



Enhancing Doctor Appointment Systems with Adaptive Rescheduling for Rural and Urban Clinics: BookMyDoc

¹Shaikh Mazz Mohammad Oomair, ²Vashi Diya Jitendrabhai, ³Patil Prerna Pravin,

⁴Pathan Safvan Khan Bismilla Khan, ⁵Jitendrakumar B Upadhyay

¹PG Student, ² PG Student, ³ PG Student, ⁴ PG Student, ⁵ Asst. Professor

¹Shrimad Rajchandra Institute of Management & Computer Application Uka Tarsadia University, Bardoli, India

ABSTRACT:— Traditional appointment management in clinics often struggles with inefficiencies in appointment scheduling, record-keeping, and patient flow, especially in smaller medical facilities. Many existing healthcare systems prioritize large hospitals, leaving small and rural clinics without efficient digital support. These clinics rely on manual appointment handling, leading to long queues, delays, and unstructured record management. In this research paper, we analyze these challenges, referencing existing clinic systems and insights from a doctor's survey. Our system addresses these gaps by introducing features like automated rescheduling, real-time queue management, and role-based analytics, overcoming the limitations of existing clinics and enhancing overall efficiency.

Keywords— *Appointment scheduling, Clinic management system, Flutter, Firebase, Role-based access, Queue management, Predictive Analytics, Adaptive Development Model, Receipt Generation.*

I INTRODUCTION

Traditionally, doctor's appointment booking relied on manual registers, long waiting queues, and phone-based scheduling, often leading to inefficiencies and delays. Patients, including those requiring urgent care, had to visit clinics in person or wait for an available time slot, making the process inconvenient and time-consuming. The need for structured appointment management became evident as healthcare services expanded, and digital transformation emerged as a solution to enhance clinic efficiency.

While large hospitals have benefited from sophisticated healthcare management systems, small clinics, particularly in rural areas, often lack access to such solutions. Most existing digital platforms are designed for multi-specialty hospitals, focusing on large-scale operations rather than the simpler yet crucial needs of smaller clinics. As a result, many clinics still depend on manual appointment scheduling and paper-based records, leading to administrative inefficiencies, long patient wait times, and difficulty in handling emergency rescheduling.

A field survey conducted with a practicing doctor reinforced the urgent need for a streamlined digital solution tailored for clinics. Many existing systems, such as the Online Clinic Management System by Teke et al. [2] and Web-Based Clinic Management by Muhammad et al. [6], provide appointment booking and record-keeping but lack real-time tracking, automated queue management, and structured patient record handling. These missing features make them insufficient for small clinics, which require a more intuitive and lightweight approach to digital transformation.

Addressing these limitations, BookMyDoc integrates real-time appointment tracking, dynamic rescheduling, and automated queue management to create a seamless and structured clinic workflow. Unlike existing systems, it provides role-based analytics to help doctors balance their workload, admins monitor clinic efficiency, and staff manage patient appointments more effectively. By leveraging intelligent scheduling and workflow automation, BookMyDoc ensures a patient-friendly and efficient clinic management experience.

This research paper analyzes the evolution of clinic management systems and their impact on appointment scheduling. Section 2 discusses the literature review, comparing previous research and identifying gaps in existing solutions. Section 3 details the proposed system development, covering the tools, technologies, methodology, distinctive features and illustration of process relevant to appointment, used to build BookMyDoc. Section 4 discusses future enhancements, outlining improvements that can further refine the system. Finally, Section 5 concludes by summarizing the study's contributions to digital healthcare transformation.

II LITERATURE REVIEW

Several studies have attempted to automate clinic management, focusing on appointment scheduling and patient data handling. Ismail et al. [1] developed a Medical Appointment Application to reduce receptionist workload, but it lacked real-time availability tracking and cancellation management.

Similarly, Teke et al. [2] introduced an Online Clinic Management System with centralized patient records, improving data handling but failing to integrate telemedicine and automated prescription generation. Malik et al. [3] attempted to enhance doctor-patient connectivity through an Android-based scheduling system, but the absence of automated reminders led to a high no-show rate.

