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Review on Automated Meeting Request and Queue Management System for Efficient Administrative Coordination

Prof. Smita Matte[1], Prof. Madhuri Ninawe[2], Aman Madavi[3], Lekha Parate[4], Ankita Raut[5]

[1,2,3,4,5]*Electronics Dept., SCET, Nagpur*
sanuicards@gmail.com[1], madhurinimje@gmail.com[2], amanmadavi11@gmail.com[3], parateprانali61@gmail.com[4], ankitaraut1437@gmail.com[5]

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Abstract

Efficient queue management is a critical requirement across diverse sectors, including healthcare, telecommunications, retail, and intelligent environments. This study presents a comprehensive Queue Management System (QMS) that integrates Artificial Intelligence (AI), the Internet of Things (IoT), and cloud-based analytics to enhance operational efficiency and user experience. By leveraging insights from various fields such as hospital queue management, network congestion control, and sensor-driven smart environments, the proposed system dynamically optimizes queue flow, reduces wait times, and improves resource utilization. AI-powered Active Queue Management (AQM) techniques facilitate efficient network traffic regulation, while IoT-based real-time monitoring enables proactive customer service in physical environments. Furthermore, mobile integration and cloud computing provide seamless queue tracking and predictive analytics for demand forecasting. This holistic approach ensures a scalable, adaptive, and industry-agnostic solution for effective queue management across multiple domains.

INTRODUCTION

This research introduces an advanced queue management system tailored for smart environments, leveraging IoT-enabled sensor networks. The objective of the system is to minimize wait times, enhance queue efficiency, and elevate customer satisfaction by utilizing proactive and context-aware decision-making mechanisms. This innovative system integrates multiple sensors alongside AI-driven algorithms to assess customer behavior and direct them toward the most suitable service points based on real-time conditions.[1]

Another aspect of this research explores the influence of queue management systems (QMS) in hospital emergency rooms, emphasizing their impact on patient satisfaction. Emergency departments (EDs) frequently face overcrowding, resulting in prolonged wait times, increased patient frustration, and heightened stress for medical personnel. Traditional queue management solutions incorporate process optimization, demand regulation, and queue prioritization. However, a digital E-Queue system is proposed to enhance patient experience through the integration of smartphone applications, cloud-based databases, and online information sharing. This system facilitates real-time queue tracking, enabling patients to efficiently utilize their waiting time rather than physically standing in line.[2]

Additionally, the study "Enhancing Network Congestion Control: A Comparative Study of Traditional and AI-Enhanced Active Queue Management Techniques" examines network congestion challenges due to the expanding

internet and increasing multi-access services. Conventional congestion control mechanisms, such as Droptail (DT), exhibit inefficiencies like excessive queue delays, global synchronization problems, and frequent disruptions. To overcome these drawbacks, Active Queue Management (AQM) techniques, including Random Early Detection (RED), were introduced to prevent buffer overflow and mitigate congestion. [3]

Furthermore, the research titled "Optimizing Doctor Availability and Appointment Allocation in Hospitals Through Digital Technology and AI Integration" addresses the critical issue of missed medical appointments, which pose a significant challenge to healthcare systems. Patients often neglect to cancel or fail to attend scheduled appointments, causing inefficiencies in resource utilization and longer wait times. To combat this issue, the study proposes a machine learning-based predictive model capable of analyzing patient behavior to estimate the likelihood of no-shows.

This system employs Support Vector Machines (SVM) for classification while integrating digital appointment scheduling with real-time doctor availability tracking. Through AI and digital platforms, the proposed solution streamlines appointment management, reduces administrative workload, and enhances patient satisfaction. The primary goal is to improve coordination between patients and healthcare providers, optimizing hospital workflows and resource allocation.[4]

RELATED WORK

Existing queue management systems predominantly utilize static solutions such as token dispensers and basic queue-length monitoring. Some studies explore smart parking solutions employing IoT for traffic control, but these approaches lack a comprehensive mechanism for human behavior recognition and proactive decision-making. Other research incorporates RFID and smart shopping carts for customer purchase tracking, yet they do not focus on queue optimization. Unlike previous studies, this research integrates real-time customer tracking, biometric analysis, and multi-agent systems to develop an intelligent queue management framework.[1]

