

Full Stack Doctor Appointment Booking System

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Peer Review Information <i>Type: Article</i> <i>Received: 02 April 2026</i> <i>Revised: 29 April 2026</i> <i>Accepted: 03 June 2026</i> <i>Published: 25 June 2026</i>	Abstract Now a days, due to digital transformation of healthcare services has significantly changed so the way of work has changed. Previously it was depended on manual system just like telephone calls physical visits or registers management. Cause of it, public was facing difficulty to book appointment and it waiting time was so longer. Even sometime patient records are also losses. Doctors were not able to manage time too. in this situation, patients load was increased and it was difficult to manage the crowd of patients. The Full Stack Doctor Appointment Booking System provides automated process like booking appointment, accepting appointment by doctor, searching doctor by patient and manage all records about doctors and patients by Admin team. Patient can check history and rating of doctors. It helps to manage the time for both doctors and patient. Patient can select better doctors based on his/her rating and history. As we know that internet is available every corner of the world so patient can book appointment from anywhere and based on appointment date they will have to go hospital. Overall, the Full Stack Doctor Appointment Booking System more reliable and scalable solution for current healthcare management system. Keywords: Doctor Appointment System; MERN Stack; Healthcare Management; Online Booking; Digital Healthcare
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Introduction

Healthcare system is important sectors for human better health. Event now a days people are facing more difficulty like booking appointment, searching better doctors. Hospital management is also facing so many issues like managing patient records and tracking appointment and manage records for doctors as well. As we know internet is available everywhere like India country but still many hospitals are not maintaining these things online. Still follow the previous pattern like off line booking by call or patient direct visit at hospital. Hospital management maintain all things in register so some time it lost and very difficult to find out it and sometime patient fell frustration because they visit in hospital but doctor does not present that day cause of some reason like meeting or any other reason is also possible. Currently information technologies are growing very fast so this type of process is not good. As we know that everyone uses mobile/ laptop so if they have facilities to do these things online that will be better for our society.

Doctor Appointment Booking System is solution of these issues. It helps to do everything online like booking appointment and manage patient records online so that records are not loosed. Patient can book appointment from anywhere and get specific date as well as per comfortable and they can able to search better doctors and department so that they can take proper treatment on time without exception or without loss more money.

Doctor Appointment Booking System ensure all type of users like patient, doctor and administrators.

They can use in easy way this system and maintain records and history. workload also get reduce cause of this system and improve better time management for all doctors, patient and management system as well. Patients get benefit like reduce waiting time, booking online so no need to visit physically at hospital and choose better doctors and department.

In this system, we are using technologies like React.js for interactive and responsive front-end interfaces, Node.js and Express.js for server-side processing data, and MongoDB for secure database and maintain records.

Overall, the proposed of full stack Doctor Appointment Booking System manage time management for both doctors and patients. Choose better doctors and department. It reduces waiting time of patient. Patient can choose better doctors so they can save money, no need to visit here and there. This is user friendly platform; patient can use it anytime from everywhere if they have mobile and internet.

Problem Statement

Still, now a day, Manual Appointment Booking Process is going on in many hospitals and clinics. Patients are still booking doctor appointment manually and Management maintain records in register. Long waiting time for patient because of it does not manage properly. Even sometime patient waits entire day or sometime they come other day as well so it is dissatisfaction and poor experience. In this situation, patient does not know about real-time information like doctor availability and it increase overbooking in a day and may be some time conflict

Due to manual system, some error happens like duplicate booking, incorrect time slots, appointment overlapping and overloading. Need more staff to manage these all thing manually like manually maintain in register so may be typo mistake happens. Administrative feel more workload so increase their burden and headache Doctors also feel more overloaded because of poor scheduling slots for patient. Even some time doctor not able to manage time. Cause of absence of online data management, sometime very difficult to manage record and retrieve record from file or register and in this type of situation sometime data get loosed.

Due to manual management like booking, data management in register some time data also get loosed and incorrect entry in register. Patients face difficulty to booking doctor appointment because staff does not receive call and not able to call back to patient cause of busy schedule In manual system, not maintain patient data properly so in some case, patient data leak or not secure. Even sometime data is also sold by staff or they share important patient data to another person.

There is no role-based access available in current manual system so it is very difficult to comminate to each other like between patient and doctor, doctor and management. Here management is nothing but admin and also between patient and management staff. In off line management system performance decrease because some time management does not able to manage booking system and issue in peak time to manage all the things.

There are so many gaps in communication system because it does not reflect anywhere current status like appointment is accepted or not doctor availability, cancellation and rescheduling. Whatever online system available now a days it is not grantee to work properly in mobile and it is not clouding based system so performance is very poor so this is very bigger disadvantages,

As we mentioned above limitation so in this condition, we need stable online platform so that patient, doctor and management can use properly and more user friendly and reduce time management issues, gap between each other's. Doctor appointment booking system that efficiently connects to patients, doctors, and administrators

Literature Review

Current Healthcare management system mainly focused on manual management and paper-based records management like physical visit at hospital for doctor appointment or mobile calls so some time facing issues to book appointment and connect with management staff. it proves that in current system gap between each other's. We observe that so many gaps in coordination between doctor and patient, patient and management staff, even between doctor and management staff. many tasks are not integrated online like maintaining records of patient, billing system, review tracking and patient and doctor data management.

Web based application reduce manual workload and this system allow to patient booking appointment online from anywhere in the world where ever internet is available. All things manage online not off line. There are many limitations available in early online booking system like doctor availability. There is no any role-based access available so that anyone can access whatever required for them. We found some authentication issue as well in current system.

