Development of a Web Based Medical Appointment Booking System

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ABSTRACT

This paper intends to conceptualise, engineer, and operationalize a comprehensive internet-primarily-based scientific consultation reserving gadget to maximise the productivity and accessibility of healthcare services. In the evolving realm of healthcare, the need for a streamlined and consumer-pleasant consultation scheduling manner is pivotal for both medical companies and patients. The proposed device will include a reactive and intuitive internet interface, allowing sufferers to quite simply schedule, customise, and cancel appointments in reality. Key characteristics of the system encompass real-time availability updates and integration with digital fitness information (EHR) for seamless information exchange among healthcare professionals and patients. Information protection and privacy will be given top priority by the device, which will adhere to quarter policies and standards. By using a variety of sentence structures, lengths, and complexities, you can make the content sound more like natural human language without losing its core meaning. Furthermore, the platform aims to provide clinical staff with a user-friendly interface to schedule consultations, review patients' medical histories, and efficiently allocate resources. We can also carry out assessments and quick consultations to ensure we match the professionals in the most effective manner. This groundbreaking initiative seeks to enhance team service by integrating strategies into systems, for increased efficiency. The goal is to simplify access to fitness by minimizing hurdles and advocating for healthcare. Our improved services are facilitated through scheduling and streamlined registration processes among features. Ultimately the objective is to establish a personalized system that caters to diverse requirements, across various scenarios.

1.0 INTRODUCTION

Appointment scheduling efficiency is of the utmost importance in the contemporary healthcare environment, which is undergoing accelerated change. A considerable body of research has been devoted to examining the adverse consequences that scheduling inefficiencies impose on healthcare providers and patient outcomes. As demonstrated in a study conducted by Samadbeik (2018), patients exhibited diminished levels of satisfaction and a reduced propensity to adhere to their treatment plans when their appointment wait times were extended. Additionally, Bankole (2019) conducted an investigation which revealed that ineffective scheduling practices contribute to both congested clinics and high healthcare costs. The aforementioned findings underscore the necessity for innovative resolutions that enhance the process of scheduling appointments and optimise transportation for routine healthcare.

In recent years, the implementation of telemedicine and the digitization of healthcare have increased substantially. This is the result of technological advancements and an increasing need for healthcare services that are easily accessible. Research conducted by Dorsey (2019) and Bashshur (2016) has demonstrated that virtual systems have the potential to significantly enhance patient engagement and facilitate healthcare access. Healthcare organisations can surpass geographical constraints, streamline administrative duties, and enhance patient communication through the implementation of digital solutions such as online appointment scheduling systems. The aforementioned findings demonstrate the potential of virtual technology to enhance the efficiency of healthcare services and improve patient outcomes.

Many Nigerians continue to encounter obstacles when attempting to obtain quality healthcare services. Nevertheless, the implementation of a medical appointment scheduling system exhibits potential in mitigating this concern. Nigeria, according to the World Health Organisation (WHO), is facing major challenges in its healthcare system. These challenges include a shortage of healthcare facilities and specialists.. By adopting digital solutions, such as online appointment-reservation systems, Nigeria can effectively tackle these challenging circumstances and ensure that its citizens have access to healthcare. Furthermore, studies with the aid of Adebiyi (2022) have emphasised the importance of leveraging the era to bolster Nigeria's healthcare gadgets and achieve prevalent fitness coverage desires. Thus, the adoption of a medical appointment booking system aligns with broader efforts to modernise healthcare delivery in Nigeria and improve health outcomes for its citizens.

3.0 SYSTEM ANALYSIS & DESIGN

This chapter will detail the machine to be built in conjunction with evidence of the chosen system version for

designing and implementing the insurance regulatory reporting system. Additionally, it'll embody diverse techniques to correctly manage the undertaking, outline the layout and improvement tools to be employed, and specify the selected methods for facts and statistics accumulating and undertaking design.

3.1 SYSTEM DESIGN

This section describes the software development process in general. The SDLC model used for this project's development was the extreme programming software process model. Multiple versions of the system were developed and tested by the device's intended users and other key stakeholders before a stable version was developed.