Security and scalability remain key concerns in healthcare management. Muhammad and Garba [6] proposed a PHP and MySQL-based system but lacked mobile integration and real-time synchronization.

Bhagat et al. [5] demonstrated how Flutter and Firebase improve accessibility, offering real-time updates and secure authentication. Nishanthan et al. [8] emphasized the importance of encryption and role-based access control, while Akingbade and Onwuasoanya [9] highlighted the need for AI-driven appointment scheduling. Future enhancements, including AI-powered scheduling, telemedicine, and automated billing, will further optimize healthcare management, as suggested by Nishanthan et al. [8].

Table I Comparison Table of Existing Systems 1

Authors	Login System	Appointment Booking	Doctor Availability
Ismail et al. [1]	Patients & Doctors	Yes	No
Teke et al. [2]	Patients & Admin	Yes	No
Malik et al. [3]	Patients & Doctors	Yes	No
Rallapalli et al. [4]	Patients & Doctors	Yes	Yes
Bhagat et al. [5]	Patients & Doctors	Yes	Yes
Muhammad & Garba [6]	Patients & Admin	Yes	No
Pise et al. [7]	Patients & Doctors	Yes	No
Nishanthan et al. [8]	Patients & Doctors	Yes	Yes
Akingbade & Onwuasoanya [9]	Patients & Doctors	Yes	No

Table II Comparison Table of Existing Systems 2

Authors	Notifications	Security & Auth.	Unique Feature
Ismail et al. [1]	No	Basic	Appointment Booking
Teke et al. [2]	No	Basic	Patient Data Management
Malik et al. [3]	No	Basic	Mobile App
Rallapalli et al. [4]	Yes	Role-based	Doctor Ratings & Profile
Bhagat et al. [5]	Yes	Firestore Auth	Flutter & Firebase Integration
Muhammad & Garba [6]	No	Basic	Web-based CMS
Pise et al. [7]	No	Basic	User-friendly UI
Nishanthan et al. [8]	Yes	Role-based	Secure Data Storage
Akingbade & Onwuasoanya [9]	No	Role-based	Medical Database

We conducted a survey among doctors from clinics in Navsari, Bardoli, Amalsad (Gujarat), and nearby rural areas to understand their challenges in managing appointments, patient queues, and medical records. Many doctors reported issues like long wait times, overcrowding, and the inefficiency of paper-based records. Over 70% believed that a digital system could improve clinic operations, especially in small and rural setups.

Our survey also covered COVID-19 experiences, where doctors shared insights on common symptoms, changes in patient visits, and safety measures they implemented. Additionally, we explored financial and administrative challenges, patient education methods, and the future role of technology in clinics. These findings guided the development of BookMyDoc, ensuring it meets the real-world needs of small healthcare facilities.

III PROPOSED SYSTEM DEVELOPMENT PROCESS

A. Development Tools

Several existing clinic management systems have faced challenges in scalability, real-time synchronization, and cross-platform accessibility due to limitations in their technology stack. Many traditional systems rely on PHP-MySQL or standalone web-based architectures, which often lack real-time updates and seamless mobile compatibility[6]. To overcome these issues, we analyzed various frameworks and concluded that Flutter, with its cross-platform capabilities and Firebase Firestore's real-time database, best suits the requirements of our system.

Our system is developed using Flutter as the toolkit, with Dart as the programming language and Firebase Firestore for database management. Development is carried out in Android Studio and Visual Studio Code, while diagrams are created using Lucidchart and Draw.io (diagrams.net). Version control is managed through Git (GitHub) to ensure efficient collaboration and code tracking.

The methodology behind the implementation of our system is further discussed in sub section B.

B. Methodology

We need a structured model to ensure efficient, adaptive, and well-organized system development. A model helps streamline the process by defining clear phases, integrating essential features at the right stages, and allowing continuous improvements. In healthcare applications, where real-time updates, security, and user-centric functionalities are critical, a tailored approach is necessary to meet evolving requirements seamlessly.

