**IEEE Standard 1016 Software Design Description (SDD) Document**

**Project Name:** Maintenance Optimization System for GB Manufacturing

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**Software Design Description**

**Version:** 1.0

**Revisions**

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| 3/27/2024 | 1.0 | Initial draft | Anaum Syed |

Introduction

The goal of this document is to offer a thorough description of the software design for the Maintenance Optimization System created for GB Manufacturing. It describes the architectural design, component details, and human interface features of the system. The paper guides developers and stakeholders through the software's design ideas and implementation details.

Scope of the Project

The Maintenance Optimization System seeks to improve efficiency in GB Manufacturing's maintenance department by streamlining material management and equipment checkout procedures. The solution will interact with existing systems and use RFID or barcode technologies to improve equipment tracking and inventory management. It will also provide reporting and data analytics tools to help users make informed decisions.

## Referenced Documents or Sources

## This document refers to the Software Requirements Specification (SRS) for comprehensive functional requirements and is a continuation of the software development process. It also incorporates industry standards and best practices for software design and development.

## Special Terms or Acronyms

## SRS: Software Requirements Specification

## RFID: Radio-Frequency Identification

## GUI: Graphical User Interface

## API: Application Programming Interface

## DFD: Data Flow Diagram

UML: Unified Modeling Language

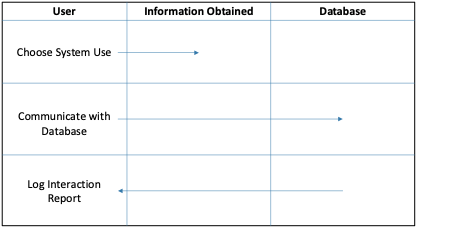
System Overview

The Maintenance Optimization System for GB Manufacturing is intended to improve and streamline several parts of the maintenance department's activities. It has various essential functions designed to improve material management, equipment checkout procedures, and decision-making through data analytics. At its foundation, the system uses RFID or barcode technology to efficiently track and manage equipment, assuring proper check-in and check-out operations. It also contains an improved warehousing system that can track inventory levels in real time, automate reordering procedures, and optimize storage configurations. Furthermore, the system has user-friendly interfaces that allow staff from diverse departments to engage with the program easily. It works with current databases and software systems to verify user identities, provide customized reports, and allow for proactive decision-making based on previous consumption trends. Overall, the Maintenance Optimization System is intended to improve operating efficiency, reduce losses, and provide stakeholders with useful data for making informed maintenance decisions.

# System Architecture

Given its connection with project objectives and support for important quality aspects, **Object** **Oriented Architecture** (OOA) is the best solution for GB Manufacturing's automated equipment checkout system. OOA stresses system structure around clearly defined objectives, resulting in a modular and adaptable design that adapts easily to changing requirements. By structuring our system around specified goals such as rapid equipment checkout and precise inventory management, we guarantee that each component contributes directly to attaining these goals. This modular approach improves maintainability by allowing updates or alterations to specific components without interrupting the entire system. Furthermore, OOA promotes encapsulation and fault isolation within well-defined modules or objects, which helps to improve reliability. This encapsulation reduces the impact of faults on the system and allows for the introduction of error-handling methods and redundancy measures to improve system resilience. In addition, OOA improves security by encapsulating critical data and functions into objects and allowing regulated access via defined interfaces. Security methods like encryption, authentication, and permission can be incorporated at the object level to provide strong protection against unwanted access or data breaches. OOA also improves functionality by breaking down complicated systems into manageable and reusable components. Clear objectives and contained functionality within objects allow for the efficient deployment of extensive features that fulfill user expectations. The modular architecture of OOA enables easy expansion and modification of functionality to match future additions or changes in business demands. Overall, OOA's emphasis on goals, encapsulation, and modularity makes it the best architectural style for meeting the dependability, security, and functionality requirements of GB Manufacturing's automated equipment checkout system.

