



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: <https://doi.org/10.22214/ijraset.2026.80368>

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Digital Queue Management System for Hospitals using QR Codes

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ABSTRACT: *The traditional queue management systems used in hospitals often result in long waiting times, overcrowding, and inefficient service delivery. Patients are required to stand in physical queues without real-time information about their turn. To address these challenges, this paper proposes a Digital Queue Management System using QR codes.*

The proposed system allows users to generate digital tokens through QR codes and track their queue status in real time. A staff panel is provided to manage token flow using FIFO (First In First Out) logic, while a live display board shows the currently serving and upcoming tokens.

Additionally, the system collects and analyzes queue data such as waiting time and peak hours to improve service efficiency. The system is developed using Python (Django) for backend and HTML, CSS, Bootstrap, and JavaScript for frontend. The proposed solution enhances user experience, reduces waiting time, and provides a scalable and efficient queue management system.

Keywords: *Queue Management, QR Code, Digital Token System, FIFO Algorithm, Real-Time Monitoring, Hospital Management System*

I. INTRODUCTION

Efficient queue management is a critical requirement in healthcare systems where patient flow directly impacts service quality and operational performance. Traditional queue systems, which rely on manual token distribution or physical waiting lines, often lead to overcrowding, increased waiting time, and lack of transparency in service delivery.

Patients are required to remain physically present in queues without knowing their exact turn, which leads to discomfort and dissatisfaction. Moreover, staff members face challenges in managing queues effectively due to the absence of real-time monitoring and proper tracking mechanisms.

With the advancement of web technologies and digital systems, there is a growing need for intelligent queue management solutions that can automate the process and improve efficiency. The proposed QueueSync system addresses these issues by introducing a QR-based digital token system combined with real-time monitoring and analytics.

The system aims to enhance patient experience, reduce manual workload, and provide a structured and transparent queue management process suitable for hospitals and other service sectors.

II. LITERATURE REVIEW

Patients are required to remain physically present in queues without knowing their exact turn, which leads to discomfort and dissatisfaction. Moreover, staff members face challenges in managing queues effectively due to the absence of real-time monitoring and proper tracking mechanisms.

With the advancement of web technologies and digital systems, there is a growing need for intelligent queue management solutions that can automate the process and improve efficiency. The proposed QueueSync system addresses these issues by introducing a QR-based digital token system combined with real-time monitoring and analytics.

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III. METHODOLOGY

A. Requirement Analysis

1) Stakeholders:

Users (Customers/Patients) Staff Members Administrators



2) *Functional Requirements:*

User registration and token generation QR code-based token system

Real-time queue tracking

Staff panel for queue management Admin dashboard for analytics

3) *Non-Functional Requirements:*

Security (authentication and data protection) Scalability (support multiple users) Reliability (continuous system operation)

Usability (user-friendly interface)

B. *System Design*

1) *Customer Module*

Users generate tokens using QR codes Users can track queue status in real time

2) *Authentication Module*

Secure login for staff and admin Role-based access control

3) *Token Management Module*

Generates unique tokens Maintains queue order using FIFO

4) *Staff Module*

Calls next token

Mark tokens as served or skipped

5) *Live Display Module*

Displays current and upcoming tokens Updates queue information in real time Provides clear visibility for users

6) *Admin Module*

Provides analytics such as waiting time and peak hours

Monitors system performance

Manages staff and system configurations

7) *Data Storage Module*

Stores token details, user information, and queue data securely

Maintains historical records for analysis Supports fast data retrieval for real-time updates

C. *Implementation Steps*

1) *Frontend Development*

HTML, CSS, Bootstrap, JavaScript User-friendly interface

2) *Backend Development*

Python (Django)

Handle token generation and queue logic

3) *Database Management*

SQLite database

Store tokens and user data

4) *Security Layer*

Authentication and access control



5) *Testing*

Unit testing, integration testing

6) *Deployment*

Web-based deployment

IV. SYSTEM ARCHITECTURE

The architecture of the proposed QueueSync system is designed to provide an efficient, scalable, and real-time queue management solution using a web-based platform. The system follows a client-server architecture, where multiple users interact with the system through a web interface, and all processing is handled at the server side.

The system consists of the following layers:

1) *User Interface Layer*

This layer includes interactions from different users such as customers (patients), staff, and administrators through web browsers. It acts as the primary point of communication between users and the system.

Customers can generate tokens and view queue status

Staff can manage tokens and control queue flow Admin can monitor system performance

Provides real-time updates and interactive dashboards

Ensures easy navigation and accessibility for all users

The interface is developed using HTML, CSS, Bootstrap, and JavaScript to provide a responsive, interactive, and user-friendly experience across different devices.

2) *Application Layer*

This layer handles the core business logic of the system.