To achieve this, we have developed the Adaptive Spiral-based Feature Implementing Model of BookMyDoc, specifically designed for our system. As shown in Figure 1, this model follows a structured yet flexible approach, addressing core system needs at each phase. It begins with requirement analysis, identifying user challenges and goals, followed by system design & planning to structure architecture and data flow. Feature implementation & testing introduces core functionalities like secure appointments and analytics, while real-time data integration ensures seamless synchronization via Firebase Firestore. The process concludes with continuous evaluation & enhancement, incorporating user feedback for ongoing refinements.

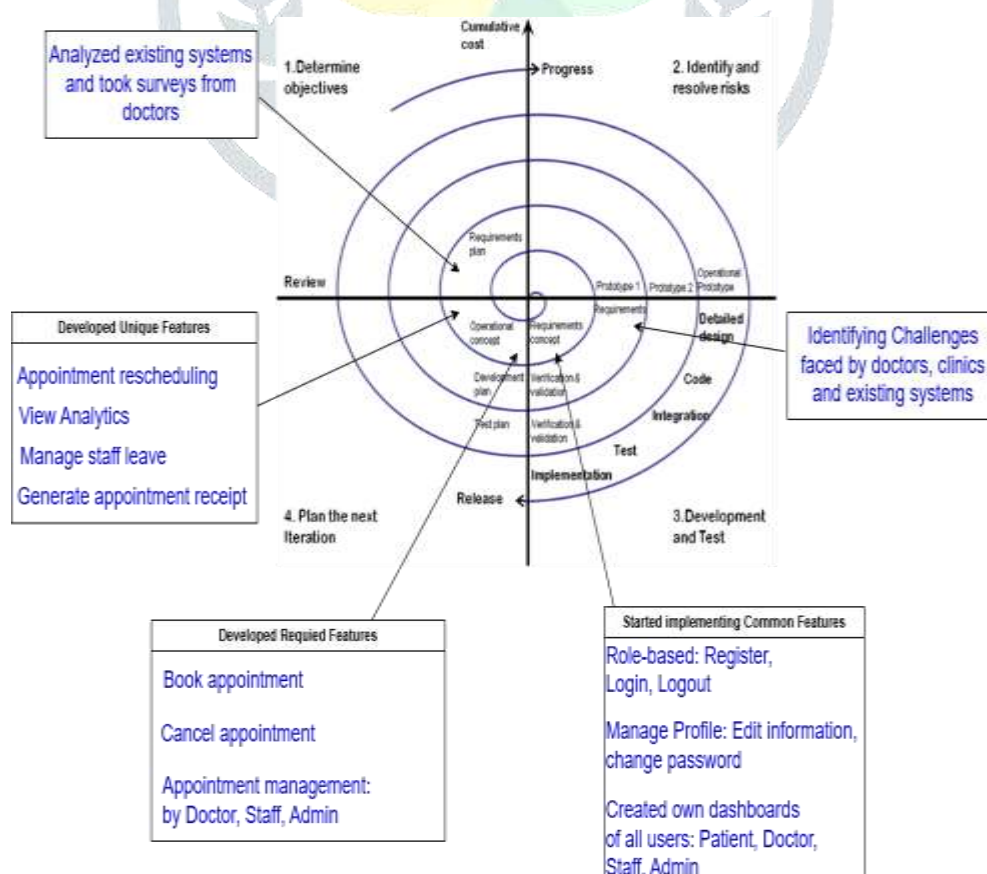


Fig. 1. Adaptive Spiral-based Feature Implementing Model of BookMyDoc

This methodology ensures our system remains scalable, responsive, and user-friendly. Unlike rigid models, it allows iterative improvements, real-time processing, and secure role-based access, making it ideal for modern healthcare applications. By following this structured approach, we create a robust clinic management system that adapts to dynamic healthcare needs efficiently.

The system is role-based, catering to Admins, Patients, Doctors, and Staff, each interacting with different system components. The UML-based role-access diagram (Figure 2) illustrates these interactions, where each user performs designated tasks linked to relevant database collections. Patients can book appointments, provide ratings, and manage receipts, while Doctors handle appointment confirmations. Admins oversee staff management, and Staff can request leaves. The centralized database ensures seamless data flow between entities, optimizing real-time clinic operations.

