System Design Document

Pharmacy Management System

Prepared by;

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Contents

1. Purpose

This System Design Document for the application Pharmacy Management system establishes a target database management system identified from the analysis of the requirements of the software system maintaining data consistency and integrity. The Entity-Relational model thus created analyzing the use case diagram is converted to a relational schema of the target Database Management System (DBMS).

1.1 Document Objectives

The primary objective of this **System Design Document** is to provide a comprehensive blueprint for the **Pharmacy Management System (PMS)** database architecture and design. This document aims to ensure that the database structure supports the system's key functionalities, including inventory management, sales processing, supplier tracking, and employee management.

This document has the following specific objectives:

1. **Define Database Requirements**
   Outline the structural and functional requirements for the database to manage core pharmacy operations. This includes capturing data on medicine inventory, sales records, supplier details.
2. **Provide a Clear Data Model**
   Present a well-organized Entity-Relationship (ER) Diagram that maps out the relationships between entities, such as medicines, suppliers, sales, employees, and customers. This data model supports efficient data retrieval, integrity, and security.
3. **Ensure Data Integrity and Security**
   Define constraints and security measures that ensure data accuracy, prevent unauthorized access, and maintain consistency across all pharmacy records. This includes setting up relational integrity constraints and access permissions based on user roles.
4. **Optimize for Performance**
   Structure the database design to support high performance, enabling fast data retrieval and efficient handling of transactions like inventory updates, sales processing, and report generation.
5. **Support Scalability**
   Design the database to be flexible and scalable, accommodating potential future enhancements, such as automated inventory alerts, customer profiles, and analytics features.

1.2 Intended Audience and Document Overview

This document is intended to serve several groups of audience members like:

- Technical reviewers for assuring and evaluating the quality of the document.
- Architects, whose overall architecture design must meet the requirements specified in this document
- Designers whose design must meet the requirements specified in this document.
- Developers for implementing as per the software requirements specified in this document.
- Quality Assurance personnel for testing and validating the requirements given in this document.

- Pharmacy Administrators and System Users: While not directly involved in database management, having a clear understanding of data storage and management helps them set realistic expectations and requirements.

The next section of the document, Assumptions and Constraints, gives an overview of the suggestions taken care of and the restrictions imposed for developing the product. The second Database wide design focuses on describing the behavior of the system laying importance to the major roles/actions along with the details of the DBMS platform, security requirements, performance and availability decisions. The fourth section, Database Administrative Functions provides the Entity Relationship Model created, the relational schema formed out from the ER diagram with the normalization and data formats details.

1.3 Definitions, Acronyms and Abbreviations

S.No	Abbreviation/Term	Definition(s)
1	ISBN	International Standard Book Number
2	SRS	Software Requirements Specifications
3	NITC	National Institute of Technology, Calicut
4	User	Staff
5	Database	Stores the catalog of the books available in the library and details of the users
6	DBMS	Database Management System
7	ER Diagram	Entity Relation Diagram
8	Inventory	The collection of medicines and consumables in stock at the pharmacy, including their quantities, expiration dates, and other relevant details.
9	PMS	The software application developed to manage the pharmacy's operations, including inventory, sales, suppliers, and employee records.

2. Assumptions and Constraints

2.1 Assumptions

The following assumptions have been made in designing the Pharmacy Management System (PMS) database to support the system's intended functionality and performance requirements:

1. **User Roles and Access**
   It is assumed that users will fall into two primary roles: Admin and Employee. Admins have full access to the system, including management of employees, suppliers, inventory, and reporting. Employees have limited access, primarily for handling sales and inventory checks.

2. **Standard Pharmacy Operations**
   The system assumes standard pharmacy operations, where medicines and consumables are tracked from procurement through inventory management to sales. It is also assumed that sales are made directly to customers at the pharmacy location, without external or online sales processing.

3. **Hardware and Network Compatibility**
   The PMS is designed to run on typical pharmacy hardware, including standard computers, printers, and barcode scanners. Network infrastructure is assumed to support reliable data storage, retrieval, and backup.

4. **Data Volume**
   It is assumed that the database will initially handle data for a mid-sized pharmacy, with potential growth as more medicines, suppliers, and sales records are added. This design accommodates scalability for future enhancements without major redesigns.

