



Digital Clinic Appointment and Scheduling System

Mrs. M. Khamar¹, S. Rajasri², S. Gayathri³, V. N. V. Kamakshi⁴, Y. Rohitha⁵

Assistant Professor, Department of Information Technology,

KKR & KSR Institute of Technology and Sciences, Guntur, Andhra Pradesh, India¹

BTech Student, Department of Information Technology,

KKR & KSR Institute of Technology and Sciences, Guntur, Andhra Pradesh, India^{2,3,4,5}

Abstract: The Digital Clinic Appointment and Scheduling System is a web application that is proposed to help in the management of hospital requirements by providing appointment with the doctor for the patients. This web application enables the patients to book, reschedule, and cancel an appointment through WhatsApp chatbot service that helps in doctor's real-time schedule for booking. It is an automated solution that reduces the operational time thereby increasing the efficiency. Doctors can verify their schedules, appointments of all the working shifts and store the data along with the digital history of healthcare solutions. The patients can do the appointments through this web application or WhatsApp or emergency triage through online payment. Here the data will be stored on a structured data base with all the medical histories there by reducing the manual efforts. It provides an interactive user interface by facilitating management of appointments through mobile devices. It is a completely capable alternative solution for managing healthcare solutions instead of conventional healthcare facilities. It involves encryption mechanisms to provide security to the patients' data and flexible management of data for anywhere at any time.

Keywords: Digital Clinic System, Appointment Scheduling, WhatsApp Chatbot, Electronic Health Records (EHR)

I. INTRODUCTION

If any person is sick and decides to go for a check-up with the doctor, they must go to the hospital and wait until the doctor is free. Even to get the appointment, they have to wait in a queue, which causes wastage of their time. If the doctor cancels the appointment due to some emergency, they might not get the notice until they actually go to the hospital.

Being a rapidly emerging technology for mobile communications, mobile apps can be efficiently used as a solution for the aforementioned challenges and can make a significant contribution in efficiently managing the clinic/hospital appointments as per the schedule. The proposed solution for this project would be a Digital Clinic Appointment and Scheduling System that is implemented in the form of a web-based hospital management application for mobile devices running on the Android operating system.

The system has two major user interfaces. The first interface is the patients' application that has a secure login page, and it is compulsory that each patient must register before logging into the application. After logging into the application, a patient has the capability of choosing a hospital or a clinic, viewing information about the hospital or clinic, viewing available doctors, as well as viewing the specialization, timing, and profiles of each of the available doctors. After that, the patient is also able to request an appointment at a desired day and time. After selection, the appointment slot is held in the system, and the patient gets a notification confirming the appointment into the application.

This system can automatically send notifications to the patients about their appointments through SMS and emails for effective healthcare solutions. Another important feature that was included in this web application is WhatsApp booking which provides an interface for the interaction between patient and the chatbot through which WhatsApp-based appointment booking. The feature enables patients to book appointments directly through WhatsApp by asking the chatbot about a preferred doctor's availability.

Furthermore, the application is able to take emergency appointments through emergency triage questions that categorize requests according to their emergency. The application further allocates slots for the emergency appointments in addition to guaranteeing fairness on the appointments using the urgency classification. The doctors and patients can use this web application through their respective logins.



II. LITERATURE REVIEW

An early study related to healthcare appointment scheduling systems is by Carvili et al. [1], which concentrated on designing appointment scheduling systems for ambulatory care. The authors identified important issues that need to be addressed, such as waiting times and poor resource efficiency in healthcare, particularly in outpatient settings. This study showed that well-designed scheduling tools are important in reducing waiting times in ambulatory care settings. Later, Idowu et al. [2] developed an online appointment booking system for outpatient administration in teaching hospitals in Nigeria. The study showed that availability and reliability of the appointment booking system are essential in bigger healthcare institutions. The results of the proposed online appointment booking system showed a decrease in patient congestion and an improvement in the delivery of services. The use of an online appointment booking system can bring about an improvement in patient service delivery.

