QTrack: Smart Queue Management

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ABSTRACT

In today's fast-paced world, long and unorganized queues are a common source of frustration for users and inefficiency for service providers. Traditional queue management systems rely heavily on manual processes such as token distribution and verbal announcements, which often result in prolonged waiting times, lack of transparency, and increased chances of mismanagement. These issues are especially prevalent in high-demand environments such as hospitals, banks, educational institutions, and government service centers, where large volumes of users must be served efficiently and fairly.

To address these challenges, this project introduces QTrack, a web-based smart queue management system designed to automate and digitize the queuing process. Q Track allows users to register for a queue online from their mobile devices or computers and track their real-time position in the queue. The system leverages modern web technologies and real-time communication protocols to send automated notifications to users when their turn is near, eliminating the need for them to remain physically present in the waiting area. This not only improves the user experience but also reduces crowding and enhances operational efficiency.

The implementation of QTrack results in significant advantages including reduced waiting times, better resource management, improved service speed, and higher customer satisfaction. It ensures fairness in the queuing process by preventing queue manipulation and providing equal service opportunities to all users. The system is scalable and adaptable, making it suitable for deployment across various sectors with high footfall and demand for systematic service delivery.

Through QTrack, this project aims to demonstrate how digital transformation can modernize everyday processes, minimize human error, and provide a structured, efficient, and user-friendly solution for queue management.

I INTRODUCTION

QTrack is a smart, web-based queue management system developed to address the inefficiencies and frustrations associated with traditional queuing methods. It enables users to join queues remotely using a digital interface and receive real-time updates on their queue position. This system is particularly beneficial in reducing long waiting periods, enhancing user experience, and streamlining operations in high-traffic environments like hospitals, banks, and universities. By automating the queue handling process, QTrack minimizes the need for manual intervention, reduces the likelihood of human errors, and lowers the workload for administrative staff. Users are notified through digital alerts when their turn is approaching, eliminating the need for physical presence and ensuring a more convenient and organized queuing experience.

II LITERATURE SURVEY

Queue management has become an essential component in modern service delivery systems, especially in high-traffic sectors such as healthcare, banking, retail, government services, and education. Traditional queue systems rely heavily on manual token handling, verbal calling, and physical presence, which lead to long wait times, increased staff workload, user dissatisfaction, and a high rate of human error. The transition to digital, automated queue management systems has therefore become a strategic necessity to improve user experience and optimize service operations.

The literature emphasizes the increasing significance of real-time, web-based queue systems to address these challenges. For instance, Bidari et al. (2021) conducted a randomized controlled trial to study the impact of a queue management system in emergency departments. The study found that introducing an automated queuing system enhanced patient satisfaction by providing transparency, reducing perceived wait times, and lowering stress through timely updates and efficient flow control.

Similarly, Mallari et al. (2022) developed a system called CLIQUE, a web-based queue management platform for academic environments. The system included real-time tracking and notification features and was implemented at the Angeles University Foundation. CLIQUE significantly improved queue transparency and administrative efficiency by reducing physical crowding and providing real-time digital updates to users.

Building on such successful systems, Q Track introduces a flexible, real-time web-based queue management solution using modern web technologies like HTML, CSS, JavaScript, with a Node.js backend and MongoDB database. The system communicates using Web Sockets (Socket.IO) for real-time updates and uses the Web Push API to send user notifications. This architecture ensures a scalable, secure, and efficient platform suitable for deployment across industries like healthcare, banking, universities, and more.

In another relevant study, Alghamdi et al. (2020) proposed a cloud-based queue system for hospitals, which emphasized scalability and accessibility, allowing patients to register remotely and receive SMS updates. The success of such models confirms the viability and user preference for remote queueing solutions, particularly in health-sensitive or pandemic-prone environments.

Wang and Lin (2018) discussed the use of IoT in queue management, where sensors and mobile connectivity helped monitor and manage customer flow in real-time. Though hardware-centric, this model supports the trend toward automated, intelligent queue systems.

Raut et al. (2019) investigated smart queue systems for banking, incorporating analytics to predict wait

times and optimize resource allocation. The study highlights how queue management systems not only improve user experience but also help institutions streamline their operations and reduce idle time for service personnel.

Finally, Patil et al. (2017) designed a basic web-based token system with notification features. Although basic, their research demonstrated the feasibility of such platforms using minimal resources and emphasized the importance of web-based communication and user interfaces in reducing operational complexity.

