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A Mini Project Report On

“Optimizing Doctor Availability and Appointment Allocation in Hospitals through Digital Technology and AI Integration”

*Submitted in partial fulfillment of the requirement for the award of Degree of Bachelor of
Engineering in Computer Science and Engineering*

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

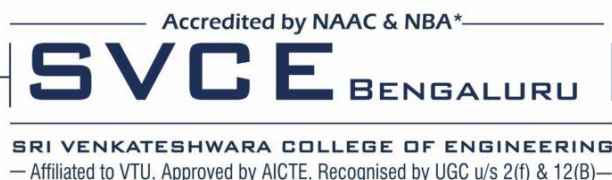
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CERTIFICATE

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ABSTRACT

This project aims to develop a robust doctor-patient management system that simplifies the process of booking doctor appointments and accessing medical reports. The system enables doctors to efficiently manage their appointment schedules online, while patients can easily book available slots and reserve them in their names. It seamlessly handles appointment data for multiple doctors across different dates and times, addressing the inconveniences of traditional appointment booking methods, which often involve long waits at hospitals and lack timely notifications of appointment cancellations.

The proposed solution includes an intelligent agent-based appointment mechanism, where junior medical staff schedule appointments based on priority levels. This application integrates with other appointment systems, enabling seamless online interactions between doctors and patients. It proves especially beneficial when doctors are unavailable or unreachable, allowing patients to communicate their health concerns online. Patients register easily, select hospitals, view detailed information about hospitals and doctors, and request appointments at their preferred times. Additionally, the system provides maps for hospital locations and options to contact hospitals or doctors via phone or email, ensuring comprehensive support and accessibility.

Chapter 1

INTRODUCTION

1.1 INTROCUCTION

This project aims to create a user-friendly doctor-patient management system that benefits both doctors and patients. Doctors can efficiently manage their appointment slots online, while patients can easily book available slots and have them reserved in their names. This system handles appointment data for multiple doctors across various dates and times, making the process seamless and efficient.

Traditionally, if someone feels unwell and needs to see a doctor, they must visit the hospital and wait for the doctor to be available. This often involves long waits in queues just to get an appointment. Additionally, if a doctor cancels an appointment due to an emergency, the patient usually remains unaware of the cancellation until they arrive at the hospital, causing further inconvenience. Our Online Appointment System addresses these issues by providing real-time updates and notifications, ensuring patients are informed of any changes. This modern approach to appointment booking eliminates unnecessary wait times and enhances the overall experience for both doctors and patients.

An intelligent agent-based appointment system has been proposed in which a scheduling system is provided for patients. The junior medical staff schedules appointments according to the priority level. This appointment-based application can be used with other appointment-based systems. This system serves the purpose of establishing an online interaction between a doctor and a patient. Generally, when doctors are not available or not reachable to patients and vice versa, this app will facilitate both the patients and doctors to interact or communicate and seek some help from the doctor regarding the patient's health condition concerns, etc. Always it may not be possible for a patient to meet a doctor in the hospital/clinic due to some busy schedule, and similarly for a doctor, it may not be possible to give an appointment for the patient to clear minor issues or doubts that the patient has. The patient has to register himself before logging in to the system. After logging in, the patient can select a hospital and view the hospital details. The patient has the option of selecting a doctor from the list of doctors and can see the doctor's details. The patient can request an appointment on his/her preferred day/time. The patient can see the location of the hospital on a map. In addition, the patient can contact the hospital and the doctor by making a call or may send an email to the doctor.

1.1 OBJECTIVE

1. To establish a web-based online doctor appointment system:
2. Track and find out the availability of doctors and manage all patients' related information.
3. Establish a paperless environment.

1.2 JUSTIFICATION OF STUDY

We implement this system for better user experience. This system is very easy to access and establishes real-time communication using modern and updated technology. Users can see updates without needing to reload or refresh. This system will be compatible with various user devices such as PCs, laptops, tablets, and smartphones, allowing users to easily access the model anytime, anywhere. The model is very simple and user-friendly, making it easy for all users to use.

1.3 SCOPE OF STUDY

The scope of the project is very broad compared to other online doctor appointment portals. Some key aspects include:

1. Optimizes the utilization of medical resources at the medical center.
2. Provides a large collection of doctor information categorized by their specialties.