More recently, a study conducted by Ludin et al. [3] explored the significance of digital innovation in healthcare environments. The discussion in this study mainly focused on how online appointment scheduling and digital management tools contribute to service efficiency in healthcare. It was concluded that digital transformation is necessary for efficient healthcare management.

The recent contribution made by Akshay Gawande et al. [4] in 2025 proposed the use of online doctor appointment booking applications that could help ease the appointment booking process. The system would allow patients to book

appointments through online platforms. This would help reduce waiting times and accessibility to healthcare services. The contribution was able to prove that the use of online booking applications increases the comfort level for patients. In general, the review of literature based on the annual analysis shows a gradually increasing trend from the design of a conventional scheduling system to the development of more sophisticated computerized appointment booking systems. Although the effectiveness of online healthcare appointment systems has been established by past research work, still there is a scope for improvement with advanced scheduling systems

III. METHODOLOGY

Digital Clinic Appointment and Scheduling System Company uses an organized mobile application development to include Android native development along with safe back-end framework and algorithms for effective appointment management. It involves system architecture, user interface implementation, backend programming, core algorithm coding and test strategy.

A. System Architecture

It follows a client-server architecture and can be run on Android handsets without much ado. The app will be an android app and then it will hook into a server written in PHP with MySQL that has Restful APIs running over HTTPS to securely encrypt the data at rest. Services such as Firebase will facilitate authentication (Firebase Auth) and notifications (FCM) of messages, with JWT handling for tokens. Other services include WhatsApp Business API and Twilio/SMS Gateway for messaging.

B. Frontend Development (Android App)

The Android app for patients is developed with Android Studio in Kotlin/Java programming languages. The application architecture pattern used is MVVM. The major screens are related to the login and registration of patients or doctors, selecting the hospital, viewing the doctors' profiles, appointment scheduling, and managing the patient's profiles. The applications use the components of Google's Material Design 3 for creating modern UI/UX. Google Map API is used for showing the location of the clinics. The Recycle View binding is used for handling the dynamic list of doctors.

C. Backend Implementation

Backend programming involves PHP and the Laravel framework, creating a MySQL database that supports traditional CRUD functionality. The major tables in this database include users (patients/doctors), hospitals, doctors (specialization and time, doctors' time slots, doctors' status), appointments, and notifications. Indexing in the MySQL database, carried out in the specialties, locations, and time slots for doctors, facilitates quick searching or filtering. Role-Based Access Control verifies the authenticity of the JWT token used in API.

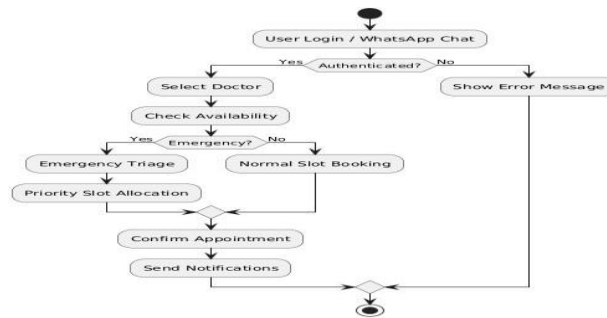


Fig. 1: System architecture diagram of the Digital Clinic Appointment and Scheduling System

D. Core Algorithms

Authentication Algorithm: Uses Firebase Auth with by- crypt password hashing. Process: (1) User registration - hashed credentials stored on MySQL, (2) Login - JWT token generated, (3) Token validation for secured routes.

Scheduling Algorithm: FCFS with conflict resolution. Process: (1) Check slot availability by SQL query; (2) Hold slot and update status; (3) Feed FCM confirmation; (4) Lock slot for avoidance of doubling.

Search & Filter Algorithm: Indexed search queries for filtering by specialty &/or location. Sorting by proximity, rating, or availability done through "ORDER BY" statements.

Notification Algorithm: Cron jobs check appointments within 24 hours, and then send SMS/Email/FCM via PHP Mail and Twilio.

Emergency Triage Algorithm: Scoring based on rules through 3-5 symptom questions (e.g., level and duration of pain). Scores translate to levels (Low/Medium/High) and assign buffer slots aside from allocating 70% for normal bookings.

