International Journal for Multidisciplinary Research (IJFMR)

E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

GovQueue: A Queue Management and Token Generation System for Public Offices

Hafiza Shaikh[1], Shakila Siddavatam[2]

[1]Master's Student, Department of Computer Science, Abeda Inamdar Senior college, India
[2]Head of Department, Department of Computer Science, Abeda Inamdar Senior college, India

Abstract

Public services are often a presence of one's main source of annoyance – the queue.Many public authorities operate with the traditional "first-in, first-out" method, crowded waiting areas for taxpayers and long wait times causing high levels of stress among clerks.

Traditional methods of queuing rely too much on manual control, thus cannot manage queues properly, distribute counters efficiently, and communicate instant messages to users. There are digital options, but they frequently fast become outdated for current service demands. They don't provide staff with the tools they need to manage operations efficiently.

This study introduces "GovQueue", an online system for queue management and token dispensing. The system offers citizens the ability to generate service-specific tokens remotely, to follow the progress of a live queue and get timely notifications while waiting online consequently cutting out space-related physical wait time as well as adding an additional layer of transparency. For admins, GovQueue dashboard is the place where they handle all of token flow, assign dynamically counters and regulate queue status on-the-fly. GovQueue includes a modular design on responsive frontend, real-time backend communication layer and smooth sychronization with low-latency updates to all user interfaces. The proposed system operates with a FCFS scheduler that is augmented by CWT and token scheduling to provide fairness and efficiency. Experimental deployment in simulation shows considerable reductions in waiting time, improved counter usage and increased engagement of the users. The framework demonstrates the potential for scalable, lightweight system in the public service sector, thereby paving the way for further integration with larger digital governance programs.

Keywords: Queue Management System, Queuing Theory, GovQueue, Citizen-Centric Services, Service Optimization, Smart Governance, Web-based application, Digital Governance, Real-Time Monitoring.

1. Introduction

For citizens to get a timely response from public services, there should be a system in place to manage queues efficiently. The type of places in which queues are used are government offices, public hospitals, banks, and local government agencies. Citizens who visit any of these types of institutions will often stand in line to receive their queued service, and usually, an employee will give them a numbered ticket for confirmation; this may be a bit outdated as the way citizens queue for service has recently undergone changes due to the growing emphasis on digital government and citizen-centric service delivery.

With this increased focus on providing more citizens with access to government services via online applications, the traditional way in which citizens have to wait for services has become more apparent than ever. Many public-sector services have a huge disparity between the number of services that are requested during certain times of the day, and the number of available service counters, employees, etc. Because of the way the traditional queuing systems are set up, citizens cannot accurately estimate how long they will need to wait for service, and many citizens have had to go back multiple times to get the services they initially went to obtain. Additionally, these inefficiencies in service delivery cause difficulties for elderly people, working occupants, and persons with disabilities when trying to use public services. The challenges faced by the public service sector today illustrate the need for effective queue management solutions that enable the public to easily access services on a timely manner while also allowing the public employee to effectively manage their queues.

Digital queue management systems developed through technological advances in web applications, systems of communication in real-time and current technological advances have addressed a number of challenges related to digital queuing.

Prior studies have shown that Queuing Theory [1], simulation models [2], and Electronic Token Systems [3] all contribute towards enhancing service flow and decreasing congestion. However, a limitation of these implementations is that they are predominantly confined to specific domains; operate in isolation or cannot provide real-time synchronization capabilities across multiple service locations and thus are restrictive in dynamic public service environments.

To that end, the GovQueue system is being proposed as an internet-based queue management solution developed to improve the efficiency of services provided by public offices. The GovQueue system is designed to combine a number of components through a single integrated software platform, a digital token generator, a real-time view of where in the queue, or live-view, a person is in relation to their token number; and a user interface that provides access to both service staff and citizens based upon their respective roles, to create a seamless experience between citizens and

service providers through the GovQueue software platform. By removing the need for physical queues and enabling a real-time visualisation of the flow of services and where an individual is in relation to their token number, GovQueue hopes to enhance the effectiveness of their service delivery process while enhancing the overall experience for the citizen. The remainder of this paper will provide a detailed account of the problem formulation, a review of the relevant literature, a description of the system design and implementation, and an analysis of the results and the future scope of the project.

2. Problem Statement

Governmental offices, banking institutions and healthcare facilities use traditional queuing techniques as their primary means of managing customer flows, resulting in extended wait periods, inconsistency of information available to the public regarding queuing times and ineffective use of staffing resources at the counter level.