It is very important user-friendly interfaces that is responsive to improve user adoption. We found in studies that system with very simple and easy navigation and responsive design. It increases patient satisfaction and system stability. In many cases there is no proper integration between front end and back-end logic, because of it increase performance issues. Even some time it fails to synch data like appointment, cancelation of appointment and data entry about patient and doctors.

There are many security breaks about patient and even doctors. In manual way there is no any authentication and authorization and even in some online system also it is not present such as like JWT token, OAuth security and role-based access to protect data about doctors and patients There is some cloud-based application is available but it has concern related to data privacy and internet availability but cloud-based application system offer scalability, flexibility and cost efficiency in our life.

Mobile application prove that it can very easy and it can be available everywhere wherever internet is available in the world. Even booking system will available in rural area as well. However, many health solutions operate independency and lack of integration between the system like one system to others system.

In our system we will add more feature for stability and connectivity. There will be reminder system so that it will reduce missed appointment and management can easily tack the patients' records in our system. Sure, it will improve communication between doctors and patients. There is very important role of AI in healthcare system recently like research, explores, AI based doctor recommendation and scheduling appointment system. It requires large data set and complex infrastructure implementation.

There are many lacks in current system. everyone focusing focus on either patient or hospital needs not both systems. Very few systems are available in market to do these things but it is also less stable. We noticed that many systems have performance issue and it is not working properly. There is load overloaded and not able to work easily even there is more gap in integration so whatever system is available online this is not sufficient because it is not user friendly. Need full stack architecture. Many research conclude that full stack architecture offers integration between front end and backend, maintainability and scalability. There is separate database that can store huge amount of data in database so that admin can easily track history of patient.

We found that there are many research gap identifications from the literature review. it ensures that there is need one secure scabble and role based full stack doctor appointment booking system that resolve all limitation whatever we found in existing system or in manual system.

Existing System

In the existing Hospital management system, doctor appointment booking process is happening manual or semi-manual methods. In many hospitals and clinics, patients need to visit at hospital physically to inquire about doctor availability and book appointments. There is in some situation, appointments are scheduled via mobile calls handled by hospital staff. These Old processes are highly dependent on human, it is making the process very slow, inconvenient, and inefficiencies. Even in manual system, patient details, appointment schedules, and medical records are maintained in paper registers or simple computer excel files, which is very difficult to maintain proper structure and integration. There is one major limitation are existing in system is the absence of real-time appointment management system. There are appointments are updated manually; patients do not receive accurate information about doctor availability so some time they need to come again on other day. There is only way to come to know doctor is available or not at hospital only no any other way to know because some time staff is also not receiving the mobile calls. It is causing frustration and dissatisfaction among patients and their families. As we can see in other end, it is very difficult to manage appointments manually and it creates a heavy workload for hospital staff.

Administrative are responsible for handling phone calls, updating registers, maintaining patient files, and responding to appointment-related queries every time. This can be increasing errors like duplicate bookings by patients; patient information may be incorrect and

misplaced records as well. As we know updating or modifying appointment schedule needs additional efforts and time too. This is also reducing operational efficiency. There is other drawback also exists in current system like centralize and sucre database system. In current system we are not able to manage data in a single database or even online because in existing system has so many gaps. Now a days we are storing data in excel sheet so it is very difficult to handle it. Even difficult to retrieve history data of patient and information too. It is very difficult to search information of patient data in database and cause of this patient is suffering many issues like they lost many here and there they do the treatment some time at wrong place as well and not getting proper treatment so they lost money and time. So sure, it will raise more frustration in life. Hospital also needs more staff to maintain all data related to doctors, patients and even regarding management too. As we know in correct situation there is so many communications gap is happening because we do not have any better online booking system. Patients are needed to call every time on mobile. Some time they are not receiving call as well so it is very difficult at that time. Other drawback like doctor is also not updating his/her status on time like they are available or not, they will come today at hospital or not and what is the time period in day to check patient or connect with patients. Sure, cause of the this increases negative feedback as well.

As we know that now a days internet is present everywhere in the world. In existing system patient need to do everything off line not online because in the market online website is not existing better way to provide the services so it is very difficult for rural area patient, they are not visiting hospital on time so cause of this some time they die or get handicap. Some time they need to repeated mobile call to connect with doctors and admin. Manual or old application-based doctor appointment booking system is not sufficient because that application is not working very well even some time application get stuck and not working anything even internet is available so as we know that is very critical time for any patient. Currently all the process are depended on manual process so it is taking more time to do all the process and patient is not feeling g good to do these much process. so, it is time to launch any new and modern application to handle all the things at one place online that's why we are going to developed this project. It will provide patient and doctors event to management as well all services online on time and we can use it from anywhere wherever internet is available in the world.

Proposed System

We have one proposed system that Doctor Appointment Booking System. it is web-based application to support all the facilities at one platform and handling all things related to hospital like how to book patients online his/her appointment and how to accept doctors' online patients' request and all these things handle by admin and they have all the access related to doctors and patients. In this application we are going to use react, node and MongoDB. As we know these all technologies are very modern and new in the market and they have capacity to handle all the things like backend, UI page and database. this will be centralized database.

In this system, patients and doctors can register his/her profile online and patient can search doctors and their qualification and department also online only and if they want then the book the appointment online from anywhere in the world wherever internet is available in world it is not mandatory only from modern city then can book from rural area also and whenever they got appointment they can reach at hospital so they do not need to spend more money and stay anywhere in night. Doctor also receives patient request online and if they will be available then the accept request or reject request if they will not available a particular day. This application will also provide authentication and authorization level security if any is patient then can access only patient t related page in the same way for others also.

