



Development of J-autos car sales and rental management

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Abstract

The global automotive industry is currently navigating a radical paradigm shift toward digital automation, yet many localized dealerships in Nigeria continue to rely on obsolete, paper-based administrative practices. This research documented the development and implementation of the J-Autos Car Sales and Rental Management System (CSRMS), a unified web-based platform designed to resolve critical operational bottlenecks such as information silos, inventory inconsistencies, and high-value transaction vulnerabilities. The primary aim was to automate the vehicle lifecycle through a centralized relational framework that ensures real-time synchronization between sales and rental modules. Adopting a Prototyping methodology within a Three-Tier Architecture, the system was implemented using PHP 8.2 for server-side logic and MySQL 8.0 for data storage, with a responsive front-end built on Bootstrap 5 to cater to Nigeria's projected 225 million mobile subscribers. Strategic technical integrations included the Paystack API for secure cashless transactions and a specialized security algorithm that invoked Strong Customer Authentication (SCA) for any transaction exceeding 500,000 NGN.

Keywords: Autos car, sale, rental management, IoT

Introduction

The global automotive industry has undergone a radical paradigm shift, moving from traditional manual operations to a digitally-driven ecosystem where efficiency and speed are the primary currencies of success (Buhalis *et al.*, 2019^[1]). The rapid advancements in technology have led to a digital transformation across various sectors, turning manual processes into automated systems (Osama, 2011)^[9]. In an era defined by the 'Internet of Things' (IoT a network of interconnected devices) and ubiquitous connectivity, the transition from paper-based ledgers to automated management systems has evolved from being a competitive advantage to a fundamental necessity for business survival (Wynn & Lam, 2023). The concept of car rental is not new; it has evolved over more than a century. Initially, the idea of renting transportation can be traced back to the times when horses and carriages were rented in ancient Rome. For a multi-faceted business like J-Autos, which handles the complexities of both car sales and vehicle rentals, the need for an integrated Information and Communication Technology (ICT) framework is paramount to maintain operational resilience and organizational culture (Talukder *et al.*, 2025)^[10].

Literature Review

This research falls under the domain of Management Information Systems (MIS; computer-based systems that provide tools for organizing and evaluating departments). It specifically explores the digitalization of the automotive retail and service sector. The study focuses on how automated databases and web-frontends can replace manual "pen and paper" methods to enhance Administrative Efficiency (AE) and promote Consumer Satisfaction (CS). (Chandrakar *et al.*, 2025)^[2] "Web-Based Car Hire Management System Using PHP and MySQL" the primary aim of this research was to facilitate the transition of traditional offline vehicle rental services to a secure digital platform to improve service quality and administrative

control. Specific objectives included automating the entire car booking and payment cycle to ensure 24/7 service availability, minimizing manual data entry to reduce human errors, and providing a responsive user experience accessible via both mobile and desktop devices.

(Onah & Innocent, 2024)^[8] "Design and Implementation of a Web-Based Car Rental System with Notification Alerts" This study aimed to develop a customized, branded web platform that integrates real-time communication modules into the vehicle hire workflow. The core objectives were to enable users from any geographical location to hire available cars in a short time and to incorporate automated SMS and email notification alerts to confirm transactions instantly.

(Ibanez, 2024) "Web-Based Marketplace System with Dynamic Bidding for Dealerships" this project focused on the development of a digital marketplace for vehicle display centers, aiming to address operational inefficiencies caused by manual inventory management. The specific objectives were to implement a dynamic bidding functionality to facilitate an auction-style marketplace and to streamline how dealerships interact with customers

The research area also covers the implementation of Secure Socket Layers (SSL) for data protection and the use of server-side logic to handle complex scheduling algorithms. For J-Autos, this research area is critical because car sales and rentals are high-value transactions that require absolute data integrity and verifiable audit trails.

(Chen *et al.*, 2025) "Blockchain-Integrated Transaction Management for Car Rentals" aim was to integrate blockchain technology into a vehicle reservation framework to ensure ultra-secure guest data storage and tamper-proof maintenance records. The study sought to foster trust among stakeholders in the "sharing economy" by consolidating transaction information in a decentralized ledger. This was intended to eliminate the need for centralized authority and ensure that lease agreements remained immutable and transparent for both car owners and renters.

