing the booking, seeing if they are confirmed, pending, or completed. This module increases the efficiency of the consultation process and ensures timely access to healthcare.

Machine Leaning

The artificial intelligence area of machine learning (ML) enables computers to gather information from data and make choices or predictions without needing to be specifically programmed for each unique scenario. Machine learning models find patterns in past data and utilize those patterns to predict results on fresh, unknown data, rather than following instructions step-by-step.

Types of Machine Learning

The three main types of machine learning are:

- **Supervised Learning:** The model learns from a labeled dataset, where the correct outputs (targets) are known. Example: predicting whether a patient has a disease based on medical records.
- **Unsupervised Learning:** The model works with data without labels, aiming to find hidden structures or patterns. Example: grouping patients with similar symptoms into clusters.
- **Reinforcement Learning:** The model learns by interacting with an environment, receiving rewards or penalties based on its actions. This is common in robotics and game strategies.

Random Forest Model

A Random Forest is an ensemble machine learning model that builds multiple decision trees during training and combines their predictions for greater accuracy and robustness. It can be used for both classification (categorizing data) and regression (predicting numeric values) tasks.

Random Forest Works:

1. **Bagging/Bootstrap Sampling:** Random samples are drawn (with replacement) from the original dataset to build multiple, slightly different data subsets.
2. **Decision Tree Construction:** Each subset is used to train a separate decision tree. When splitting data, each tree considers a random subset of features, making every tree unique.
3. **Aggregation:** For regression, the trees' predictions are averaged. For classification, their predicted categories are voted and the most common one is selected.

The Random Forest model is employed to recommend the most suitable doctors to patients by analyzing several factors such as patient location, doctor availability, and current patient load. The working process involves the following steps:

- Data Collection and Feature Preparation: The system collects input features like the patient's GPS coordinates, the distance to each doctor, real-time doctor availability, and the load or number of patients currently assigned to each doctor.
- Training the Random Forest: Using historical appointment and doctor performance data, the Random Forest algorithm—an ensemble of many decision trees trained on random subsets of data and features—is built. Each tree independently predicts the suitability or waiting time for doctors given specific patient and doctor features.
- Prediction: When a patient searches for doctors, their input (location, preferences) is transformed into a feature vector and fed to the trained Random Forest model. The model aggregates predictions from all decision trees (by averaging in regression or majority voting in classification) to estimate which doctors offer the best combination of proximity and timely availability.
- Doctor Recommendation: Based on the Random Forest’s output, the system ranks doctors and recommends the top choices to patients, balancing fairness and efficiency by considering doctors’ current patient loads alongside geographic proximity.
- Adaptation and Feedback: The model can be periodically retrained with new data reflecting changing doctor availability, patient demand, and booking patterns to ensure recommendations remain accurate and effective.