2.1 Proposed Solution

This study attempts to offer the solution to long inefficiency of classic queueing systems in public service context. With GovQueue implementation, citizens create tokens for service, monitor live status of queues and get real-time updates while staff adjusts counters spontaneously thus being able to manage their workspace efficiently for lesser congestion and waiting time. In addition to the pragmatic benefits, it brings openness, accountability and citizen-led service delivery as part of wider digital governance agendas.Academically, the research contributes to the understanding of real-time queue management, token allocation, and system design in public service contexts, offering a practical framework that can be adapted to other institutions seeking to improve operational efficiency and user satisfaction.

3. Literature Review

Inefficiencies in traditional queuing systems across public and service-oriented sectors have motivated extensive research into analytical and technology-driven queue management solutions. Existing studies span theoretical modeling, simulation-based optimization, and digital system implementation, offering valuable insights into improving service efficiency and user experience. This section reviews key contributions that form the conceptual and technical foundation for the proposed GovQueue system.

Wang and Ahmed examined queue congestion in banking environments through stochastic dynamic modeling [1]. Their study proposed adaptive queuing models capable of responding to fluctuating service demand while balancing operational costs and customer waiting time. The authors emphasized real-time decision-making as a critical factor in effective queue management. These findings provide a strong theoretical basis for flexible queue systems such as GovQueue, where dynamic adjustment of service flow and counter allocation is essential in public offices with variable workloads.

Simulation-based approaches to queue optimization were explored by Madadi et al., who developed computer-based models to analyze service counter utilization in a banking context [2]. Their results demonstrated that simulation-driven configuration of service counters could significantly reduce customer waiting time and improve system efficiency. Such modeling techniques are relevant to GovQueue, as they support performance evaluation and informed system design prior to real-world deployment, thereby reducing implementation risks in public service environments.

The role of digitalization in queue management was highlighted by Samarina et al., who studied electronic queue management systems in commercial banks under conditions of economic digital transformation [3]. Their work showed that electronic queue systems enhance transparency, regulate customer flow, and contribute to improved service quality. These findings reinforce the importance of adopting digital queue solutions in public-sector contexts, aligning closely with GovQueue's objective of modernizing traditional service delivery mechanisms.

Focusing specifically on public service institutions, Kumar and Kumar applied classical queuing theory models to counters operating in government offices and similar establishments [4]. Their analysis demonstrated that systematic evaluation of arrival rates and service times can lead to measurable reductions in waiting time and improved service performance. This study directly supports the rationale behind GovQueue by confirming the applicability of queuing theory as a decision-support tool for optimizing public-sector service operations.

Technological innovations aimed at reducing physical crowding were addressed by Ngorsed and Suesaowaluk, who proposed a wireless-based hospital queue management system [5]. Their solution enabled users to monitor queue status remotely through web and handheld interfaces, thereby minimizing unnecessary physical presence and improving space utilization. This approach aligns with GovQueue's goal of enabling remote queue visibility and reducing congestion in public offices.

Low-cost and user-centric queue monitoring solutions were further explored by Gimba et al. through the Q-CAM system, which utilized camera-based hardware and mobile applications to provide real-time queue updates [6]. Their findings demonstrated the feasibility of affordable, scalable queue monitoring under varying network conditions. This work supports GovQueue's emphasis on accessibility and transparency while keeping infrastructure and maintenance costs manageable.

In summary, the reviewed literature confirms that queuing theory, simulation modeling, and digital technologies are effective in improving service efficiency across banking, healthcare, and public service sectors. However, existing solutions are often domain-specific or focus on isolated aspects such as modeling, monitoring, or digitization. These gaps highlight the need for an integrated, real-time, web-based queue management platform. Building on established theoretical foundations and proven digital approaches, GovQueue seeks to unify these elements to enhance efficiency, transparency, and citizen satisfaction in public service delivery.

4. Methodology

4.1 Design of Research

This research is designed-oriented, and it focuses on designing and evaluating a web-based queue management system for public service settings. The research is motivated by practical challenges observed in traditional queuing practices, such as high transaction time delays, general lack of real-time visibility of people in queue and counter personnel perform in an inefficient manner. Instead of depending on theoretical investigation alone, the work focuses on constructing a practical system dealing with these operation problems in a real-world service setting.

The study follows the typical system development life cycle process form needs analysis through common service workflow in government offices. These requirements guide the design and implementation of GovQueue, which involves service type-based token issuance and live work queue monitoring, and staff-driven queue advancement. The functionality of the system is tested and analyzed in various scenarios to measure responsiveness, synchronization accuracy and usability for citizens and staff, guaranteeing that the proposed solution is feasible, scalable and deployable in a real-world deployment.