Chapter 2

LITERATURE SURVEY

2.1 WAITING TIME

Fernandes et al. (1994) describe waiting time as the duration between making a request and the commencement of the specified activity. Specifically, Ramiah (2002) defines a patient's waiting time as the interval from entering an outpatient clinic to receiving a prescription. This encompasses the entire duration from registration to the doctor's consultation. Suriani (2002) identifies two types of waiting times: one for the doctor's appointment and the other for medication. This essay focuses on the waiting period to see a doctor, highlighting that lengthy wait times are a significant issue for urban healthcare service users.

2.2 PATIENTS' APPOINTMENT SYSTEM

The concept of a patient appointment system has been in place for a long time, as noted by Harper (2002). Early works in managing patient appointments developed simple queuing models and static scheduling conditions. Efforts to minimize waiting times included using mathematical queuing models to calculate the waiting time between a patient and a doctor (Hamlin, 2002). Traditionally, these systems prioritized minimizing doctors' idle time over patients' waiting time (Wijewickrama, 2005). However, modern appointment systems are designed with considerations for both doctors and patients (Takakuwa, 2005). These systems are complex because they manage appointment times and control waiting periods based on the type and timing of the appointment (Hamlin, 2002). The goals of a patient appointment system include managing doctors' time, reducing patients' waiting time, minimizing idle time for both doctors and nurses, and improving service quality (Harper, 2002).

2.2.1 APPOINTMENT DELAY

Health care facilities have used appointment systems for a long time (Harper, 2002). Earlier research on managing patient appointments led to simpler queuing models and static scheduling scenarios. Hamlin (2002) used mathematical queuing models to calculate and reduce waiting times between patients and doctors. Traditionally, these systems prioritized doctors' time over patients' (Wijewickrama, 2005), aiming to minimize doctors' idle time. However, current appointment systems consider critical factors for both doctors and patients (Takakuwa, 2005). Given the representation of patients in the appointment system, its structure is intricate.

2.2.2 MANAGING PATIENTS' APPOINTMENT SYSTEM

Dexter (1999) emphasizes the importance of a patient appointment system in healthcare for managing and reducing patients' waiting times. Healthcare centers without such a system often face longer wait times. When patients wait over an hour, they may feel neglected. An appointment system helps patients feel valued and enables them to evaluate the quality of care.

Effectively managing healthcare appointments requires a sophisticated queuing model that reflects real-life complexities, ensuring time efficiency and reducing idle periods (Kohleder, 2001). Current

scheduling practices often focus on the type of treatment needed, which may not be sensitive to individual patient needs. Therefore, a more patient-centered approach is desirable (Classen, 2001).

2.3 ONLINE BOOKING MODEL

A web-based system accessible via the internet allows users to complete specific tasks. The internet connects millions of computer networks globally, facilitating information sharing over long distances (James, 1999). The rising demand for better healthcare and the increase in missed appointments have driven the healthcare sector to adopt more efficient systems (Chua, 2010). Traditional booking methods like fax, phone, or email are being replaced by online systems due to increasing internet penetration. For example, in Taiwan, patients can book appointments online or by phone, improving communication between hospitals and patients (Druca, 2006). Hospitals are increasingly adopting web-based appointment systems to enhance clinical efficiency and effectiveness (Wakefield, 2006).

2.4 EXISTING HOSPITAL APPOINTMENT SYSTEM

Various methods have been developed to manage patient appointments. One approach uses exponential inter-arrival times to schedule future appointments, though this model has limitations (Kohleder, 2001). Designing an effective appointment system requires considering the healthcare environment (Classen, 2001). Classen (2006) proposed a method for managing appointments across multiple periods, allowing for rescheduling if slots are full. Systems are also designed to handle multiple appointments and double bookings to maintain performance under high demand (Kohleder, 2006).

Studies suggest scheduling rules, such as limiting appointments to 10-20 clients and spreading them based on average service times (Classen, 2006). Systems may also allow patients to book without knowing the type or duration of the appointment, which can vary (Kohleder, 2006). Mustafa (2006) developed a system that enables registered patients to browse physicians' profiles, view their calendars, and book appointments online. Patients receive email confirmations or notifications if their selected times are unavailable, providing flexibility and accessibility in scheduling (Mustafa, 2006).

