SILEO

SYSTEM DESIGN DOCUMENT

Inventory Management System

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1. INTRODUCTION

The System Design Document (SDD) describes how the functional and non-functional requirements recorded in the Requirements Document, the preliminary user-oriented functional design recorded in the High-Level Technical Design Concept/Alternatives document, and the preliminary data design documented in the Logical Data Model (LDM) transform into more technical system design specifications from which the system is built. The SDD documents the high-level system design and the low-level detailed design specifications.

The SDD describes design goals and considerations, provides a high-level overview of the system architecture, and describes the data design associated with the system, as well as the human-machine interface and operational scenarios. The high-level system design is further decomposed into low-level detailed design specifications for each system component, including hardware, internal communications, software, system integrity controls, and external interfaces. The high-level system design serves as primary input to the Preliminary Design Review (PDR). The low-level detailed design serves as input to the Detailed Design Review (DDR).

1.1 Purpose

The primary purpose of this System Design Document is to furnish an in-depth understanding of the architecture and inner workings of the Inventory Management System. By offering detailed insights into the system's design, components, and their interconnections, this document aims to serve as a foundational reference for developers, architects, and other stakeholders involved in the creation, enhancement, and maintenance of the system.

The document not only outlines the high-level structure of the system but also delves into the specifics of individual components, data flow, and design considerations. It acts as a roadmap for the development team, aiding in the consistent and coherent implementation of the envisioned system. Additionally, it provides a basis for decision-making, helping stakeholders comprehend the rationale behind design choices, functional requirements, and non-functional considerations.

1.2 Scope

The scope of this document encompasses the overall system architecture, including hardware, software, data flow, and external dependencies. It is intended for developers, architects, and other stakeholders involved in the implementation and maintenance of the system.

In essence, the scope is all-encompassing, aiming to leave no ambiguity about the critical aspects influencing the design, implementation, and ongoing support of the Inventory management System. By providing a comprehensive view of the system, it empowers stakeholders to make informed decisions, fosters a shared understanding, and contributes to the overall success of the project.

2. SYSTEM OVERVIEW

2.1 System Architecture

The Swachh Bharat Mission Inventory Management System (SBM-IMS) is designed to efficiently manage and track inventory related to Swachh Bharat Mission initiatives. The system architecture is structured as follows:

2.1.1 Components and Modules

The key components include Inventory Management Module, User Authentication Module, Reporting Module, and External Integration Module. Each module serves a specific function, such as tracking inventory, ensuring secure access, generating reports, and integrating with external systems.

2.1.2 Interactions and Communication

The Inventory Management Module interacts with the User Authentication Module to ensure secure access. Additionally, the Reporting Module communicates with the Inventory Management Module to fetch data for generating various reports. Visual representations, such as flowcharts, will be provided to illustrate these interactions.

2.1.3 Diagrams and Visual Representations

Architecture diagrams will visually represent the relationships between components. These diagrams will include the flow of data and processes, showcasing how different modules collaborate to manage and monitor inventory effectively.