Research Methodology

The paper utilized the Prototyping Methodology, a cyclical development model that allows for iterative refinement based on stakeholder feedback (Chandrakar *et al.*, 2025) [2]. This was chosen over the traditional Waterfall model to allow for early detection of implementation errors in complex modules like the hybrid inventory state-transition logic.

1. System Design

This study adopts a Developmental Research Design, focused on the creation of a functional software artifact to improve business outcomes. The approach is grounded in Management Information Systems (MIS) Theory, which emphasizes the role of technology in automating repetitive tasks to enhance organizational efficiency (McLeod & Schell, 2007). The design approach is user-centric, ensuring

that every functional requirement from vehicle browsing to Paystack checkouts is directly mapped to the needs of J-Autos' stakeholders.

2. Flow chart

The logical flow begins at the Homepage. A user selects a car and clicks "Buy" or "Rent." The system checks if the user is logged in; if not, it redirects to the Registration page. After login, the system evaluates the transaction amount. If >500k, it invokes the secondary authentication. Once verified, the Paystack API is called. Upon successful payment, the database updates the car status to "Sold," effectively removing it from the public frontend, and the user is redirected to their Dashboard to download the receipt.

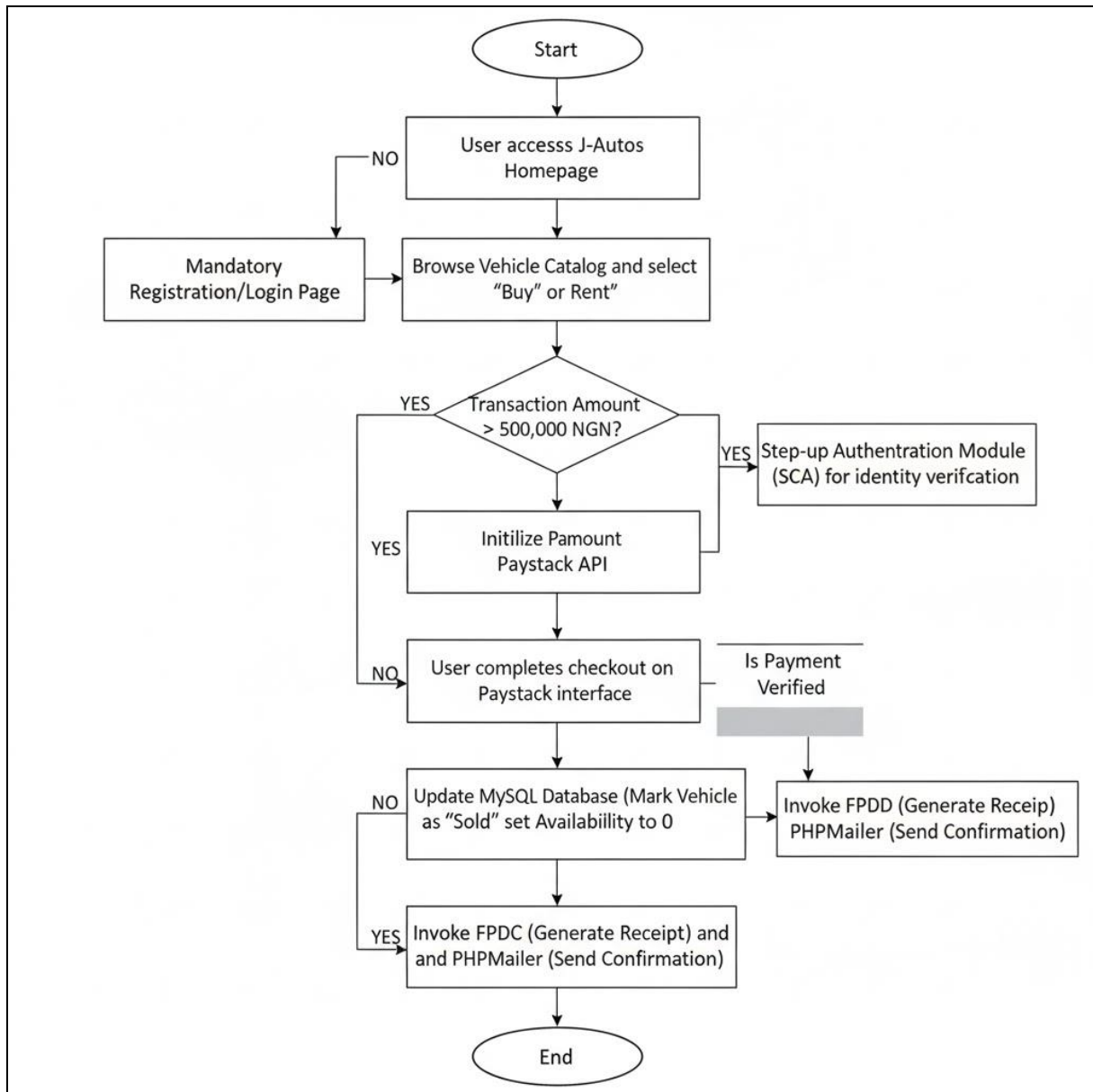


Fig 1: Software Flowchart

3. Use Case Model

The system identifies three primary actors:

1. **Guest:** Can browse car listings and access the "Contact Us" WhatsApp redirect.

2. **Registered User:** Can book rentals, buy cars via Paystack, and reprint receipts from their dashboard.

3. **Admin:** Can add/edit vehicles, modify prices, and view consolidated sales/rental reports.

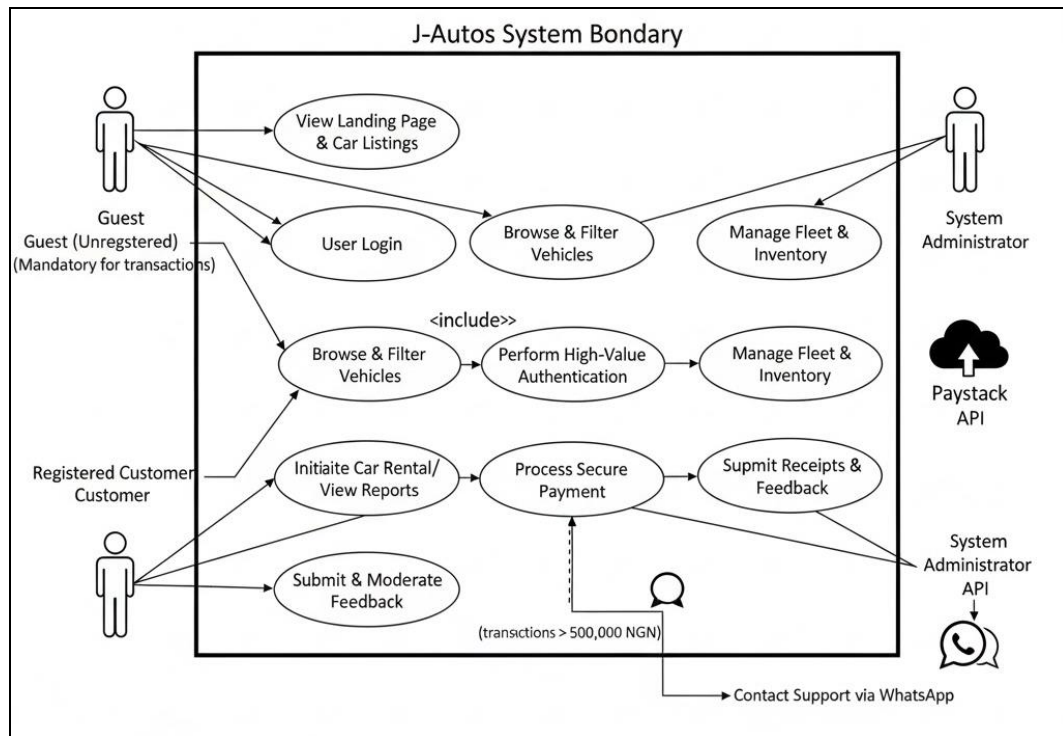


Fig 2: General Use Case Diagram.