Chapter 3

3.1 EXISTING SYSTEM

Hospitals currently rely on manual systems to manage and maintain critical information, which involves using numerous papers of critical importance and skills are scattered across different departments. This often leads to incomplete information, lost forms, and inconsistent data, creating significant challenges for hospital management. The manual system's inefficiency affects patient care and the hospital's overall efficiency, as delays in accessing patient records can result in less-than-optimal treatment decisions, potentially putting patient safety at risk. Additionally, the heavy reliance on paper forms contributes to a cluttered and disorganized work environment, increasing the chances of errors and miscommunication among healthcare staff.

Implementing an electronic health record (EHR) system could solve many of these issues by centralizing data storage and allowing real-time access to patient information. An EHR system would simplify data entry, reduce duplication, and improve accuracy. Automated alerts and reminders could help ensure that treatment protocols are followed, leading to better patient outcomes.

Moreover, a digital system would allow for data analysis, helping hospital management identify trends, optimize resources, and boost operational efficiency. Enhanced security measures, like encryption and access controls, would also protect sensitive patient information from unauthorized access.

While transitioning to a digital model requires an upfront investment in technology and staff training, the long-term benefits are well worth it. By moving away from paper forms, hospitals can enhance the quality of caring patient, streamline operations, and ensure the accuracy and security of patient information. Adopting an EHR system is a crucial step towards modernizing healthcare infrastructure and delivering better outcomes for patients.

3.2 PROPOSED SYSTEM

System Overview:

The goal is to develop a comprehensive software tool that efficiently manages doctor availability and appointment scheduling. The system includes real-time tracking, appointment management, and enhanced user experience features.

Features:

Doctor Availability:

Real-Time Updates: Display real-time availability of doctors across various departments. Use web sockets or polling mechanisms to ensure data is current.

Dynamic Scheduling: Allow doctors to update their availability, including on-call hours, breaks, and special appointments.

Appointment Allocation:

Intelligent Scheduling: Use AI algorithms to suggest optimal appointment times based on doctor availability, patient needs, and historical data.

Conflict Resolution: Automatically detect and resolve scheduling conflicts, notifying both patients and doctors of changes.

Patient and Doctor Interfaces:

User Dashboard (React + Redux Toolkit + Ant Design): Provide a user-friendly interface for patients to view available slots, book appointments, and manage their schedules.

Doctor Dashboard (React + Redux Toolkit + Ant Design): Enable doctors to view their schedules, manage appointments, and update availability.

Appointment Management:

Automated Reminders (React Hook Form + Axios): Send automated reminders and notifications to patients and doctors about upcoming appointments, cancellations, and rescheduling.

Booking History: Maintain a history of appointments and enable easy access to past records for both patients and doctors.

Location and Facility Integration:

Hospital Map Integration: Display hospital maps and provide directions to different departments or doctor's offices using embedded maps or APIs.

Facility Information: Offer contact details, working hours, and additional information about various hospital facilities.

Feedback and Ratings:

Patient Feedback: Allow patients to provide feedback on their appointment experience and rate doctors.

Doctor Reviews: Enable doctors to leave comments or reviews about their scheduling experience or system performance.

Front-End:

- React: For building dynamic and responsive user interfaces.
- Redux Toolkit: For managing global state and ensuring a consistent application state.
- Ant Design: For pre-designed components and styling to enhance user experience.
- React Hook Form: For handling form validations and submissions efficiently. Axios: For making HTTP requests to the back-end API.

Back-End:

- Express.js: For building the API endpoints and handling HTTP requests.
- Node.js: For server-side logic and integration with the front-end.
- TypeScript: For adding static types to the back-end code, enhancing maintainability and reducing bugs.
- Prisma: For ORM (Object-Relational Mapping) to manage database interactions efficiently.

Implementation Steps:

- Define Requirements: Gather detailed requirements for doctor availability, appointment allocation, and user interactions.
- Design Architecture: Create a high-level system architecture outlining front-end and back-end interactions.
- Develop Front-End: Build the user interface using React, Redux Toolkit, and Ant Design. Implement forms with React Hook Form and data fetching with Axios.
- Develop Back-End: Set up Express.js with Node.js and TypeScript. Use Prisma for database schema management and data access.
- Integrate AI: Implement AI algorithms for appointment scheduling and availability prediction.
- Testing: Conduct thorough testing of both front-end and back-end components to ensure reliability and performance.
- Deployment: Deploy the application on a suitable platform and monitor its performance and user feedback.