2.1.4 Scalability and Flexibility

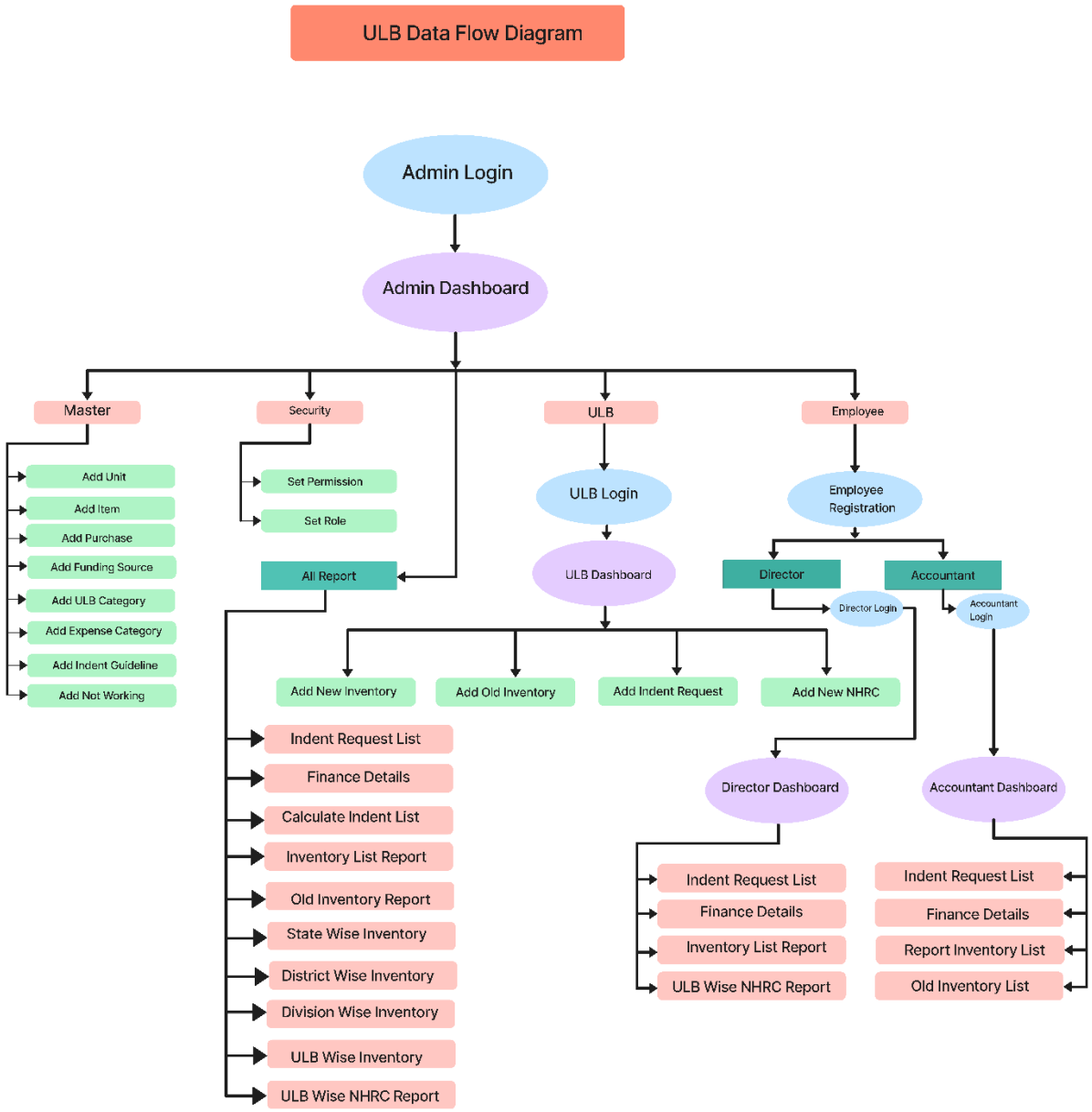
The architecture is designed to scale with the growing demands of Swachh Bharat Mission initiatives. It allows for the easy addition of new inventory items, integration with diverse external systems, and scalability to handle increased data volume.

2.1.5 Security Architecture

Security measures, such as role-based access controls, encryption of sensitive data, and secure communication channels, are implemented to ensure the integrity and confidentiality of the inventory management system.

In summary, the System Architecture section provides a tailored view of the SBM-IMS, emphasizing its ability to manage inventory efficiently and securely for Swachh Bharat Mission initiatives.

2.2 Data flow diagram:



3. DESIGN

3.1 Functional Requirements

The functional requirements of the "Swachh Bharat Mission Inventory Management System" are meticulously outlined to ensure the system aligns with the mission's objectives and operational needs.

3.1.1 Inventory Tracking

a. Real-time Inventory Updates:

- The system shall provide real-time updates on the status and quantity of each inventory item.

