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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 addressthesechallenges,thispaperproposesaDigital Queue Management System using QR codes.***

The proposed system allows users to generate digital tokens through QR codes and track their queue status inrealtime. Astaff panelisprovidedtomanagetoken flowusingFIFO(FirstInFirstOut)logic,whilealive 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.

Withtheadvancementof webtechnologiesanddigital 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 structuredand 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.

Withtheadvancementof webtechnologiesanddigital 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

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2) Functional Requirements:

User registration and token generation QR code-based token system
Real-timequeuetracking
Staff panelforqueuemanagement 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 Userscantrackqueuestatusinrealtime

2) AuthenticationModule

Secureloginforstaff andadmin Role-based access control

3) TokenManagementModule

Generates unique tokensMaintains queue order using FIFO

4) StaffModule

Callsnexttoken
Markstokensasservedor skipped

5) LiveDisplayModule

Displays current and upcoming tokens Updatesqueueinformationinreal time Provides clear visibility for users

6) AdminModule

Provides analytics such as waiting time and peak hours
Monitorssystem performance
Managesstaffandsystemconfigurations

7) DataStorageModule

Stores token details, user information, and queue data securely
Maintains historical records for analysis Supportsfastdataretrieval forreal-timeupdates

C. Implementation Steps

1) FrontendDevelopment

HTML,CSS,Bootstrap,JavaScript User-friendly interface

2) BackendDevelopment

Python(Django)
Handlestokengenerationandqueuelogic

3) DatabaseManagement

SQLitedatabase
Storestokensanduserdata

4) SecurityLayer

Authenticationandaccesscontrol

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5) Testing

Unittesting,integrationtesting

6) Deployment

Web-baseddeployment

IV. SYSTEM ARCHITECTURE

The architecture ofthe proposed QueueSync systemis 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.

Thesystemconsistsofthefollowinglayers:

1) UserInterfaceLayer

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.

Customerscangeneratetokensandviewqueue status

Staff canmanagetokensandcontrolqueueflow Admin can monitor system performance

Provides real-time updates and interactive dashboards

Ensureseasynavigationandaccessibilityforall users

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

2) ApplicationLayer

This layer handles the core business logic of the system.

TokengenerationusingQRcodes

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

Requestprocessingandsystemoperations

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

3) AuthenticationLayer

Thislayerensuressecureaccesstothesystem.

Userloginandauthentication

Role-basedaccesscontrol(Admin,Staff) Secure session management

Itpreventsunauthorizedaccessandensures system security.

4) DatabaseLayer

Thislayerisresponsibleforstoringandmanaging 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) ProcessingLayer(QueueEngine)

Thislayermanagesqueueoperations.

Implements FIFO logic for fair queue handling Updatestokenstatus(Waiting,Serving,Served, Skipped)

Coordinatesbetweenstaffactionsandsystem updates

It ensures smooth and organized queue flow.

6) DisplayLayer

This layer provides real-time queue information.

Displayscurrentlyservingtoken Shows upcoming tokens

Updatesdynamicallybasedonsystemdata

Itimprovescommunicationbetweenusersand service providers.

7) AnalyticsLayer

Thislayeranalyzesqueuedataforperformance improvement.
Calculatesaveragewaitingtime Identifies peak hours
Evaluatesserviceefficiency
Thesеinsightshelpadministratorsmakedata-driven decisions.

8) SecurityLayer

Thislayerensuressystemsafetyanddataprotection.
Data encryption and secure communication Protection against unauthorized access Reliable and stable system operation

V. DATAFLOWDIAGRAM(DFD)

User⟶TokenGeneration⟶QRCode⟶Database⟶StaffPanel⟶Queue Processing⟶Live Display ⟶Analytics

VI. SYSTEM DESIGN

A. Entity Relationship Diagram(ERD)

Thesystemconsistsof thefollowingmainentities: 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:
MaintainstheorderoftokensbasedonFIFO logic.