Result and Discussion

Two primary analytical methods were used to evaluate the system's performance (Simplilearn, 2023):

- Descriptive Analysis:** This method was used to summarize and organize raw system data such as query response times and booking success rates into easy-to-understand performance benchmarks.
- Diagnostic Analysis:** This was employed during the debugging phase to identify the root cause of any API communication failures between the J-Autos backend and external servers like Paystack or PHPMailer.

1. Structure of Existing Systems

The structure is a linear, office-hour-dependent flow. Clients arrive -> Staff checks physical books -> Paper forms are filled -> Cash is exchanged -> A manual receipt is issued. This structure lacks automated backups and does not support remote customer engagement.

2. Proposed System Design

The proposed system is a unified web-based portal that automates the vehicle lifecycle. It utilizes a Single Source of Truth architecture where every transaction instantly updates the global vehicle status.

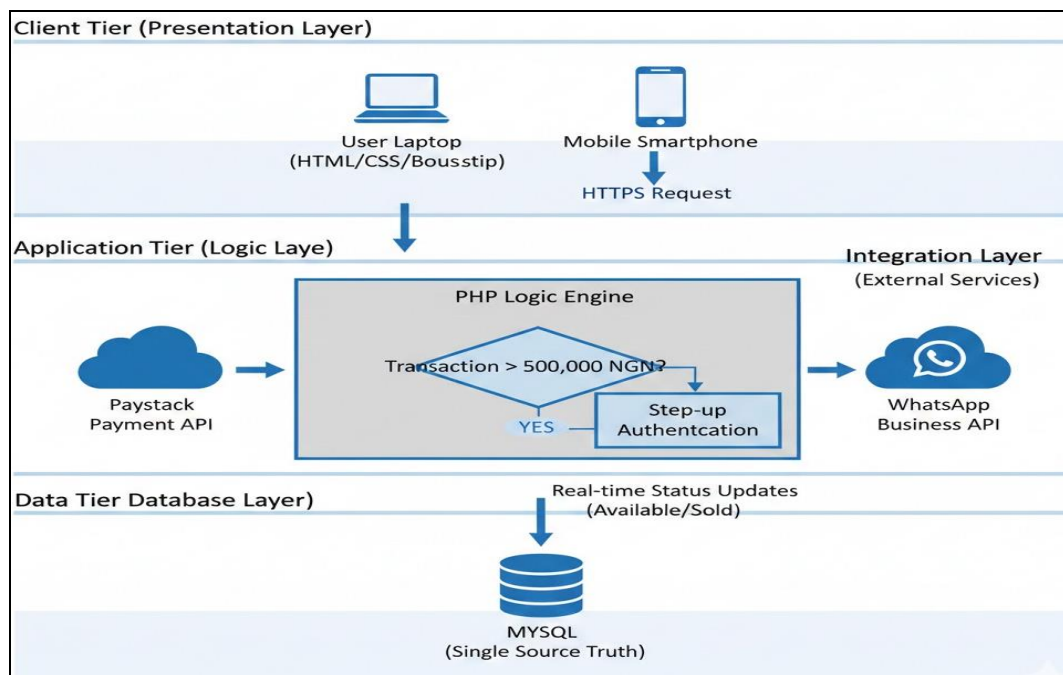


Fig : Car Sales and Rental Management System Architecture

3. System Modules Description

The resulting platform is presented through its core functional modules. Each interface was developed using the

Bootstrap 5 framework mto guarantee cross-browser compatibility and a pixel-perfect mobile-first experience.