QTrack integrates all these learnings into a unified, scalable solution that not only simplifies queue handling for administrators but also empowers users through transparency, control, and notifications. It enables users to register, monitor, and cancel queues as needed, and optionally complete payments before reaching the counter. This holistic approach to queue management aligns with the broader digital transformation goals in service sectors.
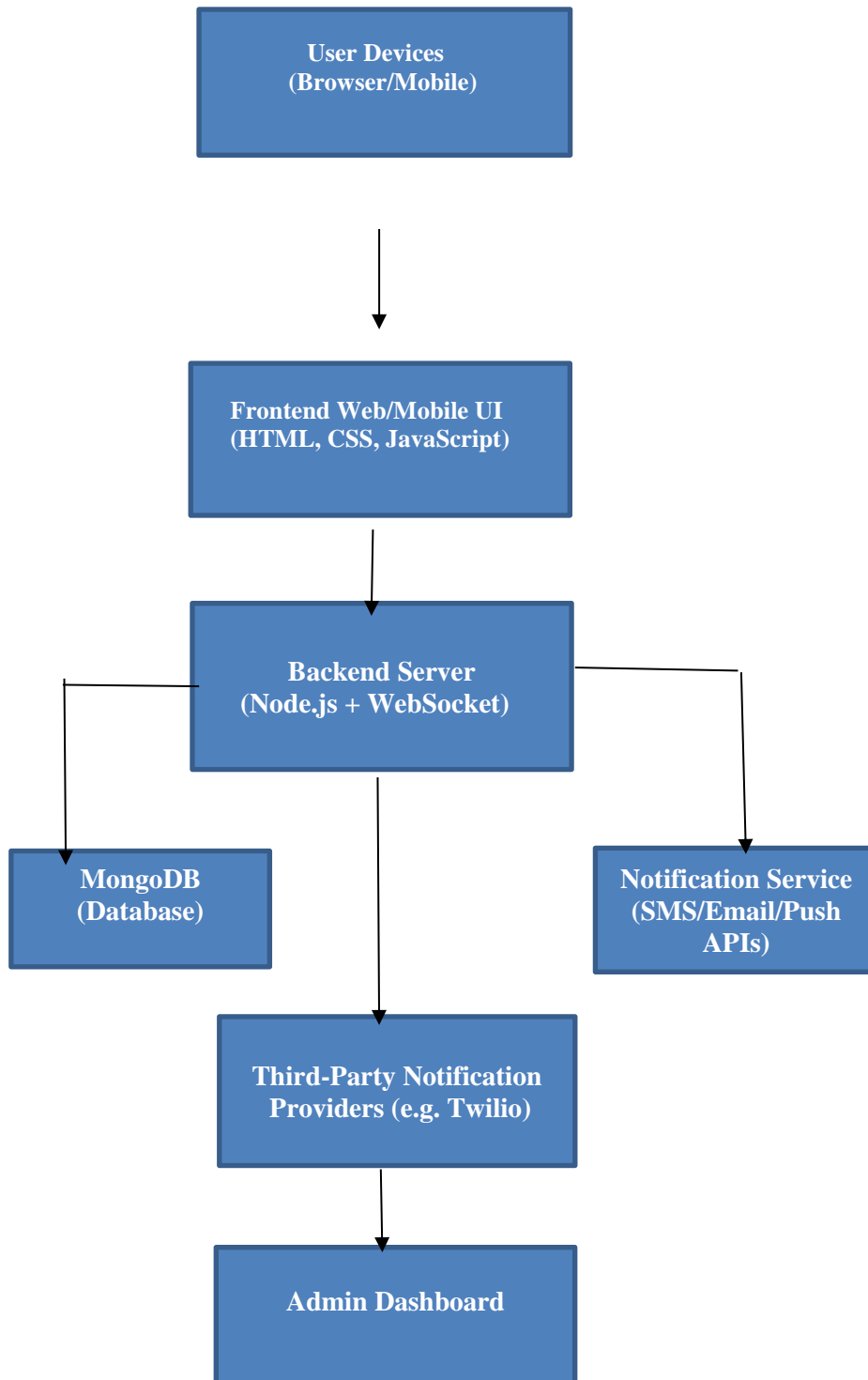
PROBLEM STATEMENT

- Existing systems lack real-time updates, forcing users to wait without knowing their status.
- Most queue systems don't send notifications, leading to missed turns and confusion.
- Users must remain physically present, causing overcrowding and discomfort.
- There is no option to cancel or reschedule a queue spot once taken.
- Billing is not integrated, leading to delays at the service counter.
- Current solutions are expensive and not easily customizable for different institutions.
- Manual handling increases chances of human error and mismanagement.
- Queue manipulation is common, as fairness and transparency are not enforced.