3.1.1 FLOW CHART DIAGRAM

The following Flow Chart diagram in Fig 1. illustrates how the proposed system will be used and some of its capabilities.
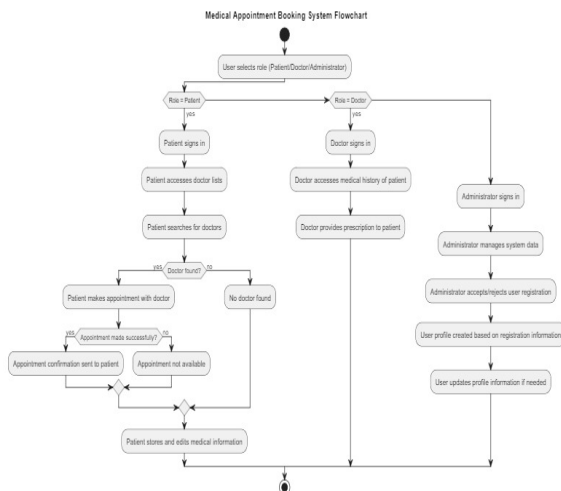

Figure 3.1: Flow Chart Diagram of Medical Appointment Booking System

The Medical Appointment Booking System consists of three user roles and administration. A user can sign in as a patient, doctor, or hospital. Patients can access the doctor lists, search for doctors after registration, and make an appointment with a doctor.

Patients can also store and edit their medical information in the system. A doctor can access the medical history of any patient. Doctors can also provide prescriptions to their patients. A hospital can add doctors and their departments after registration to ensure authenticity. An administrator can manage all the data available in the system and can accept or reject user registration. A user profile is automatically created by the system for every user based on the information provided by the user during registration. If needed, they can update information.

3.1.2 USE CASE DIAGRAM

The following Use Case Diagram in Fig 2. illustrates the Characteristics of the proposed system. It is showing the interaction of the user with the system.
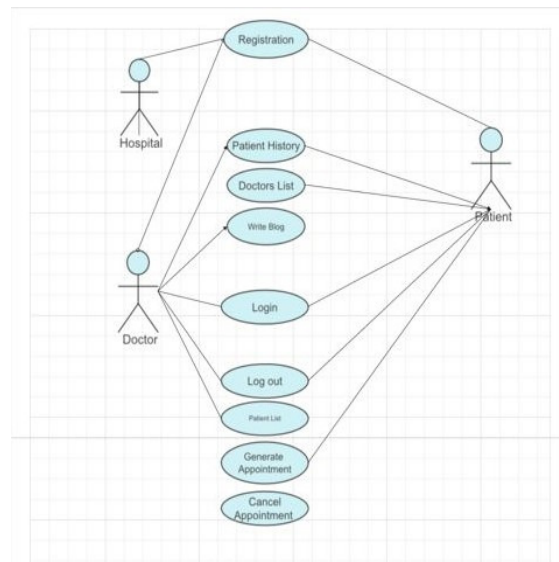

Figure 3.2: Use Case Diagram of the Medical Appointment Booking System

The use case diagram shows the features available to each user in the system

1. Patients: Patients have access to qualified and competent doctors no matter their current location. This diagram shows that they can create accounts or login, book and cancel appointments, view lists of available doctors and view their medical records.

2. Doctors: Doctors can now easily make prescriptions for patients without having to physically interact with them. This saves time and lessons appointment bulk, they can view the medical history of the patients,write reports on the patients based on diagnosis and view the list of patients that have scheduled appointments.

3. Hospital: The Hospital can add a doctor to the existing list of doctors to better treat their patients through the Medical Appointment Booking System. A hospital can add the doctor department-wise, which helps patients to find their doctors easily. Hospitals can also monitor the appointment of doctors.
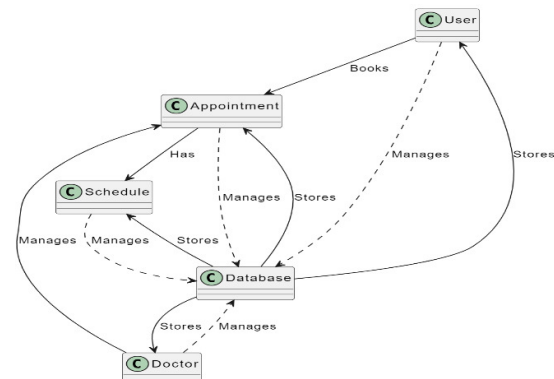
3.1.3 PROPOSED MODEL DIAGRAM

