BCSE302L - Database Systems

Project Report

Topic - DBMS Car Sales and Inventory Management

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1. Introduction & Project Goal

The Indian automobile market is vast, with information fragmented across numerous sources. This project's primary goal was to design and build a centralized Database Management System (DBMS) to solve this problem.

The application serves as a unified platform for both **Customers** and **Dealerships**.

- For customers, it provides a single portal to browse all available car models and variants, find real-time inventory at local dealerships, and book cars or test drives.
- For dealers, it provides a secure dashboard to manage their inventory, track sales, view upcoming test drives, and analyze their performance.

The system is built on a classic **3-Tier Architecture**, which separates the application into a Database, a Backend Server, and a Frontend Client.

2. Technology Stack

This project was built using a beginner-friendly, powerful, and lightweight technology stack, focusing on understanding the fundamentals of full-stack application development.

- **Database: SQLite**
  - A serverless, file-based SQL database. It's lightweight, fast, and requires zero configuration, making it perfect for managing our structured, relational data without the overhead of a large database server.
- **Backend: Node.js + Express.js**
  - Node.js allows us to use JavaScript on the server. The Express.js framework provides a minimal and flexible way to build a robust **REST API**. This "brain" connects to the database, executes logic, and serves data to any client that asks for it.
- **Frontend: HTML, Tailwind CSS, and "Vanilla" JavaScript**
  - This stack provides a direct, foundational understanding of web development.
    - **HTML:** Structures the entire application.
    - **Tailwind CSS:** A modern CSS framework for rapid, professional styling.
    - **Vanilla JS:** Used to create a dynamic Single-Page Application (SPA) experience, make API calls (fetch), and update the page without a full reload.
- **Visualization: Chart.js**
  - A simple and flexible JavaScript library used to render the graphs on the analytics dashboard, turning raw sales data from the database into insightful visualizations.

3. Core Application Features

The application is divided into two distinct portals based on a secure login system.

A. Role-Based Authentication

- A user provides an email and phone number.
- The backend checks these credentials against both the Customer and Dealer tables to determine their role.
- The frontend then dynamically loads the correct portal (Customer or Dealer) for that user.

B. Customer Portal

- **Book a Car:** A multi-step guided flow that allows the customer to:
    1. Select a Manufacturer.
    2. View and select a car model (with real images).
    3. Select a specific variant.
    4. See a list of real-time, "In Stock" inventory for that variant from all dealerships.
- **Streamlined Booking:** Once a car is selected, the app automatically fetches the logged-in customer's details and the car's pricing information. The user only needs to click one button to confirm the booking.
- **Book a Test Drive:** A separate form allows customers to select any Manufacturer, Model, and Variant, choose a local dealer, and book a test drive for a specific date and time.

C. Dealer Portal

This is the secure backend dashboard for dealership staff. It features four main tabs:
- **Inventory:** Displays a complete list of all vehicles (including In Stock and Booked) at the logged-in dealer's showroom.
- **Sales Records:** A list of all completed sales for that dealer, showing the car sold, the customer's name, and the final price.
- **Test Drives:** A schedule of all upcoming and completed test drives at that dealer's location.
- **Live Search:** A powerful search bar on the Inventory, Sales, and Test Drive tabs. This demonstrates the database's relational power by filtering results in real-time as the dealer types.

D. Data Analytics

- This tab in the Dealer Portal provides two key visualizations of the sales data:
    1. **Sales by Manufacturer:** A bar chart showing the total number of cars sold by each brand, clearly illustrating market leaders.
    2. **Sales by Body Type:** A pie chart showing the sales distribution across categories

like SUV, Sedan, and Hatchback.

4. System Architecture & Implementation

A. Database Implementation

The database consists of **8 core tables** *(Manufacturer, Car_Model, Car_Variant, Dealer, Inventory, Customer, Sale, Test_Drive).* The relationships are established using Primary Keys (e.g., dealer_id) and Foreign Keys (e.g., the Sale table links vin, customer_id, and dealer_id). This relational model ensures data integrity; for example, a car (VIN) can only be sold once, and a sale can only be made from actual, "In Stock" inventory.

