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Web-based Application for Doctor-Patient Appointment Management System

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Abstract

The proposed Doctor Appointment System (DAS) aims to significantly improve the administration process and patient access to healthcare with a user-friendly interface. DAS utilizes advanced technologies to develop a web interface that makes it simple for patients to make appointments with medical professionals in real time. Patients can search for the doctor availability, specialized doctors, and available appointment slots using the portal, and book appointments directly through the portal. Additionally, the DAS forwards automated reminders to patients and physician about their appointments, enabling them to save their scheduled appointments in a customizable profile. Furthermore, the medical data in DAS are protected with strong data security procedures to ensure that the patients' private information is safe. The proposed DAS is integrated with the Electronic Health Record (EHR) systems to provide real-time updates on the available doctors and slots. The user interface developed helps patients and the doctors to easily manage their appointments in an efficient and secure way.

Keywords: Web Interface, Doctor Appointment, EHR, Priority Scheduling, Authentication, Inbuilt Security.

1. Introduction

The technological advancements that are integrated into every aspect of our lives have caused significant revolutions in almost every field, including healthcare. The proposed doctor appointment system aims to transform healthcare accessibility and administrative efficiency

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with a user-friendly interface. The objective of this research is to reduce the waiting time for patients as well as help the doctors manage appointments and keep records of the patients who visit them. Additionally, the DAS sends reminders to the patients and the doctors and keeps them informed about their appointments. This reduces the number of missed appointments as well as enhances the clinic's efficiency [13,14].

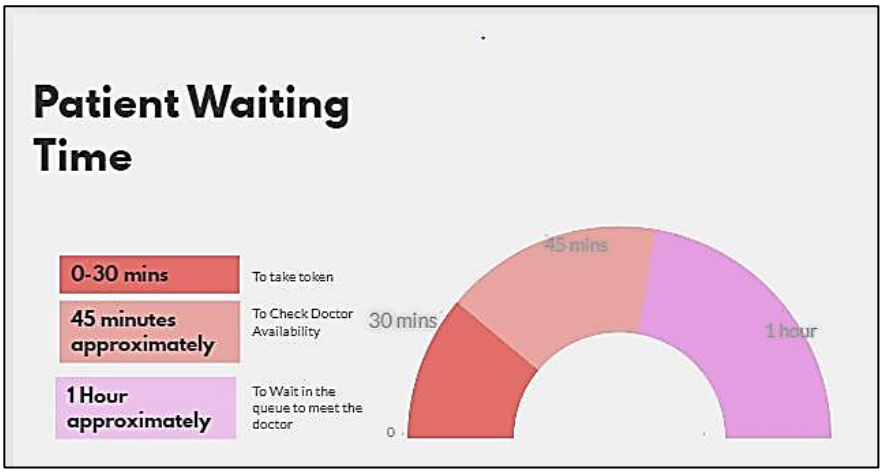

Figure 1. Manual Appointment System

The proposed system streamlines the conventional manual appointment booking process (Figure 1), which is typically done through phone calls or in person. By integrating with Electronic Health Record (EHR) systems, DAS provides real-time information on doctor availability and appointment slots to patients and updates doctors on booked slots and patient information.

The website allows patients to book their appointments directly through the portal and view their appointment status. Furthermore, the built-in security features protect patient information from unauthorized access. The proposed website is developed using React.js and Node.js to make appointment management both efficient and secure, enhancing the overall experience for patients and healthcare providers. The rest of the manuscript is organized as follows: Section 2 covers related works, Section 3 presents the proposed work, Section 4 discusses the results, and Section 5 concludes the manuscript.

2. Related Works

After COVID-19, people have started to avoid public gatherings and crowded places. Though many have returned to their normal lives, some still feel safer at home, and the

availability of online delivery services has made them more comfortable. They avoid spending much time in public places, especially in hospitals and pharmacies. Moreover, the fast-paced world has led people to seek more efficient ways to complete tasks, including medical check-ups and hospital visits. As a result, researchers have developed online booking systems for various areas, including medical centers, to reduce patient waiting times and eliminate the need for phone or in-person bookings.