5. **MS SQL as the DBMS**
   MS SQL is assumed to be the primary Database Management System for storing and managing all data related to inventory, sales, suppliers, and employees. This includes data integrity, security, and query performance tuning.

6. **User Training**
   It is assumed that users, particularly admins, will have basic training on how to navigate the system and access key functions, such as updating inventory, generating reports, and managing user accounts.

7. **Security and Data Protection**
   The system assumes a secure environment with role-based access control, ensuring data protection and confidentiality. Security features are built in to manage user authentication and prevent unauthorized access.

2.2 Constraints

The following constraints impact the design and functionality of the Pharmacy Management System (PMS) database:

a. **Hardware Limitations**
The system is designed to operate on standard pharmacy hardware, such as desktop computers and barcode scanners. This restricts the system's ability to use advanced, resource-intensive features that may require high-end hardware.

b. **Data Storage Limitations**
As the primary DBMS, MS SQL has certain limitations in terms of data storage and performance. Large data volumes, such as extensive sales histories or inventory records, may affect performance, requiring periodic data archiving or purging to maintain efficiency.

c. **Role-Based Access Control (RBAC)**
Security constraints require that only authorized users can access specific parts of the system based on their roles (Admin vs. Employee). This constraint affects system design by requiring separate user interfaces and data access restrictions for each role.

d. **Network Reliability**
The system's functionality depends on a stable network connection for data storage and retrieval. Network interruptions could affect real-time inventory updates and sales processing, necessitating local caching mechanisms.

e. **Backup and Recovery Constraints**
Regular backups are necessary to prevent data loss, particularly for sales and inventory records. However, frequent backups may introduce performance lags or require dedicated resources.

3. Database Design Decisions

3.1 Behavior

The Pharmacy Management System is designed to behave predictably in support of inventory, sales, supplier management, and user administration functionalities.

- **User Authentication and Role-Based Access**
  - **Behavior**: Upon login, the system checks user credentials and grants access based on the assigned role (Admin or Employee). Admins have access to inventory, employee, and supplier management, while employees are restricted to inventory and sales functions.
  - **Expected Outcome**: Successful login grants access to the appropriate interface; incorrect login attempts trigger error messages, and multiple failed attempts may result in temporary lockouts.

- **Inventory Management**
  - **Behavior**: Users can add, update, or view inventory items, including details like quantity, expiration date, and supplier information. Inventory updates are reflected in real-time to ensure accuracy in stock levels.
  - **Expected Outcome**: The inventory is updated immediately following any modification, preventing discrepancies in available stock. Any attempt to access or modify inventory without appropriate permission is denied.

- **Sales Processing**
  - **Behavior**: During a sale, the system checks the inventory to verify item availability. If the item is in stock, the sale proceeds, and an invoice is generated; if not, the system notifies the user of the stock shortage.
  - **Expected Outcome**: Completed transactions update the inventory in real-time, and an invoice is issued. In cases where stock is unavailable, the sale cannot proceed, and the user is notified.

- **Report Generation**
  - **Behavior**: The system generates various reports (e.g., inventory status, sales history, supplier records) based on the user's input criteria (e.g., date range, item category).
  - **Expected Outcome**: The system generates and displays the report within a few seconds. Users can download or print the report for further use. If the report criteria are invalid or if data is missing, the system prompts the user to adjust the criteria.

- **Supplier Management**
  - **Behavior**: Admin users can add or update supplier details, linking each supplier with the items they provide. This data is accessible when reviewing inventory or placing orders.
  - **Expected Outcome**: Updates to supplier records are stored in the database, and changes reflect immediately in inventory modules. Only admins are authorized to make supplier-related modifications.

- **Employee Management**
  - **Behavior**: Admins can add, modify, or remove employee records and assign roles. Each employee record includes login credentials and role information.
  - **Expected Outcome**: Employee records are updated promptly, ensuring that access permissions align with current roles. Any unauthorized attempt to modify employee records triggers a security alert.