3.1.2 Indent Processing

a. Indent creation:

- Users shall be able to create new indent for inventory items.
- If indent is approved by account department, then it will available for purchase.

3.1.3 Reporting

a. Customizable Reports:

- Users should be able to generate customizable reports on inventory levels.

b. Mission Performance Metrics:

- Provide reports that highlight key performance metrics related to inventory management in support of Swachh Bharat Mission objectives.

3.1.4 Seamless Integration

a. Data Synchronization:

- Integrate the inventory management system seamlessly with Swachh Bharat Mission data sources for real-time data synchronization.

These functional requirements serve as the foundation for the development of the Inventory Management System, ensuring that it not only meets the immediate needs of tracking inventory but also contributes to the overall success of the Swachh Bharat Mission by providing actionable insights and supporting efficient operations.

3.2 Non-Functional Requirements

The non-functional requirements of the "Swachh Bharat Mission Inventory Management System" are established that the system operates seamlessly, adheres to security standards, and caters to the user experience needs of stakeholders.

3.2.1 Performance

a. Response Time:

- The system shall respond to user requests within a 500ms to ensure a responsive user experience.

b. Scalability:

- The system should be scalable to handle number of increasing or decreasing inventory volumes without compromising performance.

c. Concurrent Users:

- Support a minimum of 1000 concurrent users without degradation in system performance.

3.2.2 Security

a. Data Encryption:

- All sensitive data, including user credentials and inventory details, shall be encrypted during transmission.

b. Access Controls:

- Implement role-based access controls to restrict system functionalities based on user roles within the Swachh Bharat Mission organization.

c. Security Compliance:

- Adhere to relevant security standards and compliance requirements, ensuring the system meets Swachh Bharat Mission's security policies.

3.2.3 Scalability

a. Data Volume Handling:

- Ensure the system can efficiently manage and process a significant increase in data volume over time.

3.2.4 User-Friendliness

a. Intuitive User Interface:

- The user interface shall be designed to be intuitive and user-friendly, requiring minimal training for Swachh Bharat Mission stakeholders.

b. Accessibility:

- Ensure the system is accessible to users with disabilities, following relevant accessibility standards.

c. Multilingual Support:

- Provide multilingual support to accommodate diverse users within the Swachh Bharat Mission organization.

3.2.5 Reliability

a. System Uptime:

- The system shall aim for a minimum 600ms uptime for multi users to accessibility during critical mission activities.
- And, for a single user minimum 4ms uptime.

b. Backup and Recovery:

- Implement regular data backups and establish a robust recovery mechanism to minimize data loss in the event of system failures.

These non-functional requirements are essential for ensuring the robustness, security, and usability of the Inventory Management System, aligning with the specific needs and expectations of Swachh Bharat Mission stakeholders.

3.3 Assumptions and Constraints

Documented assumptions and constraints play a critical role in shaping the design and implementation of the "Swachh Bharat Mission Inventory Management System." Clear identification of these factors ensures that the system aligns with mission-specific regulations and operates within defined boundaries.

3.3.1 Assumptions

a. Data Availability:

- Assumption: The required data for inventory management, including item details, stock levels, and records, will be consistently available from Swachh Bharat Mission data sources.

b. Regulatory Compliance:

- Assumption: The system design complies with existing and future regulations governing inventory management within the context of the Swachh Bharat Mission.

c. User Training:

- Assumption: Adequate training resources will be provided to ensure users can effectively operate and make the most of the Inventory Management System.

3.3.2 Constraints

a. Budget Constraints:

- Constraint: The system design and implementation must operate within the allocated budget for the Swachh Bharat Mission Inventory Management project.

b. Technology Stack Limitations:

- Constraint: The selection of technologies, frameworks, and tools is constrained by Swachh Bharat Mission's technology standards and available resources.

c. Data Privacy Regulations:

- Constraint: The system must adhere to data privacy regulations, and limitations in data sharing may be imposed to ensure compliance with legal and ethical standards.

d. Integration Complexity:

- Constraint: Integration with existing Swachh Bharat Mission data sources may face technical complexities, and efforts will be made to minimize disruption to ongoing operations during integration.

e. Mission-Specific Workflows:

- Constraint: The system design must align with mission-specific workflows, potentially limiting flexibility in certain operational processes.

f. Limited Downtime:

- Constraint: System maintenance activities that require downtime should be minimized to avoid disruptions to critical Swachh Bharat Mission activities.