Staff:
Representsserviceproviderswhomanagethe queue by calling tokens and updating status.

Admin:
Responsible for monitoring system performance and managing overall operations.

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

B. Relationships:

Usergenerates⟶Token Tokenbelongsto⟶Queue Queueismanagedby⟶ Staff Staffupdates⟶TokenStatus
Adminmonitors⟶System DisplaySystemshows⟶QueueStatus

VII. WORKPLAN

Theworkplanof theQueueSyncsystemoutlinesthe overall workflow of the system, including the interactionsbetweenusers,staff,andadministrators. It ensures a structured and efficient execution of queue management operations.

A. OverallSystemFlow

The complete system workflow is divided into three main perspectives:

1) User(Customer/Patient)Flow

User⟶TokenGeneration⟶QRCode⟶Queue Entry⟶ TrackQueueStatus⟶ ServiceCompletion

Usersaccessthesystemandgenerateadigital token

AuniqueQRcodeiscreatedforeach token

Users can monitor their position in the queue inreal time

Theyreceiveservicewhentheirtoken

2) StaffFlow

Staff⟶ViewQueue⟶CallNextToken⟶Update Status⟶CompleteService

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

Tokenstatusisupdatedas Servingandthen Served

Ensuressmoothandsystematicqueuehandling

3) AdminFlow

Admin⟶MonitorSystem⟶AnalyzeData⟶OptimizePerformance

Adminmonitorsqueueoperationsandsystem performance

Analyzesmetricssuchaswaitingtimeandpeak hours

Takes decisions to improve efficiency and service quality

B. Detailed Workflow

- Userregistersoraccessesthesystem
- UsergeneratesatokenusingQRcode
- Tokenisstoredinthedatabase
- QueueismaintainedusingFIFOlogic
- Staffcallsthenexttoken
- Displaysystemupdatesqueuestatus
- Userreceivesservice

C. WorkplanObjectives

Toensuresmoothqueueflow

Toreducewaitingtimeandovercrowding To provide real-time updates to users

Toimproveserviceefficiencythroughstructured operations

VIII. ALGORITHMSTUDY

BEGIN
GenerateToken
Assign Status = WAITING IFStaffCallsTokenTHEN
Update Status = SERVING AfterService⟶SERVED
ELSE
ContinueWaiting END IF
END

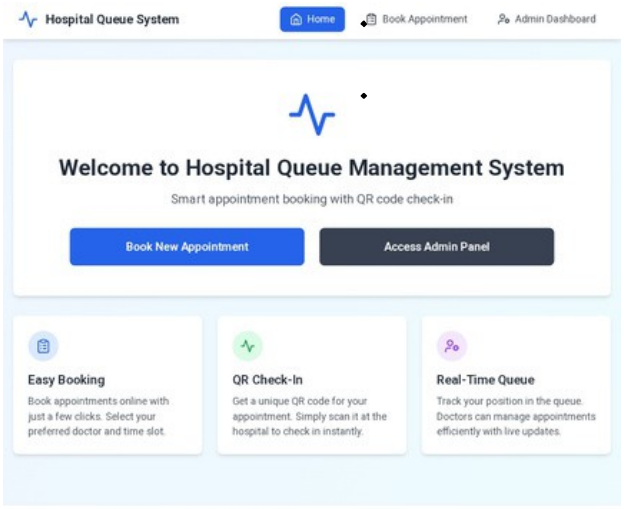
IX. TESTING&VALIDATION

Testing was performed to ensure the QueueSync systemworkscorrectly, efficiently, andsecurely.