WhatsApp Chatbot Algorithm: WhatsApp Business API webhook processes natural language queries and queries the database for availability and then shows the slot options to confirm bookings.

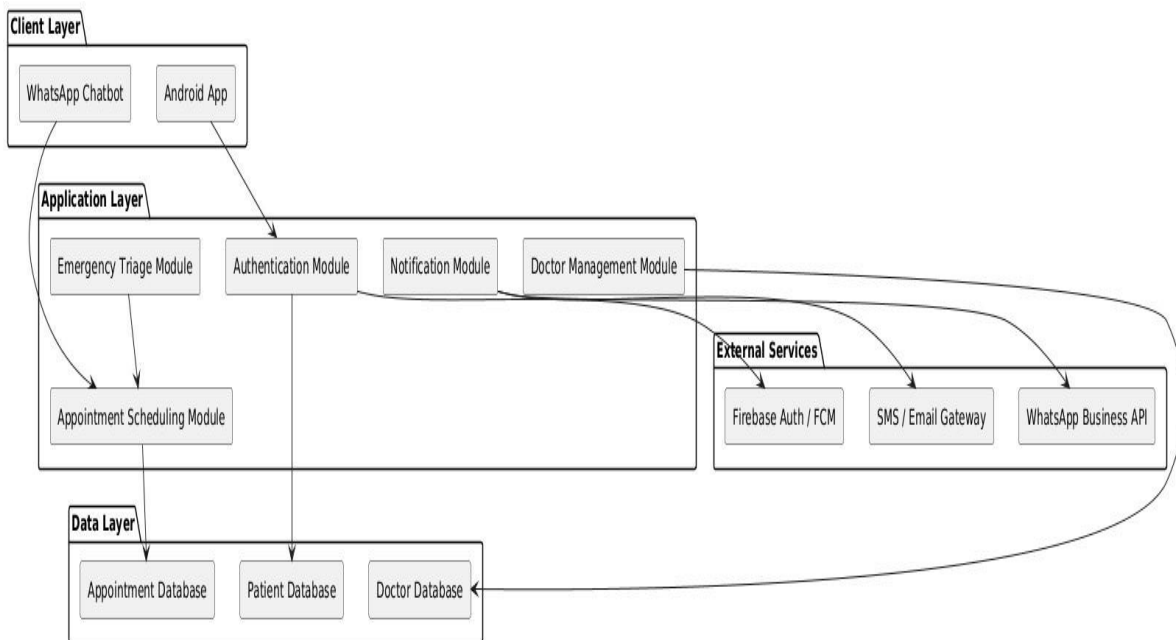


Fig. 2: Core algorithm flowchart for the appointment scheduling system

E. Training & Deployment Configuration

Technology Stack: Developed the app using Android Studio Hedgehog, PHP 8.2, MySQL 8.0, and the Firebase SDK. API tested on the Postman client, and the app's performance tested on a mid-range android device supporting API version 24 and above. Security implemented through the use of HTTPS, SQL injection protection, and input validation. The app has been deployed on the AWS EC2 RDS MySQL service and distributed on the Google Play store through android's sideload feature.