4.2 Information Gathering

The information used in this study was gathered mainly through secondary sources and technical exploration related to queue management in public service environments. Secondary data sources included review and analysis of academic journals, conference papers, government publications, and relevant articles that focused on traditional queuing systems, digital queue management systems, and service delivery challenges in public institutions. These sources were useful in their insight into the more typical operational barriers of long waits, lack of transparency, and cumbersome use with multiple service counters, as well as broader trends in technology utilization to improve public services.

Along with this, technical research was implemented on how other similar web-based systems are being designed and implemented in practice to gain insight into how they work. We looked at existing queue systems, real-time service systems, their technology choices, security considerations, and user interface approaches. This study helped us make decisions regarding system architecture, real-time communications, API design, and database design. The goal of this work was not to simply replicate existing systems, but rather to use the research to better inform what design decisions would be most practical for the needs of a government queue management system such as GovQueue.

5. Design and Implementation

5.1 System Architecture

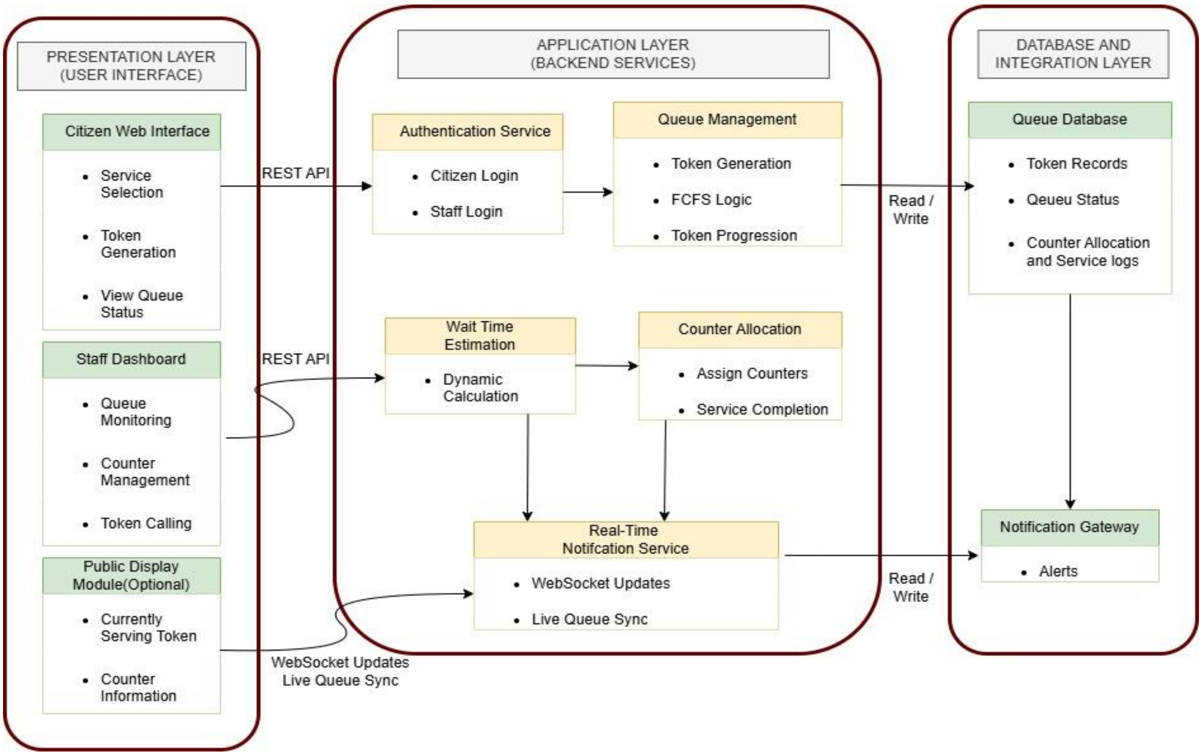
The GovQueue system follows a three-tier architecture. The architecture consists of the following components:

Frontend (Client-Side)- A HTML and JavaScript based responsive web with individual citizen, staff and administrator dashboards.
Backend (Server-Side)- Server side of the application that utilizes Node.js and Express.js to handle token generation, queue sequencing, counter allocation, authentication, and real-time updates.
Database (MongoDB)- A centralized storage to store user information, service details, token records, queue status, and counter assignments.

- **System Workflow**

1. An authenticated citizen accesses the web interface to select a required service and generate a token.
2. The system assigns a service-specific token and displays the current queue position and estimated waiting time.
3. Service staff log into the staff dashboard to monitor active queues and manage available service counters.
4. When a token is called, the backend updates the queue status and notifies connected user interfaces in real time.
5. The database is updated continuously to reflect token progression, counter allocation, and service completion.
6. Citizens receive live updates on their queue status until the service process is completed.