Hall et al. [1] developed a system to schedule doctors according to patient needs and manage patient flow in hospitals using mathematical modeling, optimization, and stochastic processes. To avoid the rush for urgent appointments and significantly reduce labor, Ismail et al. [2] created a medical appointment application using PHP. Akinode et al. [3] addressed inefficiencies in outpatient clinics in developing countries by proposing a web-based appointment system to reduce waiting times and improve healthcare delivery, utilizing AngularJS for the frontend, Ajax for client-server requests, and SQLite3 and MySQL for the backend. Ari Subhi et al. [4] developed a web application with authentication methods to secure the process.

Sriniva et al. [5] explained the inconvenience caused to outpatients and reviewed the benefits of an online appointment system. Kyambille et al. [6] emphasized the potential of mobile-based technology for future use and developed a mobile application scheduling system for Tanzanian patient visits. Boone et al. [7] stated that missed clinic appointments burden healthcare systems, but scheduling software with automatic reminders shows potential for improvement. Their study on clinics in Chile found that while reminders didn't increase visits by chronic patients, they led to a 5-7.4% increase in visits from other patients, especially benefiting clinics with more chronic patients and younger populations.

Silver et al. [8] emphasized the necessity of improving patient communication skills, conducting eHealth literacy assessments, and providing targeted resources that direct people to reliable, high-quality online health information. They also stressed the need for reminding patients to seek medical advice before using online health resources for diagnosis and treatment. Mold et al. [9] described the integration of EHR into online platforms. Chaudhari et al. [10] developed a mobile application for scheduling doctor appointments. Kumar et al. [11] created an interactive online medical appointment system that allows both doctors and patients

to schedule convenient times. Shelwante et al. [12] designed a smart healthcare appointment system where multiple doctors can join and discuss patient problems to arrive at a solution.

The proposed system, developed using React.js and Node.js, aims to enhance clinic efficiency and improve patient well-being based on these studies.

3. Proposed Work

The proposed system aims to develop a comprehensive, user-friendly website that enables users to book available slots at their convenience, checking doctor availability and available time slots. The interface includes key features such as user authentication, appointment scheduling, automated reminders, and integration with Electronic Health Records (EHR) systems to improve healthcare accessibility, streamline appointment management, and enhancing the overall patient experience. The Figure 2 below shows the inbuilt features of the DAS.