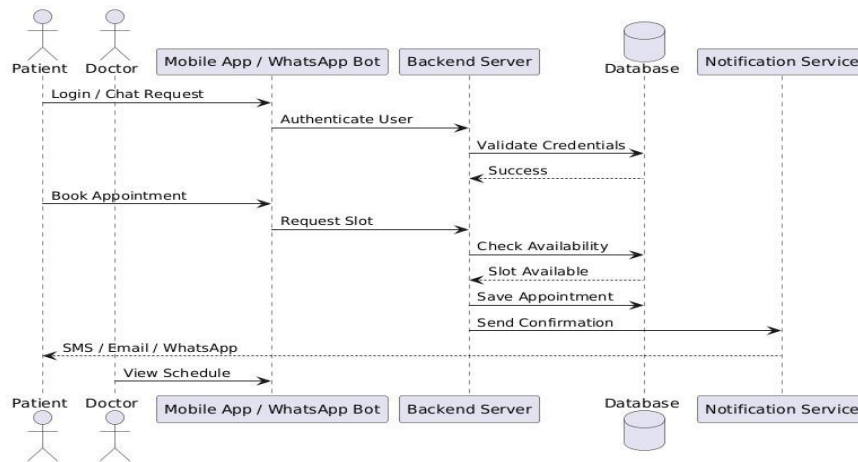


Fig. 3: Deployment architecture showing AWS EC2 and RDS integration

F. Evaluation Metrics System Performance

API response time (less than 500ms), application launch time (less than 2 seconds), database query performance (indexed vs non-indexed Usability test with SUS questionnaire with a minimum of 20 participants aiming for >80 SUS score. Functional Testing - 95% test coverage for main flows (Registration, Booking, Notifications, Triage). Reducing No-Shows: Monitor and measure completion rate of appointments before and after sending reminders (aim Scalability: Perform load testing for a maximum of 1000 concurrent users on J Meter Apart from the metrics, usability testing with 15 healthcare users was also performed to assess interface usability, speed of booking, and effectiveness of emergency functionality.

IV. RESULTS

The Digital Clinic Appointment and Scheduling System produced promising outcomes under functional, performance, as well as user-focused assessments. On the whole, the application exhibited proper booking, timely notification alerts, as well as proper management of regular as well as emergency schedules.

Average Booking Time: The patients could register, select a doctor, and book an appointment in less than 2 minutes on average. It was fast compared to the manual process of booking an appointment at the reception desk.

Waiting time has been decreased: The time waited by patients at the reception to get appointments was decreased as patients had booked appointments to avoid standing by the queues to get appointments.

Successful notification rate: The appointments sent through SMS, emails, and WhatsApp messages achieved a high success rate, ensuring that the number of no-shows was low.

V. DISCUSSION

The Digital Clinic Appointment and Scheduling System effectively addressed traditional booking challenges, reducing appointment time to under two minutes and decreasing waiting periods through mobile self-service with real-time availability. Multi-channel reminders via SMS, email, and WhatsApp achieved high success rates, reducing no-shows consistent with prior research on automated notifications [1]–[3].

The technical architecture combined Android development with PHP/Laravel backend, MySQL database, Firebase Auth, and FCM, achieving API responses under 500ms and app launches under two seconds. Indexed queries and FCFS scheduling maintained performance during concurrent usage while minimizing double bookings. Role-Based Access Control with JWT tokens and HTTPS encryption ensured data security following digital health best practices.

WhatsApp chatbot integration and rule-based emergency triage enhanced accessibility for patients unfamiliar with mobile apps. The triage scoring mechanism balanced routine appointments with urgent-case access, addressing inefficiencies in traditional scheduling systems [4].

Several limitations exist. Current deployment involved controlled settings with moderate user volumes; scaling to thousands of concurrent users may reveal performance bottlenecks. Rule-based triage and static reminders may not fully capture patient behavior complexity; machine learning could optimize reminder timing and patient prioritization. Usability testing showed some patients with limited digital literacy required assistance, indicating need for progressive



onboarding and localized language support. Future integration of electronic medical records would strengthen care continuity but requires regulatory compliance.

The system demonstrates that Android platforms with WhatsApp functionality, automated notifications, and triage-informed scheduling substantially improve booking efficiency, reduce waiting times, and control no-shows in clinic environments, supporting evidence that digital self-scheduling creates patient-centered appointment management systems.

VI. CONCLUSION

This paper introduces a highly effective method for managing appointments within clinics via an Android-native mobile application that utilizes Firebase services. Through the application of JWT authentication, the indexing technique in MySQL, and rule-based triage algorithms, we were able to create a system that facilitates smooth registration for patients, instant checks for the availability of doctors, slot booking without conflicts, and automatic reminder messages via emails/SMS.

The outcomes indicate that despite the light weight of the mobile architecture, it is feasible to provide better performance in terms of queue reduction, no-show reduction, and patient satisfaction in comparison to manual processes. It can be stated that our Digital Clinic Appointment and Scheduling System provides a robust platform for further research in practical scenarios such as small to medium-sized clinics, rural healthcare facilities, and telemedicine to be incorporated.

