Medical Informatics System for Maternal Care

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Abstract— In big cities, where the population is very large and due to long distances and traffic, travelling is problematic; many times, medical care for pregnant women is a challenge. Further, due to the rush of expecting mothers in various maternity clinics, the concerned doctor is unable to give proper attention to the patients. To minimise this problem, in this paper, an attempt has been made to develop a medical informatics system which can give medical care to expecting mothers during pregnancy and medical care to the newborn child till the immunization schedule is complete.

I. INTRODUCTION

The proposed system can be available on the website of the hospital. It will have a frontend which will have web pages for patient registration, online consultation with doctor and scheduling appointments for offline consultation with the doctor[1]. The medicines prescribed by the doctor can be directly delivered at home by the linked online chemist shop[2]. There will be a webpage providing online videos of exercises which the expecting mother should do for the well-being of herself and her child. There is an option to call an assistant at home for assisting in the regular physical workout and exercises. If the mother is facing some medical emergency during the pregnancy, she can press the emergency button on the website and immediately the doctor and nurse can come home in the telemedicine enabled ambulance. Further the expecting mother can get the diet specific to her pregnancy, if the doctor feels that the expecting mother requires a diet with specific nutrients. As soon as the expecting mother logs into the system, there will be a pop-up with advice and reminders of diet[3], medicines, specific exercises and appointments. There will be an indicator on the website indicating the overall health status of the mother. If it is in the green zone then nothing special is to be done. This webpage will have the option to schedule blood sample collection at home. Additionally, the appointment of ultrasound can be scheduled, and the report can be directly sent to the patient and doctor for evaluation. If required, the doctor can set up a video conferencing call with the patient and advice or call the patient to the clinic. This will be convenient for the patient and the doctor alike. This will also result in reducing the rush at maternity clinics. In future, this medical informatics system can be linked with the medical expert system for primary diagnosis so that any underlying issues may not be missed by the doctor[4]. Thus, an expert system can alert the doctor if there is any variation in the physiological parameter of the patient. This system will also have a backend which will organize all the databases required and maintain them. The control and management of the backend will be with the system administrator of the maternity centre. As the data in the backend is very sensitive, there will be a mechanism for data privacy. To ensure high level system security the data will be stored in the backend server after multi-level data encryptions under the supervision of database administrator (DBA)[5].

This system will feature a deduction in the fees of doctors and other additional service charges at the time of online payment. When the patient logs in initially, maternity centres can provide quality services to the patient at a nominal cost[6].

II. POST DELIVERY CARE

After the delivery of the child, the profile, medical details and parameters of the child can be entered. The system will now give information for the care of newborn children. This system can fix the appointment for the immunization of the child. Further, all the support for recovery of mother will be provided. When the immunization schedule of the child is complete, then an appointment is set up for complete checkup of the mother and child. Additionally, all the encrypted databases of the mother and child can be archived if need be. Therefore, this system can be helpful in providing healthcare to the mother and child with intelligent use of information and communication technology (ICT).[7]

III. TECHNICAL ASPECTS

This technical report consists of a detailed overview of the *medical informatics system for maternal care*. It is a full-stack web application made to give medical care to expecting mothers during pregnancy and to the newborn child. This report gives details about the technologies used in frontend and backend, its implementation, maintenance of

the database, reason for choosing these technologies and the challenges faced during development of this project[8].

Technology Stack

The Maternity Management System is built using the following technology stack:

- **Frontend -** It is made using React and Tailwind CSS. React is a JavaScript library used for building interactive user interfaces and CSS frameworks are used for UI development.
- **Backend -** It is made using Node.js and Express.js**.** Node.js is a JavaScript runtime environment for building server-side applications and Express.js is a Node.js framework which provides more features for web applications.
- **Database –** It is a NoSQL database which provides high performance and easy scalability.