Figure 3.3 Proposed Model Diagram of the Medical Appointment Booking System

3.1.4 ENTITY RELATIONSHIP DIAGRAM

The entity-relationship diagram, which portrays the structure of the existing system database, is shown in Fig. 3. It shows how entities, like a patient, Specialist (doctor), department and appointment scheduling are connected.
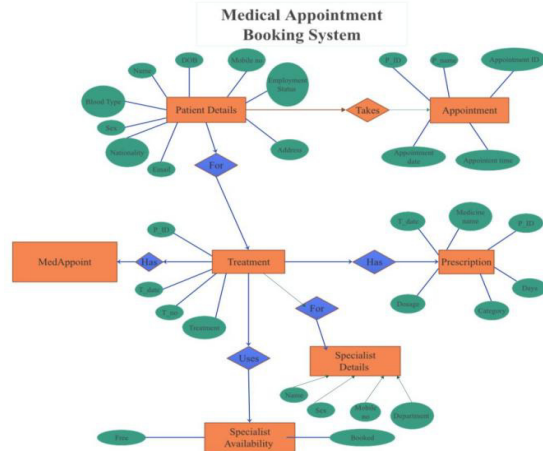

Figure 3.4: ER Diagram of the Medical Appointment Booking System

Explanation of some of the above illustrated data items.

P_ID: On Registration each individual patient is issued a unique ID which in our system we refer to as the P_ID or Patient ID.

P_name: The name provided by the patient on registration.

T_date: When a patient visits the hospital and a treatment or procedure is carried out on the patient it is recorded and saved on the patient's online profile in his medical history and it is also stored and saved in the Hospitals system.

T_no: When a treatment is carried out on a patient the patient is issued a unique serial number which the system recognizes as T_no.

Appointment ID: When an appointment is booked by a patient it is issued a unique serial number which the system recognizes as Appointment ID.

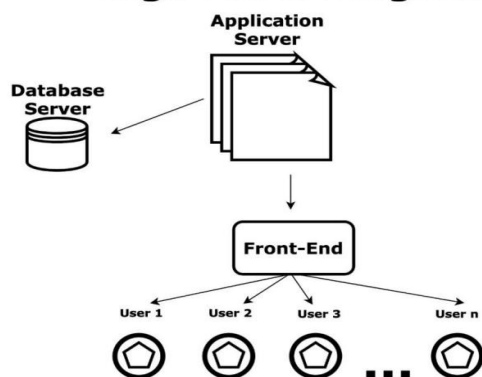### 3.1.4 SYSTEM ARCHITECTURE

Figure 3.5 System Architecture of the Medical Appointment Booking System

3.2 REQUIREMENT SPECIFICATION & ANALYSIS

The requirement analysis phase is an integral part in the development of the application. This stage analyses the various functionalities that are used to achieve the project goals and objectives. The system requirements are split into functional and non-functional requirements.

3.2.1 USER REQUIREMENTS

This section provides a summary of the crucial duties that the system ought to complete in a good way to meet the needs of those who will use it. It describes in extensive strokes what patients and doctors can assume from the machine with out moving into an excessive amount of technical jargon.

Patient Requirements:

1. User-pleasant Interface: Patients require a simple and intuitive interface that permits them to, without difficulty, navigate the system, look for healthcare providers, view their availability, and book appointments.

2. Convenient Appointment Scheduling: Patients must be capable of browse and pick out handy appointment times that healthy their time table. The device should offer actual-time availability and allow for clean rescheduling or cancellation of appointments.

3. Access to Provider Information: Patients need get right of entry to to applicable facts about healthcare carriers, along with their specialties, qualifications, and affected person evaluations, to make informed selections whilst choosing a issuer.

4. Secure and Private Data Handling: Patients expect their non-public and clinical data to be treated securely and with strict privacy measures in location. The machine must comply with information safety regulations and make certain the confidentiality of affected person records.

Five. Appointment Reminders: Patients respect appointment reminders thru e-mail, SMS, or push notifications to assist them don't forget their scheduled appointments.

