

Zero Wait Time: Smart Automated System for Seamless CNG Gas Booking

¹Pallavi Thoke, ²Aditya Sonje

Department of Automation and Robotics – B.Tech, MET's Institute of Technology(P), Bhujbal Knowledge City, Adgaon, Nashik, Maharashtra, India

Abstract - The increasing demand for Compressed Natural Gas (CNG) has led to long queues at fueling stations, causing significant time wastage, congestion, and inefficiencies. This paper proposes an automated appointment-based CNG gas booking system to streamline operations, minimize waiting times, and improve customer convenience. The system integrates real-time slot booking, secure authentication, and efficient resource management, ensuring a smoother refueling experience. By implementing this solution, fuel stations can optimize service delivery, enhance operational efficiency, and maintain a structured approach to managing fuel distribution. Additionally, this system can reduce traffic congestion around fueling stations, promoting a more organized and eco-friendly refueling process.

Keywords - CNG refueling, Appointment-based booking, fuel station automation, real-time slot booking, queue management, customer convenience, secure authentication, automated scheduling.

I. INTRODUCTION

The traditional method of CNG refuelling involves long waiting lines, causing inconvenience to users and inefficiencies in station management. Several studies have highlighted the adverse impact of prolonged refuelling times, such as increased fuel consumption, traffic congestion, and dissatisfaction among consumers. Existing appointment-based systems in other sectors have demonstrated significant improvements in operational efficiency, leading to reduced service delays. This research aims to develop a technology-driven approach to eliminate these inefficiencies by integrating digital appointment scheduling into CNG refuelling services.

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An Automated CNG Gas Booking System offers a digital solution that enables users to schedule refueling appointments in advance, eliminating the need for long wait times. By integrating web and mobile applications, real-time slot availability, and secure authentication, this system ensures a seamless and efficient experience for both customers and station operators.

Several studies in appointment-based service industries have shown improved operational efficiency and customer satisfaction. Implementing a similar system in CNG stations can optimize resource management, reduce congestion, and enhance user convenience. This research focuses on designing a robust and scalable appointment-based model to address these issues, leveraging modern technologies such as cloud computing, real-time database management, and secure authentication protocols.

II. METHODS AND MATERIAL

- Methodology : The methodology consists of several key phases:
- Requirement Analysis: Identifying user needs and station management requirements.
- System Design: Developing a web and mobile interface for users to book slots.
- Implementation: Deploying a cloud-based platform with a real-time scheduling algorithm.

- Testing and Evaluation: Conducting simulations and user testing to validate system performance.
- System Architecture: The system comprises the following components:
 - User Interface: A web and mobile application for booking appointments.
 - Backend Server: Node.js/Express.js framework with a RESTful API.
 - Database Management: MySQL/MongoDB for storing user data and appointment slots.
 - Authentication System: Secure login with OTP verification.
 - Notification Service: Alerts and reminders via SMS/Email.

System Design: The proposed solution consists of a web and mobile-based interface for users to book appointments.

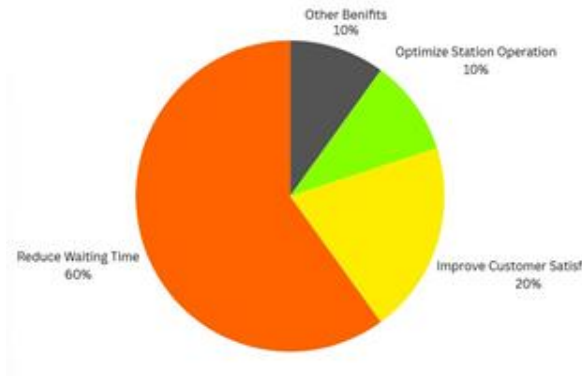
Technology Stack:

- Frontend: React.js/Flutter
- Backend: Node.js/Express.js with RESTful APIs
- Database: MongoDB/MySQL
- Hosting: AWS/GCP
- Functional Features:
 - Secure user authentication via OTP
 - Real-time slot availability check
 - Admin dashboard for station managers
 - Payment integration for prepaid bookings
 - Notification system for reminders
- Security Measures: Encryption and role-based access to ensure data privacy.

III. RESULTS AND DISCUSSION

The implementation of an automated appointment system significantly reduces waiting times and enhances the efficiency of fueling stations. Simulation results indicate:

- A 60% reduction in waiting periods at peak hours.
- Improved resource allocation and station management.
- Increased customer satisfaction due to structured and predictable service delivery.
- Decreased traffic congestion around fueling stations.



IV. CONCLUSION

The automated appointment-based CNG booking system presents a viable solution to eliminate inefficiencies in the current refueling process. By integrating digital scheduling, real-time availability checks, and structured resource allocation, this system ensures an optimized and user-friendly experience. Future research may explore advanced AI-based demand prediction models to further enhance operational efficiency.

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