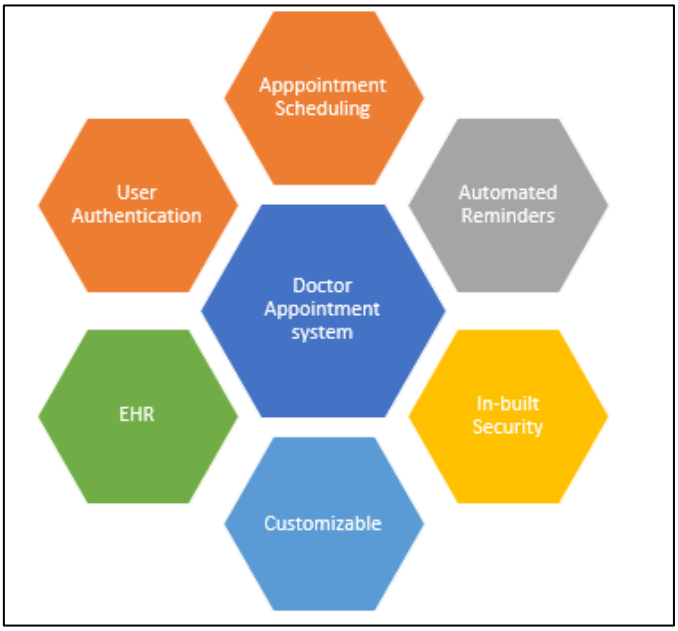

Figure 2. Features of DAS

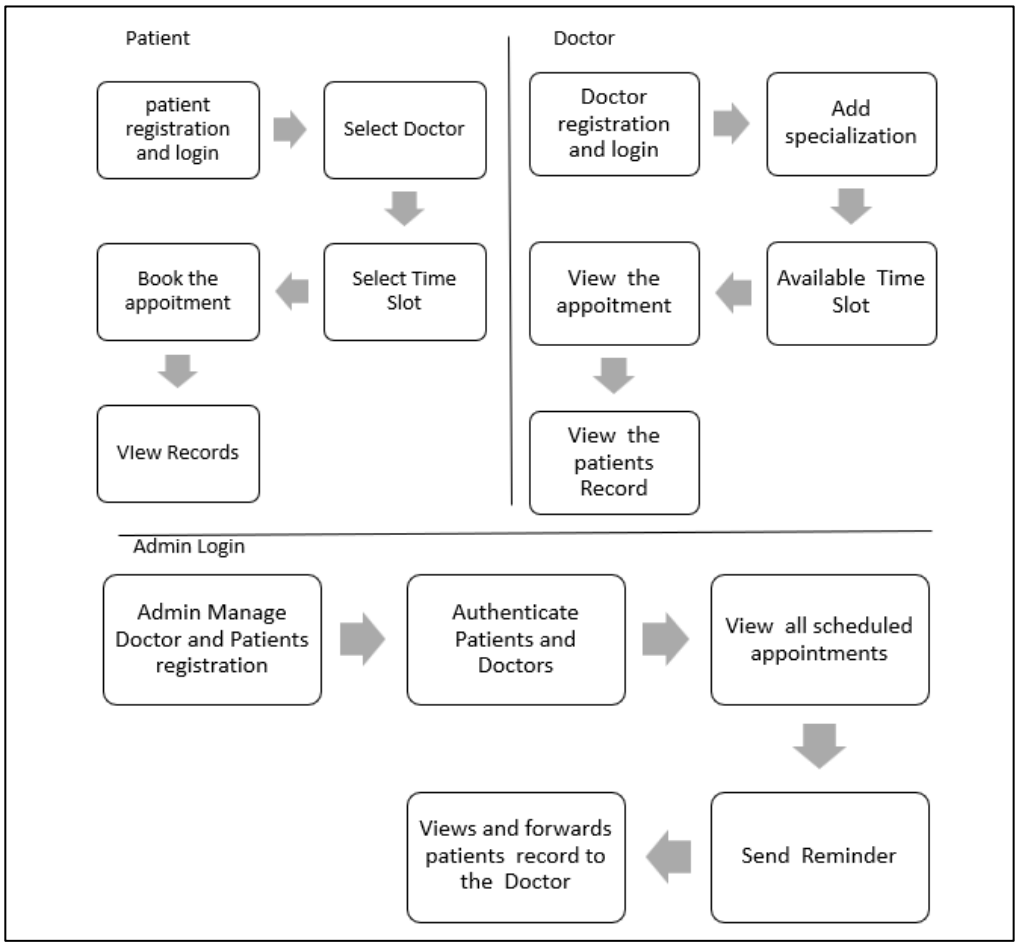

Figure 3. System Architecture

The system architecture in Figure 3 shows the three types of modules and the roles involved in the accessing the website. The admin has the access to manage the registration process, authenticate the patients, view all scheduled appointments, and send reminder to the respective patients. The patients and the doctors are allowed to log in after the registration and authentication process to book the appointment or view the appointments, respectively.

3.1 Design Procedure

The Doctor Appointment System (DAS) is designed to streamline the process of booking medical appointments, integrating Electronic Health Records (EHR), and ensuring secure, efficient management of doctor availability and patient time slots.

The doctors enter their available times into the system through a user-friendly interface and the system displays these slots to patients based on real-time availability. Patients can book the appointments with the preferred doctors on the time slots that is convenient for them from the available slots and add a message in case of emergency and mark the appointment as urgent

if necessary. The admin manages the user authentication to ensure secure access for both patients and doctors.

The system uses a priority scheduling to manage and prioritize the appointments. The regular appointments are allocated on the first-come, first-served within available slots, while emergency appointments are given higher priority, overriding regular appointments when necessary based on a priority score. Each criterion is assigned certain weights: urgency (4), special needs (3), wait time (2), and doctor availability (1). The priority score is calculated using these weights as shown below

Patient A (urgent + special needs + wait time) = 4+3+2 = 9 (priority score)

Patient B (special needs + wait time) = 3+2= 5 (priority score)

Patient C (wait time) = 2 (priority score)

The patients are sorted in descending order based on the priority scores, and the time slots are assigned. This process is repeated until all patients are allocated time slots. Additionally, doctors can set preferences for certain time slots, which is taken into consideration while scheduling patient appointments.