3.2 DBMS Platform

a) The Pharmacy Management System (PMS) database is implemented on MS SQL, an open-source relational Database Management System (DBMS) known for its reliability, scalability, and robust support for SQL (Structured Query Language). The following are key considerations for selecting MS SQL as the DBMS platform:

b) Reliability and Stability
MS SQL is widely recognized for its reliable performance in handling transaction-heavy applications, making it an ideal choice for managing pharmacy data, including inventory, sales, and supplier records.

c) Scalability
MS SQL supports scaling both vertically (by adding more powerful hardware) and horizontally (through sharding and replication). This flexibility allows the PMS database to handle increased data volumes as the pharmacy grows, accommodating future expansions or additional modules, such as customer management and analytics.

d) **Performance Optimization**
MS SQL provides tools for query optimization, indexing, and caching, which are essential for high-

speed data retrieval. This is particularly beneficial for fast response times in inventory updates, sales transactions, and report generation, ensuring efficient performance even under heavy loads.

3.3 Security Requirements

The Pharmacy Management System (PMS) database must implement stringent security measures to protect sensitive data, ensure data integrity, and prevent unauthorized access. The following security requirements have been identified:

1. **User Authentication and Authorization**
   - **Requirement**: All users must log in with a unique username and password. User roles (Admin or Employee) dictate access privileges within the system.
   - **Rationale**: Authentication verifies user identity, while role-based authorization ensures that users can only access functions permitted by their roles, minimizing unauthorized access risks.
2. **Role-Based Access Control (RBAC)**
   - **Requirement**: Access to database tables and functions must be restricted based on the user's role. Admins have full access, including inventory and employee management, while employees have limited access to sales and inventory viewing.
   - **Rationale**: RBAC reduces the risk of data exposure and manipulation by restricting access to sensitive records, such as employee details and financial data, to authorized users only.

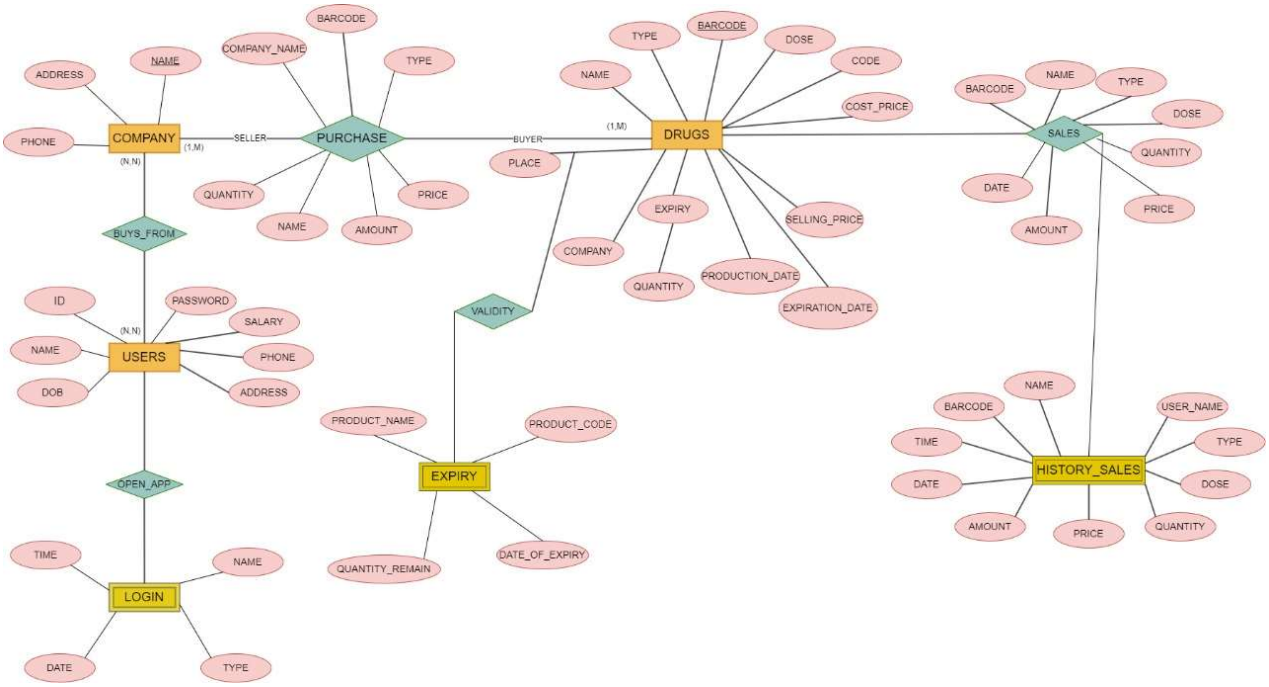
3.4 Performance and Availability Decisions

The search retrievals depend upon the updates made to the system. This system is designed to interact between inventory and sales.