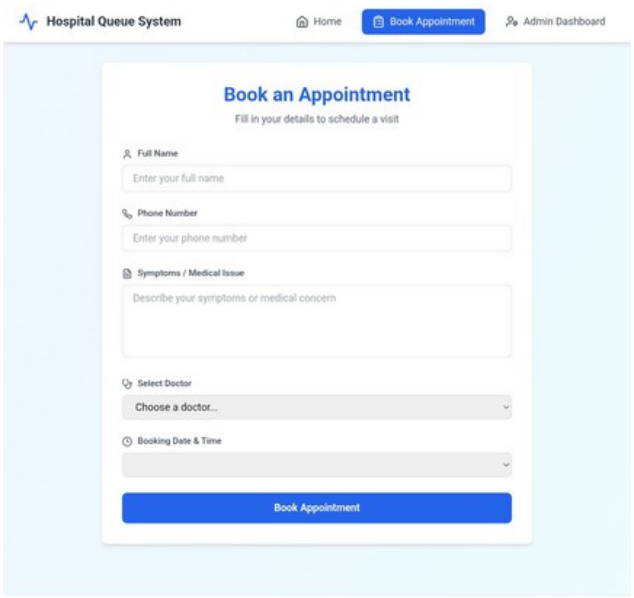
- UnitTesting:Verifiedindividualmoduleslike token generation and login
- IntegrationTesting:Checkedinteractionbetween modules
- SystemTesting:Validatedcompleteworkflow PerformanceTesting:Ensuredsmoothoperation under multiple users
- SecurityTesting:Verifiedauthenticationanddata protection

X. EXPECTED OUTCOME

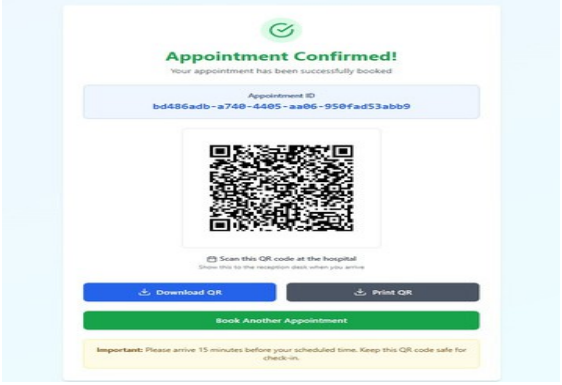
The QueueSync system is expected to improve queue management by providing a digital and automated solution. Reduceswaitingtimeandovercrowding Enables real-time queue tracking Improves service efficiencyEnhancesuserexperience Supportsdata-drivendecision making

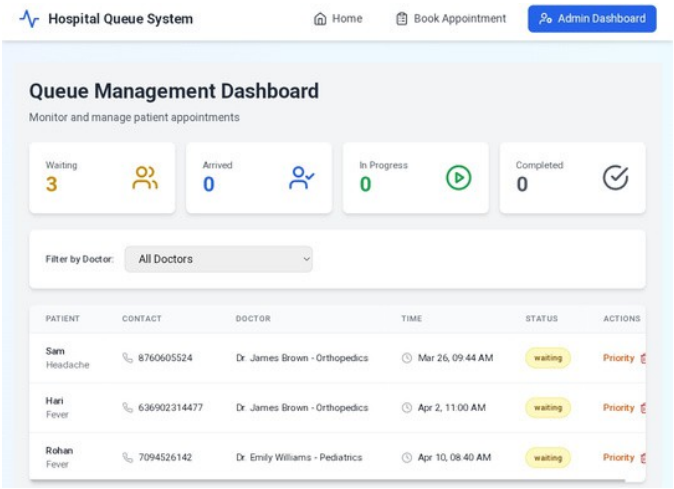


Hospital Queue Management System - Streamlining Patient Care



Hospital Queue Management System - Streamlining Patient Care





XI. SYSTEM FEATURES

- QR-basedtokengeneration
- Real-timequeuetracking
- FIFOqueuemanagement
- Livedisplaysystem
- Analyticsdashboard

XII. COMPARATIVE STUDY

Feature	**Traditional System**	**Proposed System**
QueueType	Physical	Digital
Tracking	Notavailable	Real-time
Efficiency	Low	High
Transparency	Low	High
Waiting Time	High	Reduced