Token generation using QR codes

Queue management using FIFO (First-In-First-Out) algorithm

Request processing and system operations

The backend is developed using Python with the Django framework, ensuring efficient handling of real-time operations.

3) *Authentication Layer*

This layer ensures secure access to the system.

User login and authentication

Role-based access control (Admin, Staff) Secure session management

It prevents unauthorized access and ensures system security.

4) *Database Layer*

This layer is responsible for storing and managing system data.

Stores token details, user information, and queue status

Maintains service records and timestamps Supports data retrieval for real-time updates SQLite is used as the database for efficient and lightweight data management.

5) *Processing Layer (Queue Engine)*

This layer manages queue operations.

Implements FIFO logic for fair queue handling Update token status (Waiting, Serving, Served, Skipped)

Coordinates between staff actions and system updates

It ensures smooth and organized queue flow.

6) *Display Layer*

This layer provides real-time queue information.

Displays currently serving token Shows upcoming tokens

Updates dynamically based on system data

It improves communication between users and service providers.

7) Analytics Layer

This layer analyzes queued data for performance improvement.
 Calculates average waiting time
 Identifies peak hours
 Evaluates service efficiency
 These insights help administrators make data-driven decisions.

8) Security Layer

This layer ensures system safety and data protection.
 Data encryption and secure communication
 Protection against unauthorized access
 Reliable and stable system operation

V. DATA FLOW DIAGRAM (DFD)

User → Token Generation → QR Code → Database → Staff Panel → Queue Processing → Live Display
 → Analytics

VI. SYSTEM DESIGN

A. Entity Relationship Diagram (ERD)

The system consists of the following main entities: User (Customer/Patient):
 Represents individuals who generate tokens and access queue status.

Token:

Represents the digital token generated for each user. It contains details such as token ID, time, and status.

Queue:

Maintains the order of tokens based on FIFO logic.

Staff:

Represents service providers who manage the queue by calling tokens and updating status.

Admin:

Responsible for monitoring system performance and managing overall operations.

Display System:

Shows real-time queue updates including current and upcoming tokens.

B. Relationships:

User generates → Token
 Token belongs to → Queue
 Queue is managed by → Staff
 Staff updates → Token Status
 Admin monitors → System
 Display System shows → Queue Status

VII. WORKPLAN

The workplan of the Queue Sync system outlines the overall workflow of the system, including the interactions between users, staff, and administrators. It ensures a structured and efficient execution of queue management operations.

A. Overall System Flow

The complete system workflow is divided into three main perspectives:

1) *User(Customer/Patient)Flow*

User → TokenGeneration → QRCode → Queue Entry → TrackQueueStatus → ServiceCompletion

Users access the system and generate a digital token

A unique QR code is created for each token

Users can monitor their position in the queue in real time

They receive service when their token

2) *StaffFlow*

Staff → ViewQueue → CallNextToken → Update Status → CompleteService

Staff members access the queue dashboard They call tokens based on FIFO order

Token status is updated as Serving and then Served

Ensures smooth and systematic queue handling

3) *AdminFlow*

Admin → MonitorSystem → AnalyzeData → OptimizePerformance

Admin monitors queue operations and system performance

Analyzes metrics such as waiting time and peak hours

Takes decisions to improve efficiency and service quality

B. *Detailed Workflow*

- User registers or accesses the system
- User generates a token using QR code
- Token is stored in the database
- Queue is maintained using FIFO logic
- Staff call the next token
- Displays system updates queue status
- User receives service

C. *Workplan Objectives*

To ensure smooth queue flow

To reduce waiting time and overcrowding To provide real-time updates to users

To improve service efficiency through structured operations

VIII. ALGORITHM STUDY

BEGIN

GenerateToken

Assign Status = WAITING IF Staff Calls Token THEN

Update Status = SERVING After Service → SERVED

ELSE

Continue Waiting END IF

END

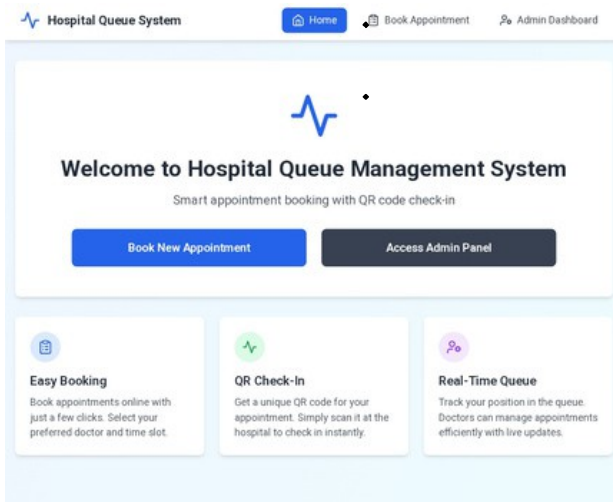
IX. TESTING & VALIDATION

Testing was performed to ensure the QueueSync system works correctly, efficiently, and securely.