PROPOSED SYSTEM

The proposed system, Q Track, is a smart, web-based queue management platform designed to improve the traditional queuing process by allowing users to join and monitor queues remotely through a digital interface. It provides real-time updates on queue positions and estimated waiting times, enabling users to receive automated notifications when their turn is approaching. This reduces the need for physical presence, minimizes waiting times, and enhances overall user convenience. For administrators, Q Track offers a centralized dashboard to manage multiple queues efficiently, track service performance, and generate data-driven reports to optimize operations. By automating queue handling and communication, the system reduces manual errors and administrative workload, making it an ideal solution for busy environments such as hospitals, banks, and universities.

III-ARCHITECTURE

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          ┌─────────────────────┐
          │    User Devices      │
          │  (Browser/Mobile)    │
          └─────────────────────┘
                    │
                    ▼
          ┌─────────────────────┐
          │ Frontend Web/Mobile  │
          │ UI                   │
          │ (HTML, CSS,          │
          │  JavaScript)         │
          └─────────────────────┘
                    │
                    ▼
          ┌─────────────────────┐
          │   Backend Server     │
          │ (Node.js +           │
          │  WebSocket)          │
          └─────────────────────┘
          │         │          │
          ▼         ▼          ▼
┌──────────┐    ┌───────────────────┐
│ MongoDB  │    │ Notification      │
│(Database)│    │ Service           │
└──────────┘    │ (SMS/Email/Push   │
                │  APIs)            │
                └───────────────────┘
          ┌─────────────────────┐
          │ Third-Party          │
          │ Notification         │
          │ Providers (e.g.      │
          │ Twilio)              │
          └─────────────────────┘
                    │
                    ▼
          ┌─────────────────────┐
          │  Admin Dashboard     │
          └─────────────────────┘
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IV-IMPLEMENTATION

Admin

- o Login (username, password)
- o View All Queues
- o Monitor Real-Time Status
- o Activate or Deactivate Queues
- o Manage Users (add/edit/delete)
- o Set Notification Preferences
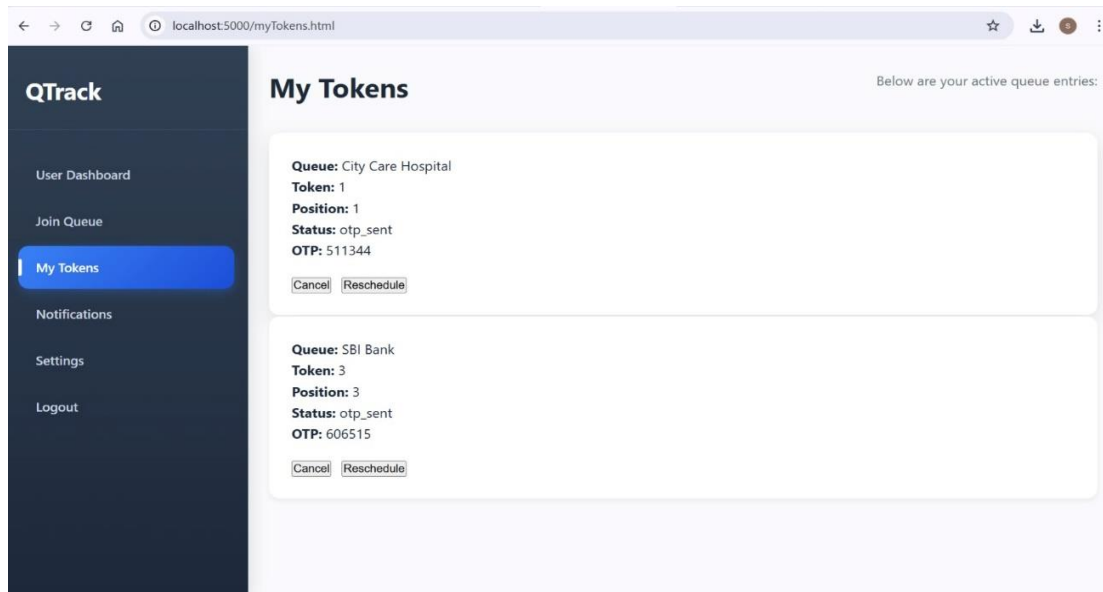- o View Billing Reports
- o Logout

