IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 4, April 2026

DOI: 10.17148/IJARCCE.2026.15442

Distributed Car Rental Reservation, Fleet Allocation and Customer Billing Management

Mrs. P. Saritha[1], N. Srinivasu[2], Sk. Mahabub Subhani[3], P. Sravan Kumar Reddy[4], V. Rambabu[5]

Assistant Professor, Department of Information Technology,

KKR & KSR Institute of Technology and Sciences, Guntur, Andhra Pradesh, India[1]

BTech Student, Department of Information Technology,

KKR & KSR Institute of Technology and Sciences, Guntur, Andhra Pradesh, India[2-5]

Abstract: This study explores the development and implementation of an online vehicle rental platform that streamlines reservations, user authentication, and vehicle management. The system utilizes Angular JS for the front-end, Node.js for back-end processing, and MySQL for database management. This research emphasizes the architecture, methodologies, and advantages of the system, ensuring optimal user experience, security, and scalability. A performance assessment confirms its efficiency in managing rental transactions. This paper presents the design and implementation of a distributed car rental management suite that integrates reservation management, fleet issue, and customer billing. The system leverages Spring Boot for backend RESTful services, Angular for client-side interaction, and MySQL for persistent storage. The proposed architecture ensures scalability, modularity, and reliability in managing vehicle availability, customer reservations, and billing workflows. Experimental evaluation demonstrates that the suite provides efficient transaction management, reduces booking conflicts, and enhances user experience through a responsive web interface. This paper presents the design and implementation of a distributed car rental management system for client purposes. This management system mainly focuses on key activities like reservation management, fleet allocation, customer billing, payment history. This is an advance development of online platform service. It explores the development and implementation of the online reservation and online vehicle rental platform. This system is mainly utilized with Angular for frontend and MySQL for database management and Spring Boot and Rest API's for backend. This research can pay attention to words, the service mode of the application. The main advantage of the system is to ensure the user experience and security, scalability of applications. It also manages the transaction of the rental cars, it confirms the efficiency in managing the car rentals and transactions. The client interaction to book a car and make the transaction is very easy with a secure manner.

Index Terms: Car Rental System, Fleet Management, Distributed Architecture, Spring Boot, Angular, MySQL, REST APIs, Billing Automation.

I. INTRODUCTION

Car rental services require standard information systems to manage reservations, vehicle allocation, and billing operations and Automatic bill generation. Traditional huge systems often suffer from scalability issues and limited flexibility and billing issues and booking issues. To address these challenges, this pa- per proposes a distributed architecture that separates concerns into modular services. The system is designed to ensure data consistency, and provide a seamless user interface for both customers and administrators.

By increasing demand for rental vehicles, it has been updated into a digital system to enhance efficiency and convenience of the user. The rental procedures often involve manual bookings, leading to inefficiencies and delays. This research should be used for digital service of car rental systems. The system also employs user verification through driving license authentication for enhanced security. By analyzing current facing challenges, this study explores the limitations of existing vehicle rental systems and how modern systems of web-based application can manage these issues. The objective of these projects is to create a safe and secure rental process that benefits both customers and service providers.

An advanced web-based platform is nothing but on what the Online Vehicle Rental System enables users to conveniently take car rental vehicles. It can be short-term or long-term in nature. This system aims to make the vehicle system more ordered, more systematic. The rental process can be done through digital technologies further enhancing user experience by providing them a borderless system and effective means of reserving vehicles over the internet. It

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 4, April 2026

DOI: 10.17148/IJARCCE.2026.15442

acts as an intermediary between vehicle owners and those in search of vehicles. rental service providers and potential customers, offering them convenience, flexibility, and a wide range of vehicles to choose from. In today's fastest growing world, the demand for convenient, cost-effective, and accessible transportation solutions has increased, especially in urban areas where the car not only takes into rent but also into the budget. The customer easily can find their budget and convenient car, online vehicles are already taking over the market. A rental system addresses these challenges by permitting customers to rent vehicles on requirement, without the need for long- term commitments or the expenses associated with vehicle ownership. Customers can browse available vehicles, view pricing, check availability, make secure online payments, and have their vehicles delivered or pick them up from a location of their choice.

