



AI-POWERED SMART QUEUE MANAGEMENT AND APPOINTMENT BOOKING SYSTEM FOR EFFICIENT PUBLIC SERVICE DELIVERY IN SRI LANKA

INTRODUCTION

Efficient public service delivery is critical for citizen satisfaction and effective governance in Sri Lanka. However, many government institutions, such as the Department of Motor Traffic, Immigration and Emigration, and Divisional Secretariats, rely on manual queue and appointment systems, leading to long waiting times, congestion, and administrative inefficiencies. The COVID-19 pandemic underscored the need for contactless, digital solutions, yet existing systems in Sri Lanka remain fragmented, lack real-time visibility, and are often inaccessible to users with low digital literacy. This project proposes a centralized, AI-driven Smart Queue Management and Appointment Booking System with a multilingual, user-friendly interface to modernize public service delivery, reduce waiting times, and enhance accessibility. By leveraging artificial intelligence for queue prediction and integrating secure, scalable technologies, the system aims to address operational and accessibility challenges, offering a replicable model for developing economies.

RESEARCH PROBLEM(S)/ISSUE(S)

The primary issue is the absence of an integrated, AI-based queue management and appointment booking system in Sri Lankan government services. Manual processes result in prolonged waiting times, inefficient resource allocation, and low public satisfaction. Existing digital systems are often siloed, lack real-time queue visibility, and fail to accommodate users with limited digital literacy, particularly in rural areas or among the elderly (Withanage, Gunawardene, and Endagamage, 2022). Additionally, data security concerns and the need for multilingual support further complicate the adoption of digital solutions. These challenges hinder Sri Lanka's progress toward efficient e-government services, exacerbating operational bottlenecks and citizen frustration.

OBJECTIVE(S)

The project aims to develop a centralized AI-based Smart Queue Management and Appointment Booking System to enhance the efficiency of government services in Sri Lanka. Specific objectives include:

1. Designing a user-friendly, multilingual (Sinhala, Tamil, English) web and mobile interface for scheduling, rescheduling, and canceling appointments remotely.
2. Developing an AI-driven model to predict queue times using historical and real-time data to optimize service delivery and reduce congestion.
3. Creating a real-time administrative dashboard for government staff to monitor queue status, prioritize urgent cases, and manage workloads.
4. Ensuring accessibility for low digital literacy users and compliance with data security standards through encrypted data handling and user authentication.



THEORETICAL CONSIDERATIONS AND EMPIRICAL EVIDENCE

The project adopts a realist ontology, assuming that inefficiencies in queue management and service delivery are observable and measurable phenomena that can be addressed through technological intervention. A positivist epistemology guides the research, relying on quantifiable data from surveys and system performance metrics to validate the solution. Empirical evidence supports the need for such a system:

- Kumar, Thiyagarajan, and Geethanjali (2018) demonstrated that IoT-enabled queue systems reduced waiting times in healthcare settings, suggesting potential for similar technologies in public services.
- Anuruddhika, Prasanth, and Rathnayaka (2022) highlighted AI's role in predicting queue times and optimizing workloads, though their study focused on healthcare and lacked conversational interfaces.
- Withanage, Gunawardene, and Endagamage (2022) identified user-unfriendly interfaces as a barrier to digital adoption in Sri Lanka, emphasizing the need for intuitive, multilingual systems.
- Dilini Aruppala, Gunawardana, and Razi (2025) underscored the importance of secure data handling to build trust in digital government services.

These studies indicate that while AI and IoT solutions show promise, their application in Sri Lanka's public sector remains limited, particularly in addressing accessibility and integration challenges.

METHODOLOGY

The research employs a mixed-methods approach within a positivist framework, combining quantitative and qualitative data to inform system development. Key methods include:

- **Questionnaire Surveys:** Conducted among government staff and citizens at Divisional Secretariats, Passports, and Licensing Divisions to identify pain points in queue management, user preferences for scheduling systems, attitudes toward AI predictions, and concerns about data privacy and accessibility.
- **Data Analysis:** Anonymized datasets (e.g., appointment timestamps, service durations, queue lengths) will be used to train AI models for queue time prediction. Synthetic datasets will be employed if real data is unavailable.
- **Prototype Development:** Using Python (for AI models), React.js (for the user interface), MySQL/PostgreSQL (for data storage), and AWS/Firebase (for hosting), a prototype will be built with features like online booking, AI-driven wait time predictions, digital token issuance, and a real-time dashboard.
- **Testing and Evaluation:** The prototype will be tested for usability, accuracy of AI predictions, and compliance with data security standards. Feedback from pilot testing with a government agency will refine the system.

The methodology ensures a data-driven, user-centric design process, addressing technical and accessibility requirements.

RESULTS AND DISCUSSION



While the project is in the proposal stage, anticipated results include a functional prototype that significantly reduces waiting times, improves resource allocation, and enhances user satisfaction. The AI model is expected to predict queue times with 15-20% higher accuracy than manual estimates. The multilingual interface should increase accessibility for low digital literacy users, addressing barriers. The real-time dashboard will enable staff to prioritize urgent cases and optimize counter operations, reducing congestion during peak hours. Data security measures, including AES encryption and secure authentication, will ensure compliance with privacy regulations, fostering public trust.

Challenges may include limited access to real government data for AI training and resistance to digital adoption among rural users. These will be mitigated by using synthetic datasets and designing an intuitive interface with offline options. The system's modular architecture allows integration with existing workflows, making it scalable and adaptable for other public sector contexts.

CONCLUSION(S)

The proposed AI-powered Smart Queue Management and Appointment Booking System addresses critical inefficiencies in Sri Lanka's public service delivery. By integrating AI-driven queue predictions, a multilingual interface, and real-time monitoring, the system aims to reduce waiting times, enhance accessibility, and improve operational efficiency. Grounded in a realist and positivist framework, it leverages empirical evidence and user feedback to ensure practical relevance. The project's focus on inclusivity and data security positions it as a transformative solution for Sri Lanka's e-government initiatives, with potential for replication in similar developing economies. Future work will involve pilot testing and iterative refinement to ensure scalability and user adoption.

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