IV. RESULT

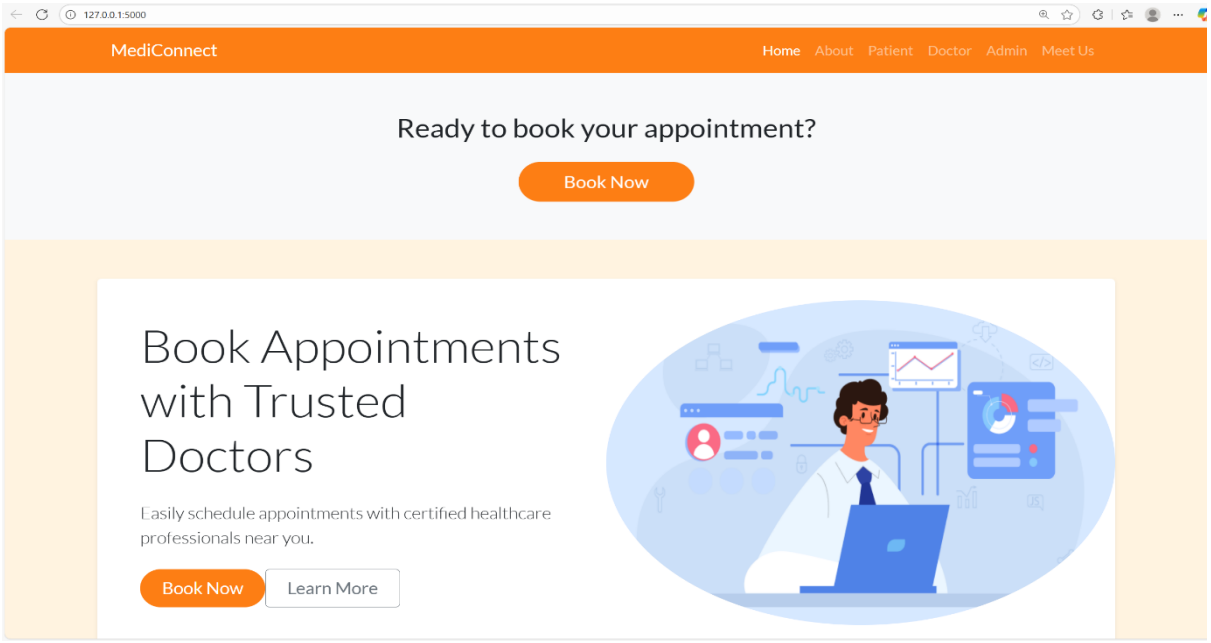

Figure2 Home Page

The figure(2) shows that, the home page of the MediConnect platform provides a simple and welcoming introduction for users who want to book medical appointments. It features a clear invitation to book an appointment with prominent "Book Now" buttons, easy navigation for different user roles, and a reassuring message about connecting with trusted doctors. The layout is user-friendly, making it easy for anyone to start the appointment booking process right from the home screen.

Admin Login page

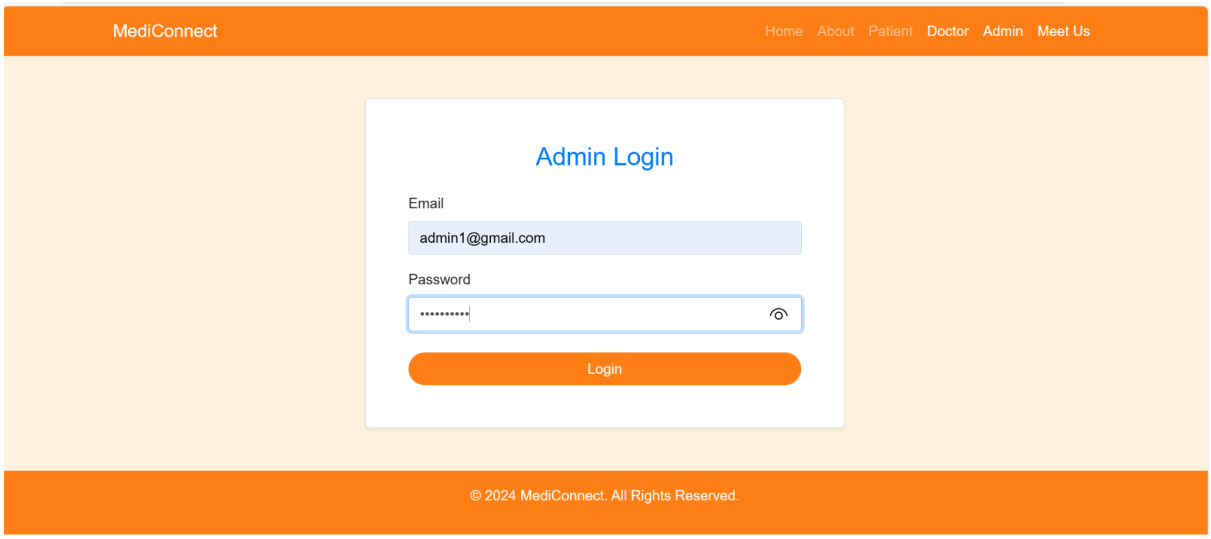

Figure3 Admin Login Page

This is the Admin Login page fig (3) shows of the MediConnect platform. It displays a simple and clean interface where an admin can securely log into the system by entering their registered email and password. The login form is centered on the page with fields for email input and password entry, along with a visible toggle option to show or hide the password for user convenience. The “Login" button below the fields encourages action. This page is designed to provide secure access control, allowing only authorized administrators to manage doctor and patient data, appointments, and system settings efficiently.