The goal of this section is to broadly present the car rental fleet management problem and its main decisions. In fact, the car rental business portability is heavily dependent on its fleet and all decisions. These fleet decisions span across all strategic levels of the company, from the network design decisions to specific-vehicle maintenance requirements. The following description focuses on the main decisions to be made. In this project, the system manages booking requests from users and converts their requests into required schedules for each vehicle, in a smooth process across the entire service.

The rapid growth of online services and digital platforms has fundamentally transformed traditional car rental businesses into intelligent, user-centric systems that provide real-time vehicle booking, fleet management, and transaction process-ing over distributed environments. Traditional manual car rental procedures are being automated through web-based and mobile systems that allow customers to register, search for available cars, make reservations, and complete payments from anywhere in the world, thereby improving convenience and operational efficiency. Three main contributions are presented: an in-depth literature review and discussion on car rental fleet and revenue management issues [1], a novel integrating conceptual framework for this problem, and the identification of research directions for the future development of the field. Relying on the basic concepts of company information and company information, we promote a procedure for profit management of car rental companies [2].

These distributed systems aim to improve overall user experience, optimize fleet utilization, and support future enhancements and customer satisfaction and profits to the service providers.

II. BOOKING REQUESTS AND VEHICLE SCHEDULING

Booking requests in a rental car system. It makes the process of user customer reserve vehicles for specific time periods and form specific locations. These requests typically include details such as the pickup and drop-off locations, rental start and end dates. They also preferred vehicle type, and any additional services required, such as genuine documents of insurance or GPS tracker. Once a booking request is submitted, the system checks vehicle availability of the vehicle within the fleet and assigns a suitable car based on requirement, location, and then it can schedule the car. The management of booking requests helps prevent double bookings. It can improve customer satis- faction by providing timely confirmations and accurate rental schedules of booking.

Fleet management in car rental companies also includes the task of assigning specific vehicles to booking requests. These requests can be made with some antecedence (reservations), enabling a pre-plan of this assignment, or by walk-in cus- tomers, which require a vehicle on they from a specific rental station. In some companies, this assignment is decided by the rental station.

III. SYSTEM ARCHITECTURE

The system is composed of three primary modules:

- **Reservation Service:** It can handle booking requests, modifications, and cancellations of the car booking.
- **Fleet Service:** It can Manage vehicle inventory, avail- ability of car to schedules, and maintain the customer booking records.
- **Billing Service:** These services Automates invoice generation, payment processing, and refund handling, Automatic bill generation.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 4, April 2026