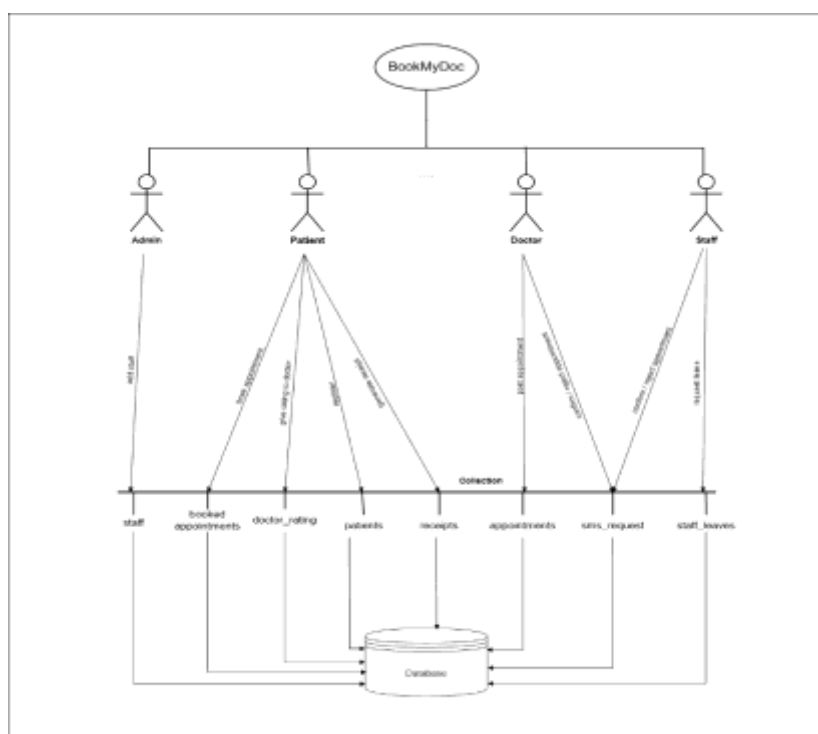


Fig. 2. System Connectivity with database in BookMyDoc

By adopting this adaptive methodology, *BookMyDoc* ensures a modern, efficient, and patient-friendly clinic management solution. The unique features developed through this process are elaborated in sub section C.

C. Distinctive Aspects of Proposed System

Existing systems lack data-driven insights, flexible rescheduling, and patient engagement features, as analyzed in Table 1 (Existing System Comparison Table). Our system introduces role-based analytics, where admins view last 7 days' appointment trends, doctors see next 7 days' workload, and staff analyze appointment status and attendance pie charts. The advanced rescheduling system allows patients to request changes, while doctors, staff, and admins manage approvals. Patients can rate doctors, enhancing service quality. A receipt generation and cancellation feature ensures seamless transactions. Multi-level appointment management allows doctors to post and manage appointments, staff to assist in scheduling, and admins to oversee everything. Each role has distinct functionalities, ensuring an efficient, role-based clinic management system.

D. Illustrating BookMyDoc's Capabilities

Our system includes essential features like login, registration, profile updates, and password management. The key focus is appointment management, ensuring seamless booking, cancellation, and emergency rescheduling. The following screenshots illustrate this process.

Patients can book appointments by selecting an available date and time, ensuring no double bookings. Once confirmed, a booking request is sent to the staff. Patients can track their appointment status as pending, accepted, or canceled. In case of a doctor's emergency, staff can send a reschedule request to affected patients, who receive a notification with the option to accept or decline. If accepted, the appointment moves to the next available slot and is

marked as "Rescheduled." Patients who accept a reschedule request are given first priority at their new appointment time, as they were originally scheduled but had to adjust due to the doctor's unavailability.

- Appointment Booking – Patient selects date and time, confirms booking.