Doctor Signup Page

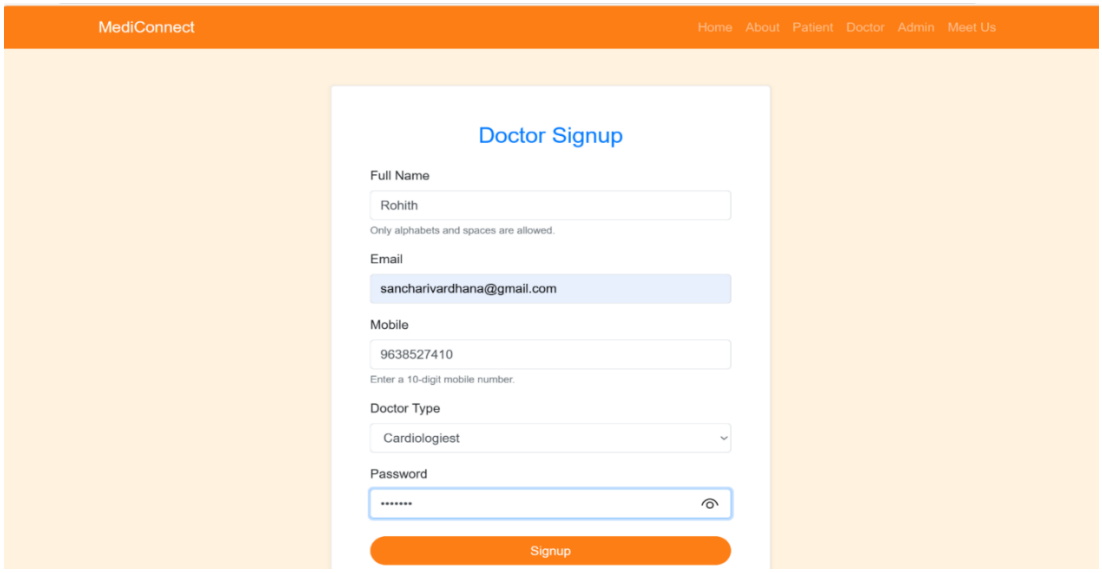

Figure4 Doctor Signup Page

The fig (4), shows the Doctor Signup page of the MediConnect platform. It provides a simple form for doctors to register themselves on the system by entering their full name, email, mobile number, selecting their specialty (doctor type), and creating a password. After filling in the details, doctors can click the "Signup" button to create their account, enabling them to manage appointments and update their availability within the system. This page is designed to make doctor registration smooth and secure on the platform.