DOI: 10.17148/IJARCCE.2026.15442

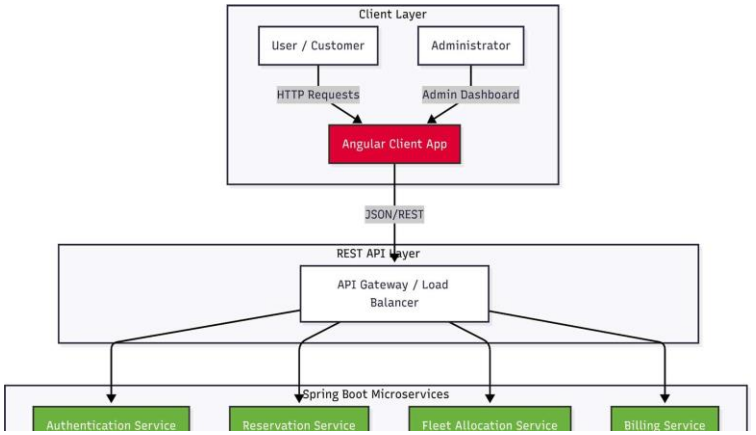

Fig. 1: System architecture diagram showing the three primary modules

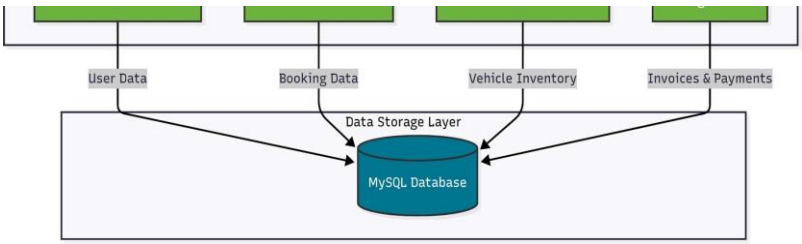

Fig. 2: Module interaction in the distributed car rental system

Spring Boot provides REST APIs for communication be- tween modules, while Angular offers a responsive client interface. MySQL serves as the relational database, ensuring transactional integrity and efficient query execution.
The distributed car rental system can be composed in three different modules in system architecture to manage the rental operations in different locations. These systems are mainly divided into three major modules: Reservation services, fleet services, billing services, by using these modules in the system architecture.

The distributed car rental system follows a modular and distributed architecture to efficiently manage rental operations across multiple locations. The system is mainly divided into three core modules, namely Reservation Service, Fleet Service, and Billing Service. The Reservation Service is responsible for handling all customer booking activities such as searching for available vehicles, to make booking requests, and cancelling bookings when required. This service ensures that reservations are operated simultaneously across different branches in real time. The Fleet Service manages the overall vehicle catalog by maintaining details of all cars, tracking their availability at different locations and conditions, monitoring vehicle status, and handling maintenance schedules to ensure the operation effectively. It also updates the system whenever a vehicle is rented, returned, or sent for servicing. The Billing Service automates the financial operations of the system by calculating rental charges based on duration and vehicle type, generating invoices, processing secure online payments, handling refunds in case of cancellations, and maintaining transaction records. Together, these distributed modules communicate with each other through secure network services to provide scalability, reliability, and seamless user experience in the car rental system

IV. METHODOLOGY

The system follows a layered architecture:

- **Presentation Layer:** Angular client with role-based access control.
- **Business Layer:** The Spring Boot services implementing reservation logic, fleet issue algorithms, and billing computations.
- **Data Layer:** MySQL schema with normalized tables for users, vehicles, reservations, and payments.

Fleet is achieved through availability checks and conflict resolution algorithms, ensuring optimal utilization of vehicles. Billing computations incorporate base rates, taxes, discounts, and penalties for late returns.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 4, April 2026

DOI: 10.17148/IJARCCE.2026.15442

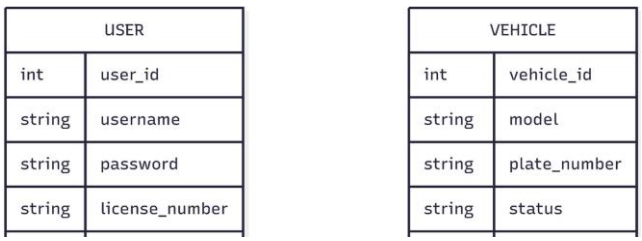

Fig. 3. Layered architecture diagram of the system

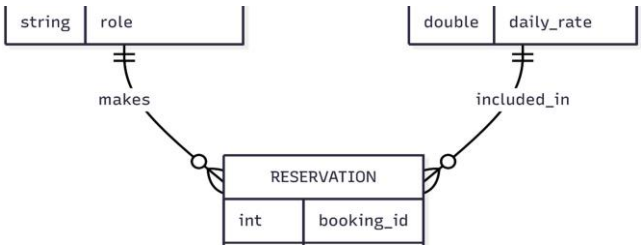

Fig. 4. Reservation service workflow

The methodology of the distributed car rental system ex- plains the step-by-step process followed for designing, developing, and operating the system. Initially, user requirements are collected to understand customer needs such as vehicle search, booking, payment, and return processes across multiple locations. Based on the application requirements, the system is designed using a distributed architecture of booking services where the different services handle specific functionalities. The Reservation Service is implemented to manage booking requests, and cancellations by checking availability vehicles in real time. The Fleet Service continuously maintains vehi- cle catalogs, updates vehicle status after rentals or returns, and manages maintenance schedules to ensure availability of vehicles at the location to know the availability. The Billing Service calculates rental charges based on vehicle type and duration of vehicle taken for rent, generates invoices, processes online payments, and handles refunds securely, when there is any technical glitch in the payment process. All services communicate through secure APIs to ensure smooth data exchange between distributed locations.