This system is reducing waiting time, prevents appointment conflicts, improves data accuracy, ensures data security, increase performance of the system and enhances the overall efficiency and accessibility of hospital management services.

As we can see in above figure 1, architecture of our Doctor Appointment Booking System. This architecture is divided in multiple layers and each layer has own responsibility. Suppose that at UI level they will handle UI page like how to register patient and doctors online and we have other layer that is backed so in backend layer we have all the backend related logic. This logic is nothing but business logic that will process our patient and doctor data to database and we have also data layer where we can use MongoDB so this DB will maintain all data related to patient and doctors even for admin as well. As we know MongoDB is non-SQL database so it is working very fast.

As we can say in business term there are many types of modules like patient module, doctor's module and admin module. they have also own business logic. Patient can book the appointment and get the notification on mobile if doctor will accept their proposal or request in them of technically. If patient book any appointment, then doctor also get notification on mobile and they can also accept or reject this is totally based on his/her availability and admin can have all the access of the application they can see all the information related to doctors and patients and also whatever action is performing by them. This application is very useful in today world for everyone who is using internet but as per our knowledge everyone is using internet or at every family at least using internet so they can use this system from anywhere in the world.

This application also provides high security without username and password no anyone can login his/her profile. If anyone try to use with wrong username and password, they will not able to use and after three attempts at will lock but they have facility to change password online with the registered mobile number. they can get OTP on register mobile number or Temperley password on mobile then they can

change password even they need to use very strong password otherwise system will not accept password. As we can see this application is going to provide very strong security for any users.

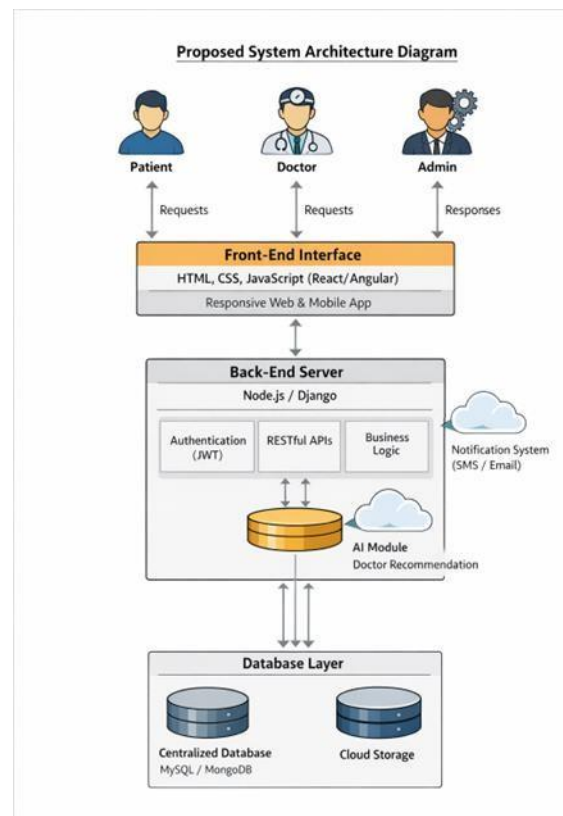


Fig. 1. Proposed System Architecture Diagram Explanation

The database layer is consisting of a centralized MongoDB database that securely stores patient records, doctor information, and appointment details in details. This single

data storage ensures data high consistency, easily retrieval, and improved data security of patient, doctor and admin. This architecture also supports integration with notification services like as email or SMS to provide appointment confirmations and reminders again and again to patient and doctor.

Overall, this proposed system architecture is ensuring efficient interaction between system components like patient, doctor and admin, reduces manual intervention, avoids appointment conflicts, provide high security, restrict required access only and enhances the reliability and performance of online services.

Technologies Used

This Full Stack Doctor Appointment Booking System is developing using modern and reliable web technologies to ensure efficiency, high scalability, high security, and easy to use. This system is following a layered based architecture, which divides the application into three major components the Front-End, Back-End, and Database. Each layer is designed based on industry standard technologies to provide a smooth and secure experience for patients, doctors and admin.

Front-End Technology: We are going to use React.js

The front-end page of this application that is nothing but online Doctor Appointment Booking System is developing using react. Now a day this is using everywhere in company so we can say that this is company standard technology. This will manage our front-end page like how to register patient, doctors and admin. They can easily register their account online. React will provide easy configuration to achieve the aim. As we know react is nothing but virtual DOM so they can enhance performance very fast. This module gives more readability, maintainability of the coding part. Any developer can easy to understand and develop any code in our application because this is more popular technology in the market. we are using react so it will provide very fast page loading and jump from one page to another page or any link is mentioned on front end page. Cause of this front-end page looks very attractive and user friendly also we can use front end-based security as well they can validate all the field whatever entered by any user like patient, doctors and admin. Overall react will present here very important role to developed this application because it will provide very user-friendly UI page to our application and any

user can understand easily

Back End Technology: We are going to use Node.js and Express.js. We are going to build back using Node.js; it is also known as asynchronous and non-blocking I/O model. It is allowing server to handle more or multiple requests at same time because in our application that is Online Doctor Appointment System using by multiple users at same time like many patients can book appointment at same time in the world or in India anything you can say. It is very light weight technology. It has many features for handling HTTP requests, routing and any error. It provides better restful Apis to communicate between frontend and database so we can say that it is just like contractor in the real world because it will establish communication between front end and database that is MongoDB in our application. We can also implement JWT token for security purpose in our application. It provides authentication and authorization level security which is provide better and high-level security to our application and users like patients, doctors and admin.

