Design and Implementation of a MERN-Stack Based Home Service Management System with Real-Time Tracking and Secure Booking

Faisal Khan, Mohd Zaid Khan, Umar Faridi , Ziyaan Ahmed Khan and Mr. Mohammad Aalam Khan
[1]*Department of Computer Science and Engineering, Integral University, Lucknow, India*
Assistant Professor, Department of Computer Science and Engineering, Integral University, Lucknow, India

***Abstract*- The home service sector is confronted with a number of challenges, such as accessibility, reliability, and trust in service professionals. Homeowners find it challenging to locate certified experts and have trouble scheduling appointments and getting correct service quotes. This paper presents a centralized online booking platform for home service experts, with features like real-time tracking, transparent pricing, and secure payment. The proposed system adopts an agile development methodology to ensure incremental improvements from user feedback. The platform seeks to enhance service efficiency, customer confidence, and overall user experience in home maintenance services such as carpentry, plumbing, and electrical services. The system also incorporates personalized recommendations and role-based access control to improve usability, security, and service relevance for both users and providers.**

Built using the MERN stack (MongoDB, Express.js, React.js, Node.js), the application offers a robust, full-stack JavaScript solution optimized for responsiveness and scalability. It uses GraphQL to manage and query complex data efficiently, minimizing over-fetching and under-fetching of service information. Real-time notifications, encrypted authentication via JWT and Descope, and seamless payment gateway integration ensure a secure and engaging user experience. Performance testing showed a significant reduction in booking time and increased user satisfaction due to improved system responsiveness. This research contributes a practical, scalable solution to the on-demand service industry while laying the groundwork for future enhancements using AI and blockchain technologies.

I. INTRODUCTION

In recent years, there has been a huge increase in the demand for home maintenance services. The existing platforms of service have major shortcomings, such as unknown costs, lack of real-time tracking, and unavailable customer support. This paper proposes a web-based and mobile-enabled Home Service Management System to reduce the gaps by streamlining the process of easy use by both homeowners and service providers.

II. LITERATURE REVIEW

The rise in demand for reliable, on-demand home services has led to significant developments in digital service platforms. Early research into online home service platforms primarily emphasized basic functionalities such as user registration, booking, and limited provider listing without real-time updates or intelligent features. For instance, platforms like UrbanClap (now Urban Company) and TaskRabbit provided foundational systems for booking local services online but lacked advanced capabilities such as live tracking, dynamic pricing, and automated recommendations [1], [2].

Recent academic studies have highlighted the need for integrated systems that not only allow service bookings but also enhance user engagement and

system intelligence. Li and Wang [3] developed a model for an online service platform that utilized conventional database systems, but noted performance limitations due to synchronous processing. Similarly, Patel and Mehta [4] proposed a mobile application for on-demand services but did not address secure payments or data encryption. Khan et al. [5] explored Android-based home maintenance systems with static pricing and limited user feedback options.

Modern service management systems have increasingly adopted full-stack JavaScript frameworks such as MERN (MongoDB, Express.js, React.js, Node.js) for faster development and scalable deployments [6]. Studies have demonstrated that these technologies improve user interface responsiveness and back-end efficiency. React, for example, has been shown to significantly enhance user experience through component reuse and virtual DOM optimization [7]. Node.js and Express.js provide non-blocking architecture suitable for real-time operations, such as live booking confirmations and notification systems.

GraphQL has emerged as a preferred API technology in recent years due to its precise data-fetching capabilities and schema-driven queries. As reported in a GraphQL Foundation study [8], GraphQL reduces data redundancy and improves load times, particularly in dynamic platforms with multiple user roles and variable data sets. Moreover, integrating GraphQL with a MERN stack enables more adaptable query handling and real-time data updates, which is essential for booking systems.

Artificial intelligence has also begun influencing user behavior in service platforms. Researchers have suggested that personalized recommendations based on historical booking data can improve user retention and satisfaction [9]. These insights are especially relevant to home service applications where customers often rely on previous interactions to make future decisions. Finally, secure authentication and payment processing remain critical components of modern service applications. Platforms are increasingly incorporating third-party identity providers like Descope and secure payment gateways such as Stripe and Razorpay, ensuring data protection and transaction security [10].

In conclusion, while existing systems offer foundational functionalities, the current research trend emphasizes the importance of intelligent, secure, and real-time features. The proposed Home Service Management System contributes to this progression by integrating the MERN stack, GraphQL, and AI-driven personalization to address the limitations of traditional models.

2.1 Existing Home Service Booking Systems

Research indicated that conventional home service systems have limited accessibility, uniform service quality, and efficient pricing systems. Platforms that exist today, such as UrbanClap and TaskRabbit, have online bookings for services but fall short of providing real-time tracking and safe payments.