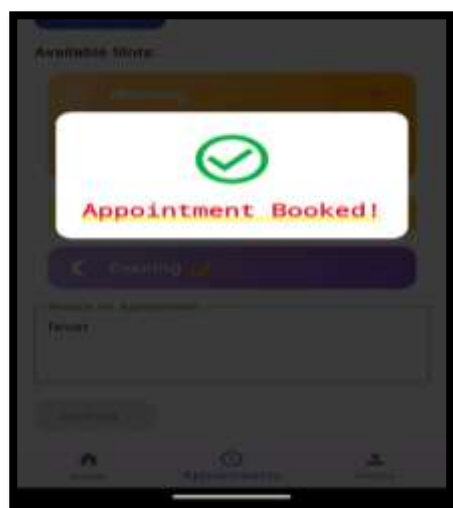
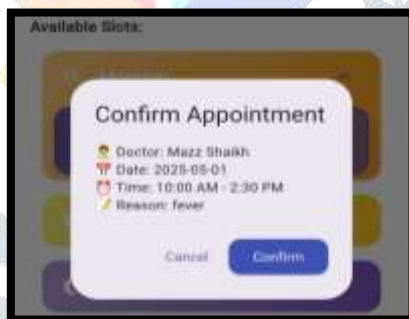
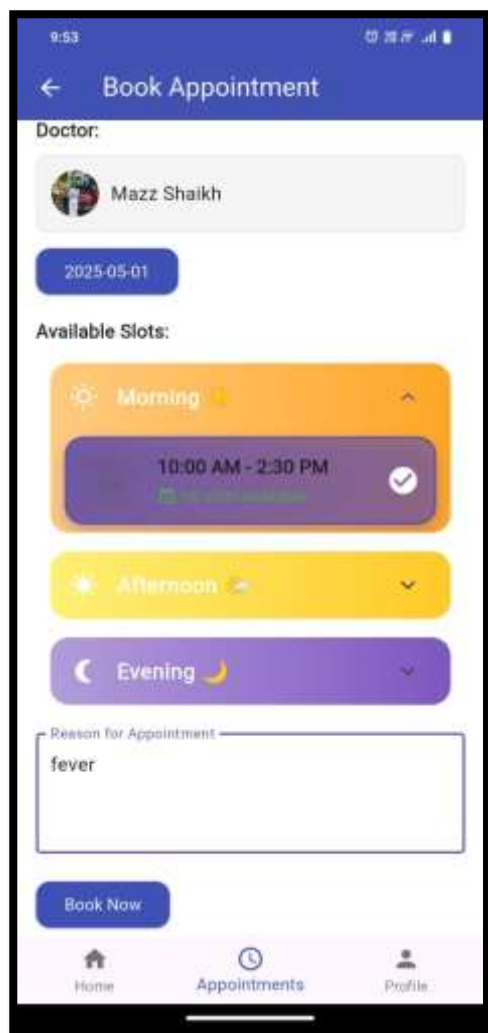


Fig. 3. Appointment booking

Fig. 4. Confirm booking

Fig. 5. Appointment Booked

- Appointment Request Sent – Staff receives booking request.

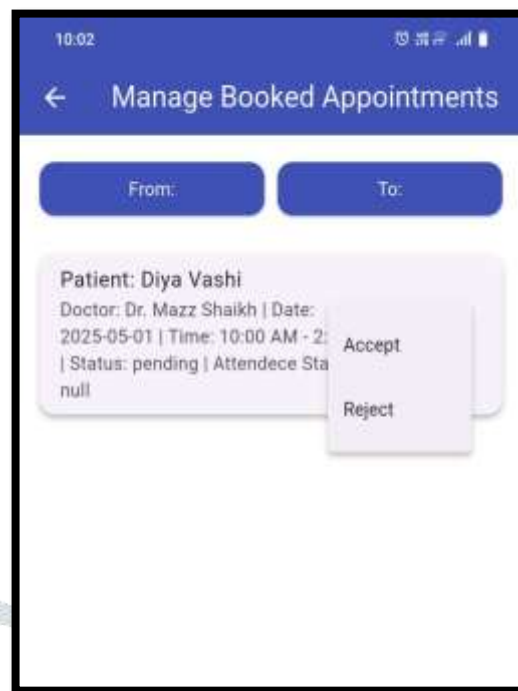


Fig. 6. Accept or reject appointment request

- Appointment Status View – Patient sees appointment status as pending/accepted/cancelled.