Additionally, it also allows to provide notification on mobile and email id whatever registered at the time of creating account in our application by patients, doctors and admin as well. Suppose that patients book appointment then doctor can get notification on mobile and if doctors will reject or accept appointment the patient can get notification on mobile via message or email.

It has separate business logic which is apart from front end and database to establish the communication between both that is front end and database as we know that we are using from front end technology as react and database as MongoDB. Finally, all the module is speared to each other's. There is no any impact on each other's like if anything wrong in business logic then we have to handle in business logic only.

Database Technology: We are going to use MongoDB

In our application, we are using database as MongoDB. It is very popular database in the market because it is no SQL database. It is working very fast because it has not needed any SQL query. It is working as key and value that is nothing but Json format. There are many benefits to work with MongoDB like its schema flexibility, light weight database without any SQL query. we have many databases in the market like oracle and MySQL but it is very heavy database that's why we are going to use MongoDB database in our application.

It has facility to add easily username and password as key and value and it is very strong and high secure database. It is also providing schema to validate data in database like if anyone try to enter password less than required password length then database will not accept their password and then need to generate new and strong password with small and capital letter and they need to include digit and special character.

MongoDB ensure secure data strong based on module or role based that patient, doctors and admin. they can store data separately in MongoDB so anyone can retrieve data easily from database and database will work very fast. Cause of this they can maintain high security on data part because users have some essential information like password, account number, Aadhar number even mobile number.

In future we have planned to deploy it on cloud as well so it will work faster. For any operation it will take in milli second time like whenever anyone open account and click on submit button it will not take more time and easily store all the information in database and if they want to look into that data they can see in profile page easily. It is very fast to communicate to business logic in our application.

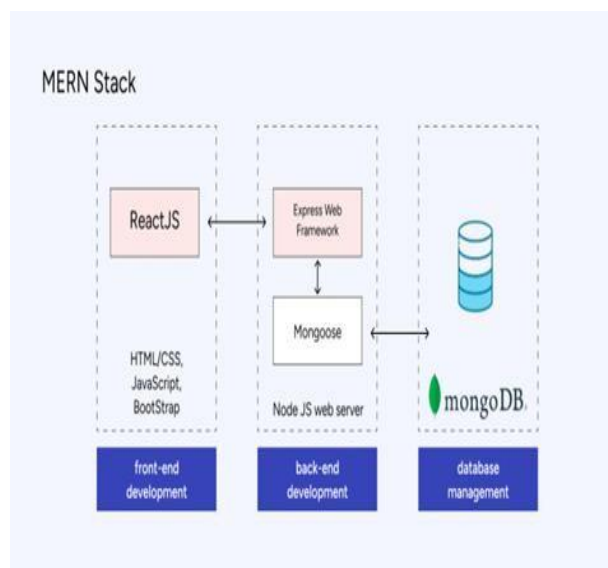


Fig. 2. Technologies Stack

Proposed Work

As we know our application that Online Doctor Appointment System have two major primary panels first is Patient and Second is Doctor Panel. We are using backend server and database for secure database system that is nothing but MongoDB in our application because it is very light weight and secure database.

Patient Panel: This is user related module; any user can interact with this module. It is provided smooth and secure operation for patient. Patient can book appointment online in hospital and get appointment at comfortable time so they cannot waste time for waiting in queue.

Registration and Login by users: New patient can register first with all the required details like name, phone number, email id and they can generate strong password at the time of registration and after that they can login no need to register gain in life.

Security: This application is using authentication and authorization level security. If any wrong user tries to use with any password, they cannot able to login and message will trigger on actual user's mobile number. Authorization means that it will be based on role access suppose that if anyone is patient, they can access only patient related page and doctors can access only doctors related page and same for admin.

Search and Filter: Patient can search the doctor and based on information like specialization, availability, location, fee and time slot. Because may be some doctor will not available that day whatever day patient want to select for appointment and they can filter also based on filtration option like availability or time.

Profile: Patient can see the doctor's profile on line on our application based on rating, degree specialization and slot time. Based on this search they can easily select doctor whatever they want.

Booking: Patient can book appointment online from anywhere in the world but internet is required. As we know internet is available now a days everywhere so patient can book appointment easily from mobile od desktop. They can schedule or select time slots based on their comfortable time.

Status: Patient can track status online via application and message will also trigger on mobile phone and also on email like what is current status of appointment. Doctor is accepted their appointment or not because some time it is possible doctor can reject some appointment to heavy traffic of patient in hospital.

Notification and Reminders: Patient and doctor can get notification on registered mobile number and email id automatically this is beauty of our application and also application send reminder again and again to patient and doctors regarding booking like booking status and cancellation.

Cancellation and Rescheduling: Patient can cancel the booking because some time maybe it is not possible to come to hospital due to some reason and they can reschedule also on other day whenever they want to come hospital and same for doctors also because doctor is also human so may be some time not possible to come hospital then they can cancel and request to patient please reschedule it again.

Profile's management: Patient can update/ delete and add anything related to profile like some time it is possible to change mobile number or email id they can update this information easily and it will reflect immediately on profile page but for this they need OTP on mobile number or email id or some time on both for security purpose.

History of patient: Patients can view past history like appointment records and when the visit last time in this hospital what is doctor name and doctor details and also what was illness type and medicine so it is very important for patient to track their history.

Rating and feedback: Patient can provide feedback with comment and rating to the doctors so it is very useful for others patients. Other patients can check first rating and feedback.