Advantages of Chosen Technologies

- **React:** React provides code reusability and maintainability (by breaking down the UI into its independent components). It enhances the performance by updating only the necessary parts of the DOM and provides access to a vast library of tools.
- **Tailwind CSS:** The utility classes in Tailwind CSS allows users quick styling without writing CSS for many common styles. It offers large configuration options to make design specific frameworks. Removes unused CSS classes automatically, resulting in smaller CSS file.
- **Node.js:** It allows code sharing between the frontend and backend. It handles a large number of concurrent connections efficiently, making it suitable for real-time applications. It provides access to a large collection of open-source packages and libraries. Also, it is designed for handling increasing user loads and data traffic.
- **Express.js:** It provides necessary features for building web applications without forcing programmers to follow a set of rules or a specific way of doing things. It helps programmers to easily set up different paths in the app and handle requests. It makes it easy to add new features by using reusable pieces of code, known as middleware function.
- **MongoDB:** MongoDB can handle a large amount of data and traffic by spreading the load across multiple servers. It is easy to work with and it stores data in a format similar to JSON. It is fast and efficient, providing quick searching and retrieval[9].

1. Frontend Functionalities

The frontend is built with React and styled with Tailwind CSS. This provides the user interface for the Maternity Management System. The key pages and their functionalities are detailed below:

- **Create Account Page** – This page allows users to register on the system. It also includes the link to login if the user is already registered. It contains input fields for essential user details such as name, email address and password. It has a button to create an account. Upon submission, the entered data is validated on the frontend, if it is valid then a request is sent to the user registration API to create a new user account in the database. Successful registration redirects the user to the home page.
- **Login Page** – This page allows users to login on the system if the user is already registered. A link to create an account is given if the user is not registered. It contains input fields for registered email Id and password.: Upon submission, the entered credentials are sent to the backend API for authentication. If the credentials are valid, the backend returns a session token or sets a cookie, granting the user access to protected routes. Successful login redirects the user to the home page. Error messages are displayed for invalid credentials.
- **Home Page** – This page Serves as the central dashboard. It has certain elements like Welcome message personalized with the user's name, quick access to other pages such as all doctors page, contact us page, about us page, create account button . For logged in users, this page provides an additional link to the book appointment page, my appointments page and logout button instead of creating an account button.
- **About Page** – This page provides information about the Maternity Management System, its goals, and the team behind it. It helps in building trust and provides context about the application.
- **Contact Page** – This page allows users to get in touch with the system administrators or support team. It enables users to report issues or provide feedback. It has a link to feedback form. On submitting the form, it sends the message to the designated administrators.
- **All Doctors Page** - This page displays a comprehensive list of all registered doctors specializing in maternity care. This page contains each doctor in a card which has details such as doctor's name, profile image, speciality, experience, availability status, educational qualification, about and fees. On the left side it has the list of specialities from which all doctors of that speciality would be displayed. This allows users to browse and find suitable doctors based on their specific needs and preferences. Clicking on a doctor's card navigates to their detailed profile and booking options.
- **Appointment Booking page** – This page enables users to view a specific doctor's detailed profile and book an appointment. It contains Detailed information about the selected doctor which was the expanded view of the information on the "All Doctors" page, available calender and time slots option to select a preferred date, and time slot for booking and book appointment button. It also displays the related doctors based on the above doctor's speciality below the book appointment button.
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- **My Appointment Page** – This page allows logged-in users to view and manage their booked appointments. For each appointment, it contains details such as doctor's name, profile image, selected date and time. A cancel appointment button is also created for upcoming appointments. This provides users with a clear overview of their scheduled appointments and the ability to cancel appointments if needed. Clicking the "Cancel Appointment" button triggers a request to the backend to update the appointment status in the database.

2. Backend Functionalities (APIs)

Node js and Express js are used for implementing backend. The following functionalities are given below and their APIs

- **Registration of the users** – The API uses the post method and handles the registration of the users if the account does not exist. This uses the json data details containing name, email, password. If the user is already registered, then it gives an alert message that the user already exists and has strong password functionality. This data is stored in MONGODB as the collection of users. In the database the hashed password is stored to maintain the user's privacy. API address used /api/user/register.

