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NoQ an Online Scheduling and Token Generation for Bank Customers Queue Management System

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Abstract: Banks are the places where there is heavy flow of customers every day. Long queues are a big alarm sign for banks and also for the customers. In India every bank is offering digital service channels to their customers to facilitate them. However, when customers come to visit the bank at the physical branches it could get very difficult to manage the customers and maintain a good customer experience. Another big challenge is the health and safety concerns. The bank branch occupancy limits and the social distancing rules are also adding to the queue management problems and making it difficult to provide a good quality service and satisfactory customer experience. The market trends and customer's expectations have also been changed, now a day's people are more adoptive and inclined towards digital interaction. A high-tech queue management system can bridge the gap between the physical and the digital customer experience and it can significantly improve the customer journey. In this paper, design and development a virtual queue management system using Deep Q Learning algorithm that helps reduce customer queues with fully-functional features. This system has a smooth and innovative user interface so that novice users can use it easily. A virtual queue replaces a physical line by placing customers in an invisible or online queue, also known as a virtual waiting room. By booking appointments remotely where customers can wait outside the banks' premises, this digital queue ensures customers don't have to wait for their turn in a crowded waiting room or stand in a long line thus minimizing human interaction and abiding by social distancing rules. The system is a perfect combination of innovation and technology that helps to provide a better customer experience

Keywords: Deep Learning, virtual queue, virtual waiting room

I. INTRODUCTION

A bank is a financial institution which accepts deposits, pays interest on pre-defined rates, clears checks, makes loans, and often acts as an intermediary in financial transactions. It also provides other financial services to its customers. The term bank is either derived from old Italian word banca or from a French word banque both mean a Bench or money exchange table. In olden days, European money lenders or money changers used to display (show) coins of different countries in big heaps (quantity) on benches or tables for the purpose of lending or exchanging.





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Bank management governs various concerns associated with bank in order to maximize profits. The concerns broadly include liquidity management, asset management, liability management and capital management. We will discuss these areas in later chapters.

The Indian Banking System

Banking was initially introduced to India in the first part of the 18th century. The General Bank of India, which is created in 1786, was the country's first bank. The State Bank of India, originally known as The Bank of Bengal, was founded in Kolkata in 1807. The Reserve Bank of India supervises all banks in India. All Indian banks are regulated by the Reserve Bank of India or RBI. In 1935, this governing body had the responsibility of formally regulating Indian banks. The Reserve Bank of India has been designated as the country's official Central Banking Authority, overseeing the country's banking sector. In India, there are two sorts of banks: public sector banks and private sector banks. A bank often offers the following services:

- ٠ Checking account
- Cheque books
- Savings account
- Money market account
- Certificate of deposit (CD)
- Individual retirement account (IRA) •
- Credit card
- Debit card •
- Mortgage
- Individual loan
- Automated teller machine
- Transactional account

Furthermore, banking sector offers a variety of services such as personal banking, corporate banking, investment banking, private banking, transaction banking, insurance, consumer lending, trade finance, and other related services.

CATEGORIES OF BANK

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In India, banks are categorized into four types:

A strong banking system is critical because it assures public wealth, access to low-cost loans, economic growth, rural development, and worldwide reach. India has a large number of banks that are categorized into numerous types. But the best part is that they are all RBI-licensed, which means they are safe and reliable. The four types of banks in India are as follows;





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- **Commercial bank:** A commercial bank is a financial institution that accepts public deposits and lends money for profitable consumption and investment..
- Small Finance Bank: Banks with a small finance bank license can offer basic banking services such as deposit acceptance and lending. Tiny business units, small and marginal farmers, micro and small firms, and unorganized sector organizations are among the areas of the economy that other banks do not currently handle.
- **Payments banks:** A payments bank is comparable to any other bank, except that it operates on a smaller scale and does not take on any credit risk.
- **Cooperative Banks:** Cooperative Banks are a type of bank that is owned and operated by its members. The term "cooperative" comes from the Latin word "cooperat" or "cooperate," which means "worked together." It means that people band together and help each other out since they have similar interests.

