Garage Management System

Phase 3: Project Design Phase

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1. Problem-Solution Fit

A. Identified Problems

1. **Manual Job Scheduling**
    - Technicians are assigned work manually, which causes scheduling conflicts and inefficiencies.
    - Service managers face difficulties in managing peak hours and technician availability.
2. **Inventory Mismatches**
    - No real-time tracking of spare parts and consumables.
    - Stock-outs during service operations result in delays and customer dissatisfaction.
3. **Customer Communication Gaps**
    - Customers are not kept updated on the status of their service requests.
    - Lack of communication regarding estimated costs, service duration, and delivery dates.
4. **Billing Errors**
    - Manual generation of bills leads to calculation errors.
    - Lack of integration with digital payment systems affects timely payments.
5. **Operational Visibility and Performance Monitoring**
    - Garage managers lack a centralized dashboard to monitor daily operations.
    - No real-time data analytics to evaluate service quality, staff efficiency, or inventory turnover.

B. Need for a Solution

- To enhance operational efficiency and reduce manual dependency.
- To deliver transparent and effective communication to customers.
- To ensure accurate billing and effective inventory management.
- To provide a scalable and integrated digital platform for garage operations.

2. Proposed Solution

An integrated, AI-powered **Garage Management System (GMS)** tailored to handle day-to-day garage operations. The solution will be modular and cloud-based, offering high scalability, availability, and performance.

A. Customer Module

- Online appointment scheduling
- Service tracking and updates via SMS, Email, and App notifications
- Digital access to service history, invoices, and vehicle maintenance records

B. Job Management Module

- AI-assisted auto-scheduling based on technician availability and skill
- Digital job cards for each vehicle with timestamped logs
- Monitoring of job progress and technician productivity

C. Inventory Management Module

- Real-time updates on part usage and availability
- Automated low-stock alerts and reorder triggers
- Supplier integration for purchase orders

D. Billing & Payments Module

- Auto-calculation of service charges, taxes, and discounts
- Digital invoicing and secure payment options (UPI, Cards, Wallets)
- Refunds and adjustment management

E. Admin Dashboard & Reports

- Visual dashboards for daily revenue, job status, and performance
- Analytical reports on technician efficiency, customer feedback, and inventory trends
- User management and access control for multi-role login (Admin, Technician, Customer)

F. Customer Support and Feedback

- Chatbot integration for 24/7 basic queries
- Post-service feedback forms and service rating system

3. Solution Architecture

The Garage Management System will follow a modular, layered architecture for flexibility, maintainability, and security.

A. Presentation Layer (Frontend)

- Developed using **React.js** or **Angular** for responsive UI
- Separate interfaces for customers, technicians, and administrators
- Supports desktop, tablet, and mobile devices

B. Application Layer (Backend)

- Built using **Node.js**, **Django**, or **Spring Boot**
- Handles business logic, API endpoints, and microservices
- Integration with third-party services for SMS, email, payments, etc.

C. Database Layer

- **Relational Database (MySQL/PostgreSQL)**: Stores structured data like users, jobs, inventory, billing records
- **NoSQL Database (MongoDB)**: Stores logs, user sessions, analytics data
- Periodic backups and disaster recovery setup

D. AI/Automation Layer

- **AI Models for:**
  - Predicting service time based on historical data
  - Spare parts demand forecasting
  - Technician job allocation
- **Automation Bots:**
  - Notification dispatch (reminders, alerts)
  - Invoice generation and feedback collection

E. Notification and Communication Layer

- **SMS Gateway** (Twilio, Textlocal)
- **Email Services** (SendGrid, Mailgun)
- **Push Notifications** for app users
- In-app alerts and updates

F. Integration Layer

- Payment gateways (Razorpay, Stripe, Paytm)
- CRM or ERP systems if needed
- Diagnostic tool integration for smart garages

G. Security Layer

- **Authentication:** JWT-based login, password encryption
- **Authorization:** Role-Based Access Control (RBAC)

- **Data Protection:** AES-256 encryption for critical data
- **Audit Logs:** For all critical activities and changes
- **Secure APIs:** HTTPS with OAuth 2.0 standards

Summary

This design phase clearly aligns the solution with the identified problems, offering a robust and scalable Garage Management System architecture that ensures better customer service, operational efficiency, and intelligent business insights. The next phase will focus on implementation planning and prototyping.