6. Integration with Patient Portals: Integration with patient portals allows patients to get admission to their medical records, check effects, and prescriptions, providing a complete healthcare experience.

Doctor Requirements:

1. Availability Management: Doctors want the ability to set their availability, which includes everyday running hours, breaks, and days off. The gadget has to allow them to effortlessly control their timetable and make adjustments as desired.

2. Patient Appointment Notifications: Doctors should acquire notifications while patients book, reschedule, or cancel appointments. This helps them stay updated and plan their day as a consequence.

3. Seamless Integration with Practice Management Systems: The appointment reserving gadget should combine smoothly with the medical doctor's exercise management software, bearing in mind green control of patient appointments, scientific data, and billing.

4. Patient Information Access: Doctors require access to applicable patient records, including clinical records and

preceding appointments, and take a look at results to offer personalized and knowledgeable care.

5. Telehealth Integration: In the generation of telemedicine, doctors can also require the capability to offer digital appointments through video calls. The gadget needs to guide telehealth integration for remote consultations.

6. Analytics and Reporting: Doctors might also benefit from getting admission to analytics and reporting functions that offer insights into appointment volume, patient attendance, and other metrics. This enables them to optimise their practice and improve patient care.

3.2.2 SYSTEM REQUIREMENTS

This section presents a complete summary of the elicited desires of the proposed gadget's senior stakeholders and builders. Any machine's gadget wishes are normally described in terms of functional and non-functional requirements.

Functional Requirements:

1. User Registration and Authentication: The machine needs to permit users (sufferers and documents) to create money owed, provide important information, and authenticate their identities to get entry to the machine.

2. Appointment Scheduling: Patients ought to search for clinical doctors, view their schedules, and book appointments for precise dates and times. The device has to save you from double-reserving and make sure that appointments are nicely scheduled.

3. Availability Management: Doctors need to have the potential to set their availability, which includes everyday operating hours, breaks, and days off. The gadget must mirror their availability effectively to keep patients from booking appointments in unavailable instances.

4. Appointment Confirmation and Reminders: The system has to ship affirmation notifications to patients after they effectively book an appointment. It also has to deliver reminders to sufferers in advance of their scheduled appointments to lessen no-display expenses.

5. Appointment Modification and Cancellation: Patients ought to be able to adjust or cancel their appointments if needed. The system has to permit clean rescheduling or cancellation while also ensuring that any changes are well communicated to the patient and the medical doctor.

6. Patient and Doctor Profiles: The machine has to save and display applicable data about patients and doctors, including contact information, clinical records, specialties, qualifications, and affected person opinions. This information helps sufferers make informed choices when selecting a health practitioner.

7. Waiting List Management: In case of cancellations or unavailability, the system has to allow patients to enrol in a ready list for a selected physician or time slot. When an appointment is to be had, the machine can notify the following patient on the waiting list.

8. Integration with External Systems: The appointment reserving system can also want to integrate with other healthcare systems, inclusive of electronic fitness facts (EHR) or practice management software, to access patient facts, update statistics, and streamline administrative procedures.

9. Reporting and Analytics: The system needs to offer reporting and analytics skills for music appointment statistics, including appointment extent, affected person attendance costs, and average ready times. This information can help healthcare providers optimize their operations and enhance patient care.

10. Security and Privacy: The gadget should put into effect appropriate safety features to defend patient records, together with encryption, get entry to controls, and compliance with records protection guidelines.

Non-functional requirements:

1. Performance: The gadget has to be responsive and provide brief and efficient overall performance, making sure that clients can get right of entry to and use the system without good sized delays or slowdowns.

2. Reliability: The machine needs to be reliable and be available for use always, minimizing downtime and ensuring that clients can rely on it to e-book appointments without interruptions.

3. Usability: The tool needs to be person-best and smooth to navigate, with clean instructions and intuitive interfaces that allow customers (each patients and medical doctors) to have interaction with the machine without confusion or hassle.

4. Security: The machine desires to put in area sturdy protection features to defend sensitive affected person statistics, which include encryption of facts, steady customer authentication, and adherence to privateness regulations such as HIPAA (Health Insurance Portability and Accountability Act).

5. Scalability: The machine need to be able to looking after developing numbers of customers and appointments without causing a good sized degradation in average performance. It should be designed to scale and accommodate growth in utilization without compromising its functionality.