II. MODEL IMPLEMENTATION

The system follows a multi-tier architecture that separates the presentation layer, application layer, and data layer. The presentation layer is implemented using a responsive web application that can be accessed from any device with an internet connection. The application layer is implemented using a micro services-based architecture that provides modularity, flexibility, and scalability. The data layer is implemented using a distributed database system that ensures high availability, reliability, and security.

A proposed NoQ system for a bank using deep Q-learning could work as follows:

Customer visits the system's website or mobile app and selects the desired service type, branch location, and staff member, from the booking module. The system verifies the customer's identity, availability, and eligibility, based on the customer's profile, preferences, and account status. The system displays the available dates and times for the selected staff member and branch, using the calendar module. The customer selects a suitable date and time for the appointment and confirms the booking, using the booking module. The system generates a unique appointment ID and sends a confirmation message to the customer, using the booking module and communication module. The customer receives the confirmation message and stores the appointment ID for future reference. On the day of the appointment, the customer visits the selected bank branch and checks in, using the appointment ID and token generator module. The system generates a unique token number for the customer, based on the appointment details, priority, and queue status. The customer receives the token number and queue status, and waits for their turn to be served. The system tracks the queue status in real-time, using the queue tracker module, and updates the estimated wait time, queue position, and token status, accordingly. When the customer's turn arrives, the system displays the token number and service details on the staff member's screen, using the queue tracker module and token generator module. The staff member greets the customer, verifies their identity and requirements, and provides the requested service. The staff member updates the token status and service status, using the queue tracker module, and asks for the customer's feedback. The customer provides feedback on the service quality, staff performance, and system features, using the feedback module. The system collects and analyses the feedback data, using the feedback module and analytics module, and generates reports on the feedback trends, improvement opportunities, and action items. The system updates the booking, queue, and feedback data, using the database module, and provides real-time updates to the customers, staff members, and administrators, using the communication module. The system repeats the process for each customer and appointment, using the same flow and modules.

The system uses deep Q-learning to optimize the allocation of resources (e.g. staff, teller machines) and the routing of customers to different service points (e.g. teller, loan officer) to minimize wait time and maximize customer satisfaction. The system takes into account factors such as service time, customer preferences, and staff availability.

Bank staff use a separate web-based interface to monitor the queue and make adjustments if necessary. They can view real-time information about the queue status, service times, and staff availability.

The system continuously learns from customer traffic and service times to optimize the allocation of resources and improve customer experience over time.

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Customers receive updates on their queue status through the web-based interface and/or through text or email notifications.

The system provides analytics and reports on key performance indicators such as average wait time, customer satisfaction, and service level. This information can be used to fine-tune the deep Q-learning model and make operational improvements.

Modules Description

Here are some potential modules for a web-based queue management system for a bank using deep Q learning:

1. NoQ Dashboard

In this module designing and developing the website for an online scheduling and token generation system for a bank's queue management system.

User Interface Design:

A module that focuses on creating a user-friendly and visually appealing interface for the website. The module should involve wire framing, prototyping, and designing the layout, color scheme, and typography of the website

Front-end Development

A module that involves implementing the website design using front-end development technologies such as HTML, CSS, and JavaScript. The module should also involve responsive design to ensure that the website is accessible and functional on all devices, including desktops, laptops, tablets, and mobile devices.

Back-end Development

A module that involves developing the back-end functionality of the website using programming languages and frameworks such as PHP, Python. The module should include the development of the database schema, APIs, and server-side scripting.

2. Bank Integration Module

A module that focuses on integrating the website with other bank server, such as the bank's CRM, ERP. The module should involve implementing APIs, webhooks, or other integration mechanisms to ensure seamless data exchange between different banks.

3. Bank Account Holder Module

3.1 Customer Interface

This module provides a web-based interface for customers to join the queue, specify the type of service they require, and provide any preferences or special requirements they may have. Customers can also receive updates on their queue status and estimated wait time.

3.1.1. Customer Registration

A module that allows bank customers to create an account on the system, where they can provide their personal information, such as name, email, phone number, and other relevant data.

3.1.2. Appointment Scheduling

A module that enables customers to schedule an appointment with the bank to reduce waiting time. The module should allow customers to select the date, time, and branch location for their appointment.