This system aims to streamline appointment scheduling, enhance doctor availability management, and improve overall hospital efficiency through advanced digital and AI technologies

Chapter 4

FUTURE ENHANCEMENT

- Online Appointment Booking

The Online Appointment Booking feature makes it access able for patients to gather information and book appointments with doctors across the country, all from the comfort of their homes. Patients can search for healthcare professionals based on their specialty, location, availability, and even read reviews from other patients. Once they find the right doctor, they can choose an available time slot that works best for them. This system eliminates the neediness for phone calls or in-person visits to schedule an appointment, making the entire process faster and more convenient. Plus, it can send automated reminders to patients, helping reduce the chances of missed appointments.

- Personal Digital Assistant

The Personal Digital Assistant is a comprehensive tool for managing hospital med records digitally. Patients can store and access their medical history, test results, prescriptions, and other health-related information from anywhere in the world, as long as they have internet access. This feature ensures that important medical data is always at hand, whether the patient is visiting a new doctor, traveling, or simply managing their health. The digital assistant can also integrate with wearable devices and health apps to track vital statistics and provide insights into the patient's health trends over time.

- Practice Management System

The Practice Management System is designed to support healthcare providers in managing their practices more efficiently. It allows doctors to promote their profiles and open appointments to a larger audience, increasing their visibility and patient base. The system enables the management of patient health records and accounts online, ensuring that all information is up-to-date and easily accessible. Doctors can generate electronic prescriptions, which are more convenient and secure than traditional paper prescriptions. Additionally, the system facilitates online communication with stakeholders, such as pharmacies, insurance companies, and other healthcare providers, ensuring seamless coordination and care continuity.

- Content Management System (CMS)