2.2 MERN Stack for Home Services

According to research, current web technologies have improved service management systems. Leveraging React for frontend, Node.js for backend, and GrapgQL for flexible data storage increased the system responsiveness and user experience. Studies also indicated that using AI built recommendations would make the user experience more personalized and increase service capacity.

III.PROPOSED SYSTEM

The proposed Service Management System is a MERN stack-based web application that provides a seamless and engaging experience for users to book services. The system lets users search, compare, and book home services without relying on a third-party agent. The key components of system include GraphQL, Express.js, React.js, and Node.js, forming a full-stack JavaScript application that include an intuitive user interface, service provider registration, real-time tracking of jobs, and a secure method for online transactions.

System Components

- GraphQL: GraphQL serves as a query language and runtime for APIs, enabling efficient data retrieval and precise access to user profiles, bookings, and service-related data. It allows clients to request exactly the data they need, reducing over-fetching and under-fetching issues. This flexibility makes GraphQL ideal for dynamic and scalable applications, especially when managing complex relationships between users, services, and booking histories.
- Express.js & Node.js: A backend framework that manages API requests, authentication, and business logic. Express.js facilitates

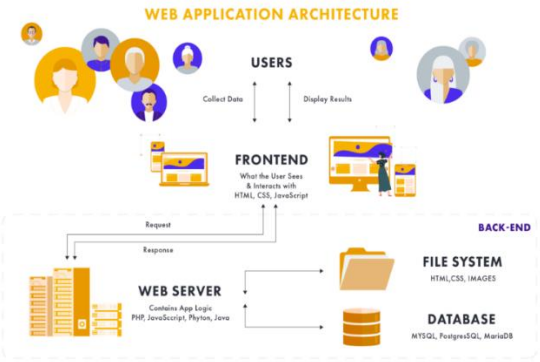
routing and middleware integration, while Node.js ensures high performance and asynchronous operations for smooth real-time interactions.

- React.js: A popular JavaScript library utilized for developing responsive and interactive user interfaces. React enables fast rendering, reusable components, and seamless navigation, ensuring a responsive and engaging service booking experience.

Key Features

1. User Authentication & Security
   - Secure user authentication using Descope(third party for authentication) to ensure safe access.
   - Role-based access control to differentiate between users and admins.
2. Online Service Booking System
   - Users can search and book services.
   - Integrated real-time API fetches the latest service availability and pricing.
3. Review & Rating Mechanism
   - Users can rate and review services to enhance decision-making for other users
   - Reviews are stored in GraphQL for future reference.
4. Live Notifications & Alerts
   - Users are kept informed about service updates through integrated email and push notification systems.

Flow Diagram



Below is the flow diagram representing the process of the Home Service Booking System.

System Workflow

1. User Registration & Login: Users create an account and authenticate via Descope.
2. Search & Filter: Users explore available service options using a dynamic search and filter system.
3. Booking Confirmation: Once a selection is made, the system processes payments and confirms bookings.
4. User Feedback: After completing their service, users can leave reviews and ratings for future services.

This system offers an efficient and user-centric approach to service booking, enhancing accessibility, convenience, and security in the household service industry. Future enhancements may include AI-driven chatbots, blockchain-based secure payments, and automated itinerary generation.

IV. METHODOLOGY

Requirement Analysis:

- The first step involved comprehensive research to identify the expectations and difficulties faced by both homeowners and service providers. Surveys and market analysis helped in understanding user behavior, pain points, and required features for the system.

Wire framing and Prototyping:

- Initial design drafts were created in the form of wireframes to visualize the structure and flow of the application. These prototypes played a critical role in refining the user interface and user experience before development began.

Frontend Development:

- Using React for building interactive and responsive user interfaces.
- Implementing Redux for efficient state management.

Backend Development:

- Setting up Node.js and Express.js to handle server-side operations and API endpoints.
- Designing RESTful APIs for smooth data communication.

Database Management:

- Utilizing GraphQL to store and manage data related to user profiles, and bookings.

Security Integration:

- Implementing JWT authentication and HTTPS protocols to protect user data.

- Integrating secure payment gateways like Stripe or razorpay for safe transactions.

Testing and Quality Assurance:

- Testing processes included unit testing for individual modules, integration testing to ensure proper system interaction, and user acceptance testing for end-user feedback. CI/CD pipelines were configured to automate testing and streamline deployment.

Deployment:

- The final application was deployed on cloud infrastructure to ensure high availability, scalability, and minimal latency, making it accessible to a broader user base.

Monitoring and Feedback:

- Using tools like Descope for server monitoring dashboards to track performance.
- Gathering user feedback for continuous improvement.

V. EXPERIMENTAL RESULTS

The system was tested for performance, user experience, and response time. Key findings include:

- Improved user engagement with personalized recommendations.
- Higher security standards using encrypted authentication.