B. Backend Implementation (server.js)

The backend exposes a **REST API** with over 15 endpoints.
- **Data Endpoints:** (e.g., GET /api/models/:id) run SQL SELECT queries to fetch data.
- **Logic Endpoints:** (e.g., POST /api/book) perform a series of database operations:
  1. Find the selected car in Inventory.
  2. Create a new record in the Sale table.
  3. UPDATE the car's status in the Inventory table to "Booked" to remove it from stock.
- **Search Endpoints:** (e.g., GET /api/dealer/:id/inventory?search=...) dynamically build complex SQL queries using JOIN and LIKE to filter results across multiple tables based on user input.
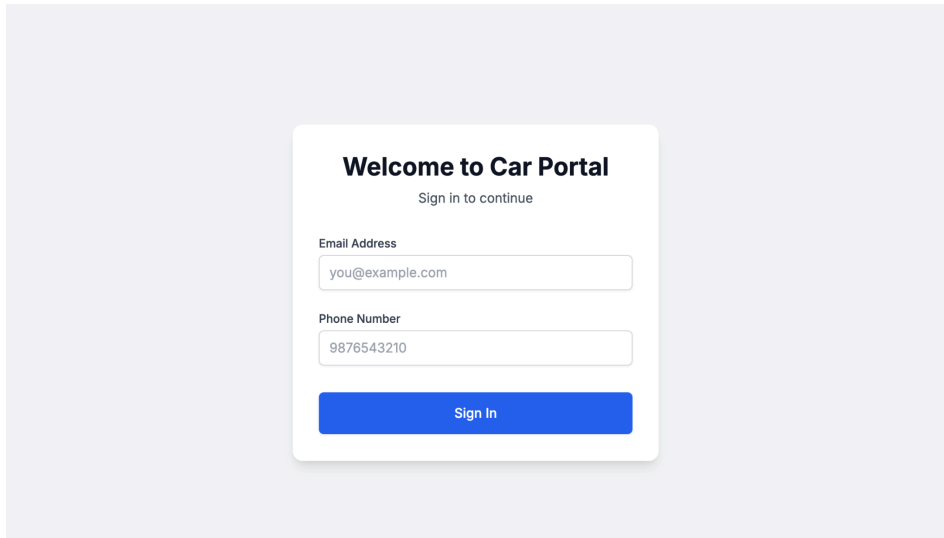
C. Frontend Implementation (index.html)

The frontend is a **Single-Page Application (SPA)**.
- **Dynamic Rendering:** Instead of reloading, JavaScript functions like renderModels() are used to generate HTML on the fly based on the JSON data received from the backend.
- **State Management:** A global currentUser object stores the logged-in user's data, which is then used to personalize the portal and auto-fill information during booking.
- **Asynchronous Calls:** The fetch() function is used to make asynchronous API calls to the backend, and a "Loading..." spinner is shown while the data is being retrieved. This ensures the user interface never freezes.

5. Project Output Screenshots

Screenshot 1: Login Page
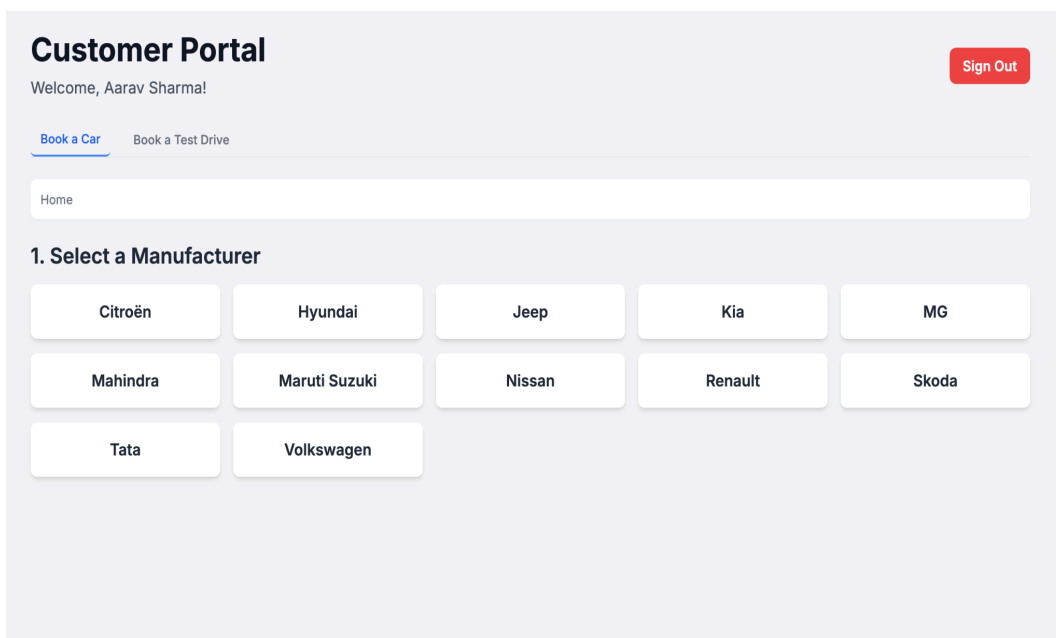
Welcome to Car Portal