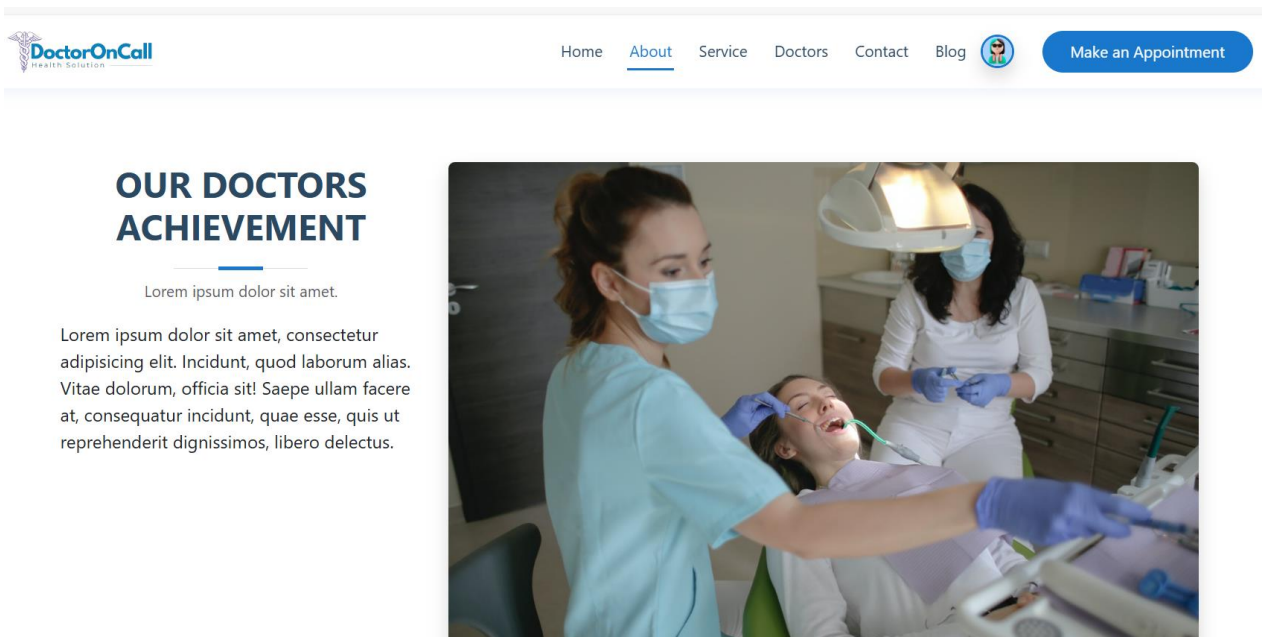
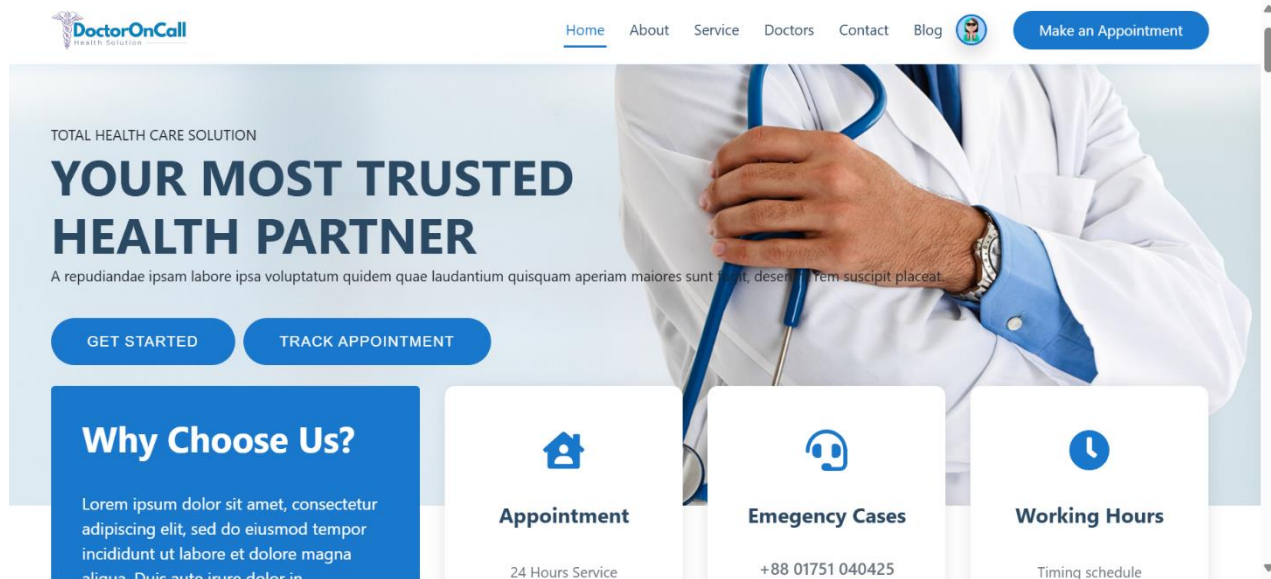
The Content Management System (CMS) empowers the admin to easily manage the website's content. This includes updating sections such as the "About Us" and "Contact" pages, ensuring that all information is current and relevant. The CMS allows for quick edits and updates without the need for technical expertise, making it simple to keep the website fresh and engaging for visitors. This tool ensures that the website's content aligns with the organization's goals and provides accurate information to patients and visitors.