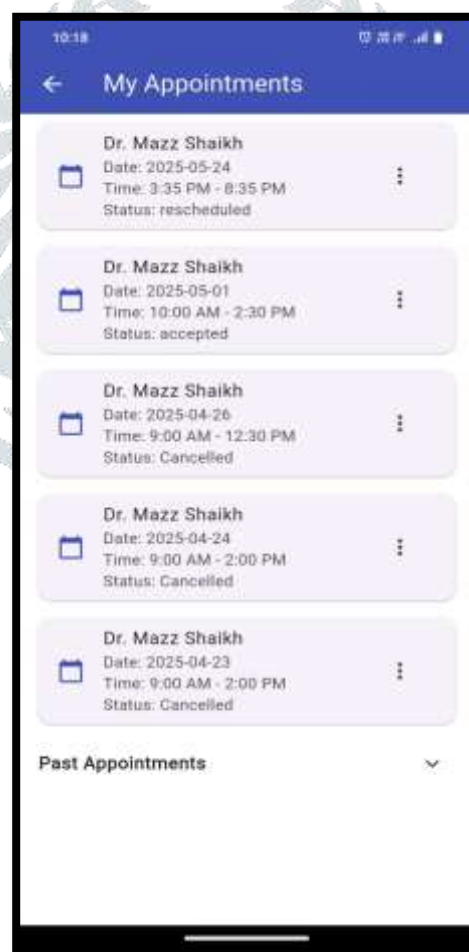


Fig. 7. View appointment status

- Doctor Requests Reschedule – Due to emergency, staff sends reschedule request.

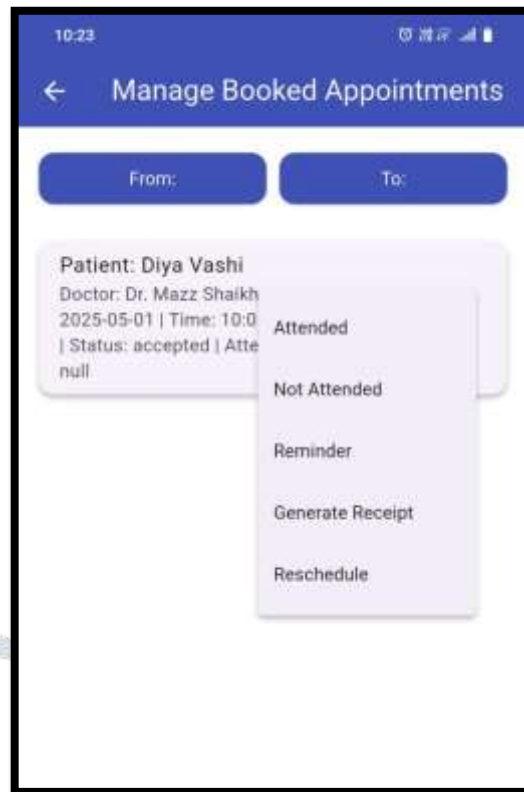


Fig. 8. Appointment reschedule

- Patient Receives Notification – Option to accept or cancel reschedule request.