Patient Login Page

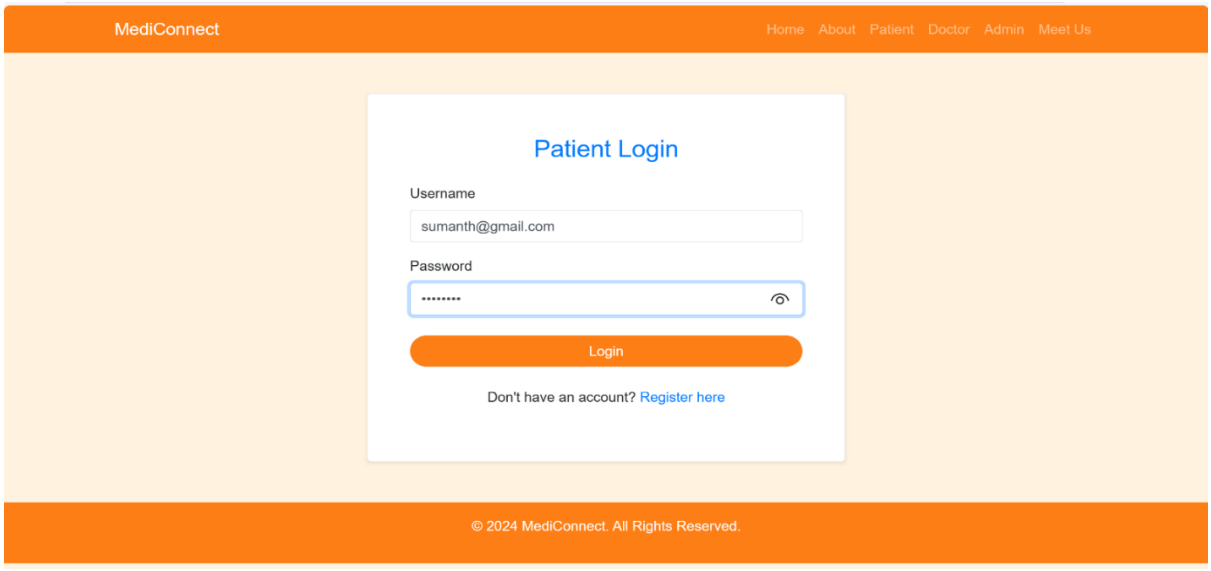

Figure 5 Patient Login Page

This page represents fig(5) shows, the Patient Login interface of the MediConnect healthcare system. It allows registered patients to securely access their personal medical accounts. The page includes input fields for entering a username (email) and password, along with a Login button to authenticate the user. There is also an option for new users to register if they don't already have an account. The navigation bar at the top provides links to different sections of the website, such as Home, About, Patient, Doctor, Admin, and Meet Us.

Doctor Availability Set Page

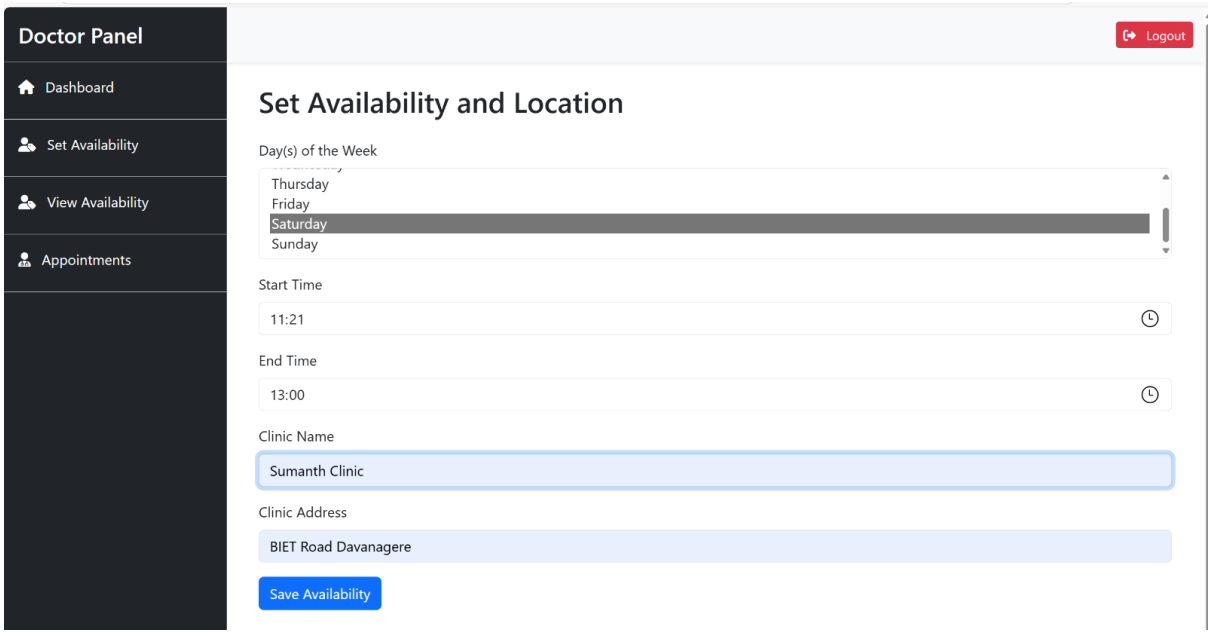

Figure6 Doctor Availability Set Page

This page fig(6) shows, the Doctor Panel of the MediConnect system, specifically the Set Availability and Location section. It allows doctors to define their working schedule and clinic details. Doctors can select specific days of the week, set their start and end times, and enter their clinic name and clinic address. Once the details are filled in, they can click Save Availability to update their schedule in the system. The menu provides easy navigation options such as Dashboard, Set Availability, View Availability, and Appointments, while a Logout button is available for secure exit. This feature helps streamline appointment management by ensuring patients can view accurate doctor availability.