6. Compatibility: The gadget wishes to be compatible with unique devices and structures, allowing customers to get entry to and use it from several gadgets together with laptop laptop structures, laptops, capsules, and smartphones. It wishes to moreover be compatible with specific net browsers and running structures.

7. Integration: The device has to have the functionality to combine with different healthcare structures, which include electronic fitness records (EHR) or exercise management software programmes, to change applicable affected person data and streamline administrative tactics.

8. Data Backup and Recovery: The device needs to have mechanisms in place to regularly backup facts and make certain that they may be recovered in the event of machine disasters or record loss.

9. Compliance: The device has to follow relevant rules and standards inside the healthcare industry, including HIPAA, to ensure the privacy and safety of affected persons.

10. Performance Monitoring and Reporting: The gadget should have tracking competencies to tune its performance, pick out bottlenecks or problems, and generate reports on

system utilization, appointment statistics, and other applicable metrics.

3.3 DESIGN AND DEVELOPMENT TOOLS
The medical appointment system will be implemented via a platform based on web applications. To ensure the proper design, programming language and development of the software, the following tools and application will be employed

HYPERTEXT MARKUP LANGUAGE (HTML)
HTML is the standard markup language for documents meant to be displayed in a web browser. It is used to organize the content of a webpage or defines the structure of the webpage and organizes its content. It was developed by Tim Berner-lee in the year 1991. This will be used in our project to organize the webpage structure.
CASCADING STYLE SHEET(CSS)
Cascading style sheet is a style sheet used to style in the elements in a markup language e.g., HTML or XML. It is used to describe the presentation of the document written in markup language. It is the style sheet that gives html elements their exterior appearance, making the web look pleasant. It was first proposed by Hakon lie in the year 1994. This will be used in our project to beautify the webpage.
JAVASCRIPT
JavaScript is one of the popular and widely accepted programming language used to create interactive client and server web page. It was developed in the year 1995 by Brendan Eich. Since the development of JavaScript, a lot of JavaScript engines has been developed to aid the process of creating web pages and also make the page more interactive. Some JavaScript engines are React.js, Angular.js, vue.js, Chrome V8 JavaScript* , svelte.js, three.js, jQuery. React.js and node.js will be utilised, accordingly, for the front-end and back-end of this project.
VISUAL STUDIO CODE
VS Code, short for Visual Studio Code, is a source code editor created by Microsoft. It is available for Windows, Linux, and macOS operating systems. The text mentions several features of the software, such as debugging support, embedded Git control, syntax highlighting, intelligent code completion, snippets, and code refactoring. The software is designed to be highly customizable, so users can easily install extensions to add extra features and functionality. Developers have been drawn to VS Code because of its lightweight design and powerful features, which make it a top choice for web development projects.
PHP
PHP is an important part of making websites today because it is a coding language for the server. As a hacker with roots in both Denmark and Canada, Rasmus Lerdorf made PHP in 1994. This tool has changed a lot since then, and now coders can use it to make live, interactive web pages.
PHP and HTML get along great, which is one of its best features. This means that coders can add PHP code directly to HTML pages. This integration lets you make dynamic web pages, where most of the content is made in response to requests to a database or input from the user. There are also different content management systems (CMS), web frameworks, and internet template styles that can be used with PHP. In turn, this makes it easier to use and better for making websites.

There are a lot of reasons for this since PHP is used by so many people. To begin, coders of all levels can use it because it is easy to understand. They can quickly pick up the basics and start making useful web apps. PHP is also very adaptable, which means that programmers can change how things are done to suit different jobs. PHP gives developers the tools they need to make a lot of different features, like ones that verify users' identities, handle form entries, and talk to databases.