Automated reminders for both patients and doctors about their appointments are managed by the admin, and SSL certificates are used to ensure secure data transmission

3.2 Tools Used

The frontend of the DAS is built using React.js for the user interface, along with HTML and CSS for structure and styling, and JavaScript for client-side logic and interactions. The backend utilizes Node.js with Express for server-side logic and API requests, and Java can be used for additional server-side processing or integration with existing Java-based systems. SQLite3 and MySQL manage patient and appointment data, while RESTful APIs facilitate integration with EHR systems for real-time updates and access to patient records.

The Figure 4 below shows the description of the web application developed

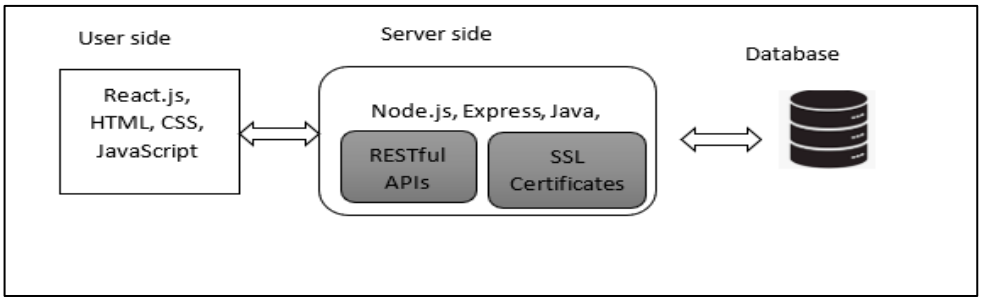

Figure 4. Web Application

The users provide their personal details and appointment preferences. The system validates and stores this information, then generates a Word document summarizing the appointment specifics. Confirmation of the appointment is subsequently provided to the user.

4. Results and Discussion

The proposed system was developed using a Dell PowerEdge T440 Server, equipped with an Intel Xeon Silver 4210R processor featuring 10 cores at 2.4 GHz, 16 GB of DDR4 RAM. This setup provided the necessary performance and reliability for effectively managing and deploying the Doctor Appointment System.