Admin Manage Doctor

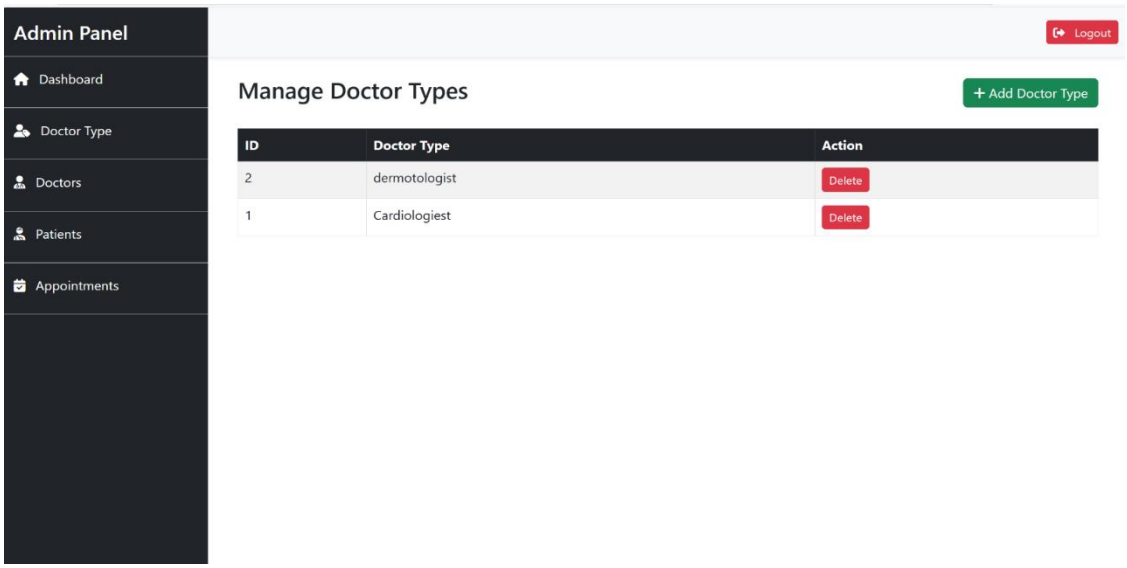

Figure 7 Admin Manage Doctor

This fig(7) shows an Admin Panel interface used for managing doctor types in a healthcare management system. it provides navigation options to access the dashboard, doctor types, doctors, patients, and appointments. The main section displays a table listing two doctor types—dermotologist and Cardiologiest—with their corresponding IDs, and offers a button to delete each entry or add a new doctor type using the green "Add Doctor Type" button.