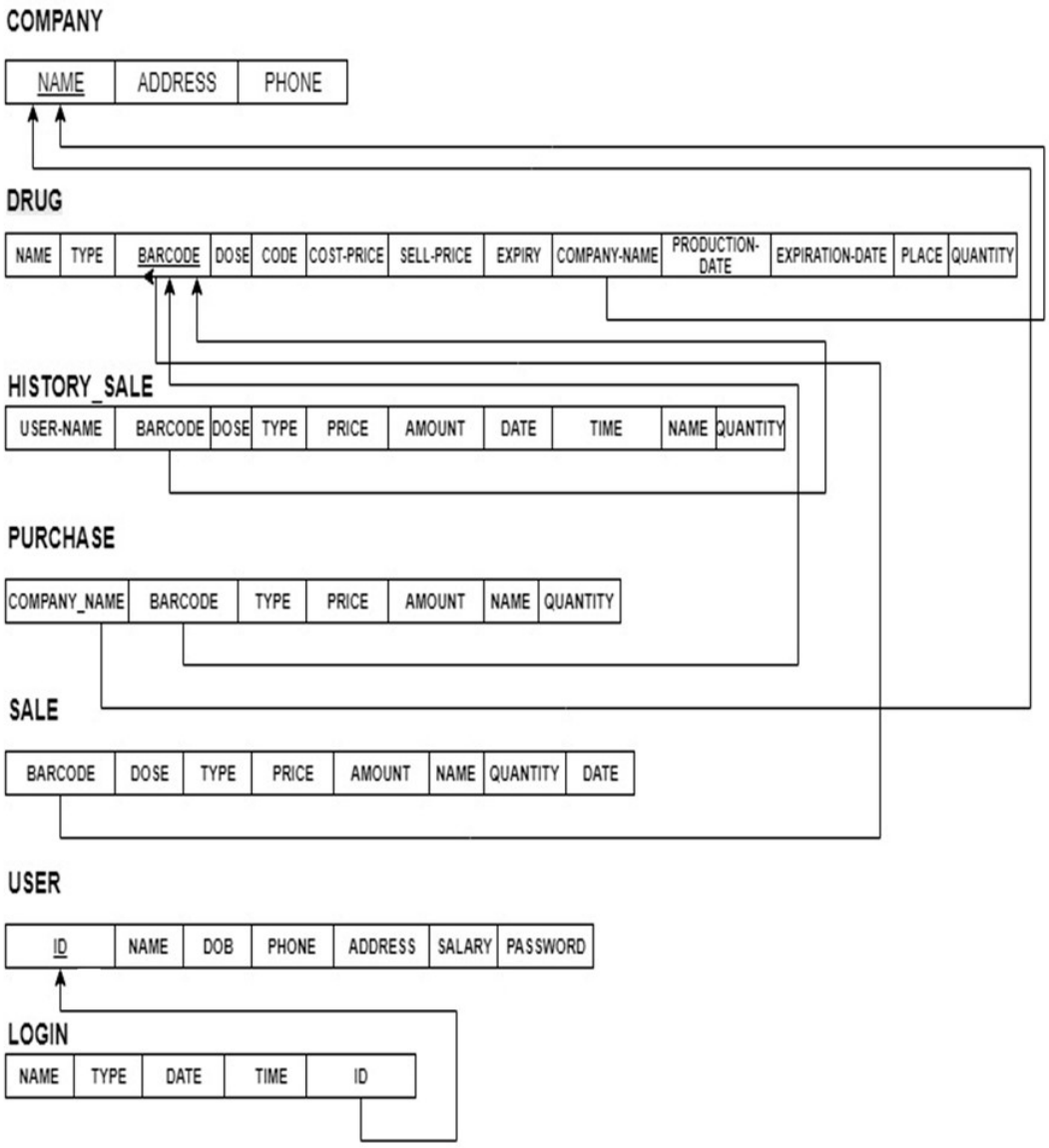
The system will respond to the user in less than a second of submitting a request. The view of history may take a few seconds extra. Overall, the performance will be fast and accurate.
The system will be capable of handling a large amount of data and hence accommodate a high number of records, user transaction history, user credentials, etc.