Figure 1. System Architecture of GovQueue



5.2 Technologies Used

Technology included in GovQueue is as follows:

Table 1 Technology Stack for GovQueue

Component	Technologies Used
Frontend	HTML, CSS, Bootstrap, JavaScript

Backend	Node.js, Express.js
Database	MongoDB
API Communication	REST API
Authentication	JSON Web Token (JWT)

5.3 User Interface(UI)

GovQueue website is built using simple and attractive user interface to make sure that citizens, staff, and administrator can use it effectively and easily. The website consists of minimal steps, allowing users to navigate them easily.

5.3.1 System Validation and Testing

Test Case 1- User Authentication (Citizen Login)

- **Purpose:** To ensure that any registered citizen has the ability to successfully log into their account.
- **Input:** Valid username and password.
- **Expected Result:** User is authenticated and redirected to the citizen dashboard.
- **Outcome:** Successful login confirms secure access control.

Test Case 2- Token Generation

- **Purpose:** To ensure that citizens have the ability to generate tokens.
- **Input:** Citizens who are authenticated can choose a specific service from a list of available services.
- **Expected Result:** A unique token number is generated and displayed along the queeu position.
- **Outcome:** Succesfully token is generated and secure queue entry.

Test Case 3- Live Queue Update

- **Purpose:** To confirm that a citizen's queue continues to progress in real-time.
- **Input:** Staff will have the ability to call the next token, which advances the queue.
- **Expected Result:** Queue status is instantly updated for the other citizens in the queue.
- **Outcome:** provides confirmation that the actions of staff will be synchronized with the citizens' view of the real-time queue.

Test Case 4: Staff Queue Management

- **Purpose:** To evaluate staff capacity to administer the operation of service counters.
- **Input:** Staff logs in to the application and updates status of service counter (opened/closed/next token).
- **Expected outcome:** The flow of customers through the queue will be adjusted according to the available service counter.
- **Result:** Validates the effectiveness of role-based controls and maximizes staff efficiency.

Test Case 6: Database Consistency

- **Purpose:** To confirm that the database is accurately updated after operations completed on the Queue.
- **Input:** Token generated, position advanced in queue and serviced.
- **Expected Outcome:** The actions taken should be accurately reflected in the system's database.
- **Result:** Establishes reliability of database systems and absolute integrity of information.

5.3.2 User Interface Overview

The system has role-based interfaces to support different user responsibilities:

- **Homepage:** Provides overview of the platform, displaying the key features, and options for login and registration.

- **Registration Page:** Allows new users to create their account
- **Login Page:** Common interface for each user to log in.
- **Citizen Interface:** Citizens can access to services, book tokens online, track their token status, and submit feedbacks.
- **Staff Dashboard Interface:** Staff can monitor queue status, call next token, accept or hold any user and control token progress.
- **Admin Dashboard Interface:** Admin have complete access to the system, add or remove new or existing staff, monitor queue, generate reports of peak hours, and maintain overall system.

