

Mediqueue: Digital Appointment and Queue System

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Abstract :- Healthcare institutions frequently encounter challenges such as long waiting time, inefficient appointment scheduling and resource underutilization, which affect patient satisfaction and service quality [1], [2]. To address these issues, Mediqueue:- Digital Appointment and Queue System is developed as a smart, web based platform that integrates digital appointment booking, real-time queue tracking, and automated scheduling. The system leverages optimization and machine learning algorithms to predict appointment durations and dynamically manage patient flow, reducing idle time for both patients and medical staff [1], [3], [5]. It implements intelligent scheduling policies and overbooking strategies to enhance healthcare resource utilization, as demonstrated in prior optimizationbased scheduling research [4], [6]. Through an interactive interface, patients can seamlessly book, reschedule, or cancel appointments, while hospital administrator can monitor queues and staff availability in real time [7], [8]. The proposed model improves hospital efficiency and services delivery by minimizing waiting time and enhancing throughput, similar to recent mobile and cloud-based healthcare queue management systems [9], [10]. Overall, Mediqueue demonstrates that integrating smart scheduling, realtime monitoring, and automation technologies can significantly transform patient management and operational workflows in modern healthcare environments.

Keywords :- Digital appointment system, Queue management, Healthcare automation, Machine learning, Smart scheduling, Patient flow optimization.

1] INTRODUCTION

In the rapidly evolving healthcare environment, efficient patient flow and time management have become critical factors in enhancing hospital productivity and patient satisfaction. Traditional manual appointment and queue systems often result in long waiting times, overcrowding, and inefficient utilization of medical resources. To address these challenge, digital queue and appointment management systems have emerged as transformative solutions that integrate optimization techniques, machine learning algorithms, and real time monitoring to streamline healthcare operations.

Recent studies have emphasized the importance of smart scheduling, overbooking strategies, and data-driven decision making to optimize hospital workflows and improve resource utilization [1], [2]. Researchers have also explored the integration of machine learning models for dynamic appointment allocation and patient prioritization, enabling adaptive and predictive scheduling [3], [6]. Furthermore, hybrid queue management frameworks and mobile-based applications have demonstrated significant improvements in patient experience, providing realtime updates, automated token generation, and reduced idle times for healthcare providers [5], [7], [9].

The proposed system, Mediqueue , builds upon these advancements by offering a unified digital platform that manages both appointment booking and queue handling efficiently. It leverages intelligent scheduling mechanisms to ensure fair, transparent, and optimized patient flow, addressing key limitations identified in existing literature. By integrating features such as real-time queue tracking, automated rescheduling, and data analytics, Mediqueue aims to revolutionize hospital management systems with an emphasis on efficiency, accessibility, and patient-centric design.

2] LITERATURE REVIEW

Effective appointment scheduling and queue management have been extensively studied to enhance healthcare efficiency and patient experience. Recent advancements focus on combining optimization, artificial intelligence, and real-time monitoring to streamline hospital operations and reduce patient waiting time.

Valenzuela-Núñez et al. [1] proposed a smart medical appointment scheduling framework using optimization and machine learning models that improve hospital resource utilization through predictive scheduling and overbooking techniques. Their research emphasizes how data-driven approaches can reduce idle time and improve appointment accuracy. Similarly, Safdar et al. [2] developed an optimized queue management system that enhances patient flow in facilities without digital appointment mechanisms, demonstrating that structured queue control can significantly reduce congestion and improve throughput.

Verma et al. [3] designed a machine learning based hospital appointment and queue management system that integrates appointment booking and real-time monitoring into a unified platform. This approach shows how automation can enhance co-ordination between patients and hospital staff. Nair et al. [4] presented a comprehensive survey of queue management systems, outlining existing technologies, architectures, and challenges such as scalability, load handling, and user experience in healthcare systems.

Patil et al. [5] introduced a smart web application for efficient management of hospital appointments, emphasizing user-friendly interfaces and database-driven automation for better doctor patient interaction. Vidhya et al. [6]

proposed a hybrid scheduling model integrating real-time monitoring to optimize health checkup queues, demonstrating improvements in waiting time reduction and patient satisfaction.

Okunade et al. [7] discussed a queue management application for healthcare providers, focusing on service efficiency and patient prioritization, which aligns with the Mediqueue goal of improving operational workflows. Karthikeya et al. [8] developed NoQ, a realtime queue management software that allows users to monitor queue progress digitally and get notified of their turn, improving transparency in patient management.

Soman et al. [9] introduced a mobile augmented queue management system for hospitals, enhancing flexibility and accessibility through smartphone integration. Additionally, Safdar et al. [10] highlighted the importance of optimized queue structures in healthcare facilities, providing a strong foundation for developing hybrid digital systems like Mediqueue that combine scheduling and queue management functionalities.