The Figure 5 depicts the login Page of the proposed DAS system

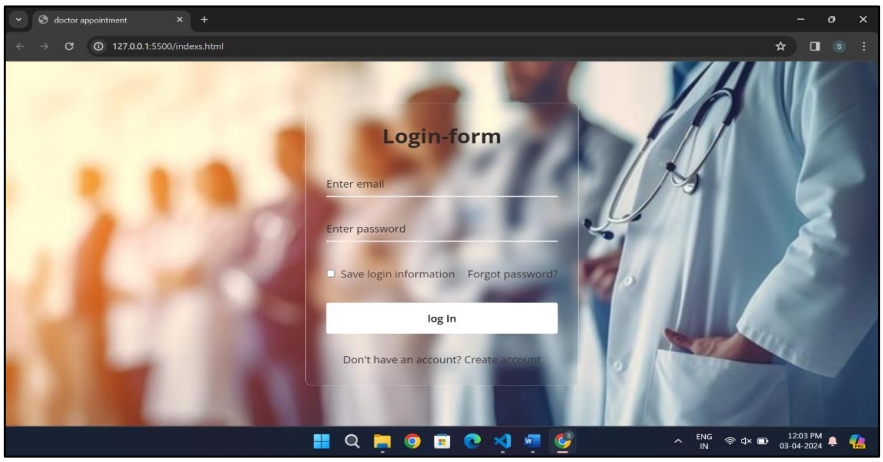

Figure 5. Login Page

Figure 6 depicts the data entry page of the patients

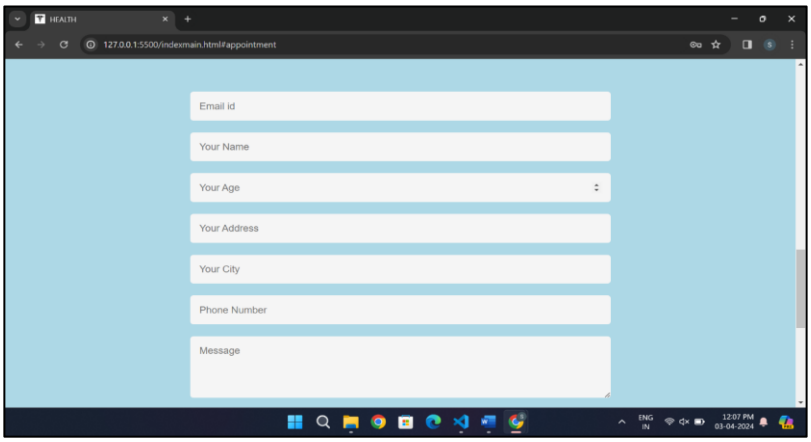

Figure 6. Data Entry Page

The Figure 7 depicts the Information stored in the database

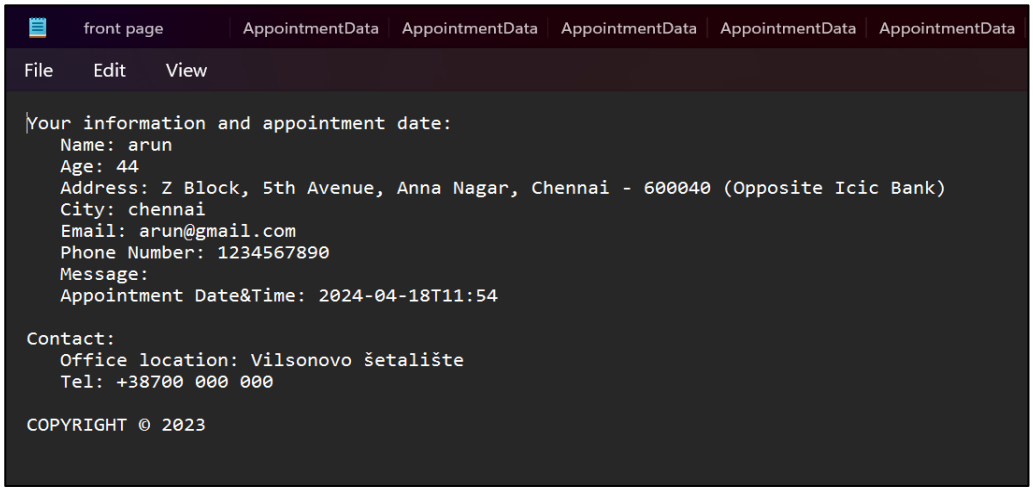

Figure 7. Stored Data

The login page for the doctor availability system serves as the gateway for authorized access to the platform's functionalities This interface presents fields for healthcare professionals to input their credentials securely. Upon successful authentication, doctors gain entry to the system's tools, including appointment management, patient communication, and schedule updates. This login interface prioritizes simplicity and security, ensuring seamless navigation for busy healthcare providers while upholding strict data protection measures. The login page serves as the gateway to the Doctor Appointment System (DAS), providing secure access for both healthcare providers and patients. In the future, the website will be integrated with blockchain technology to enhance the security and transparency of the developed system.

4.1 Benefits of the Proposed System

By allowing patients to book appointments online or through an automated system, waiting times can be minimized. Patients can choose convenient time slots, reducing the need for long waits in the waiting room. The system's features provide patients with the ability to book appointments at their convenience, improving their overall experience with the healthcare provider. They can book appointments from anywhere, at any time, without having to call during office hours.

The automated reminders and notifications sent by the system to patients about upcoming appointments, reduces the likelihood of missed appointments. Additionally, it can

facilitate communication between patients and healthcare providers, allowing patients to ask questions or provide updates before their appointments.

5. Conclusion

The proposed system has developed a user interface for the patients to book the doctor visits with convenience and reduced time compared to the manual appointment system. The patients can select their convenient timing and doctor, and indicate if the appointment is an emergency. The priority scheduling feature helps allocate time slots based on patient needs. The system's key features, such as user authentication, appointment scheduling, automated reminders, and integration with Electronic Health Records (EHR) systems improves the healthcare accessibility, with proper appointment management, enhancing the overall patient experience.

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