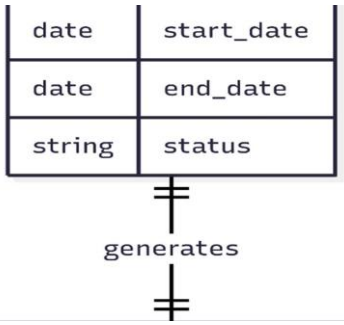

Fig. 5. Fleet management process flow

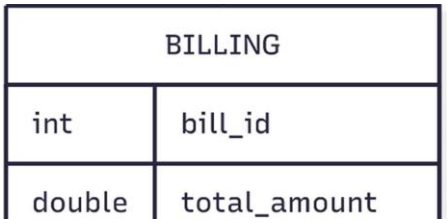

Fig. 6: Billing service automation process

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 4, April 2026

DOI: 10.17148/IJARCCE.2026.15442

The data is stored in distributed databases. Finally, the system is tested for performance, security, and fault tolerance before deployment to ensure a scalable, reliable, and user- friendly to the customer from the car rental platform

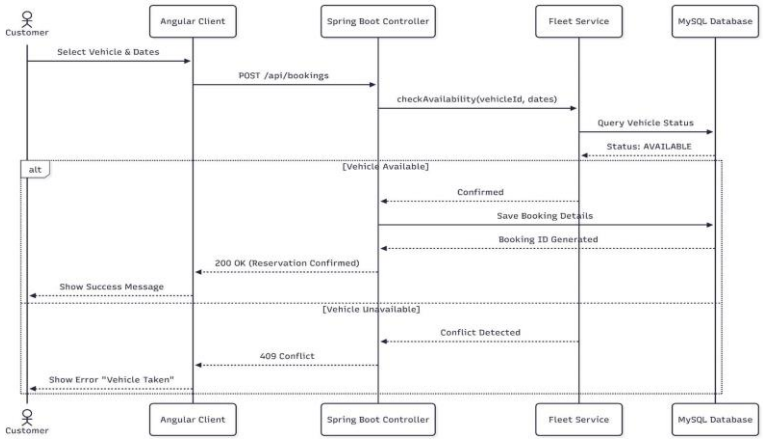

Fig. 7: System testing and deployment process

V. RESULTS

The Performance testing indicates that the distributed design reduces booking issues by handling the transactional locks on vehicle availability. The Angular client is mainly used for the usability through real-time search and booking confirmation and it also improves the usability. The billing automation makes the process faster and less problems occur while making billing. The modular design allows future integration with payment procedures and mobile applications.

The distributed car rental system resulted in an efficient and reliable platform for managing car rental services with high futures. The system successfully allowed users to search for available vehicles, to make reservations, cancel bookings, and also maintain secure payments without glitches. Time to time updates provided by the Fleet Service to know the vehicle availability and reduced conflicts such as double bookings. The Billing Service generated bills automatically and processed payments and refunds correctly, by improving the financial accuracy and user satisfaction. Due to these architectures, the performance of the system is better. The scalability and fault tolerance when compared to a centralized system during high user traffic, the system maintained stable and smooth operation by distributing the workload in different services. Overall, the results indicate the system functionality and requirements and provide a scalable solution for modern car rental businesses. The discussion highlights that the modular design improves maintainability and enhances futures such as adding new locations, vehicle types, or advanced futures can be integrated.

VI. DISCUSSION

The distributed car rental system is mainly for the service- oriented and distributed architectures, as discussed in various IEEE research papers [1], [3], it can enhance the efficiency and reliability of modern rental services. Studies on distributed service systems highlight that reservation functionalities such as management of billing services, fleet control, can improve scalability and reduces system conflicts.