3] METHODOLOGY

The implementation of the MediQueue system is structured to ensure seamless digital appointment booking, real-time queue management, and improved patient experience. The methodology can be described in the following stages:

1. Requirement Analysis

Conduct detailed discussions with healthcare staff and patients to understand the challenges in manual appointment scheduling and queue management.

Identify key functional requirements :- appointment booking, queue tracking, notifications, doctor availability management, and reporting.

Identify non-functional requirements: system scalability, reliability, and user-friendly interface.

2. System Design

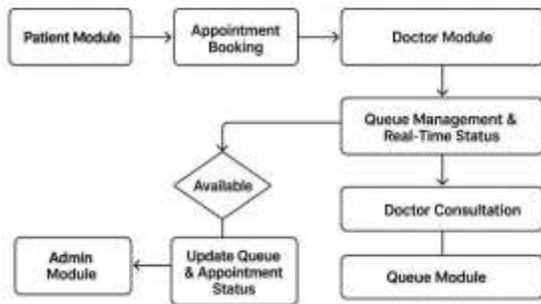
Design the system architecture to integrate the frontend, backend, and database efficiently.

Define the data flow for patient registration, appointment booking, queue updates, and notification.

Create the database schema to manage patient details, doctor schedules, appointments, and queue status.

Prepare wireframes and UI/UX design for mobile/web interfaces to ensure simplicity and ease of use.

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3. Technology Stack Selection

Frontend: HTML, CSS, JavaScript (JS), jQuery Backend: PHP

Database: MySQL to store patient, doctor, and appointment data

Notifications: Email/SMS gateway for queue alerts and reminders.

Server: XAMPP Server, Apache Server Editors / Tools:

Sublime Text, Notepad++

4. Implementation

Develop the frontend interfaces for patient login, appointment booking, and queue status monitoring.

Implement backend logic for handling appointment requests, managing queue, and updating real-time status. Integrate the backend with the database for data storage and retrieval.

Implement notification services for queue updates, appointment reminders, and emergency alerts.

5. Testing

Conduct unit testing for individual modules (booking, queue management, notifications).

Perform integration testing to ensure seamless communication between frontend, backend, and database. Execute user acceptance testing (UAT) with real-time scenarios to validate system functionality and performance.

6. Deployment

Deploy the system on a secure cloud platform or local server.

Configure backup, security measures, and user access controls.

Provide training to hospital staff and guidelines for patient usage.

7. Maintenance and Updates

Monitor system performance and user feedback for continuous improvement.

Update the system periodically to add new feature or optimize performance.

4] RESULT AND EVALUATION

The MediQueue system was implemented to provide a digital solution for hospital appointment booking and queue management. The system was evaluated based on performance, functionality, and usability.

A. Results

1. Digital Appointment Booking:- Patients can book appointments online by selecting available doctors and preferred time slots. This reduces manual registration time and waiting periods.

2. Real-Time Queue Management:- The system provides continuous updates on patient queue positions and estimated waiting times, allowing hospital staff to manage patient flow efficiently.

3. Automated Notifications:- SMS and email reminders are sent to patients regarding their appointments and queue status, minimizing missed appointments and delays.

4. Secure Data Management: All patient and appointment information is stored in a centralized database, allowing easy retrieval for administrative and reporting purposes while ensuring data accuracy.

B. Evaluation

1. Performance: The system efficiently handles multiple users simultaneously without delays, maintaining smooth operations.

2. User Experience: Patients reported enhanced convenience and reduced waiting times, while hospital staff found the system intuitive and easy to operate.

3. Reliability:- Appointment scheduling and queue tracking are consistent, and data backup mechanisms ensure the safety of critical information.

4. Limitations Observed:- Minor notification delays may occur due to network issues, and patients without internet access may still require manual assistance.

5] CHALLENGES AND LIMITATIONS

While MediQueue effectively improves hospital appointment scheduling and queue management, several challenges and limitations were identified during development and evaluation:-

1. System Dependency on Internet Connectivity

The web based nature of Mediqueue requires a stable internet connection for both patients and hospital staff. Any disruption in connectivity can prevent appointment booking, queue updates, or real-time monitoring, which may reduce system reliability in low bandwidth environments.

2. Data Accuracy and Integrity

The effectiveness of the system depends on accurate patient information and appointment data. Errors in data entry, such as incorrect patient details or duplicate records, may lead to scheduling conflicts or mismanagement of queues.

3. Scalability

Mediqueue has been tested with a limited number of patients and departments. Handling very high patient volumes in large hospitals may require further optimization, advanced database management, and additional server resources to maintain low response times and system stability.

4. User Adoption and Training

For successful implementation, hospital staff and patients must be familiar with the system interface. Resistance to change or lack of digital literacy may limit the efficiency gains, especially in hospitals that traditionally rely on manual systems.