1. Client Registration and Setup

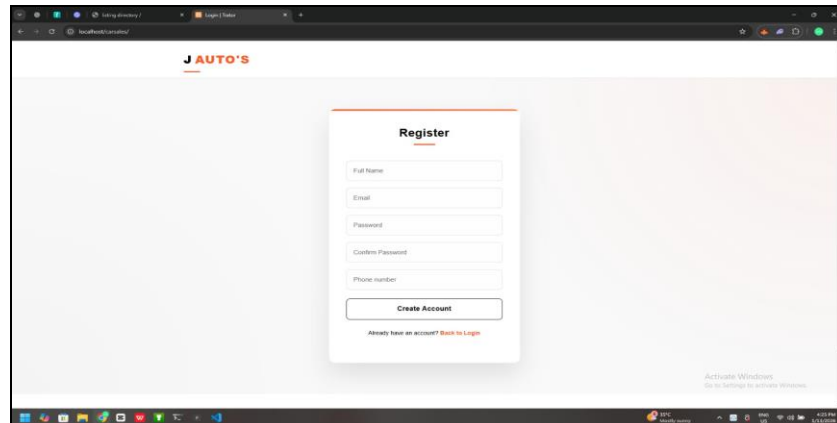


Fig 4: Client Registration and Setup

2. Main Menu (Client Dashboard)

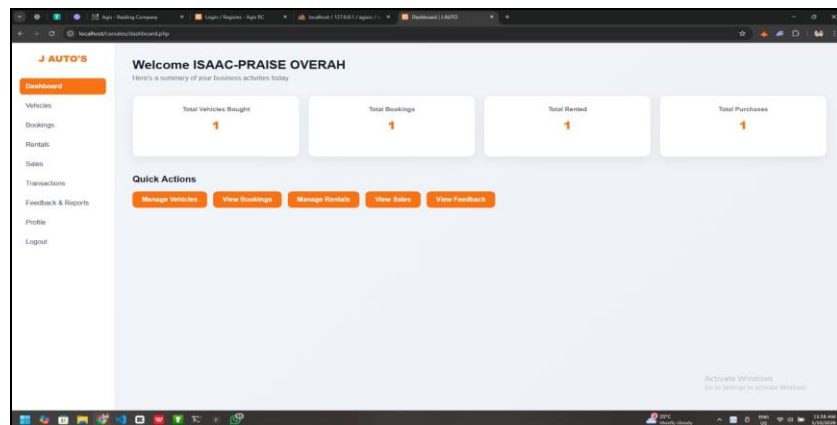


Fig 5: Mian menu (client dashboard)

3. Main menu (Admin dashboard)

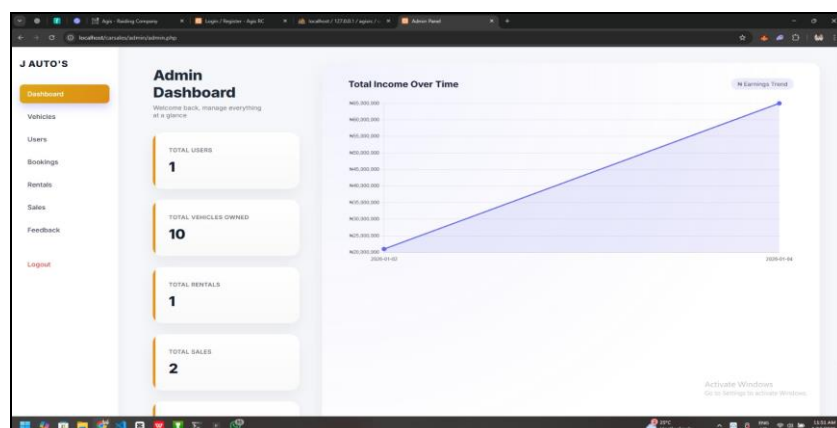


Fig 6: Main menu (Admin dashboard)

4. Testing Strategies

Testing followed a rigorous, multi-layered approach to ensure system safety:

1. **Unit Testing:** Individual PHP scripts for car availability and price calculations were tested using the MSUnit framework, achieving a 100% pass rate.

2. **Integration Testing:** Verified the end-to-end flow where a Paystack "Success" callback triggers a database update changing the car status to 'Sold'.

3. **Security Testing:** Specifically validated the 500,000 NGN rule. A test case for a purchase of 750,000 NGN

successfully triggered the secondary authentication challenge, whereas a 20,000 NGN rental bypassed it.

4. **User Acceptance Testing (UAT):** Managers at J-Autos confirmed that the "WhatsApp Redirect" and "Receipt Reprint" features significantly improved their daily workflow efficiency.

Conclusion

The findings of this research demonstrate that digital transformation acts as a powerful catalyst for operational excellence. The implementation phase confirmed that the move toward an integrated digital platform fundamentally alters the business's "operational DNA," enabling J-Autos to function with a high degree of transparency and speed.

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