Patient Doctor Search page

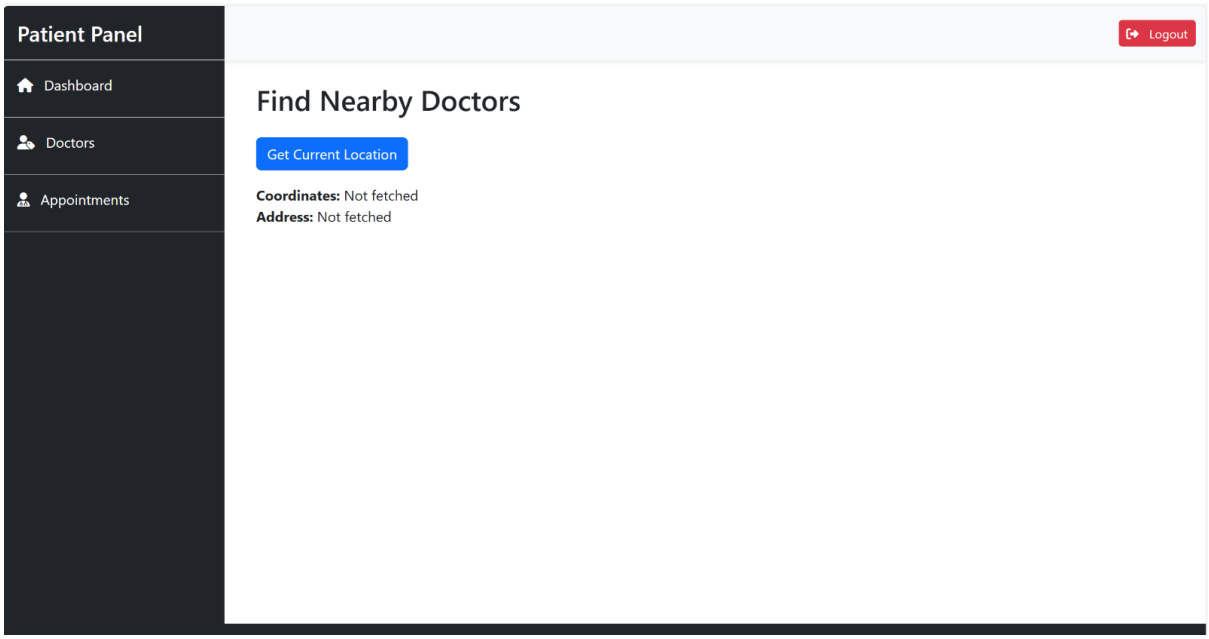

Figure 8 Patient Doctor Search page

This fig(8), displays a Patient Panel interface designed to help users find nearby doctors. It includes navigation options for the dashboard, viewing doctors, and managing appointments. The main section features a prominent "Get Current Location" button, with sections below showing that the coordinates and address have not yet been fetched, indicating the location search has not been initiated

Result Page

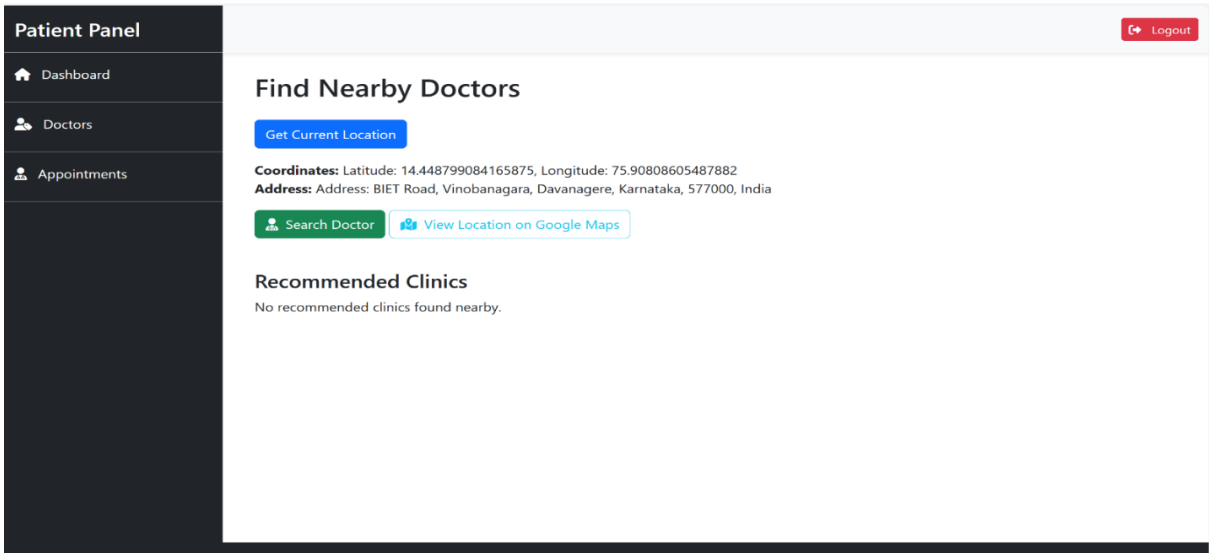

Figure 9 Result Page

The fig(9)shows that Patient Panel page where patients can view their current location details and search for nearby doctors or clinics.

V. CONCLUSION

The Doctor Appointment Booking System effectively bridges the communication gap between doctors and patients by providing a user-friendly platform for arranging appointments. With features made for administrators, doctors, and patients, the system ensures smooth operation for everything from patient reservations and appointment tracking to doctor registration and availability updates. The integration of modern technologies like Python, MySQL, HTML/CSS, and Google Maps has enabled a dynamic, user-friendly, and responsive application. The Random Forest Regressor machine learning technology, which adds an intelligence layer by recommending doctors based on their proximity and current workload, streamlines the booking process. Overall, the system has been thoroughly tested and meets all of its goals, such as safe login, role-based access, real-time updates, and efficient data processing. In addition to expediting the appointment process, it enhances communication between patients and medical staff. Features like online consultations, patient health history, and payment integration can be added to this project in the future to create a more comprehensive medical assistance platform. It also demonstrates the potential of digital healthcare solutions.