Logout: In the end, patients, doctors and admin need to logout successfully because some time cookies maintain the password and if that is shared system then may be security will get break and someone else can use their profile and update something wrong or they can get some major and secure information about users. This is calling security break so finally everyone has responsibility to maintain this thing seriously.

Doctor 's Panel: Doctor panel is more important here because doctor need to active because some time patient book appointment but they do not receive any mail or message notification about status and remain status is showing pending status so Doctor panel is needed more active to give the response about cancellation or rejection to patient.

Login and Profile Manage: Doctor need to use our application securely because some time someone will not login properly with valid password then may be account will get lock after three attempts because we will have this type of code implementation for security so no anyone can break security with wrong password. They need to manage profile properly need to update correct information on profile may

be sometime valid certificate or evidence because this is related to trust of patient. They need to response properly online in system if anyone book the appointment.

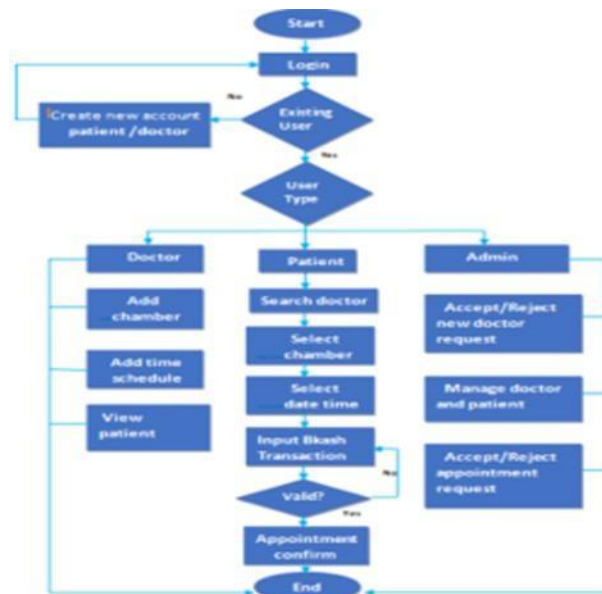


Fig. 3. Panel Details

Appointment Managing: Doctor need to manage appointment properly if they will not available on any day, they need to update in profile so that client will not get any difficulty at the time of booking and sometime may be exceptional because doctor has also human body and sometime may be get some accidental thing so that id different thing it will be acceptable but not every time.

Doctor availability and scheduling: Doctor need to update correctly regarding their availability because if they will not update correctly may be any patient can book the appointment so this type of conflict is not possible in real time. they need to update time to time availability and slot so that overloading just like in hospital term overbooking will not happen.

Need patient details access: They need patient details access in the system so that before consultant they can see patient history and illness type and also previous medicine if they visited earlier. It will really help to them to analyse about patient and it will provide the help to find out real root cause of illness.

Manage notification and mobile alerts: They need to manage notification and alerts on mobile time to time because it is online platform so anyone can book the appointment then need to response but doctor panel like it is booking is accepted or rejected or on hold anything. It is really very beneficial and for patient to get response on time so need to alert every time, our mean 24 hrs. in day because if any patient get proper response, then they can get benefit of online application.

Notifications and Alerts: The system sends automatic notifications to doctors for new appointment requests from patient, confirmations, cancellations, and reminders. This ensures timely awareness and reduces missed or delayed consultations for patient so that is will save time for patient as well.

Report analysis: They need to analyses the report very well regarding patient because some time they have peak time and may be overloaded patient population so need to care about this. It is very important to all doctors.

Feedback and rating access: They need access for feedback and rating what patient is provided because based on that they can work or improve work and patient can get benefit of this.

Correct communication: Doctor need to communicate correctly information with patient regarding appointment so patient will not waste time at hospital so doctor need to update profile again and again like whenever they will available so mentioned that time slot and information.

Successfully Logout: Doctor need to login and log out properly in the system. Need to maintain session and if they will not do anything for some particular of time then automatically session will get log off for security and they need to keep password in mind ne need to write anywhere on notebook because of high security and secure the data always is on high priority in online system.

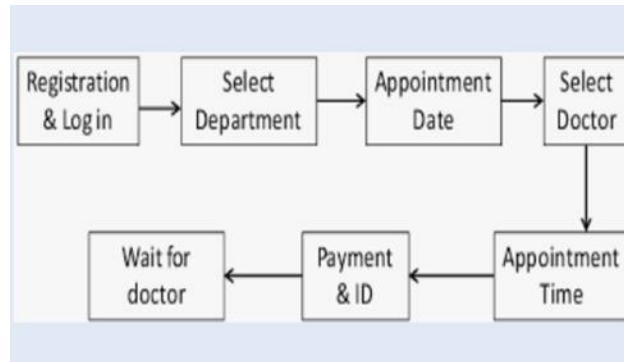


Fig. 4. Registration and book appointment

Admin Panel: This is panel to use our application online to manage administrator related work. What is administrator related work that is nothing but control on the entire system. They need to manage all communication between doctor and patient so in general we can say this is coordinator role they have full access of the application because they need to manage all the thing related to booking appointment.

Login and access: They need access for all application because they need to manage all the things but they also need to aware about security so they can login properly with valid credential otherwise system can lock automatically after three attempts. Some time it will create delay in response because if it will get lock then they need to do unlock the system.

Patient and Doctor Management: They have important role in this application. They can remove any user either doctor or patient. It does not matter totally depend on Admin. Suppose that any doctor will not want to continue with hospital then they need to remove from system and sometime itis happening with patient as well. May be some patient does not login since long time then they need to remove from system.