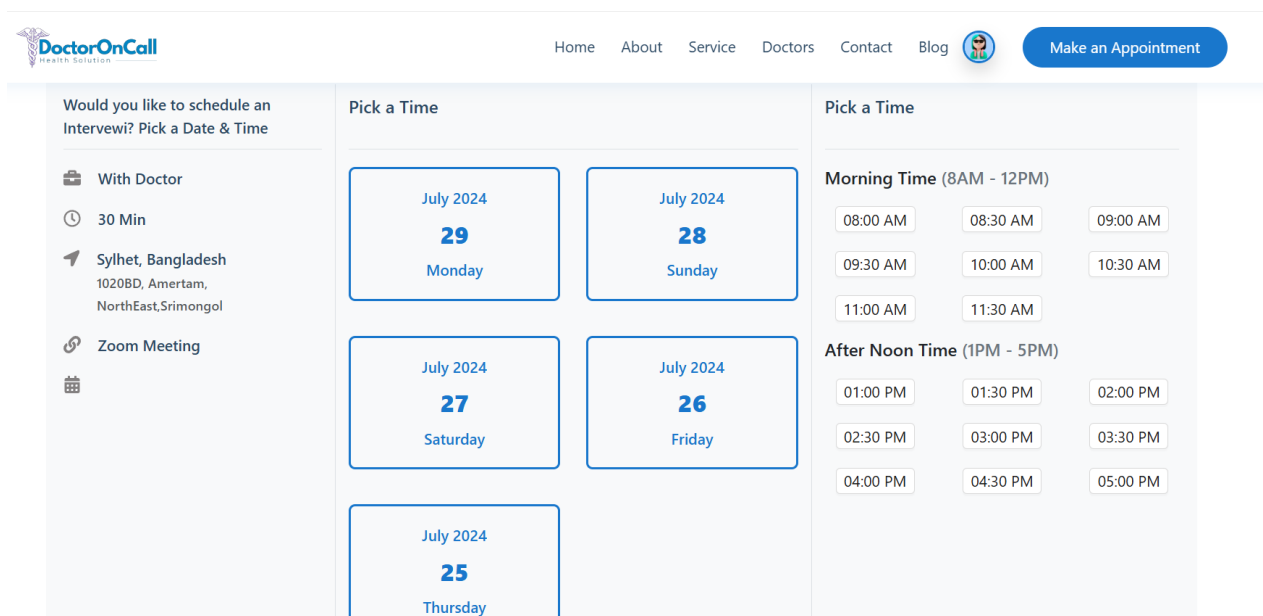
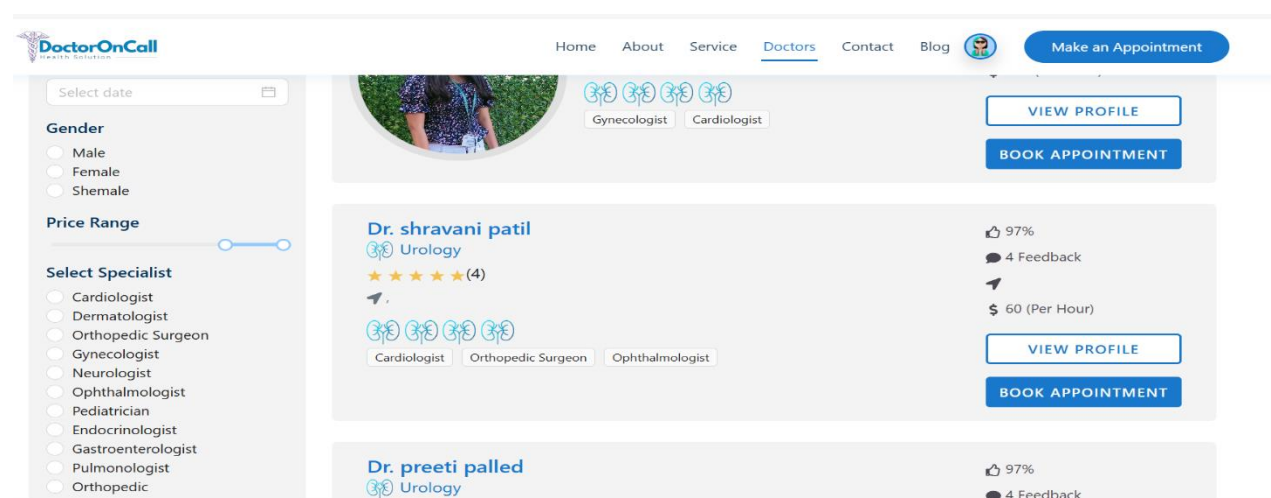
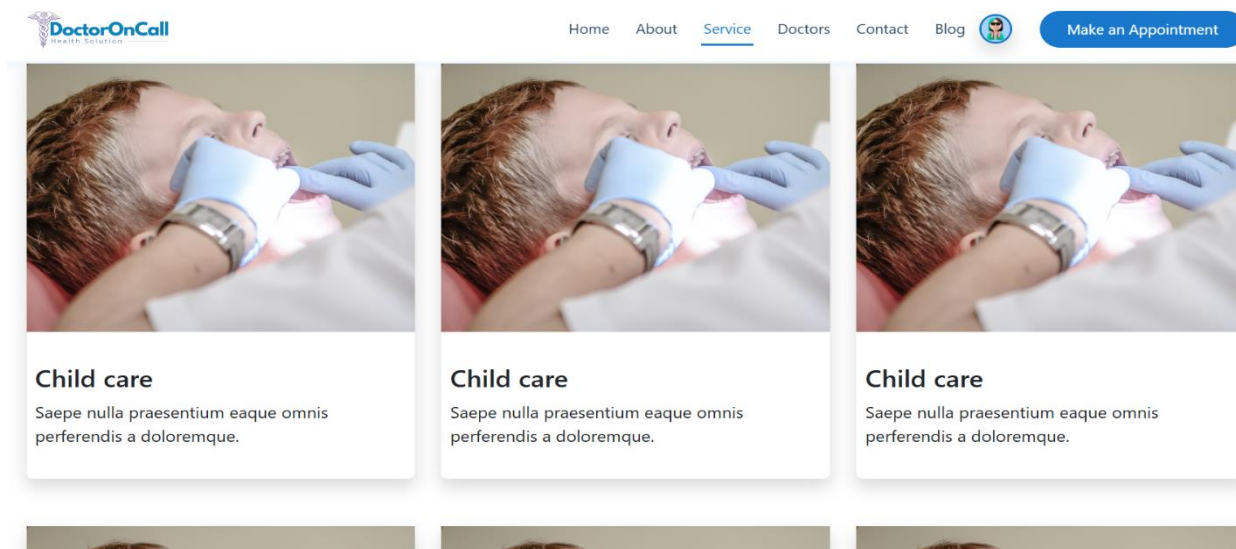
- Mobile Responsive Design