References

[1]. Kosalairaman, T., et al. "Smart Health Consulting and Appointment Booking System with Real-Time Scheduling and Patient-Doctor Communication." 2025 3rd International Conference on Artificial Intelligence and Machine Learning Applications Theme: Healthcare and Internet of Things (AIMLA). IEEE, 2025.

[2]. M. N, M. A, P. B and R. Gilmary, "AI-Driven Disease Prediction and Doctor Recommendation System," 2025 3rd International Conference on Advancement in Computation & Computer Technologies (InCACCT), Gharuan, India, 2025, pp. 172-176, doi: 10.1109/InCACCT65424.2025.11011451.

[3]. Bhaskarwar, R. V., Das, P., Gaikar, S., Chavan, C., & Jog, S. (2025). Online Doctor Appointment using Machine Learning. INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT, 09(03), 1–9. https://doi.org/10.55041/ijsrem42822.

[4]. K. T, M. D, K. R, J. SK, N. T and P. P, "Smart Health Consulting and Appointment Booking System with Real-Time Scheduling and Patient-Doctor Communication," 2025 3rd International Conference on Artificial Intelligence and Machine Learning Applications Theme: Healthcare and Internet of Things (AIMLA), Namakkal, India, 2025, pp. 1-6, doi: 10.1109/AIMLA63829.2025.11040602.

[5]. V. M and E. B. Kumar, “Smart Health Consulting System,” International Journal of Innovative Science and Research Technology, pp. 1236–1242, Apr. 2025, doi: 10.38124/ijisrt/25apr619.

[6]. A Tamizharasi, D. Sriram Siddharth, G. Srivatsan and V. Shreenath, "Optimization and Enhancement of Doctor Appointment Booking System Using Next.js, Strapi, and REST API," 2024 4th International Conference on Pervasive Computing and Social Networking (ICPCSN), Salem, India, 2024, pp. 79-83, doi: 10.1109/ICPCSN62568.2024.00021.

[7]. S, R., Shadheem, S., & Surya, S. (2024). Web-based Application for Doctor-Patient Appointment Management System. Journal of ISMAC The Journal of IoT in Social, Mobile, Analytics, and Cloud, 6(3), 261–270. https://doi.org/10.36548/jismac.2024.3.006.

[8]. N. Manasa, S. Suhasini, P. B. Sri, D. Thanuja and V. Jahnavi, "A Comprehensive Survey of Healthcare Applications for Web and Mobile Platforms," 2024 International Conference on Recent Innovation in Smart and Sustainable Technology (ICRISST), Bengaluru, India, 2024, pp. 1-6, doi: 10.1109/ICRISST59181.2024.10921802.

[9]. N. Mahanthi and T. P. Jacob, "Transforming Traditional Medical Appointment Booking with Advanced Technologies and User-Centric Design," 2023 3rd International Conference on Pervasive Computing and Social Networking (ICPCSN), Salem, India, 2023, pp. 1656-1660, doi: 10.1109/ICPCSN58827.2023.00277.

[10]. Mohammed, Mehmood Ali. "Use of Machine Learning in Optimizing Medical Appointment Schedules." (IJCSIT) International Journal of Computer Science and Information Technologies 14.1 (2023): 3-7.

[11]. Mr. S. Agrawal, “Online HealthCare Online Doctor Appointment Booking System,” INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT, vol. 06, no. 04, Apr. 2022, doi: 10.55041/ijsrem12512.

[12]. A. Ahmed, M. T. Mahmud and M. M. Khan, "Info Hospital: Web/Mobile Application based Health Care System," 2022 6th International Conference on Computing Methodologies and Communication (ICCMC), Erode, India, 2022, pp. 1546-1552, doi: 10.1109/ICCMC53470.2022.9753895.

[13]. P. Kanani and M. Padole, "Real-time Location Tracker for Critical Health Patient using Arduino, GPS Neo6m and GSM Sim800L in Health Care," 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2020, pp. 242-249, doi: 10.1109/ICICCS48265.2020.9121128.