5.3.3 User Interface Screenshots

The following figures illustrates the UI screens of GovQueue application:-

Figure 2: HomePage

Figure 3. Signup Page

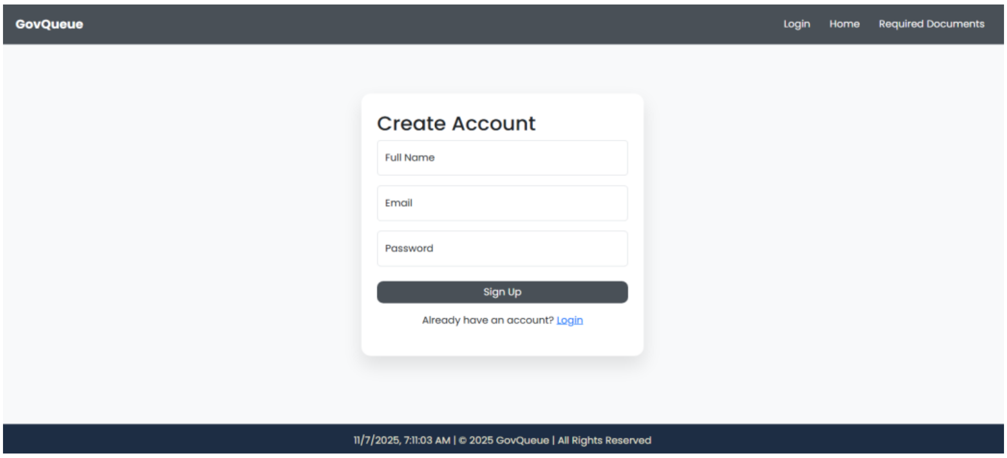


Figure 4: Login Page

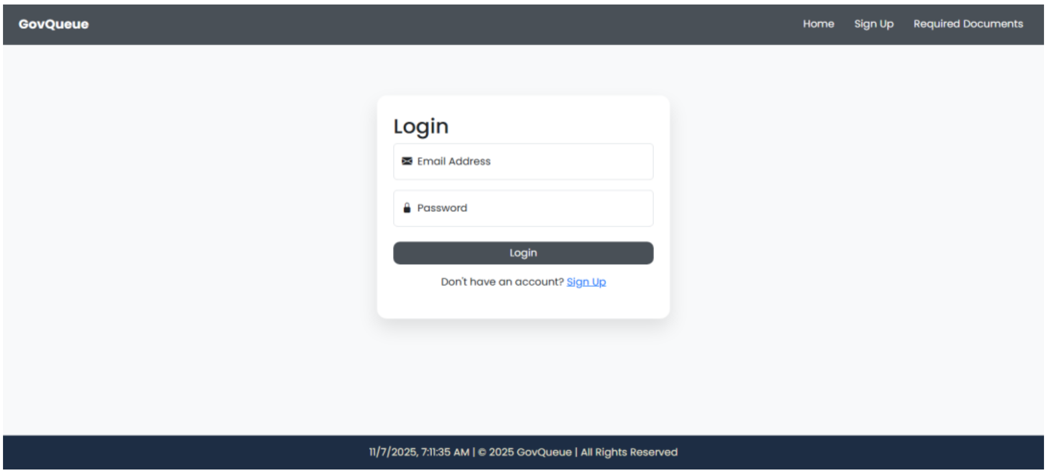


Figure 5a: Citizen Dashboard