Sign in to continue

Email Address

you@example.com

Phone Number

9876543210

Sign In

Screenshot 2: Customer Portal - Car Model Selection

Customer Portal

Welcome, Aarav Sharma!

Sign Out

Book a Car   Book a Test Drive

Home

1. Select a Manufacturer

Citroën	Hyundai	Jeep	Kia	MG
Mahindra	Maruti Suzuki	Nissan	Renault	Skoda
Tata	Volkswagen			

Customer Portal

Welcome, Aarav Sharma!

Book a Car   Book a Test Drive

Home / Maruti Suzuki

2. Select a Car Model

Alto K10
Hatchback

Baleno
Hatchback

Brezza
SUV

Celerio
Hatchback

Dzire
Sedan

Eeco
MUV

Customer Portal

Welcome, Aarav Sharma!

Home / Maruti Suzuki / Baleno

3. Select a Variant

Alpha
1.2L Petrol DualJet | AMT
₹9,83,000   ›

Delta
1.2L Petrol DualJet | 5MT
₹7,50,000   ›

Sigma
1.2L Petrol DualJet | 5MT
₹6,74,000   ›

Zeta
1.2L Petrol DualJet | 5MT
₹8,35,000   ›

Zeta AMT
1.2L Petrol DualJet | AMT
₹8,90,000   ›

Customer Portal

Welcome, Aarav Sharma!

Sign Out

Home / Maruti Suzuki / Baleno

4. Available Cars in Dealerships

Nexa KR Puram
Bengaluru, Karnataka
Color: **Nexa Blue**   Book Now

Arena Motors Mumbai
Mumbai, Maharashtra
Color: **Grandeur Grey**   Book Now

Customer Portal

Welcome, Aarav Sharma!

Book a Car   Book a Test Drive

Home / Maruti Suzuki / Baleno

5. Confirm Your Booking

Booking Summary

Car Details:

Car: Baleno Alpha

Dealer: Nexa KR Puram, Bengaluru

Color: Nexa Blue

Ex-Showroom Price: ₹9,83,000

Estimated On-Road Price: ₹11,59,940

Your Details:

Name: Aarav Sharma
Email: aarav.sharma@email.com
Phone: 9988776601

Confirm & Book Now

Customer Portal

Welcome, Aarav Sharma!

Sign Out

Book a Car Book a Test Drive

Book a Test Drive

1. Select Manufacturer

Select a Manufacturer

2. Select Model

3. Select Variant

4. Select Dealership

5. Preferred Date & Time

mm / dd / yyyy , --:-- --

Request Test Drive

Screenshot 3: Dealer Portal - Live Inventory Search

Dealer Portal
Nexa KR Puram

Sign Out

Inventory | Sales Records | Test Drives | Analytics

Search by VIN, model, color, status...