These documented assumptions and constraints provide a foundation for decision-making throughout the design and implementation phases of the Inventory Management System, ensuring that the system remains in harmony with the mission's goals and operates within defined parameters.

4. DATA STORAGE

4.1 Database design:

4.1.1 Database Schema

The database design for the "Swachh Bharat Mission Inventory Management System" is crafted to effectively store and manage data related to inventory items, orders, and user information. The schema encompasses the following tables:

a. Inventory Items Table:

- Fields: ULB ID (Primary Key), Item Code, Description, Unit of Measurement, Current Stock Level, Last Updated Timestamp.

b. Indent Table:

- Fields: Indent ID (Primary Key), User ID (Foreign Key referencing Users Table), Order Date, Status, Items (List of items with quantities).

c. Users Table:

- Fields: User ID (Primary Key), Username, Password (Hashed), Role.

4.1.2 Indexes

To optimize query performance, strategic indexes are implemented:

a. Inventory Items Table:

- Index on Item Code for efficient retrieval of specific items.

b. Indent Table:

- Composite index on Indent Date and Status for approval to orders based on date and status.

c. Users Table:

- Index on Username for streamlined user authentication.

4.1.3 Rationale behind Database Technology

The chosen Database Management System (DBMS) for the system is SQL. The decision is grounded in several key considerations:

- Relational Model: SQL supports a robust relational database model, ideal for structured and interconnected data typical of inventory management systems.
- ACID Compliance: SQL adheres to ACID properties, ensuring the reliability and consistency of transactions within the database.

- Performance Optimization: With features like indexing and query optimization, SQL offers performance benefits crucial for efficient data retrieval and storage.
- Community Support: SQL has a vibrant and supportive community, providing timely updates, comprehensive documentation, and a wealth of knowledge.

4.2 Data Access layer

4.2.1 Interaction with Data Storage Layer

The Data Access Layer (DAL) serves as the intermediary between the application's business logic and the data storage layer, facilitating seamless interactions.

4.2.2 Data Retrieval

- Queries: The DAL issues optimized SQL queries to retrieve data from the SQL database, such as fetching inventory items, order details, or user information.
- Index Utilization: Leveraging indexes, the DAL minimizes database hits, enhancing the efficiency of data retrieval operations.

4.2.3 Data Updates

- Transaction Management: The DAL manages transactions for secure data updates, encompassing operations like inserting new records, updating existing ones, and handling deletions.
- Concurrency Control: Mechanisms are in place to address concurrent updates, preventing data inconsistencies through effective concurrency control.

4.2.4 Transactions

- Atomic Operations: Transactions are designed to be atomic, ensuring that changes are applied in their entirely or not at all.
- Rollback Mechanism: In the event of an error, the DAL initiates a rollback to maintain the consistency and integrity of the SQL database.

The DAL establishes a structured interface for the application to interact with the SQL database, ensuring reliable and optimized data retrieval, updates, and transactions within the Swachh Bharat Mission Inventory Management System.

5. SECURITY

5.1 Authentication and Authorization:

5.1.1 User Authentication

a. Mechanism:

The system employs a robust user authentication mechanism based on username and password.

- Hashed passwords: User passwords are securely hashed using industry-standard hashing algorithms (e.g.., bcrypt) before storage in the database.

5.1.2 User Authorization

a. Roles and Permissions

The system implements a role-based access control (RBAC) model with predefined roles and associated permissions.