4.2 TESTING OF THE APPLICATION
Testing is an important part of making software, and this software includes a tool for setting up clinical meetings. In this way, it makes sure that the app works as planned and meets users' wants and expectations in a wide range of situations.
1. Unit Testing:
Individual units or parts of the machine are checked on their own to make sure they are accurate. This is called unit testing. Unit exams could test different parts of the appointment booking device, like how it handles notifications, how it registers customers, and how it schedules appointments, among other things. Any possible flaws can be found and fixed during the early stages of development by using independent testing and paying close attention to every detail. This makes sure that the whole system is stable and strong.
2. Integration Testing:
Checking for integration means looking at how different parts or sections of the tool work together to make sure they work well together and as a whole. In your appointment booking device, integration testing might include checking out the interactions among frontend components (e.g., user interface) and backend components (e.g., database, server-aspect good judgement). This type of checking out helps uncover any inconsistencies or compatibility troubles that may arise when different parts of the gadget are combined, allowing you to cope with them before deployment.
3. User Acceptance Testing (UAT):
User Acceptance Testing includes trying out the gadget from the perspective of give-up -users to make sure that it meets their expectations and fulfils the intended business requirements. In the case of your scientific appointment reserving system, UAT would contain actual customers (e.g., patients, healthcare vendors) interacting with the software to carry out not unusual tasks such as scheduling appointments, updating private information, and receiving notifications. By soliciting feedback from real users, you could discover usability troubles, accumulate insights for development, and validate that the system aligns with people's needs and options.

4.3 SYSTEM REQUIREMENTS

Hardware Requirements:

1. Server:

- A server capable of website hosting the medical appointment reserving machine software. This server must have sufficient processing energy, reminiscence, and storage potential to address user requests, database operations, and different gadget obligations efficaciously.

- Recommended specs: Quad-center processor (or better), 8GB RAM (or extra), SSD storage for faster statistics get entry to.

2. Networking Equipment:

- Reliable net connection to make certain non-stop get entry to to the device from numerous gadgets and places.

- Network switches, routers, and cables to facilitate communication between clients and the server.

3. Client Devices:

- Desktop computers, laptops, pills, or smartphones for getting access to the medical appointment booking system.

- These gadgets have to meet minimum requirements for web browsing and strolling contemporary internet programs.

Software Requirements:

1. Operating System:

- Server: Linux (e.G., Ubuntu Server, CentOS) or Windows Server working system.

- Clients: Any present day working gadget like minded with trendy web browsers (e.G., Windows, macOS, Linux, iOS, Android).

2. Web Server:

- Apache, Nginx, or Microsoft Internet Information Services (IIS) to host the clinical appointment booking device software on the server.

3. Database Management System (DBMS):

- MySQL, PostgreSQL, or SQLite for storing and dealing with appointment statistics, person information, and device configurations.

4. Web Browser:

- Any present day net browser together with Google Chrome, Mozilla Firefox, Safari, or Microsoft Edge for getting access to the medical appointment reserving system from consumer devices.

4.4 SYSTEM SECURITY

Ensuring the safety of your clinical appointment booking gadget is critical to shield sensitive patient facts and hold agree with inside the gadget. Implement robust encryption protocols to protect data throughout transmission and storage, and use steady authentication techniques like electronic mail and password verification to authenticate customers. Validate and sanitize consumer input to prevent commonplace attacks like SQL injection and cross-site scripting. Manage user sessions securely to prevent unauthorized access and hold specified logs of device sports for auditing purposes. Regularly check the system's protection posture through testing and tracking, addressing any vulnerabilities directly to establish a sturdy safety framework for your clinical appointment booking system.

4.5 SNAPSHOTS

Landing Page

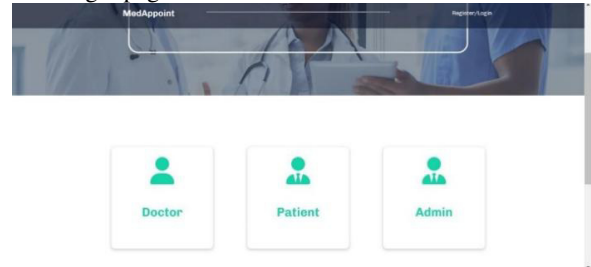Figure 4:1: Landing page

User login page

Figure 4:2: User Login Page
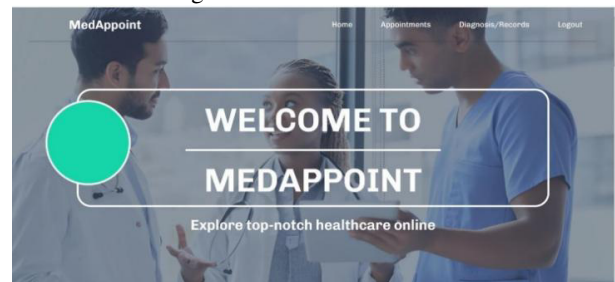
User Welcome Page