- **Login of the users** – The API uses the post method and handles the login of the users if the account already exists. This uses the json data details containing the user's email id and password with which she had registered earlier. The api matches the email id as well as hashed password stored in the users database from the user's email id and password. If the registered email id or correct password is not used then api throws the error of invalid credentials. Upon successful authentication it generates a session token using JWT which is used as the token for user's functionality. Returns a success response with the session token with status code 200 or error response with a status code 401 for invalid credentials. API address used /api/user/login.

- **Logout** – This simply uses the token generated when the user logged in. This makes the token to be false upon clicking the logout button. Due to unavailability of token, then users logged out of the page

- **Adding doctors** – This API uses the post method, allowing admin to add new doctors' profiles to the system. This uses the json data details containing doctors' details like name, speciality, experience, availability, education, about, fees etc. This data is stored in MONGODB as the collection in doctors. The API returns the success response with status 201 upon successful addition of the doctor's valid details and error response with status code 401 upon invalid data. API address used /api/add-doctors along with admin token

- **Getting doctors details** – This API uses the get method and docId for displaying the details of a particular doctor. This API may or may not require authentication. The unique identifier used to get a particular doctor which is docId. The API queries the doctors collection in MongoDB for a doctor with the matching docId. This returns a JSON Object containing the doctor's details with the status code 201. Also returning the error response with status code 401 , if DocId does not match . API address used /api/doctors/:docId .

- **Appointment Booking** – This API uses the post method and handles the booking of the appointment slots. This uses the json data details containing userId, docId, slot_Time , slot_Date . It contains user authentication which uses the session token. This API checks if the requested time slot is available for the specified doctor and stores the data in MongoDB collection as appointments. It returns the success response with status code 201 upon successful booking and error response with status code 401 if the slot is unavailable or data is invalid. The API address used /api/book-appointment.

- **Users Appointment details** – This Api uses the get method and retrieves the list of appointments for the currently logged in user. It requires user authentication. The API extracts the userId from the session and queries the appointments collection in Mongodb to find appointments associated with the userId. Returns the array of appointments upon success response of the API . The API address used /api/my-appointments.

- **Cancel Appointment** – This API uses the Delete method and handles the cancellation of a specific requirement by the user. This uses user authentication. AppointmentId is used as the unique identifier for cancellation. The API validates the appointmentId and ensures the requesting user owns the appointment followed by updation of status of appointment in the my appointment page. Returns a success response with status code 201 upon cancellation of appointment and error response with status code 401 if the appointment is not found or the user is not authorized. The API address used /api/appointments/:appointmentId/cancel

- **Related Doctors recommendation** – This API uses the get method and recommends doctors with the same speciality while booking the appointment for a particular doctor. Doctor's Speciality is used as a special parameter to find related doctors. The API queries the doctor collection in MongoDB to find related doctor excluding the currently viewed doctor. This returns the json array of doctors upon successful response of the API. The API address usec/api/doctors/related/:speciality[10].

3. Database Functionalities (MongoDB)

MongoDB is used to store the application's data. The key collections and their structures are detailed below:

- **users Collection:** Stores information about registered users (expectant mothers).
- **Doctors Collection:** Stores information about registered doctors.

- **appointments Collection:** Stores details of booked appointments.

The Home Page is the main entry point for users, which provides a clear interface for both registered and unregistered users. Unregistered users are presented an option to create their account or log in, while registered users are greeted with a welcome message and a navigation menu. These features include the All Doctors page, where users can select doctors of their choice, the My Appointments page for managing scheduled checkups, the About Us page is for the information about the platform, and the Contact Us page for support inquiries. The users which are not registered, don't have the feature to book appointments and manage their appointments[12].

The All Doctors page makes it easy for users to find and choose the right doctor. Each doctor's profile gives an overview about their speciality, years of experience, availability, qualifications and consultation fees. For helping users find the doctors with particular specifications, this page includes filters for fees, years of experience, availability and more with a sorting feature to arrange specifications in increasing or decreasing order. There's also a search bar for finding doctors by their name or speciality[13].