VIN	CAR	COLOR	STATUS	ARRIVAL DATE
MSBLN25AC003ZEBL	Baleno Zeta	Arctic White	In Stock	8/27/2025
MSBLN25AA001ALBL	Baleno Alpha	Nexa Blue	In Stock	8/25/2025
MSBRZ25AC003VXIWH	Brezza VXI	Exuberant Blue	In Stock	8/17/2025
MSBRZ25AA001ZXIWH	Brezza ZXi	Splendid Silver	Booked	8/15/2025
MSSWF25AC003ZXIRD	Swift ZXi AMT	Sizzling Red	In Stock	8/7/2025
MSSWF25AA001VXIWH	Swift VXI	Prime Luster Blue	In Stock	8/5/2025
SLD1B2C3D4E5F6G725	Wagon R VXI	Arctic White	Sold	6/8/2025
SLD1B2C3D4E5F6G719	Swift LXI	Arctic White	Sold	6/2/2025
MA1B2C3D4E5F6G715	Swift ZXi	Metallic Magma Grey	Sold	5/29/2025
SLD1B2C3D4E5F6G713	Dzire ZXi	Arctic White	Sold	5/27/2025
MA1B2C3D4E5F6G713	Dzire VXI AMT	Sherwood Brown	Sold	5/27/2025
MA1B2C3D4E5F6G711	Brezza LXi	Splendid Silver	Sold	5/25/2025
MA1B2C3D4E5F6G709	Swift LXI	Solid Fire Red	Sold	5/23/2025
SLD1B2C3D4E5F6G707	Swift ZXi+ AMT	All colours	Sold	5/21/2025
MA1B2C3D4E5F6G707	Wagon R VXI	Silky Silver	Sold	5/21/2025

Dealer Portal

Nexa KR Puram

Sign Out

Inventory   Sales Records   Test Drives   Analytics

Search by customer, model, VIN...

SALE ID	DATE	CAR	CUSTOMER	FINAL PRICE
62	10/16/2025	Brezza ZXi	Aarav Sharma	₹13,28,680
25	8/15/2025	Wagon R VXI	Dhruv Kulkarni	₹7,61,100
19	8/1/2025	Swift LXI	Kabir Bose	₹7,65,820
45	7/20/2025	Swift ZXi	Myra Aggarwal	₹9,78,220
13	7/15/2025	Dzire ZXi	Diya Mehta	₹10,07,720
43	7/15/2025	Dzire VXI AMT	Diya Mehta	₹9,93,560
41	7/10/2025	Brezza LXi	Saanvi Mishra	₹10,25,420
39	7/5/2025	Swift LXI	Ishaan Malhotra	₹7,65,820
7	7/1/2025	Swift ZXi+ AMT	Arjun Reddy	₹11,37,520
37	7/1/2025	Wagon R VXI	Arjun Reddy	₹7,61,100
35	6/25/2025	Dzire ZXi	Reyansh Patel	₹10,07,720
33	6/20/2025	Swift ZXi+ AMT	Vivaan Singh	₹11,37,520
1	6/15/2025	Brezza ZXi+	Aarav Sharma	₹14,84,440
31	6/15/2025	Brezza ZXi+	Aarav Sharma	₹14,84,440

Dealer Portal

Nexa KR Puram

Sign Out

Inventory   Sales Records   Test Drives   Analytics

Search by customer, model, status...

DATE & TIME	CUSTOMER	CAR	STATUS
10/17/2025, 9:00:00 AM	Aarav Sharma (9988776601)	Grand Vitara Alpha+	Scheduled
10/17/2025, 9:00:00 AM	Aarav Sharma (9988776601)	Baleno Alpha	Scheduled
9/25/2025, 2:00:00 PM	Abhinav Chavan (9988776649)	Swift LXI	Scheduled
9/19/2025, 12:30:00 PM	Shahid Dutta (9988776643)	Dzire ZXi	Completed
9/12/2025, 11:30:00 AM	Pooja Nadar (9988776637)	Swift ZXi+ AMT	Completed
9/5/2025, 11:00:00 AM	Yuvan Chauhan (9988776631)	Brezza ZXi+	Completed

Screenshot 4: Dealer Portal - Analytics Dashboard

Dealer Portal
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Sign Out

Inventory   Sales Records   Test Drives   **Analytics**

Cars Sold by Manufacturer

of Cars Sold

Maruti Suzuki   Tata   Hyundai

Cars Sold by Body Type

SUV   Hatchback   MUV   Sedan

Hatchback
Sales by Body Type: 18