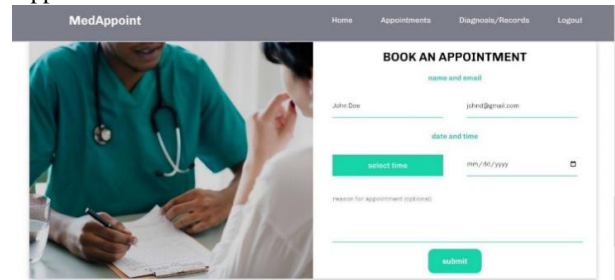Figure 4:3: User Welcome Page

Appointment form

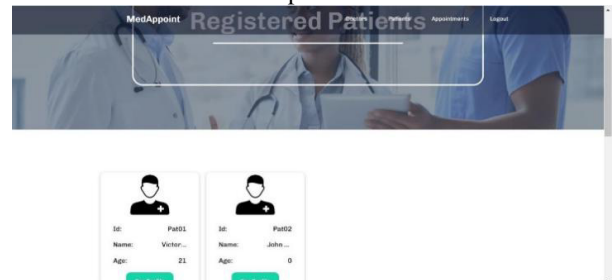Figure 4:4: Appointment form

Administrative view of the patients

Figure 4:5: Admin view of the service recievers

Admin view of an individual patient

Figure 4:6: Administrative view of an individual patient
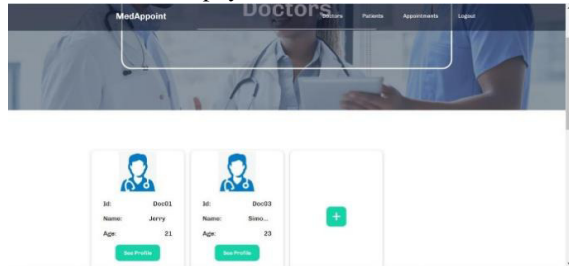
Admin view of the physicians

Figure 4:7: Admin view of all the doctor

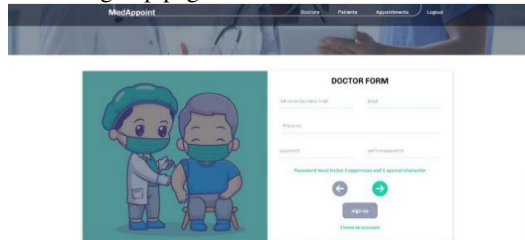Admin sign up page for the doctor

Figure 4:8: View from the admin end for the doctors

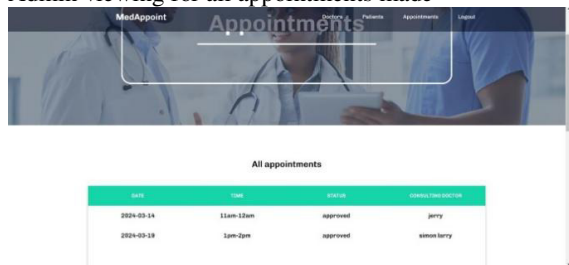Admin viewing for all appointments made

Figure 4:9: Administrative viewing for all appointments made
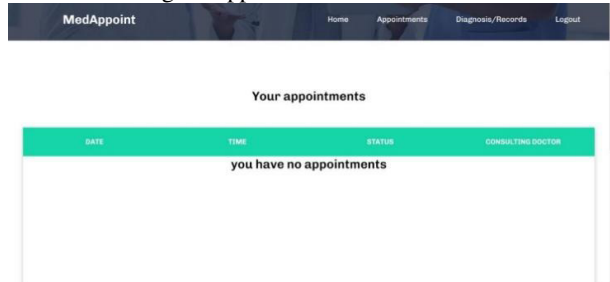
Doctors viewing for appointments