Information Management: They need to validate information about doctor. Whatever document is uploaded that is correct or not like doctor degree and certificate like doctorate and training certificate. It is totally building the trust of patient and management so no any exception will happen in future.

Monitor and control: They need to monitor appointment of patient, doctor availability, slot of patient, doctor fee, patient details. All the work is related to panel only because they have full access and they need to control on the system and manage properly without any exception.

Configuration: Admin can update all the configuration in the system like when there is any holiday in hospital, doctor time slot, any activities in hospital, how much capacity of the patient in hospital so everything they need to take care and update it time to time. So, any type of conflict will not come in future and patient will also not facing any difficulty regarding time waste and wrong information.

Reports: They need to analyse the report as per monthly basis even they want to analyse day basis that will also fine they need to monitor it closely because if anyone doing anything wrong, they can find quickly without wasting time. Also, they need to monitor doctor feedback and rating whatever provided by patient.

Mortification and communication: They need to monitor these things as well. They need to send reminder again and again if any patient books the appointment via message, mail and even sometime system call also possible. Finally, they have important role to manage communication between doctor and patient.

Data and Data backup: They need to collect all the data correctly and they also need to do backup of the previous data so any patient can ask randomly about history they can provide them easily on time. Because in online system data security is on high priority for everyone. No anyone can want to loss in online system.

Security and Audit: They need to secure all the system so they need to analyse the log time to time and also, they need to guide if anyone doing any mistake because it will help suspicious activities because now a days it is very popular thing hacker want to data from any online platform so this is considered as high priority.

Feedback and Complaint: They need to handle these things as well because in hospital feedback of patient is very important for doctors and hospital management. They need to view feedback if anything wrong then then need to resolve and improve the system so that hospital performance and trust will increase.

System Update: They need to think about future feature so that time to time this application will get updated and new feature will be added in the system. That will improve the trust and management et system what they think.

Logout: Then need to login and log out properly otherwise data can be loss because they have full access and anyone other person can access these data that will break data security and essential data can be leak so they need to keep the password in mind instead to write anywhere on notebook or in mobile and they cannot share data and password with anyone.

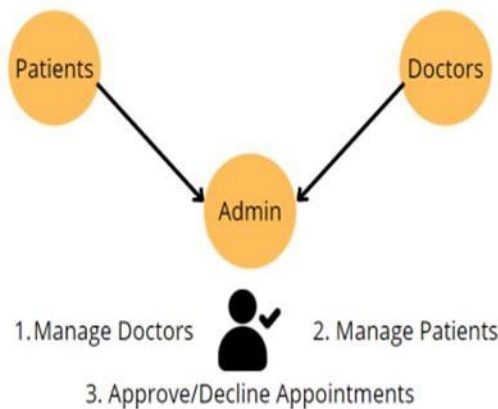


Fig.5. Admin Panel

Advantages Of the System

Online Doctor Appointment System has more advantages compare to manual or semi online platform whatever present in the market. This is developing based on new technologies and we have separate module like front end, backend and database module and as per business level also we have separate module like patient, doctors and panel module. All model is separate to each other and no anyone can disturb to others.

Efficiency: This application has more efficiency because it developed based on new technologies that is very light weight and give high performance. This application cannot stick anywhere online. Anyone can use if they are using internet even in mobile also.

Time Management: This application saves the time of patient because everything can do via online centralize platform because offline patient has to visit direct in hospital to they need to spend more time but now this issue will get resolved cause of this application.

Real time update: Patient can receive real time update on mobile via email and message. Doctor is available or not, they get the information on time because doctor is also human so may be some time at end moment, they will not available because of some accidental reason. If patient book appointment, then doctor is also getting real time update immediately without waiting time.

Notification: If anything is happening in the system, they need to get notification on mobile via email or message because some time hacker also can do this thing using wrong password, they actual users get notification on mobile and they need to change password immediately and any action done by patient or doctor or even admin everyone get notification on mobile immediately without delay.

Data Management: As we know that data is very important of everyone in the world but it was very difficult to manage data without online application and most chance to leaks the data because they maintain in excel sheet or in open register but now it is online so it will maintain in database and we are using MongoDB database so it is very secure data base in today world and without validating data no anyone can insert in database because we are using everywhere validation on filed level. Also, we implemented authorization and authentication so no anyone invalid use can access this application.

Accessible and convenience: This can access anyone from everywhere but internet is required. Wherever internet is available they can access this application even in mobile also and then can book appointment from rural area as well. Cause of this they can save the money also and it is very user-friendly application and page so anyone can create account on this and book the appointment also doctor can create and provide valid document for validation because validation is very important for document. it is not possible to list any fake doctor.

High Performance: As we are using very latest technologies in this system like MongoDB, react and node so these technologies have very high performance and light weight application and user friendly as well so performance wise this application is excellent application and it will work without any issue.

Scalability: They have capacity to increase the user at any moment of time because it is very flexible software and it will more stable as well. It will work anywhere without any issue only thing is this internet is required but as we know now a days everyone has internet in mobile at least. Any new feature can add without changing integration and without affecting current business.

Patient Satisfaction: We are providing notification related facilities so if anyone book appointment and forget the date so in this situation they will get notification again and again on mobile call email, message and call as well that is system call. They have right to provide feedback and rating to doctors. Application can accessible from anywhere in the world. Application is very fast and user friendly Ui page.