Roles:

- Admin: Full access to all system functionalities, including user management, inventory control, and reporting.
- Manager: Permissions for order approval, inventory tracking, and generating reports.
- Accountant Director or other: Basic permissions for inventory tracking and order creation.

b. Authorization Mechanism

- Policy-Based Authorization: Authorization policies are defined to control access to specific features and functionalities based on user roles.

c. Dynamic Authorization

- Dynamic authorization ensures that permissions are dynamically assigned based on the context of the user's actions and responsibilities.
- Indent Approval Authorization: Managers, for example, dynamically receive the authorization to approve orders based on their role and the specific workflow.

5.1.3 Security Measures:

a. HTTPS protocol:

- All communication between the user interface, application server, and database occurs over HTTPS, ensuring data confidentiality during transit.

b. Session Management:

- Secure Session Tokens: Session tokens are securely generated, stored.
- Session Timeout: Implement a session timeout mechanism to automatically log users out after a period of inactivity.

The combined use of strong authentication mechanisms, role-based authorization, and additional security measures ensures a secure environment within the Swachh Bharat Mission Inventory Management System. Regular security audits and compliance checks are conducted to uphold the system's integrity and protect against emerging threats.

5.2 Data Encryption:

5.2.1 Encryption during storage:

a. Mechanism

Sensitive data stored in the database, such as user passwords and certain inventory details, undergoes encryption to protect against unauthorized access.

- Hashing Passwords: User passwords are securely hashed using a one-way cryptographic hashing algorithm (e.g., bcrypt). The hashed passwords, rather than plaintext, are stored in the database.

5.2.2 Encryption during transmission:

a. Transport Layer Security (TLS)

- All data transmitted between system components, including communication between the user interface, application server, and database, is encrypted using Transport Layer Security (TLS).
- HTTPS Protocol: The system enforces the use of HTTPS (HTTP Secure) to encrypt data in transit.

b. Certificate Management

- SSL/TLS Certificates: The system utilizes valid SSL/TLS certificates to establish secure connections and ensure the authenticity of the communication channels.
- Certificate Renewal: Certificates are renewed regularly to maintain security and prevent potential vulnerabilities.

5.2.3 Continuous Monitoring:

- Security Audits: Regular security audits are conducted to assess the effectiveness of encryption measures and identify potential vulnerabilities.

- Intrusion Detection Systems (IDS): Continuous monitoring using IDS helps detect any unauthorized attempts to access or tamper with encrypted data.

By employing a combination of hashing and TLS protocols, the Swachh Bharat Mission Inventory Management System ensures that sensitive data remains protected during storage and transmission. Continuous monitoring and adherence to encryption best practices contribute to a robust security posture within the system.

6. DEPLOYMENT ARCHITECTURE

6.1 Server Architecture

6.1.1 Deployment Configurations

The server architecture of the Swachh Bharat Mission Inventory Management System is designed to ensure scalability, high availability, and optimal performance. The deployment configuration includes:

a. Three-Tier Architecture

The system adopts a three-tier architecture:

- Presentation Tier (Client): User interfaces and client applications.
- Application Tier (Server): Business logic and application processes.
- Data Tier (Database): Database servers for data storage.

b. Microservices

- Certain functionalities are organized into microservices to promote modularity and flexibility.
- Microservices handle specific tasks, such as user authentication, order processing, and inventory management.

c. Containerization

- Components are containerized using technologies like Docker for consistent deployment across various environments.
- This ensures that each microservice and its dependencies are encapsulated within containers.

6.1.2 Load Balancing

a. Purpose

- Load balancing is implemented to distribute incoming network traffic across multiple servers. This ensures efficient resource utilization, prevents overloading of a single server, and enhances system reliability.

b. Load Balancer

- A dedicated load balancer is employed to evenly distribute requests among multiple instances of the application servers.
- Load balancing algorithms, such as round-robin or least connections, are utilized to optimize the distribution of incoming requests.