Figure 5.0: A Doctor viewing all his appointments

5.1 CONCLUSION

In conclusion, the final touch of the net-based totally medical appointment reserving machine marks a pivotal achievement in our quest to enhance healthcare accessibility and performance. Through meticulous planning, rigorous improvement, and collaborative efforts, we've got efficiently crafted a platform that not only simplifies the appointment scheduling process for patients but also streamlines administrative responsibilities for healthcare vendors. By harnessing the brand new technological advancements and adhering to high-quality practices in user revel in design, we've created an answer that prioritizes ease of use, reliability, and safety. Looking ahead, our dedication extends past the initial launch as we embark on a journey of continuous development and innovation. We will remain vigilant in addressing person remarks, imposing necessary updates, and staying abreast of rising trends to make sure the system stays at the vanguard of healthcare generation. Furthermore, we understand the importance of ongoing assistance and renovation to uphold the device's performance and shield affected person records. With this project, we expect tangible advantages such as stepped-forward affected person satisfaction, optimized clinic work flows, and, in the long run, better healthcare effects for all. Our dedication to advancing healthcare innovation stays unwavering, and we are excited to see the high-quality impact this system may have on healthcare delivery now and in the future.

RECOMMENDATIONS

Based on the successful development of the internet-based totally medical appointment booking system, it is recommended to enforce a phased rollout method to ensure easy adoption and maximize its blessings. The first segment ought to focus on conducting thorough education periods for the healthcare body of workers and supplying complete consumer guides for sufferers to familiarize themselves with the system's features and functionalities. Additionally, targeted advertising efforts ought to be employed to raise awareness and inspire patients to make use of the platform for reserving appointments.

In the following levels, it's highly recommended to intently reveal gadget performance and collect remarks from each sufferer and healthcare provider to identify regions for improvement and cope with any issues that may arise. This iterative technique will permit the non-stop refinement of the system to better meet the needs of its customers and enhance the overall user experience.

Furthermore, it is beneficial to discover opportunities for integration with different healthcare systems, inclusive of Electronic Health Record (EHR) platforms, to similarly streamline processes and improve data sharing throughout extraordinary healthcare settings. This integration will facilitate seamless access to patient records and ensure continuity of care in the long run, leading to better fitness outcomes for sufferers.

LIMITATIONS OF THE STUDY

The proposed system has some barriers, which can be:

1. One drawback of the study is the capability for choice bias in the facts collected throughout the evaluation segment.

2. Since the study relies on voluntary participation from patients and healthcare vendors, there can be a bent for those who are more technologically savvy or captivated by the machine to take part, leading to a skewed representation of user studies.

3. Additionally, the have a look at won't seize the views of positive demographics, including aged patients or those with restrained access to technology, who may additionally face particular demanding situations or barriers to the usage of the web-based totally booking gadget.

4. This hindrance may have an effect on the generalizability of the findings and might require additional efforts to ensure inclusiveness and representativeness within the information collection system.

Suggestions for in additional research or Research

The following hints can be taken into consideration in the case of furtherance of the body of labour or within the case of associated unbiased studies:

1. Investigate the effect of the web-based totally clinical appointment booking machine on affected person effects, such as appointment adherence costs, affected person pride, and normal healthcare utilisation patterns. This could include engaging in longitudinal research to evaluate changes in affected person behaviour and fitness effects over the years.

2. Explore the feasibility and effectiveness of integrating extra functions into the internet-based booking machine, including telemedicine offerings, patient portals for gaining access to scientific records, or AI-powered chat bots for imparting real-time assistance and aid to sufferers.

3. Conduct comparative studies to assess the performance and person delight of the web-based totally booking system compared to traditional appointment scheduling strategies, including phone calls or in-character scheduling. This may help perceive regions where the machine excels and possibilities for further development.

4. Investigate the capacity barriers to adoption and use of the internet-based totally reserving gadget amongst particular affected person populations, alongside elderly patients or those with constrained get admission to to technology. Understanding these barriers can inform the improvement of targeted interventions to improve accessibility and value for all customers.

5. Explore the scalability of the internet-primarily based general reserving gadget to cope with massive healthcare networks or specialised scientific practices. This should contain assessing the system's performance underneath the hundreds and identifying strategies for optimizing scalability and overall performance.

6. Investigate the cyber safety and privateness implications of storing touchy affected individual facts inside the net-based reservation device. This should include carrying out safety audits, implementing encryption protocols, and making sure compliance with healthcare information safety regulations to guard patient privateness and confidentiality.

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