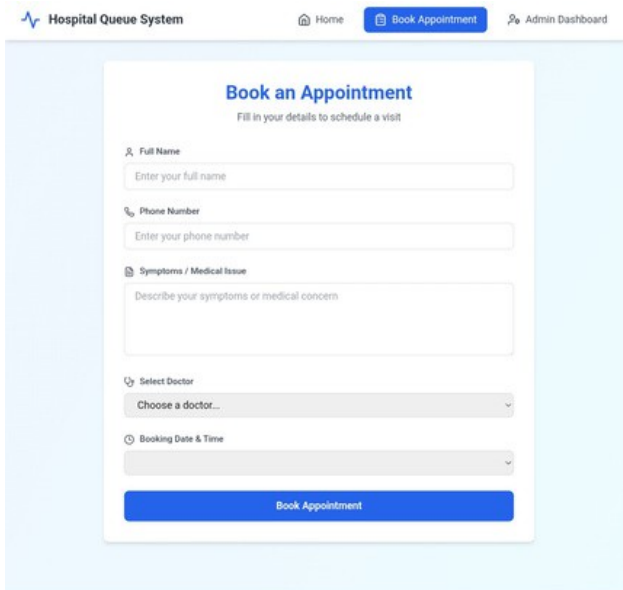
- Unit Testing: Verified individual modules like token generation and login
- Integration Testing: Checked interaction between modules
- System Testing: Validated complete workflow Performance Testing: Ensured smooth operation under multiple users
- Security Testing: Verified authentication and data protection

X. EXPECTED OUTCOME

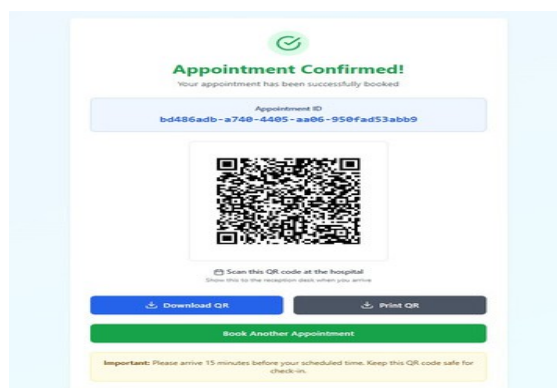
The QueueSync system is expected to improve queue management by providing a digital and automated solution. Reduces waiting time and overcrowding. Enables real-time queue tracking. Improves service efficiency. Enhances user experience. Supports data-driven decision making.

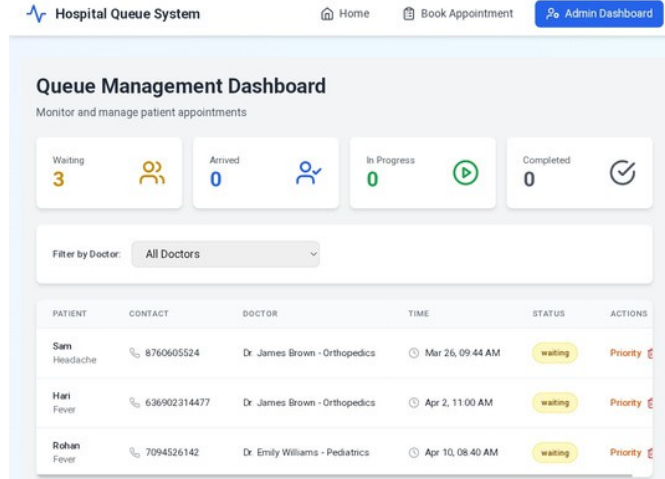


Hospital Queue Management System - Streamlining Patient Care



Hospital Queue Management System - Streamlining Patient Care





XI. SYSTEM FEATURES

- QR-based token generation
- Real-time queue tracking
- FIFO queue management
- Live display system
- Analytics dashboard

XII. COMPARATIVE STUDY

Feature	Traditional System	Proposed System
Queue Type	Physical	Digital
Tracking	Not available	Real-time
Efficiency	Low	High
Transparency	Low	High
Waiting Time	High	Reduced

XIII. FUTURE ENHANCEMENTS

- Mobileapplication
- SMS/Emailnotifications
- AI-basedqueueprediction
- Multi-branchsupport

XIV. CONCLUSION

- The proposed digital queue management system provides an efficient solution to overcome the limitations of traditional queue systems. By integrating QR-based token generation, real-time tracking, and analytics, the system improves service efficiency and user experience.
- It reduces waiting time, avoids overcrowding, and ensures a smooth and transparent queue management process. The system is scalable and can be implemented in various service environments.

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