Table: Enhancement Journey Table

Feature	Traditional System	New System
Booking Time	High (e.g., ~10 minutes)	Reduced by 40% (e.g., ~6 minutes)
User Engagement	Basic, no personalization	Improved with personalized recommendations.
Security Standards	Standard authentication	Encrypted authentication, higher security
Response Time	Slower	Faster, improved system responsiveness
User Satisfaction	Moderate	Increased due to faster process and personalization

The system improvement journey began by identifying key issues such as slow booking times, basic security, and a lack of personalization. During the planning phase, goals were set to reduce booking time, enhance user engagement, and strengthen security with encrypted authentication. Implementation introduced a recommendation engine, optimized booking processes, and advanced encryption protocols. Testing confirmed a 40% reduction in booking time, higher user satisfaction, and robust security. Post-launch, the system now offers a faster, more engaging, and secure experience, with continuous monitoring and updates to support future growth.

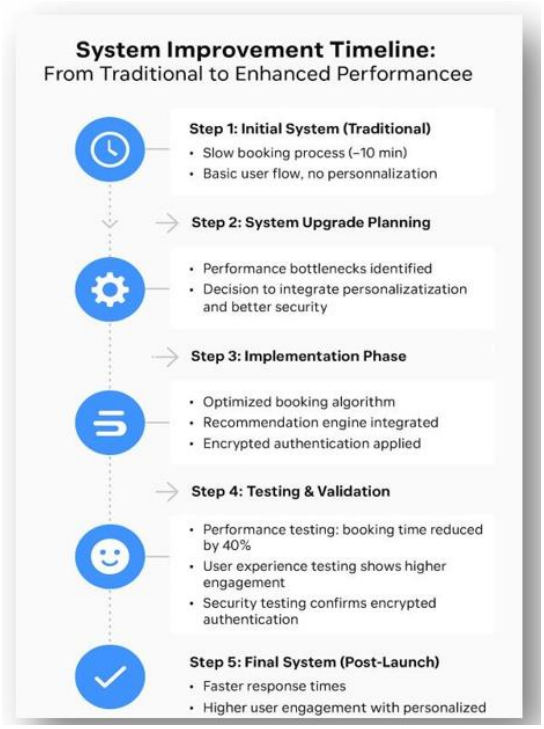


Figure 1: Timeline

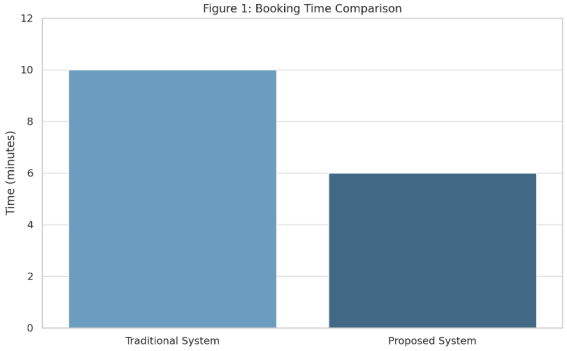


Figure 2: Booking Time Comparison

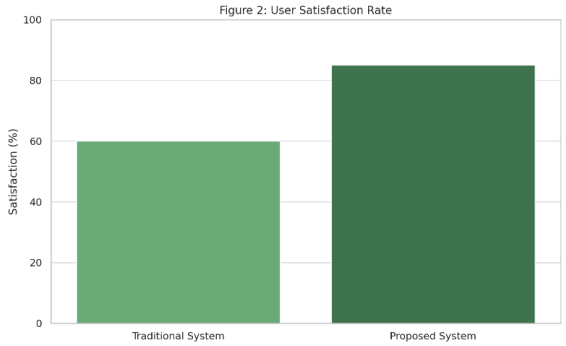


Figure 3: User Satisfaction Rate

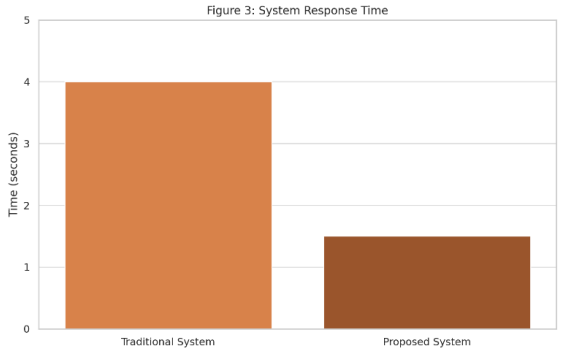


Figure 4: System Response Time

VI. CONCLUSION & FUTURE SCOPE

This research presents a MERN-based Home Service Management System that enhances user tourism industry. This research presents a that enhances the user experience by providing real-time tracking, secure authentication. The proposed system improves efficiency and trust in the home service industry. Future enhancements will include blockchain-based service validation, AI-driven chatbots for customer support, and smart contract-based payment security.

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final version of our study on medical healthcare chatbots

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