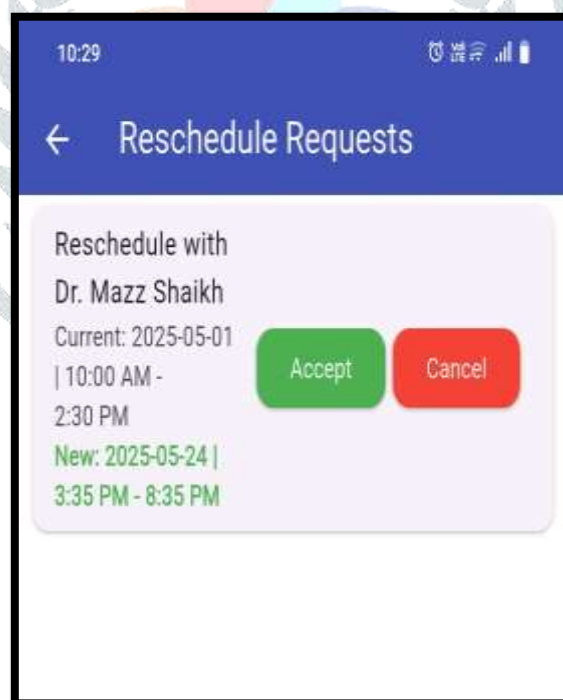


Fig. 9. Patient receives notification

- Reschedule Confirmation – If accepted, appointment is moved to the next available slot, marked as "Rescheduled."

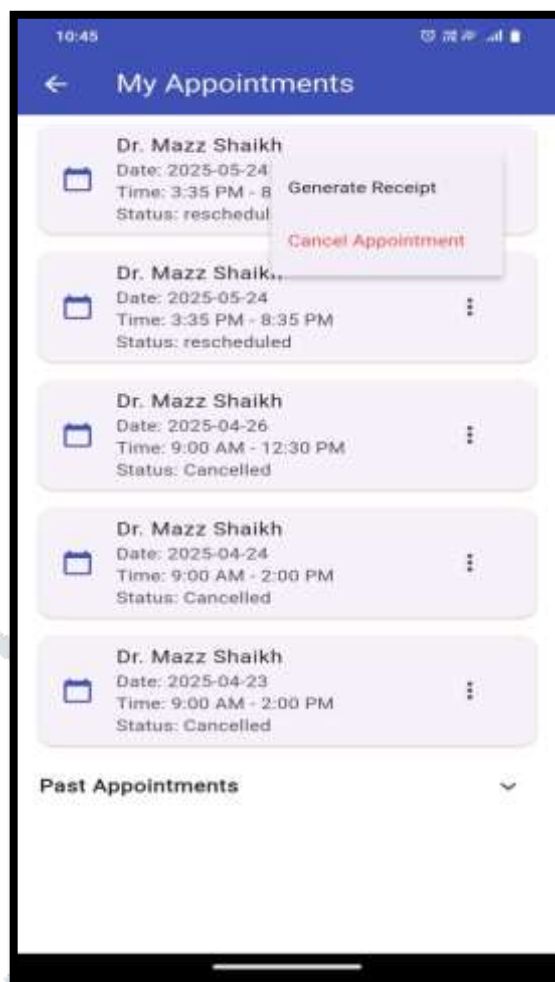


Fig. 10. Reschedule confirmation

IV FUTURE ENHANCEMENTS

As BookMyDoc evolves, one of the key enhancements includes offering first-aid prescription suggestions based on patient history, helping doctors provide quick recommendations for recurring or minor health issues. This data-driven support aims to enhance treatment continuity and reduce consultation time for returning patients. Furthermore, we have acknowledged for more patient-focused functionalities. In response, we plan to introduce gradual enhancements such as patient medical history tracking, e-prescriptions, and feedback systems to provide a more holistic clinic management experience.

Currently designed for a single doctor and clinic, BookMyDoc's future versions will support multi-clinic and multi-doctor environments, allowing individual clinics to manage their operations independently, enable doctor-specific scheduling, support inter-clinic referrals, and synchronize multi-branch activities. To enrich the patient experience, we also aim to add more interactive features and service options, making BookMyDoc an even more powerful and user-centered clinic management platform.

V CONCLUSION

BookMyDoc transforms appointment scheduling with role-based management, real-time analytics, and flexible rescheduling. Secure data handling via Firebase Firestore and a seamless Flutter-based interface enhance efficiency for patients, doctors, and administrators. Through doctor surveys, we analyzed existing systems and identified challenges faced by emergency patients, especially during crises like Covid-19. BookMyDoc evolves by addressing these issues, improving scheduling, rescheduling, and supporting small clinics with streamlined management. Features like automated notifications, receipt generation, doctor ratings, and future scalability through machine learning and multi-clinic support make it a smarter, more accessible healthcare solution.

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