**Sequence Diagram:**



**Machine State Diagram:**

**A diagram of a software company

Description automatically generated**

**Dynamic View:**



**Static View:**



# Data Dictionary

1. **Equipment:**

* Description: Represents actual equipment or machinery that is available for checkout through the system.
* Attributes:
* ID: Each equipment piece is assigned a unique identity.
* Name: The name or label of the device.
* Type: Category or categorization of equipment.
* Status: The equipment's current state (such as available or checked out).
* Location: The physical place in which the equipment is stored.

1. **User:**

* Description: Individuals who are permitted to interact with the system.
* Attributes:
* ID: A unique identification for each user.
* Name: The full name of the user.
* Role: The user's position inside the company.
* Username: A unique username used to authenticate.
* Password: An encrypted password for user authentication.

1. **Transaction:**

* Description: Represents a transaction in which a user checks out or returns equipment.
* Attributes:
* ID: A unique identification for each transaction.
* EquipmentID: The identifier of the equipment used in the transaction.
* UserID: The identifier of the user initiating the transaction.
* TransactionType indicates the kind of transaction (e.g., checkout, return).
* Timestamp: The date and time when the transaction happened.

1. **InventoryItem:**

* Description: An item in the inventory or supply of materials.
* Attributes:
* ID: A unique identifier for each inventory item.
* Name: This is the inventory item's name or description.
* Quantity: The current amount or stock level of the item.
* Location: The physical location in which the item is housed within the warehouse.

1. **Report:**

* Description: A produced report that includes information on equipment usage, inventory levels, or maintenance actions.
* Attributes:
* ID: A unique identification for each report.
* Type: Type or category of the report (for example, equipment usage report, inventory report).
* Content: The actual content or data provided in the report.
* Timestamp: The date and time when the report was created.

1. **Alert:**

* Description: An alert notification is prompted by specified system, events, or conditions.
* Attributes:
* ID: A unique identification for each alert.
* Type The alert's type or category (for example, late equipment returns, low inventory levels).
* Description: Details about the alert message or notice.
* Recipient: The user or group that receives the alert notice.

# Component Design

1. **User Authentication and Access Control Component:**

- Functionality: This component controls system access control and user authentication. It guarantees that only individuals with permission can access the system and carry out particular tasks in accordance with their duties.

- Static View: This component's static view contains the UserAuthAccessControl table, which houses roles, user credentials (password and username), and management roles (if relevant).

- Dynamic View: Under the dynamic view, users must authenticate themselves by providing their login and password in order to access the system. Based on the user's role, the system determines the appropriate level of access by comparing the credentials to the information kept in the UserAuthAccessControl database.

**2. Equipment Management Component:**

- Functionality: This component manages the tracking of equipment availability, the procedures for checking in and checking out, and status updates.

- Static View: This component's static view is represented by the Equipment table, which has details on each piece of equipment, including its ID, name, description, status, and location.

- Dynamic View:  The dynamic view includes the procedure by which users check out equipment. The equipment is updated in the Equipment database and the transaction is recorded in the EquipmentCheckout table when a user wishes to check out equipment.

**3. Inventory Management Component:**

-Functionality: This component keeps track of amounts, locations, and reordering procedures while managing the inventory of goods required for maintenance tasks.

- Static View: This component's static view is represented by the Inventory table, which has details about each inventory item, including ItemID, ItemName, Description, Quantity, and Location.

- Dynamic View: The dynamic view includes tracking and inventory replenishment. The system starts the reordering process and generates notifications when inventory levels drop below a predetermined threshold. The system modifies the Inventory database in accordance with newly received inventory.

**4. Maintenance Activities Component:**

- Functionality: Employee maintenance operations, both routine and non-routine, are tracked by this component along with the descriptions and timestamps that go with them.

- Static View: This component's static view is represented by the MaintenanceActivities table, which has details about each maintenance action, including ActivityID, UserID, ActivityDate, and Description.