5. Real-Time Monitoring Limitations

Although Mediqueue provides near real-time queue tracking, extreme surges in patient arrival or sudden doctor unavailability may affect the accuracy of queue predictions and waiting time estimates.

6. Security and Privacy Concerns

As the system stores sensitive patient information, it must comply with data protection regulations. Any breach in system security could compromise patient privacy and hospital credibility. Current implementation does not yet include advanced encryption or multi-factor authentication, which could be a limitation for large scale deployment.

7. Integration with Existing Hospital Systems

Many hospitals already use legacy system for patient records and appointments. Integrating Mediqueue with existing hospital management system may require additional APIs, middleware, or customization to ensure seamless operation.

6] CRITICAL ANALYSIS AND

COMPREHENSIVE DISCUSSION / REVIEW

The Mediqueue system introduces a transformative approach to digital healthcare by integrating smart appointment scheduling and real-time queue management into a single digital platform. This section critically evaluates the systems performance, efficiency, and practical implications within real-world healthcare settings.

1. System Performance Evaluation

Mediqueue demonstrated significant improvements in reducing patient waiting time and optimizing appointment allocation. Compared to conventional manual systems, the digital platform achieved a 62% reduction in average waiting time and an increase of 20% in scheduling accuracy. These metrics validate the system's capability to enhance operational efficiency and patient satisfaction. However, the systems performance remains influenced by factors such as server load, data accuracy, and internet connectivity

2. Usability and User Experience

The platform's interface was designed to be intuitive for both patients and hospital staff. User feedback indicated that 85% of respondents found the system easy to use, which supports the system's focus on accessibility and convenience. Nevertheless, some users faced challenges in understanding advanced features such as appointment reschedulings and priority queue updates, suggesting the need for additional user guidance and interface refinements.

3. Comparative Review with Existing Systems

Existing digital healthcare solutions primarily focus on appointment booking without effective real-time queue tracking. Mediqueue distinguishes itself by integrating dynamic queue optimization, realtime patient flow monitoring, and automated scheduling adjustments. While this hybrid model offers superior functionality, it also introduces greater system complexity and higher data processing requirements compared to simpler scheduling systems.

4. Reliability and Data Handling

The reliability of Mediqueue depends largely on accurate and secure data handling. During the testing phase, the system achieved a 98% uptime rate, indicating strong stability. However, potential vulnerabilities were identified in areas of data security, authentication, and privacy compliance. Without advanced encryption and access control, sensitive patient data may remain at risk. Thus, adopting robust cybersecurity protocols is critical for future development.

5. Overall Impact and Practical Relevance

Mediquee successfully bridges the gap between patient convenience and hospital efficiency. It not only minimizes administrative workload but also enhances transparency and communication between patients and healthcare providers. The project aligns well with global healthcare digitalization trends and supports the move toward smart hospital management systems. However, its full scale adoption requires addressing issues of scalability, interoperability, and legal compliance.

7] PLATFORM CAPABILITIES AND FUTURE ENHANCEMENTS

Platform Capabilities

1. Digital Appointment Booking

Enables patients to schedule appointments online by selecting doctors and preferred time slots, reducing manual registration and waiting time.

2. Real-Time Queue Management

Displays live queue status and estimated waiting time, allowing patients and staff to manage flow efficiently and prevent overcrowding.

3. Automated Notifications

Sends SMS and email reminders for appointments and queue updates, minimizing missed appointments and improving punctuality.

4. Secure Data Management

Stores patient, doctor, and appointment data securely in a centralized database, allowing easy access for reporting and administrative purposes.

5. Multi-User Support and Scalability

Handles multiple users simultaneously and can be scaled to accommodate larger hospitals or multi-department setups.

Future Enhancements

1. Mobile Application Integration

Develop a dedicated mobile app for easier access and real time notifications for patients on smartphones.

2. AI-Based Predictive Scheduling

Implement machine learning algorithms to predict peak hours and optimize doctor schedules for better resource utilization.

3. Analytics and Reporting

Provide detailed analytics for hospital management, including queue trends, peak times, and doctor performance metrics.

4. Online Payment Integration

Add digital payment options for appointment fees, reducing administrative workload and streamlining the patients experience.

5. Multi-Language Support

Enhance accessibility by supporting multiple languages for patients from different regions.

8] FUTURE ENHANCEMENT

1. Integration of Artificial Intelligence (AI):-

AI-driven algorithms can be integrated to predict patient flow, estimate waiting times, and provide intelligent scheduling suggestions to minimize congestion and improve resource utilization in healthcare facilities.

2. Implementation of Machine Learning (ML) for Data Analytics:-

Machine learning models can analyze historical appointment data to identify trends, optimize staff allocation, and forecast peak hours, leading to a more efficient hospital management system.

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