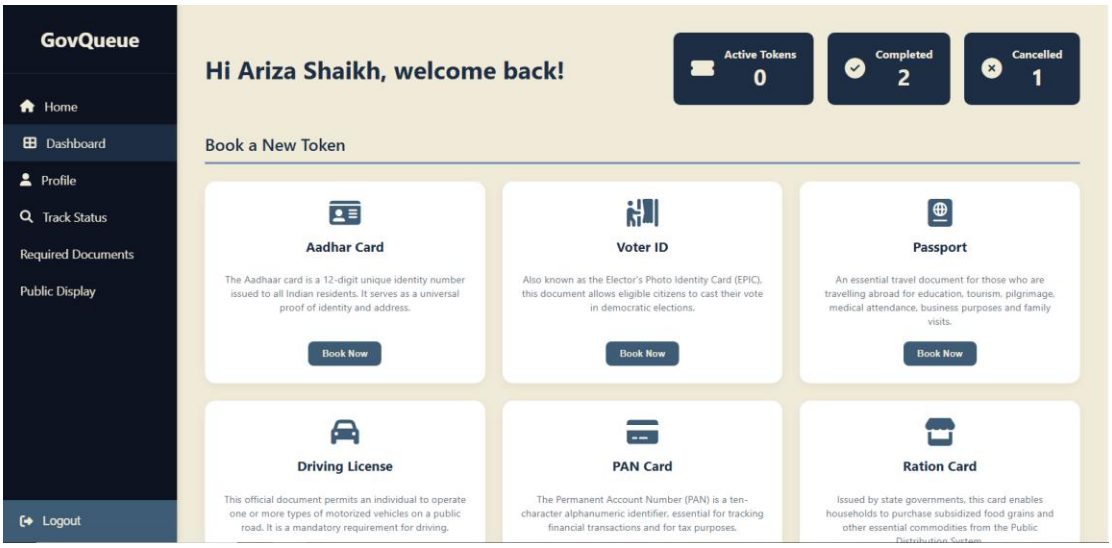


Figure 5b: Citizen Dashboard - Book Token for any Service

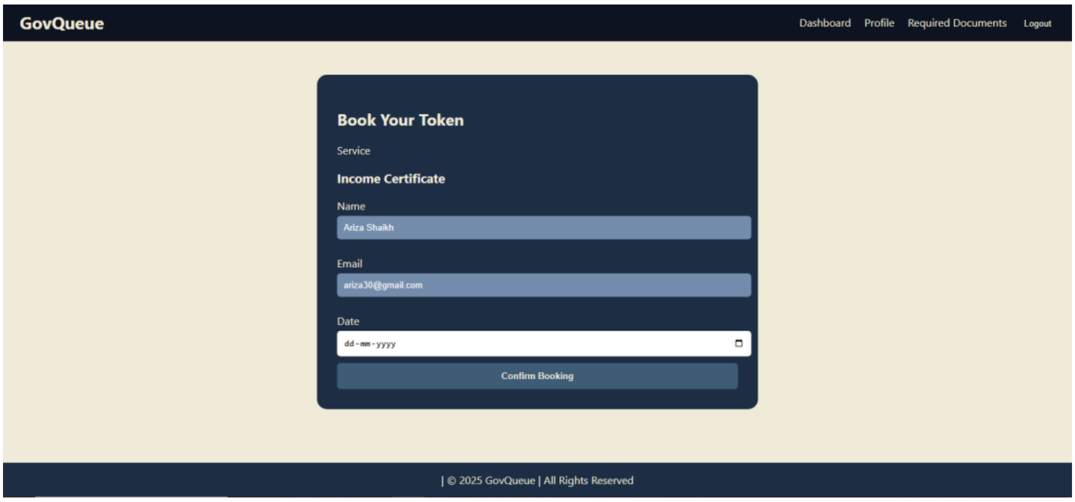


Figure 5c. Citizen Dashboard - View Token Status

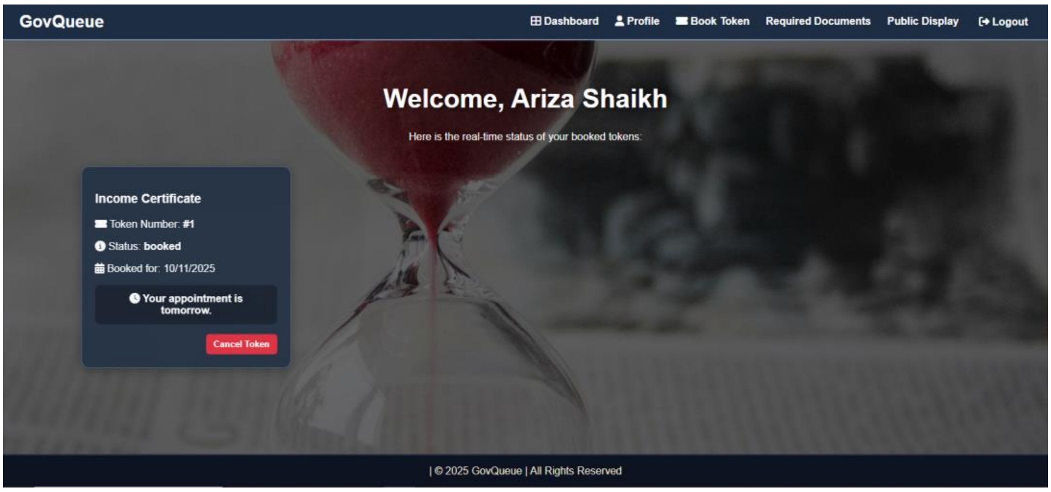


Figure 6a: Staff Dashboard

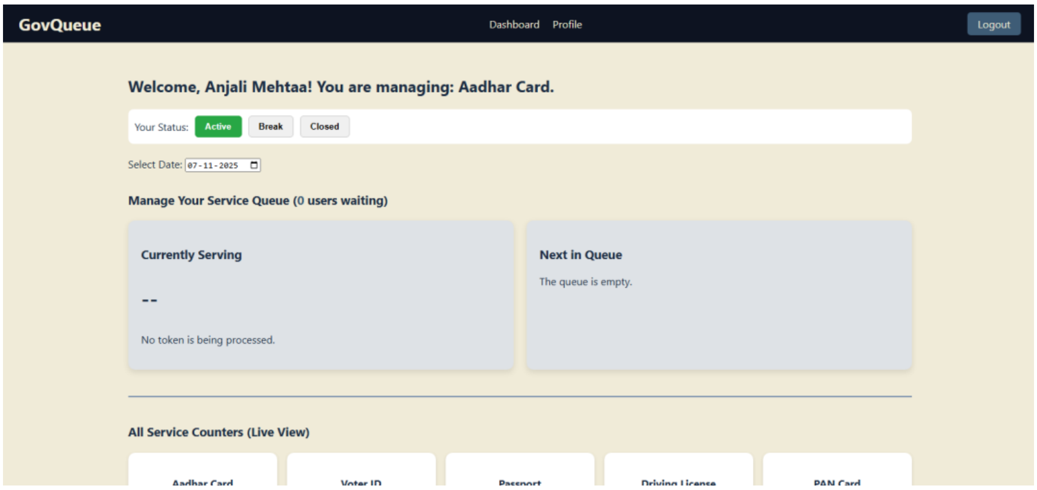