- Dynamic View: Real-time maintenance activity logs are part of the dynamic view. Upon completion of a maintenance task by an employee, the system logs the action in the MaintenanceActivities table, obtaining information about the task including the employee ID, timestamp, and description.

**5. Reporting Component:**

Functionality: By offering information on equipment usage, inventory levels, and maintenance trends, this component makes it easier to generate reports that assist the maintenance department's decision-making processes

- Static View: This component's static view is represented by the Reports table, which holds details about each created report, including ReportID, UserID, ReportDate, ReportType, and Data.

- Dynamic View: This feature creates reports according to customized parameters or pre-established templates. Through the system interface, users can request specific reports, and the system will pull pertinent data from the database and convert it into an easily understandable report.

**Dynamic View:**



**Static View:**



# Human Interface Design

The goal of GB Manufacturing's Automated Equipment Checkout System's human interface design is to offer a simple, easy-to-use interface that facilitates effective inventory control, equipment checkout, and reporting features. Usability standards are followed in the design to guarantee responsiveness to user inputs, clarity of information, and simplicity of navigation.

**Equipment Checkout Interface:**

- Layout: Searching for equipment, viewing availability, and starting checkout transactions are all made easy with this straightforward and user-friendly interface for equipment checkout.

- User Input: To authenticate and gain access to the checkout system, users can provide their credentials (such as their employment ID). After that, they can confirm their checkout and choose the desired equipment items from a list.

- Response: After a successful checkout, users get notifications confirming the completion of the transaction and providing information about the equipment they checked out.

**Inventory Management Interface**

-Layout: The inventory management interface presents users with comprehensive views of current inventory levels, material usage statistics, and replenishment options.

-User Input: Users can search for specific inventory items, view their quantities, and request updates or replenishments as needed. They can also access detailed reports on inventory usage and trends.

-Response: The system provides real-time updates on inventory quantities, confirms successful updates or requests, and generates reports with relevant inventory information.

**Reporting and Analytics Interface:**

-Layout: The reporting and analytics interface offers users customizable options for generating reports on equipment usage, inventory levels, and maintenance activities.

-User Input: Users can specify report parameters such as date ranges, equipment categories, or specific inventory items for analysis. They can also choose the format and delivery method for generated reports.

-Response: The system generates reports based on user-defined criteria, presents them in visually appealing formats (e.g., charts, graphs), and allows users to download or share the reports for further analysis or decision-making.

# Requirements Matrix

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Requirement ID** | **Requirement Description** | **Component(s)** | **Interface(s)** | **Other Element(s)** |
| REQ-001 | The equipment shall be efficiently tracked by the system using barcode or RFID technology. | Equipment Checkout Component | Hardware Interfaces | Data Dictionary:  Equipment: |
| REQ-002 | The equipment checkout screens shall be simple to utilize on the user interface. | Equipment Checkout Component | User Interfaces |  |
| REQ-003 | Information about equipment check-in and check-out shall be tracked by the system. | Equipment Checkout Component | Database Requirements | Data  Dictionary: Equipment |
| REQ-004 | Screens for inventory management shall be included in the user interface. | Inventory Management Interface | User Interfaces |  |
| REQ-005 | The employee database and the system shall be integrated. | Authentication Component | Software Interfaces | Data  Dictionary: Users |
| REQ-006 | When equipment returns are past due, the system shall generate notifications. | Notification Component | Communications Interfaces |  |
| REQ-007 | Role-based access control shall be supported by the user interface. | Authentication Component | Human Interface Design |  |
| REQ-008 | The system shall provide tools for reporting maintenance patterns. | Reporting and Analytics Interface | Functional Requirements |  |
| REQ-009 | The system shall make proactive decisions by utilizing data analytics tools. | Reporting and Analytics Component | Performance Requirements |  |
| REQ-010 | The system shall record every action taken by users in an audit trail. | Audit Trail Component | Functional Requirements |  |

# Appendices

(optional)