When a doctor's profile is clicked, a detailed page opens where users can know more about the doctor.

ER Diagram
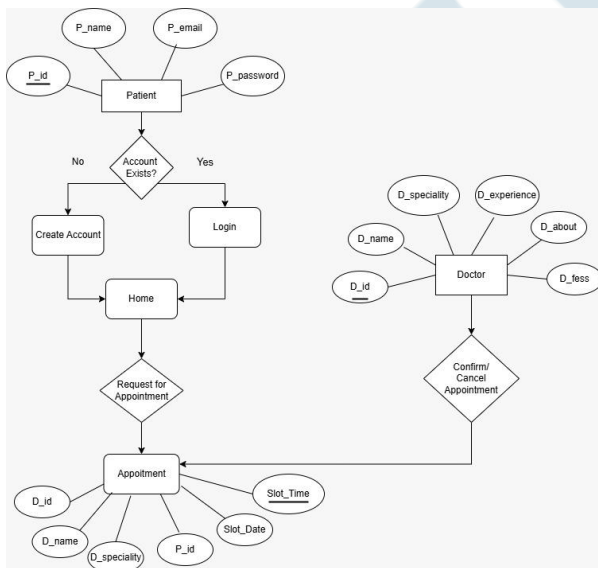
Figure. 1
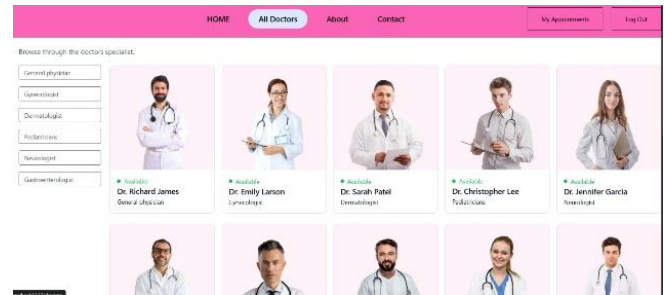
Figure. 2

IV. FUTURE WORK

In the future, an attempt will be made to incorporate the modules for the video conferencing, online payment and accounts and linking the system with the online chemist[14]. Further, when this medical informatics system is complete as a website then the mobile app of this system will be developed which can be installed on mobile phone or tablet for use[15].
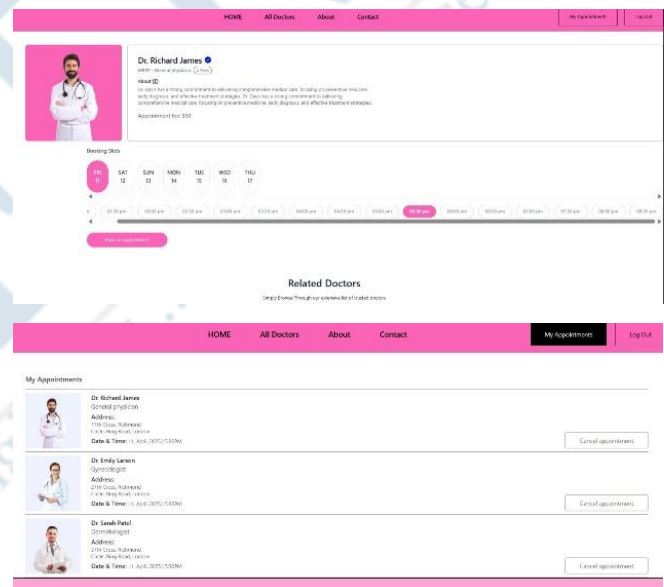
Figure. 3

V. CONCLUSION

This medical informatics system can be used for giving healthcare to the masses through the schemes of government like Matri-Suraksha etc[16]. Hence, this system with telemedicine and ICT can be very beneficial for the masses and people who are unable to afford good medical care for expecting mothers. This system can be applied to privately owned medical centres and even government maternity centres[17]. Thus, by developing this medical informatics system, maternal care can be given to tribal areas and other disadvantaged areas across India. This system can very easily be linked with medical expert system and well as telemedicine services and systems by ICT [18].

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