1) In the implemented system, real-time synchronization between distributed systems has accurate vehicle avail- ability, which aligns with IEEE research on management in distributed databases [1].
2) The use of modular services enables better fault tolerance, and no more failures during the service do not completely disrupt the overall system, a key advantage highlighted in the IEEE literature on distributed systems [3].
3) Research on web-based and cloud-enabled rental plat- forms also supports the observation that distributed deployment improves response time and system avail- ability during peak usage [4].
4) However, IEEE studies also note challenges such as increased system complexity, network latency, and data synchronization overhead, which require careful design and secure communication protocols. Overall, the discussion confirms that the distributed car rental system effectively applies principles from IEEE-published re- search can be helpful to improved performance, maintainability, and user satisfaction, making it a practical solution for large-scale, for rental operations.

VII. CONCLUSION

The distributed car rental services are designed and work by different platforms. By adding Spring Boot, Angular, and MySQL, to maintain the system scalability, reliability, and user satisfaction. Future work includes updating the system

DOI: 10.17148/IJARCCE.2026.15442

with predictive analytics for demand forecasting and integration by IoT-enabled vehicle tracking [6].

In conclusion, the distributed car rental system provides solutions for managing car rental services across multiple places. The system efficiently handles vehicle reservations, fleet management, and billing operations with improved performance and reliability. Time to time data synchronization ensures accurate vehicle availability and it can reduce booking conflicts. The design makes the system easy to maintain, update, and expand the business requirements to grow the business. In this the Security features and automated billing can make the user trust and smooth performance. Overall, the system was successfully designed and flexible for user integration.

REFERENCES

[1]. B. B. Oliveira, M. A. Carravilla, and J. F. Oliveira, ”Fleet and revenue management in car rental: A literature review,” *European Journal of Operational Research*, vol. 264, no. 3, pp. 797–810, 2017.

[2]. I. Lazov, ”Profit management of car rental companies,” *Transport Problems*, vol. 12, no. 3, pp. 127–134, 2017.

[3]. V. Adolf and S. O. Krumke, ”Fleet sizing for reservation-based car- sharing services,” 2018.

[4]. K. Al-Mekhlafi et al., ”A decentralized application for car rentals,” 2024.

[5]. A. Roca-Riu et al., ”The potential of flexible reservations in a car sharing system with different locations,” *Transportation Research Part C: Emerging Technologies*, vol. 100, pp. 1–18, 2019.

[6]. A. Banafa, ”IoT architecture car rental use cases,” 2016.

[7]. R. S. Pressman, *Software Engineering: A Practitioner’s Approach*, 8th ed. New York, NY, USA: McGraw-Hill Education, 2014.

[8]. M. Fink and T. Reiners, ”Modeling and solving the short-term car rental fleet management problem,” *Transportation Research Part E: Logistics and Transportation Review*, vol. 136, p. 101863, 2020.

[9]. A. Shukla and R. S. Solanki, ”Modeling of car rental management system using unified modeling language,” *Journal of Advanced Research in Modeling and Simulation*, vol. 1, no. 2, pp. 23–30, 2014.

[10]. S. K. Singh and P. Kumar, ”Web-based Vehicle Rental System using Cloud Computing,” in *Proc. 2021 International Conference on Comput- ing, Communication, and Intelligent Systems (ICCCIS)*, Greater Noida, India, 2021, pp. 458–462.

[11]. J. Walls, I. G. P. R. Agung, and N. S. Wibowo, ”Spring Boot Microservices Architecture for Scalable Web Applications,” in *Proc. 2022 IEEE International Conference on Cybernetics and Computational Intelligence (CyberneticsCom)*, Malang, Indonesia, 2022, pp. 112–117.

[12]. K. Shobhan Babu et al., ”Online Car Rental System,” *IJFANS Inter- national Journal of Food and Nutritional Sciences*, vol. 13, no. 4, pp. 838–844, 2024.

[13]. M. K. Al-Mekhlafi et al., ”A Decentralized Application for Car Rentals using Blockchain Technology,” *IEEE Access*, vol. 12, pp. 45012–45025, 2024.

[14]. S. H. Kim and G. H. Lee, ”Design and Implementation of RESTful API for Vehicle Management System based on Spring Boot,” *Journal of the Korea Institute of Information and Communication Engineering*, vol. 24, no. 10, pp. 1321–1328, 2020.