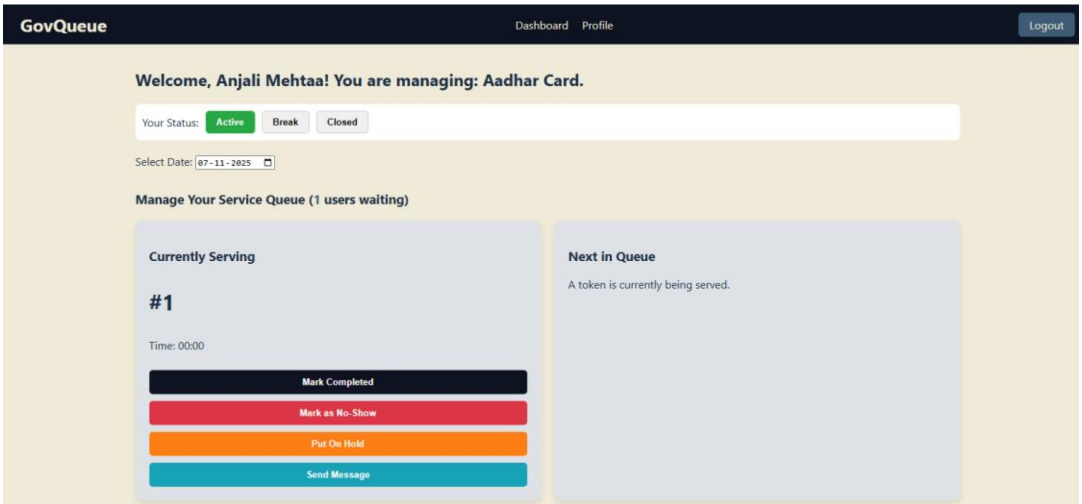


Figure 6b: Staff Monitoring and Managing Queues



International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Figure 7a: Admin Dashbaord

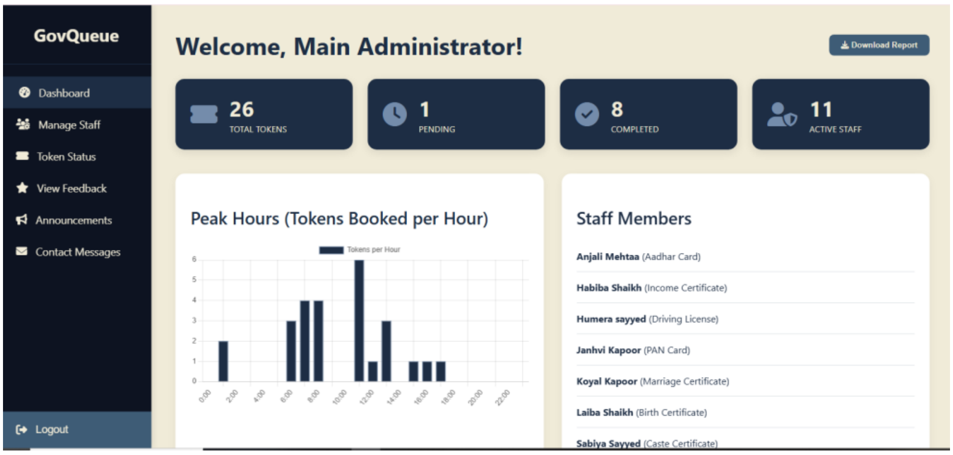
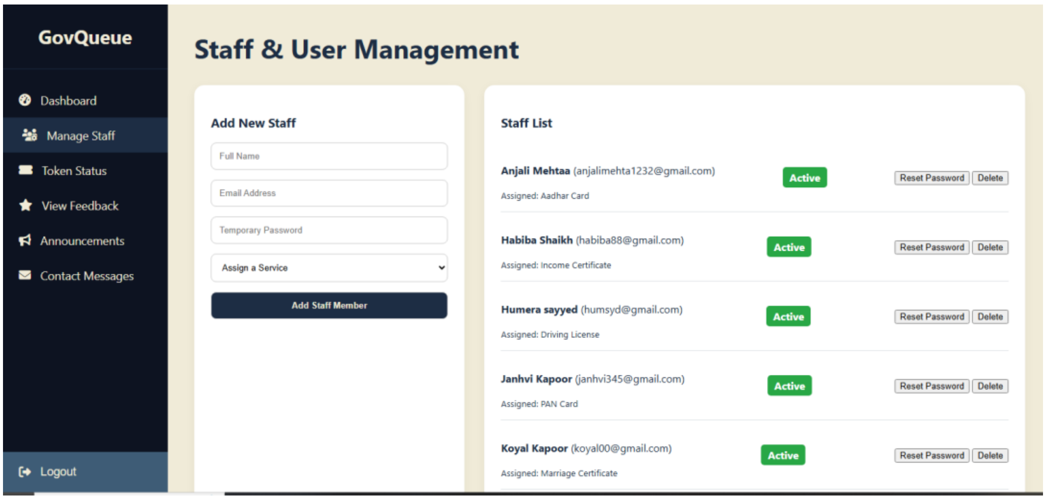