XIII. FUTURE ENHANCEMENTS

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

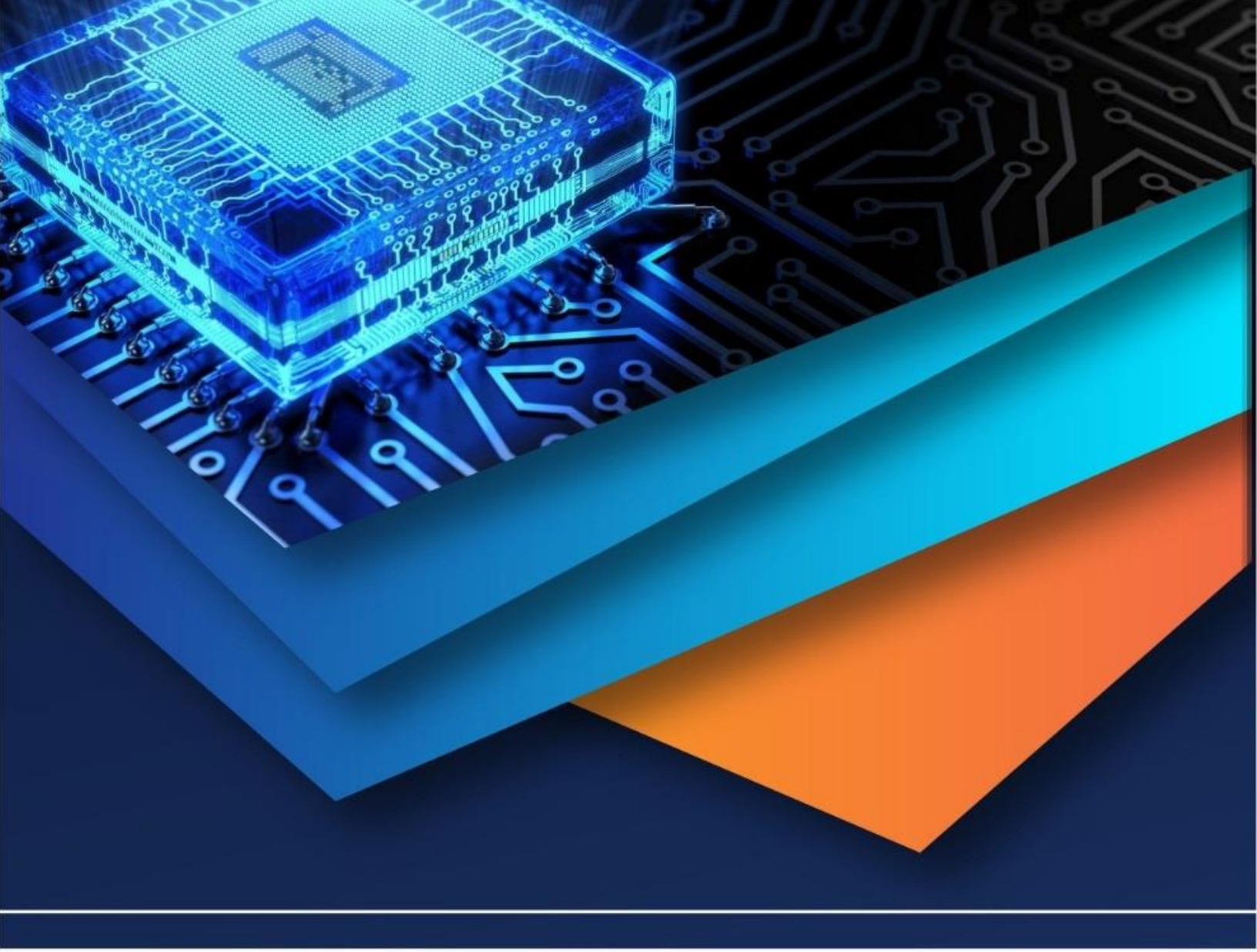
XIV. CONCLUSION

- 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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