6.1.3 Failover Mechanisms

a. High Availability

To ensure high availability, failover mechanisms are in place:

- Redundant Servers: Multiple instances of application servers and databases are deployed to provide redundancy.
- Automated Failover: Monitoring tools detect server failures, triggering automated failover to healthy instances.

b. Database Replication

- Database replication is implemented to create redundant copies of the database. Changes to the primary database are replicated to secondary databases in real-time.
- In the event of a database server failure, the system automatically switches to a healthy replica to maintain data availability.

6.1.4 Security Measures

a. Firewalls and Security Groups

- Firewalls and security groups are configured to restrict unauthorized access to servers and services.

b. Regular Security Patching

- Regular security patches and updates are applied to servers to address vulnerabilities and ensure a secure server environment.

c. Network Isolation

- Components are deployed in isolated network segments to minimize the impact of security breaches.

6.1.5 Scalability

a. Horizontal Scaling

- The system supports horizontal scaling, allowing additional instances of application servers to be added to handle increased traffic.

b. Auto-scaling

- Auto-scaling mechanisms are implemented to dynamically adjust the number of instances based on traffic patterns, ensuring optimal performance during peak periods.

The server architecture of the Swachh Bharat Mission Inventory Management System is designed with a focus on scalability, high availability, and security. The combination of microservices, containerization, load balancing, and failover mechanisms contributes to a resilient and efficient deployment environment.

6.2 Client Architecture

6.2.1 Supported platforms

The client-side architecture of the Swachh Bharat Mission Inventory Management System is designed to provide a seamless user experience across multiple platforms. The supported platforms include:

a. Web Application

- Web Browsers: The system is accessible through popular web browsers, such as Google Chrome, Mozilla Firefox, Microsoft Edge, and Safari.
- Cross-Browser Compatibility: The web application is designed to ensure cross-browser compatibility, allowing users to access the system consistently across different browsers.

b. Mobile Devices

- Responsive Design: The web application incorporates responsive design principles, ensuring a user-friendly experience on various mobile devices, including smartphones and tablets.
- Mobile Browsers: Users can access the system through mobile browsers on devices running iOS and Android.

6.2.2 User Interface (UI) Components

a. Dashboard

- Overview: The dashboard provides users with an overview of critical inventory metrics, recent orders, and alerts.

b. Inventory Management

- Real-time Tracking: The inventory management interface allows users to track inventory items in real-time, view details, and manage stock levels.

c. Indent Processing

- Intuitive Order Forms: Users can create and process orders through intuitive forms, with features such as item selection, quantity input.

d. Reporting

- Customizable Reports: The reporting section allows users to generate customizable reports on inventory levels, order history, and mission performance metrics.

6.2.3 User Authentication

a. Login Mechanism

- Username and Password: Users authenticate themselves using a username and password.

6.2.4 Accessibility

a. WCAG Compliance

- Accessibility Standards: The client-side architecture adheres to Web Content Accessibility Guidelines (WCAG) standards to ensure accessibility for users with disabilities.

The client-side architecture is focused on providing a user-friendly and accessible experience across web browsers and mobile devices. Leveraging .Net Core, Bootstrap, jQuery, SQL server principles, the architecture ensures responsiveness, modularity, for users involved in inventory management system within the Swachh Bharat Mission.

7. CONCLUSION

The Swachh Bharat Mission Inventory Management System is designed with a robust and scalable architecture to meet the mission's specific needs. Key points highlighted in the system design document include:

Architecture:

a. Three-tier architecture
b. Microservices and Containerization

Components:

a. Inventory management module
b. Data storage
c. Security
d. Deployment architecture
e. Client Architecture

The system design prioritizes efficiency, security, and user accessibility in line with the objectives of the Swachh Bharat Mission. The thoughtful consideration of architecture, components, and security measures ensures a reliable and scalable solution for inventory management, supporting the mission's commitment to cleanliness and sanitation initiatives. The system is poised to contribute significantly to the success of the Swachh Bharat Mission by providing a streamlined and secure inventory management solution.