Figure 7b: Admin Managing Tokens, Citizens, and Staff



7. Discussion

7.1 Strengths of the System

- **Real-time queue visibility:** The system reduces uncertainty by providing live queue status and estimated waiting time for the user's queue position.
- **Role-based access and usability:** The use of different interfaces for citizens, staff, and administrators, ensures that user interacts with relevant features only, improving operational activity.
- **Improved service efficiency:** Staff can now process queues more efficiently due to the ability to handle tokens in a more automated manner, hence less workload and reduced delay times.
- **Scalable and modular architecture:** The system can support multiple services and a growing number of users, making it capable for numerous public service environments.
- **Enhanced transparency and accountability:** Handling digital records of tokens and service flow enables better monitoring and reduced mismanagement of unfair queue handling.

7.2 Limitations of the System

- **Dependency on the internet:** The system is highly dependant on internet and requires stable internet connectivity for accessing real-time updates.

- **User adaptability:** Some users with limited digital knowledge may require initial assistance to the system.
- **Capacity bottlenecks under high concurrency:** Despite the system's scalable design, performance degradation may occur at risk during peak hours.

8. Conclusion

This study addresses the existing challenges in various public sectors such as government offices, hospitals, or banks. The traditional queuing methods often lead to overcrowded service counters, lack of transparency, and extended waiting times, which impact the operational activities and customer satisfaction.

To address these challenges, this study introduces GovQueue a web-based queue management system, to optimize and enhance service delivery in public sectors.

Our solution, based on existing research, employs a web-based system that enables digital token generation, queue monitoring, and role-based access. GovQueue is a service-oriented solution tailored to improve transparency, efficiency, and fairness in public service environments.

Although the platform has certain limitations, such as dependency on internet connection and the need for digital literacy, the system offers a practical response to queue inefficiencies. With further improvements including mobile application support, predictive wait-time estimation, multi-department expansion, and multiple language support, GovQueue has the potential to support and improve citizen experience and operational optimization in public service delivery, contributing meaningfully to broader digital governance initiatives.

9. Future Scope

- **AI-based prediction management:** Integrating machine learning models to predict service times and staff requirements during peak hours.
- **Integration with mobile application:** Developing a citizen-friendly mobile app version that enables remote token booking, push notifications, and real-time queue tracking on smartphones.
- **Multi-Language Interface:** Expanding the user interface to support multiple regional languages for better access in public sectors across India.
- **Multi-Department Expansion:** Extending the system's functionality to hospitals, RTOs, educational institutions, and corporate offices where crowd handling is a major concern.

10. References

1. S. Wang and N. U. Ahmed, "Dynamic model of bank queuing system and its optimal management," *International Journal of Service Science, Management, Engineering, and Technology*, vol. 9, no. 2, pp. 1–15, 2018.
2. N. Madadi, A. H. Roudsari, K. Y. Wong, and M. R. Galankashi, "Modeling and simulation of a bank queuing system," *Simulation Modelling Practice and Theory*, vol. 38, pp. 95–106, 2013.
3. E. A. Samarina, A. V. Karpov, and D. A. Kiseleva, "Electronic queue management system in commercial banks in conditions of economy digitalization," *Journal of Physics: Conference Series*, vol. 1728, no. 1, 2021.
4. M. Kumar and N. Kumar, "Implementation of queuing theory in counters serving the public service sector," *International Journal of Engineering Research and Technology (IJERT)*, vol. 12, no. 6, pp.

210–215, 2023.

5. M. Ngorsed and P. Suesaowaluk, "Hospital service queue management system with wireless approach," *International Journal of Computer Applications*, vol. 144, no. 5, pp. 24–30, 2016.
6. U. A. Gimba, M. A. Ramlee, and S. N. A. M. Nasir, "Q-CAM: Queue monitoring system using camera," *International Journal of Electrical and Computer Engineering*, vol. 11, no. 4, pp. 3281–3289, 2021.