4. Database Administrative Functions

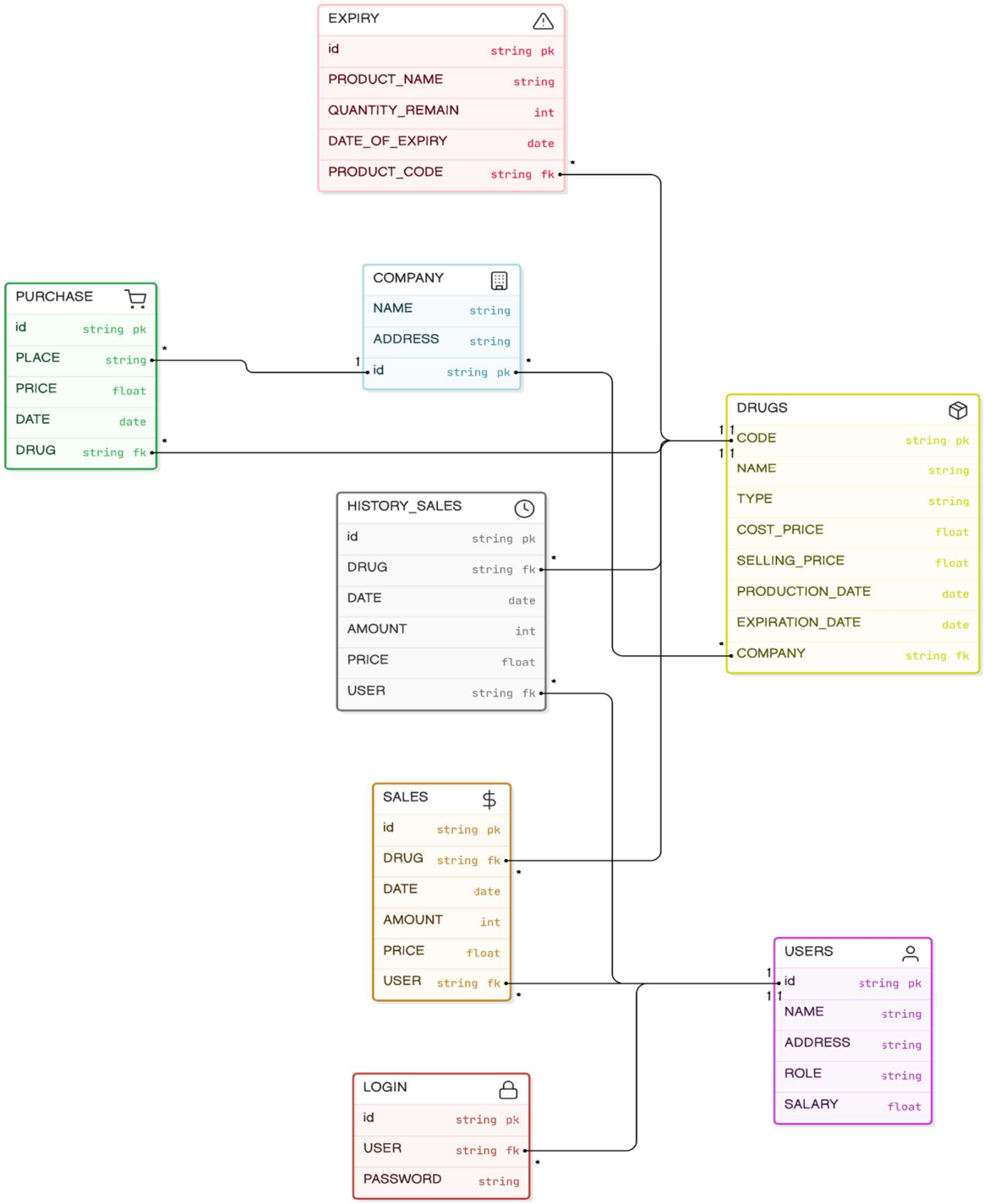
4.1 Entity-Relation Model



4.2 Relational Schema



4.3 Schema Description & Data Formats



4.4 Control Flow Diagram