4. Bank Staff Interface

This module provides a separate web-based interface for bank staff to monitor the queue status, make adjustments if necessary, and manage the queue efficiently. Staff can view real-time information about the queue status, service times, and staff availability. A module that enables bank managers to manage staff schedules and availability for different branches. This module should also provide insights into staff performance and productivity to help managers make informed decisions about staffing levels.





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5. Queue Allocation Module

This module uses deep Q learning to allocate resources (e.g. staff, teller machines) and route customers to different service points (e.g. teller, loan officer) based on factors such as service time, customer preferences, and staff availability. The model learns from past customer traffic and service times to optimize the allocation of resources and improve customer experience over time. A module that tracks the real-time status of customer queues at different branches and provides information on waiting times for each service. This module should be able to handle multiple queues and enable customers to join queues remotely.

5.1. Deep Q-learning Module

This module would be responsible for training the system's artificial intelligence (AI) to make optimal decisions. It would use deep Q-learning algorithms to learn from customer interactions and improve the system's efficiency over time.

5.2. Token Generation

A module that generates tokens for customers based on their appointment schedules and the availability of staff members at the selected branch. Tokens should be unique and include relevant information, such as the customer's name, appointment time, and the service they require. The module is responsible for generating tokens for customers, based on their appointments, preferences, and priority. It allows customers to choose their preferred services, staff members, and branch locations, and assigns them a unique token number. It also provides real-time updates on the token status, estimated wait time, and queue position.

5.3. Dynamic Queue Management Module

This module adjusts the queue management algorithm in real-time based on current queue conditions, such as unexpected spikes in customer traffic or staff availability.

5.4. Queue Tracker Module

The module is responsible for tracking the queue status for customers, staff members, and administrators. It allows customers to view their queue position, estimated wait time, and token status. It also allows staff members to view the queue status, assign tokens to customers, and update the token status. It allows administrators to view the queue analytics, monitor the staff performance, and manage the system settings.

5.5. Predictive Analytics Module

This module uses machine learning algorithms to predict future queue conditions and resource requirements, enabling the bank to proactively allocate resources and improve customer experience.

6. Booking Module

The booking module is responsible for managing the appointment booking process for bank customers. It provides an easy-to-use interface for customers to schedule appointments with their preferred bank branches, staff members, and service types.

7. Analytics and Reporting Module

This module provides analytics and reports on key performance indicators such as average wait time, customer satisfaction, and service level. This information can be used to fine-tune the deep Q-learning model and make operational improvements.

8. Admin Dashboard Module

This module provides administrative tools to manage the system, such as user management, configuration settings, and system logs. This module would provide an interface for bank administrators to monitor and manage the queue system. They would be able to view real-time queue statistics, configure queue settings, and manage employee assignments.

9. Feedback Module

This module allows customers to provide feedback on their experience, which can be used to improve the queue management system. These modules work together to provide a comprehensive web-based queue management system

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591

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for a bank using deep Q learning. However, the exact modules and their features may vary depending on the specific needs and requirements of the bank.

III. CONCLUSION

In conclusion, the NoQ system that utilizes Deep Q-Learning is an innovative approach to managing bank customer queues. The system aims to improve the customer experience, reduce the waiting time, and increase the service quality, while providing a convenient and flexible service to the customers. The system uses deep Q learning algorithms to optimize the scheduling and token generation process, providing customers with the most efficient and personalized service possible. The Deep Q-Learning model has been trained on data from the bank's historical queue management data and can make accurate predictions about future customer traffic, allowing it to allocate resources efficiently and avoid congestion. The use of this technology has enabled the system to adapt to changing customer demands and bank staffing levels, making it highly flexible and responsive. Hence, the NoQ system using deep Q learning is a valuable addition to the bank's queue management process, providing customers with a superior experience while improving the bank's operational efficiency and reputation. This system leverages advanced artificial intelligence algorithms to optimize and automate the queue management process, improving the customer experience and reducing waiting times. Its implementation is highly recommended for banks that want to remain competitive and provide a superior service to their customers.

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