Administrative Benefits: Users can get benefit of administrator also because they have job to monitor each thing in the system even, they have full access to view then cannot write any information for doctors and patient but they can view everything about everyone. They establish the communication between doctor and patient as well they monitor the history and rating of doctor and feedback of the patient

Resolved error and improve accuracy of the system: In this application, it is not possible to find any error. 99% is accuracy. Application is more stable user friendly and no any error. Users can use it from anywhere in the world wherever internet is available they can use easily from there. This is error for application and hope no anyone will get any error at any moment of time.

Extensible Architecture: This is extensible architecture because in this application everything separated through module and technology even business as well. At any time if admin want to add any feature, then that is possible in less moment of time and it can easily extend any feature. Already we have planned to AI features in future like receiving call from users and they can do reminder time to time.

Finally, this system is very effective for everyone. users can save the time after using this system and they can also save the money because now a days all users visiting physically in hospital and some time, they do not aware about slots and doctor and they do not have provide any feedback and rating online if they are not satisfied from doctor.

Limitations And Disadvantages of The Existing (Old) System

Manual Booking Process: As we know that in current situation, we have off line of semi online application so it is very difficult to book appointment in any hospital. Patients are visiting physically for appointment booking or on mobile sometime but every time they do not get response on mobile from administrator and again, they need to go hospital directly so it is creating burden on head of patient. Doctor also not able to manage everything off line and not able to track history of patients.

Taking more time: Physically book appointment is taking more time so it is totally time waste but if anyone use our application, they can save the more time to booking appointment. Sometime they need to stand in queue as well for token and number so it is very difficult to stand in queue for long time.

Long time waiting: Some time treatment is not completed even in one day. It is taking more time to stay in hospital or around hospital in any hotel so it is more time consuming. This is increasing frustration in today busy life.

Doctor Unavailability: Most of the time patients do not know about doctor availability and once they reach the hospital then they know that doctor is not available because generally administrator do not response on phone also because they have some other work so they busy in that work as well.

Overbooking: Sometime management receive overbooking so it is very difficult to manage it because suddenly patients come in hospital directly and no anyone can say we do not have capacity today because it will create negative feedback if anyone return without health check from hospital.

Conflict: Sometime appointment also conflicts and wrong data entry by administrator or hospital staff because same person call many times for booking. It is very difficult to enter write data in register.

Poor record entry: Patients records are maintained in register so sometime may be enter wrong entry and wrong data or duplicate date so it is very bigger issue to maintain manually in register. As we know that data security is high priority for anyone but here no any data security maintain.

Data loss risk: Many times, in this situation data get loosed because it is very difficult to write every time correct information in register and sometime may be fire is happened or water fall, they register will loosed and in that time data retrieving is very difficult.

Database absence: There is not centralize database so it is very difficult issue or bigger issue in manual process or sometime in semi online application because they also maintain data in multiple databases. some data online and some data off line.

Human Error: We cannot ignore human error because this is nature of human. Maybe they write wrong information because of busy schedule and may be sometime listening issue. They can sure sometime enter incorrect information about patient and even for doctors also.

Poor Communication: This is more important issue in off line or manual process because patient do not able to call every time for everything and not get real time update like doctor availability and slots of doctor and may be sometime overbooking in hospital. Even sometime patients direct visit in hospital with booking appointment.

Accessibility issue: There is no any option to access everything. If Patients want to see the rating of doctor or feedback of doctor then cannot see because of manual process. Even they cannot track history, how many times they visit in hospital or when last time they visit.

No 24 hrs availability: There is some period of time provide by staff to book the appointment. Patient cannot book appointment whenever they want to book because of time period issue. This is critical issue in current situation.

Increased workload: As we know in manual system there is more work load on staff because everything is done by staff only even some time, they frustrated and not do good behave with patient as well because of more tension.

High Cost: Patient also spend more money to visit hospital regarding appointment booking and hospital management also spending more money on staff. they need to hire more staff because they have to maintain all the things off line in register.

Security issue: There is more security issue in off line or in semi online application because in register no anyone can provide the security so may be possible to leak the information or essential data of patients and doctors even it is applied for management also. This is high critical issue in today life.

Transparency issue: There is not any transparency about doctors. What is qualification, what training they have completed, how much experience they have carried out and what is rating and feedback.

Data analysis issue: Data analysis is very difficult in manual processing system or in semi online application because we can find record at one place or in one database and it is very difficult to find older data in register as well because may be sometime register get loosed or damage and may be accidently destroy it.

Not scalability: We cannot increase additional power immediately at some moment because everything happens off line so manage each and everything is difficult in manual system. We cannot increase resource in a day only it takes some time and if resource increases then they need to spend more money by management and it will increase burden.

Not updated technologies: There is some online application is existing in the market but that is not enough because they are not using modern technologies like react, node and MongoDB.

Patient experience is poor: There is poor experience because everything happens via off line or in multiple tables but there is no centralize database is using cause of this patient feel burden. Sometime they need to stand in queue for long time even we saw in hospital this type of situation.

Future Scope of The System

As we know that full Stack Doctor Appointment Booking System is designed with a flexible and scalable architecture that allows future enhancements and integration of advanced technologies. As medical care continues to evolve with digital transformation, the system can be extended to provide smarter, more personalized and more efficient healthcare services. The following below points describe the potential future scope and enhancements of the system.

AI-Based Doctor Recommendation System: In the future, artificial intelligence can be integrated to recommend the most suitable doctors for patients in this system. By analysing patient medical history, symptoms, past consultations, and doctor expertise, the system can suggest optimal doctors and appointment slots. Machine learning algorithms can improve recommendation accuracy over time, leading to faster decision-making, improved treatment outcomes, and higher patient satisfaction.