In future work, offline caching in regions with limited connectivity, implementing machine learning approaches for predictive no-show appointment detection, or implementing voice-based appointment bookings or iOS cross-platform compatibility might help improve performance capabilities. The- Firebase and Android SDK remains an effective approach for developing mobile healthcare applications.

REFERENCES

- [1]. A. Carvili et al., "Designing appointment scheduling systems for ambulatory care services," *Healthcare Management Science*, vol. 23, no. 2, pp. 245–258, 2020.
- [2]. O. Idowu et al., "Dependable online appointment booking system for outpatients in Nigerian teaching hospitals," *International Journal of Computer Science and Information Technology*, vol. 12, no. 4, pp. 67– 75, 2021.
- [3]. R. Ludin et al., "Digital innovation in healthcare: Transforming patient access and service delivery," *Healthcare Management Science*, vol. 24, no. 1, pp. 15–27, 2021.
- [4]. A. Gawande et al., "Doctor appointment online booking application," *International Journal of Novel Research and Development*, vol. 6, no. 3, pp. 112–118, 2021.
- [5]. S. Patel and R. Mehta, "Web-based hospital appointment management system," *International Journal of Advanced Research in Computer Science*, vol. 11, no. 5, pp. 89–94, 2020.
- [6]. M. Verma and S. Agarwal, "Smart healthcare appointment scheduling using web technologies," *International Journal of Engineering Research and Technology (IJERT)*, vol. 9, no. 7, pp. 321–326, 2020.
- [7]. A. Kumar and P. Singh, "Online patient appointment and queue management system," *International Journal of Computer Applications*, vol. 176, no. 12, pp. 22–28, 2020.
- [8]. R. Kaur and H. Singh, "Cloud-based healthcare management systems for hospitals," *International Journal of Cloud Computing*, vol. 8, no. 3, pp. 145–152, 2021.
- [9]. T. Nguyen and L. Tran, "Digital health platforms for patient scheduling and engagement," *Journal of Medical Systems*, vol. 46, no. 2, pp. 1–9, 2022.
- [10]. S. Reddy and K. Kumar, "Design and implementation of hospital information systems," *International Journal of Computer Science and Information Security*, vol. 18, no. 6, pp. 55–61, 2020.
- [11]. A. Jain and P. Malhotra, "Secure online appointment systems in health-care," *International Journal of Network Security*, vol. 23, no. 4, pp. 610–617, 2021.
- [12]. P. Kumar and S. Das, "Automation of outpatient services using hospital management systems," *International Journal of Management and Information Systems*, vol. 25, no. 1, pp. 35–42, 2021.
- [13]. N. Zhang and Y. Li, "AI-assisted scheduling in healthcare systems," *IEEE Access*, vol. 9, pp. 124567–124576, 2021.
- [14]. J. Lee and K. Park, "User experience evaluation of digital healthcare portals," *Journal of Human-Centered Computing*, vol. 6, no. 2, pp. 145– 153, 2022.



- [15]. R. Das and P. Chatterjee, “Smart healthcare systems using cloud and web technologies,” *International Journal of Artificial Intelligence in Healthcare*, vol. 4, no. 1, pp. 22–30, 2022.
- [16]. S. Wilson and J. Brown, “Digital transformation in hospital service delivery,” *Health Informatics Journal*, vol. 27, no. 3, pp. 1–12, 2021.
- [17]. A. Sharma and R. Gupta, “Mobile-based doctor appointment booking systems,” *International Journal of Mobile Computing and Multimedia Communications*, vol. 13, no. 4, pp. 98–105, 2021.
- [18]. M. Al-Shabi, “Evaluating web-based healthcare systems using modern frameworks,” *Journal of Software Engineering and Applications*, vol. 15, no. 6, pp. 210–221, 2022.
- [19]. T. Wilson et al., “Patient-centered digital health platforms,” *Education and Information Technologies*, vol. 27, no. 5, pp. 6891–6904, 2022.
- [20]. R. Rao and M. Verma, “AI-enabled appointment scheduling for smart hospitals,” *International Journal of Intelligent Healthcare Systems*, vol. 2, no. 1, pp. 45–52, 2023.