Regarding hospital queue management, existing research covers various approaches:

- **Mobile-based appointment scheduling:** Heiau et al. (2018) developed an Android-based queue system allowing patients to book doctor appointments and receive notifications.
- **Walk-away queue systems:** Aizen et al. (2019) introduced a mobile-based virtual token system, replacing conventional token dispensers.
- **Smart hospital queue management:** Sahney (2016) explored the benefits of intelligent queue systems in large healthcare centres.
- **IoT-enabled queue tracking:** Ghazal et al. (2015) developed an IoT-based real-time queue monitoring system to streamline hospital patient flow.
- **Emergency department queue management:** Tan et al. (2013) suggested a dynamic queue management approach to minimize patient wait times in emergency rooms.[2]

For network congestion control and AQM techniques, existing research evaluates:

- **Traditional AQM Techniques:** Solutions like RED, Controlled Delay (CoDel), and Proportional Integral Controller Enhanced (PIE) aim to prevent congestion and reduce queue delays.
- **AI-Based AQM Enhancements:** Modern studies incorporate DRL for congestion management, with methods such as[3]

optimizing doctor availability and appointment allocation in hospitals through digital technology and AI integration:

DQN-AQM: A Deep Q-Network-based AQM dynamically adjusts queue management based on real-time traffic data.

DeepAAQM: Optimizes energy consumption in IoT sensor networks while maintaining minimal congestion.

iCoCoA: Improves congestion control for CoAP-based IoT networks using AI predictions.

QueuePilot: A reinforcement learning-based AQM technique optimizing small buffer management in backbone routers.[4]

METHODOLOGY

The proposed queue management system follows a multi-agent architecture with specialized agents performing designated tasks:

- **Identification Agent (IA):** Recognizes customers using facial recognition and biometric data.
- **Guard Agent (GA):** Monitors individual attributes such as age, stress levels, and physical conditions.
- **Virtual Queue Agent (VA):** Manages pre-queue interactions, directing customers to optimal service points.
- **Queue Agent (QA):** Oversees real-time queue operations, estimating wait durations and adjusting accordingly.
- **Exit Agent (XA):** Manages customer

departures and updates historical records.
- The system utilizes IoT-based sensors, including cameras, Bluetooth Low Energy (BLE) sensors, and Wi-Fi tracking devices. Data is processed through context-aware algorithms to optimize queue management dynamically. The system was tested in a simulated setting, demonstrating improvements in queue time reduction, customer classification, and service efficiency.[1]

For hospital queue management, the digital system integrates:
- **Mobile-Augmented Smart Queue System:** Patients receive live queue status updates via mobile apps.
- **Cloud-Based Database:** Stores patient records, appointment history, and queue data for decision-making.
- **Internet-Based Information Sharing:** Ensures real-time queue visibility for hospital staff.
- **Dynamic Resource Allocation:** Uses intelligent algorithms to adjust staffing based on urgency.
- **Queue Optimization Models:** Utilizes mathematical models like Poisson Distribution and Kendall Notation.
- **Wireless Nurse Call System:** Enables patients to request immediate medical attention via Bluetooth-based alerts.[2]

For congestion control, a comparative analysis methodology is employed:
- **Literature Review:** Sources from IEEE Xplore, Google Scholar, and ScienceDirect are analyzed
- **Selection Criteria:** Articles relevant to RED, DRL-AQM, and congestion control mechanisms are included.
- **Algorithm Evaluation:** Traditional AQM methods are compared against DRL-based AQM techniques using metrics such as latency, packet loss, and throughput.
- **Simulation and Testing:** Simulated environments using NS-3, Linux Kernel, and Mininet validate the effectiveness of AI models before real-world deployment.
- For appointment scheduling optimization, machine learning models analyze a dataset of over 110,000 medical appointments. [3]

optimizing doctor availability and appointment allocation in hospitals through digital technology and AI integration
The methodology includes:
- **Data Preprocessing:** Handling missing values, encoding categorical variables, and feature selection.
- **Classification Algorithms:** SVM, Decision Trees, Logistic Regression, and Deep Learning models.
- **Model Evaluation:** Performance assessed through accuracy, F1-score, and confusion matrices.
- **Application Layer:** A web-based system with Django, MySQL, and automated appointment reminders.[4]

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