Telemedicine and Virtual Consultation Integration: The system can be enhanced to support mobile services like video and audio consultations so that patient will feel easy. This feature will allow patients to consult doctors remotely, reducing the need for physical visits in hospital. Telemedicine integration is especially beneficial for patients in rural or remote areas wherever internet is present in the world, elderly patients, and individuals with mobility constraints. It will be also helping doctors extend healthcare services beyond geographical boundaries.

Predictive Analytics for Smart Scheduling: As we know that by analysing historical appointment data, patient visit trends, and doctor workload patterns, predictive analytics can be implemented to forecast peak hours and demand. The system can automatically suggest optimal appointment schedules, reduce waiting times, and prevent overbooking at same moment of time. Predictive insights can also help hospitals in resource planning and staff management so that they do not need to pay more money.

Mobile Application Development: Developing dedicated mobile applications for Android and iOS platforms can significantly enhance system accessibility. Mobile apps will be allowing patients and doctors to manage appointments, receive notifications, and access healthcare services on-the-go. Push notifications, offline reminders, and biometric login features can further improve user experience and engagement.

Advanced Notifications and Smart Alerts: As we hope that future enhancements may include intelligent notification systems such as push notifications, calendar synchronization and automated follow-up reminders. Patients can receive alerts for upcoming appointments on mobile via message or mail, medication reminders, vaccination schedules, and routine health checkups. We think this type of proactive communication improves treatment adherence and overall healthcare outcomes.

Integration with Hospital Management Systems (HMS): The appointment booking system can be integrated with existing hospital management systems to enable seamless data sharing. Integration with billing, laboratory, pharmacy, and electronic health record systems will provide a unified healthcare platform. This will be reducing data redundancy, improve coordination among departments, and enhance service efficiency.

Advanced Analytics Dashboard for Administrators: A comprehensive analytics dashboard can be developed for administrators to visualize system performance metrics. Insights like patient flow, doctor utilization rates, appointment cancellations, and service efficiency can support data-driven decision-making. Visual dashboards with charts and reports will help hospital management optimize operations and improve service quality.

Enhanced Security and Regulatory Compliance: As we know that in medical care data security becomes increasingly important, future updates can include compliance with global healthcare regulations like HIPAA and GDPR. Advanced encryption techniques, secure data transmission, multi-factor authentication, and audit logging can further protect sensitive patient information and ensure legal compliance.

Multi-Language and Regional Support: As we know that there are multiple languages present in the world even in India also so serve a diverse population, the system can be extended with multi-language support. Users will be able to interact with the system in their preferred language, improving accessibility and user satisfaction. Regional customization like local health guidelines and cultural considerations can also be incorporated.

Integration with Wearable and IoT Health Devices: Integration with wearable devices and Internet of Things technologies can enable real-time health monitoring. Data like heart rate, blood pressure, and activity levels can be analysed to trigger timely appointment recommendations. This feature will be supporting preventive healthcare and early detection of medical conditions.

Cloud Deployment and Scalability: We hope that future enhancements may include cloud-based deployment to improve scalability, reliability, and disaster recovery. Cloud infrastructure will be allowing the system to handle large volumes of users and data while ensuring high availability and performance.

AI-Based Chatbots and Virtual Assistants: As we know that this is very power full in today world that AI-powered chatbots can be introduced to assist patients with appointment booking, FAQs, and basic healthcare guidance. Virtual assistants can reduce administrative workload and provide 24/7 support to patient.

Conclusion

This Full Stack Doctor Appointment Booking System demonstrates the significant potential of new web technologies in transforming and improving medical care services. As we know that by integrating React.js for the front-end interface, Node.js and Express.js for server-side logic, and MongoDB for secure and centralized data storage, the system provides a robust, reliable, and user-friendly platform that caters to the needs of patients, doctors, and administrators. The role-based architecture is ensuring that each user group has access to relevant functionalities while maintaining security and data integrity.

It is very important key strengths of the system is its ability to manage appointments in real-time. Patients can search for doctors based on specialization and availability, book or reschedule appointments online, and receive automated notifications and reminders via email or message on mobile. Doctors benefit from a streamlined scheduling process, reducing the risk of overlapping appointments and improving time management. Administrators also can monitor system activity, manage user accounts, and ensure smooth operation of healthcare services. This integrated approach is reducing manual intervention and administrative workload, making the overall process more efficient and error-free without any exception.

As we know that the system also emphasizes data security and privacy. By implementing secure authentication mechanisms like JWT token and role-based access control, sensitive patient and doctor information is protected against unauthorized access. Centralized storage in MongoDB is ensuring data consistency, easy retrieval, and scalability, allowing the system to handle an increasing number of users and appointments without performance issue.

Despite these advantages, the system does have certain limitations. Its performance is dependent on stable internet connectivity, which may be a concern in rural or underdeveloped regions. In additionally, while the system provides comprehensive appointment management, advanced features such as artificial intelligence-based doctor recommendations, predictive analytics, and telemedicine are not yet

integrated. These features are also further enhancing decision-making, patient engagement, and healthcare efficiency.

Looking ahead, the Full Stack Doctor Appointment Booking System is highly scalable and adaptable. It can be extended to include mobile applications, video consultations, AI-driven analytics, and integration with electronic health records. Such enhancements would not only broaden accessibility but also improve healthcare service quality in hospital and our society, making it a truly modern digital healthcare platform. Finally, overall, this full-stack solution is giving comprehensive, efficient, and practical approach to managing doctor appointments, streamlining workflows, reducing administrative burden, and enhancing patient satisfaction across healthcare institutions.

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