User

- o Login / Register (username, password, email, mobile
- o Join Queue (select department/service)
- o View Real-Time Queue Status
- o Receive Notifications (SMS/Email/App)
- o Cancel or Reschedule Spot
- o Rate Service / Provide Feedback
- o View Billing / Payment Status
- o Logout
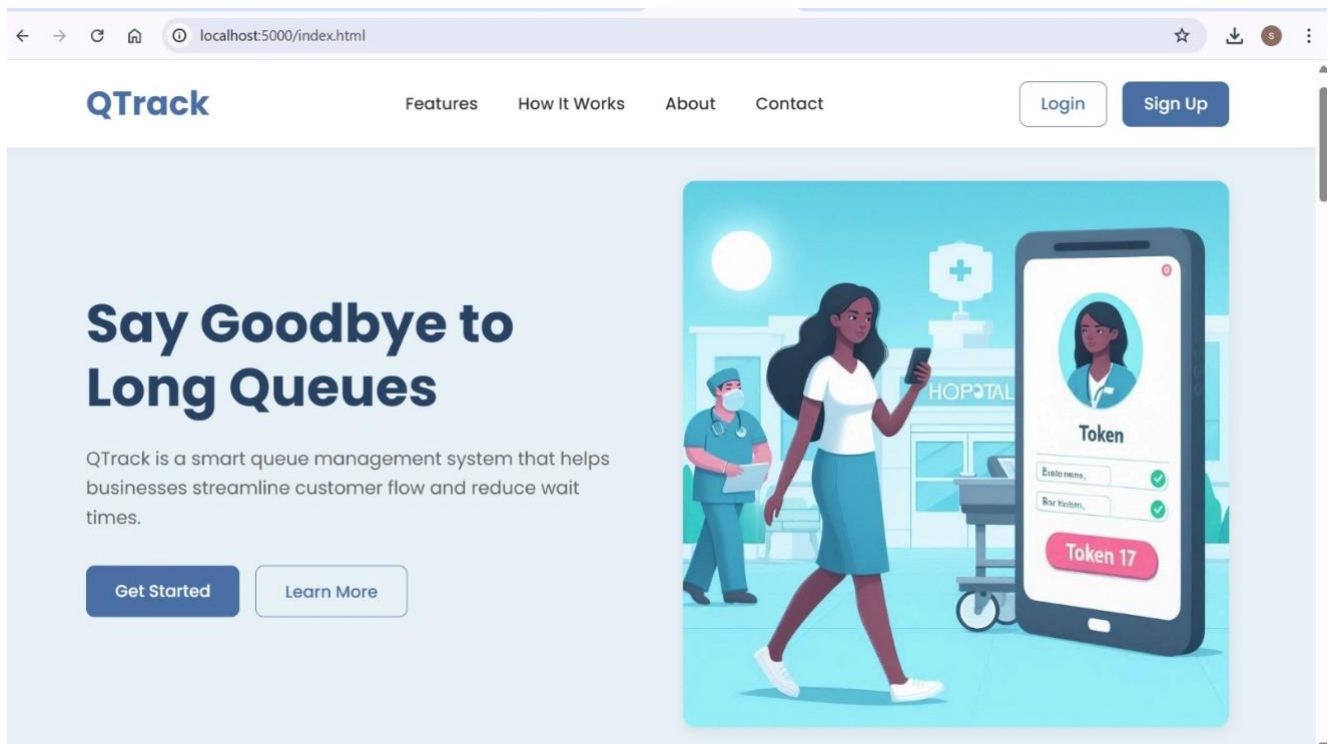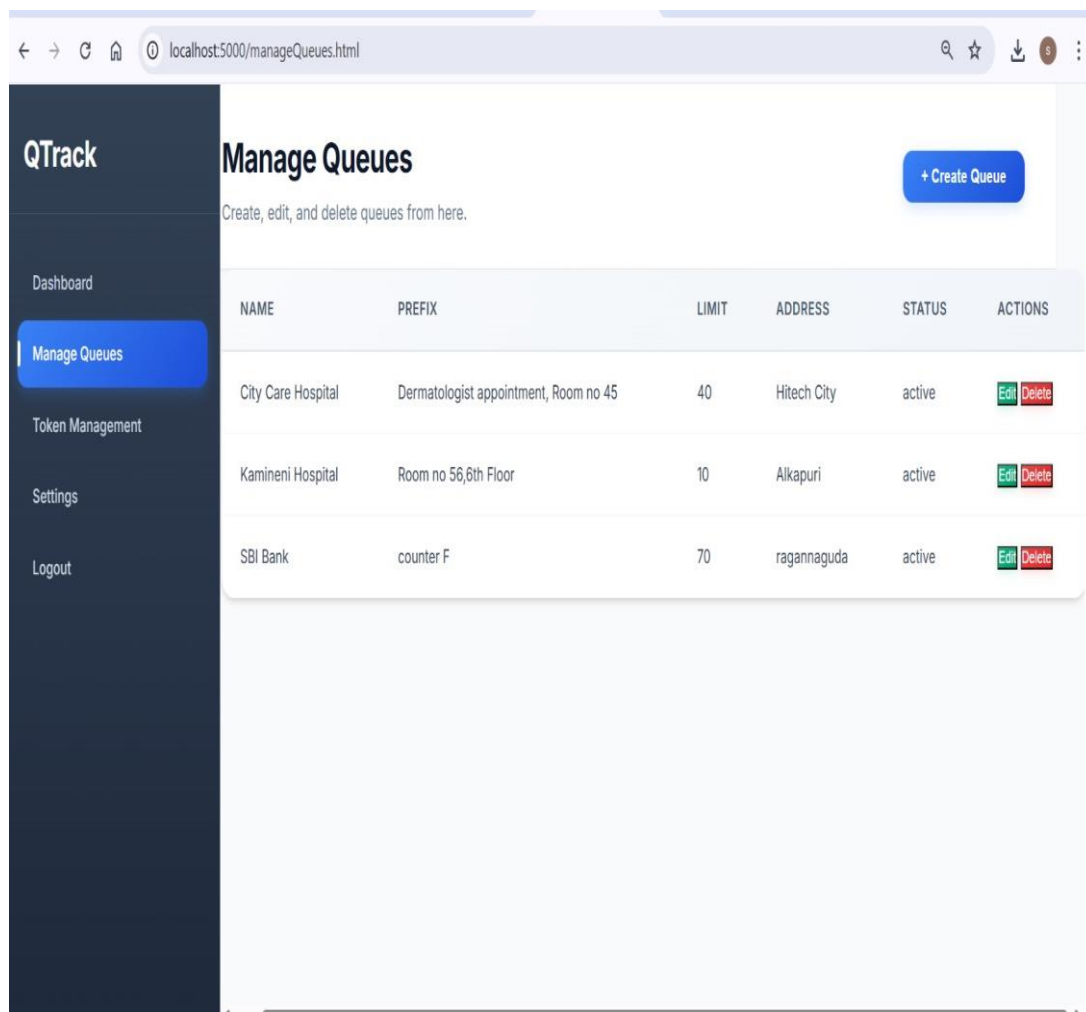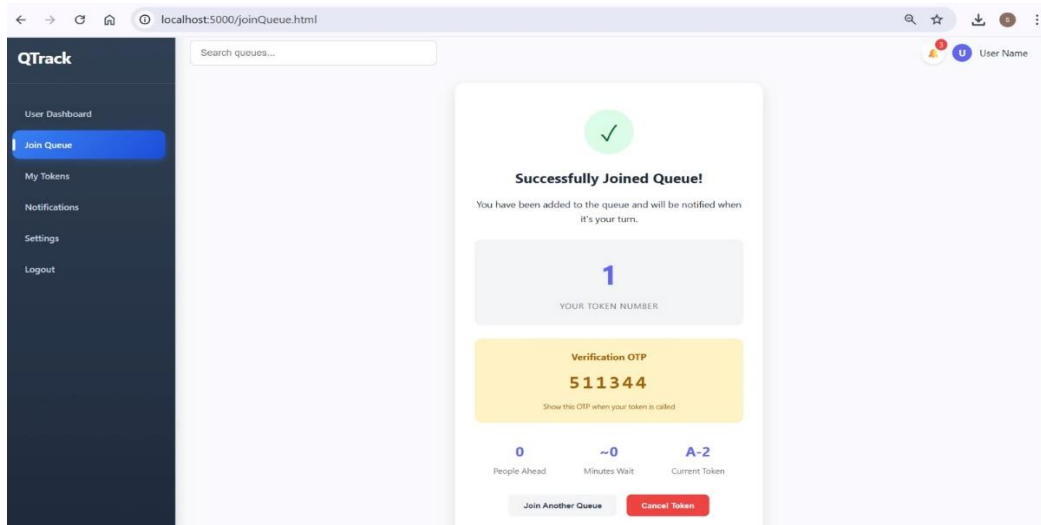
V- RESULTS

VI-CONCLUSION

The development of a comprehensive queue management system effectively mitigates the inherent limitations of conventional queuing processes. By incorporating functionalities such as real-time status updates, automated user notifications, and the ability to cancel or reschedule appointments, the system significantly enhances operational efficiency and user experience. Furthermore, the integration of billing mechanisms and role-based access control ensures streamlined service delivery and administrative oversight. The customizable and cost-effective nature of the solution makes it adaptable to a variety of institutional requirements. Ultimately, this system fosters transparency, reduces physical congestion, and minimizes the potential for human error, thereby establishing a more organized, equitable, and reliable queuing environment.

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