The website is guaranteed to work flawlessly on mobile devices thanks to mobile responsive design. This implies that patients can use their cellphones or tablets to access all capabilities, including making appointments. Regardless of the device being used, the design adjusts to multiple screen sizes and resolutions to provide a user-friendly experience. In the fast-paced world of today, when many people rely on their mobile devices for daily chores, mobile compatibility is essential. Patients may conveniently handle their healthcare needs while on the go thanks to this service.

Chapter 5

RESULT AND OUTCOME





Chapter 6

6.1 CONCLUSION

In conclusion, the development of a doctor-patient handling management system marks a significant advancement in the healthcare industry, addressing the numerous inefficiencies inherent in traditional manual systems. This project aims to revolutionize the way doctors and patients interact, facilitating seamless appointment booking and access to medical records. By enabling doctors to manage their booking slots online and allowing patients to reserve these slots at their convenience, the system eliminates the need for in-person visits and long waiting times.

The proposed intelligent agent-based appointment system ensures that appointments are scheduled according to priority levels, enhancing the efficiency and effectiveness of medical consultations. This system not only benefits patients by providing them with timely access to healthcare but also supports doctors by streamlining their practice management, allowing them to focus more on patient care rather than administrative tasks. Features like electronic prescriptions, patient health records management, and online stakeholder communication further contribute to a comprehensive and integrated healthcare solution.

Moreover, the system's mobile responsiveness ensures that both doctors and patients can access its features on the go, making healthcare management more flexible and accessible. The inclusion of a Content Management System (CMS) allows for easy updates and maintenance of the website content, ensuring that all information remains current and accurate.

Transitioning from a manual to a digital system also addresses critical issues such as data loss, duplication, and inconsistencies, which are prevalent in traditional systems. By centralizing data storage through an Electronic Health Record (EHR) system, hospitals can enhance data accuracy, improve patient safety, and optimize operational efficiency. The implementation of EHRs supports data analytics, enabling better resource allocation and trend identification, ultimately leading to improved patient outcomes.

Although the shift to a digital system requires an initial investment in technology and training, the long-term benefits significantly outweigh the costs. Enhanced data security, reduced administrative burden, and improved healthcare delivery are just a few of the advantages that underscore the necessity of this transition.

In essence, this project not only modernizes the healthcare infrastructure but also paves the way for a more efficient, patient-centric, and technologically advanced medical environment. By leveraging the capabilities of an intelligent, integrated system, we can ensure that healthcare services are more responsive, reliable, and readily accessible, ultimately leading to better healthcare outcomes for all.

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