**Library Management System**

**Architecture Design**

CSCE 3513 – Software Engineering

Group 1:

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**Introduction**

The Library Management System’s (LMS) purpose is to decrease the amount of administrative and logistical overhead created when operating a library. The LMS is targeted toward smaller libraries whose entire collection is close to 2,000 books.

This document lays out the architectural design for the LMS. First, basic terms are defined to ensure the clarity of what this document describes. These definitions are followed by a description of the physical architecture of the LMS. Immediately afterward, an overview of the main components which compose the LMS’ architecture is given. After the overview, these main components are then further broken down to demonstrate the exact behavior and structure of each component.

**Definitions**

Below are some basic definitions which are used throughout this document.

1. *Administrator* – Someone who manages the overall operation of the library. There is only one administrator per library.
2. *Librarian* – An employee working at a library.
3. *Library’s Collection* – All books which belong to the library regardless if they are currently checked-out to a patron.
4. *GUI* – Graphical User Interface. The combination of all graphical features displayed on a given screen which allow the LMS to communicate with the user.
5. *LMS* – Library Management System. Usually referring to the application as a whole.
6. *LMS Network Interface* – Refers to the local network which workstations use to communicate with the LMS’ database. This network is distinct from the Internet, though at times the Internet may be used to expand its reach.
7. *Server* – A physical computer whose main function is to facilitate network communication by processing requests for information made by various applications which may or may not be on one or several physically independent computers.
8. *Web Browser GUI* – The GUI which is displayed by the LMS on a Web browser when a user visits the library’s website.
9. *Web Server* – An application which dispatches all networking requests related to the library’s website.
10. *Workstation* – A desktop program which allows librarians and administrators to perform their specific tasks.
11. *Workstation GUI* – The GUI which is displayed by the LMS on a workstation and used by librarians and administrators.

**Physical Architecture**

The physical architecture of the LMS is as follows. The LMS is composed of one dedicated server. This server supports the LMS’ web server, database manager, and database components. The web server, which is running on the dedicated server, handles any and all requests by users who wish to utilize the LMS’ website. The dedicated server is also connected to any workstations to allow librarians and administrators to request any information which is relevant to the prescribed tasks. The workstations communicate with the rest of the LMS through a network interface which may involve the use of a local network or the Internet. The physical architecture of the LMS is shown below in diagram 1.

0…N 1

Workstations

Dedicated Server

**Diagram 1: LMS Physical Architecture**

**Architectural Component Overview**

Below diagram 2 gives an overview of the various components which comprise the layers of which the LMS is constructed. The diagram is followed by the explanations of each component.

Web Browser GUI

Workstation GUI

Librarian Login / Queries / Response Processing

Browsing / Welcome / Account Management

Web Server

Network Interface

Database Manager

Database

**Diagram 2: LMS Architecture Component Overview**

**Workstation GUI**

The Workstation GUI component of the LMS is responsible for the appearance and visual behavior of the user interface used by both librarians and administrators. This GUI allows librarians and administrators to view the various menus and controls which are needed to perform their respective tasks as specified in the LMS’ System Requirements specification. The structure and behavior of the workstation’s GUI is discussed in further detail in the next section of this document.

**Librarian Login/Queries/Response Processing**

This component of the LMS lies between the workstation GUI and the LMS’ network interface. This layer controls what operations the workstation’s GUI can access. All of the operations which are available to the Workstation GUI fall into three categories: Login, Querying the LMS, and Responding to the LMS. This component is responsible for transforming the user requests supplied by the workstation’s GUI into a formal request which LMS’ network interface can send to the appropriate components of the LMS. All three categories of actions are discussed in further detail in the next section of this document.

**Network Interface**

The network interface component of the LMS is the lowest level component operating on a workstation. This component is responsible for any and all networking tasks which a workstation will perform. The Network’s responsibilities include creating and maintaining a connection to the LMS’ database manager as well as handling the required levels of encryption necessary when communicating over the LMS’ network.

**Web Browser GUI**

While no new web browser is being develop for the LMS, the GUI seen by users when visiting the LMS website is still an important part of the LMS. The GUI shown to users is affected by the actions of a user during a particular visit. Therefore, the GUI shown to users is dependent on both the user’s actions and the structure of the LMS’ website.

**Browsing/Welcome/Account Management**

The structure which affects the GUI shown in a user’s web browser allows for three views of the LMS’ website: Welcome, Browsing, and Account Management. These separate views dictate what operations the user can request of the LMS. Then all of the user requests from these views are sent to the LMS’ web server. These views are explained in further detail in the next section of this document.

**Web Server**

The structure and behavior of the LMS’ website is maintained by its web server. The web server handles all requests generated by users who are using any of the three views of the LMS’ website. The web server also maintains a connection with the database manager to facilitate a user’s ability to browse the collection and manage their account settings.

**Database Manager**

The database manager creates and maintains connections to the LMS’ web server and the network of LMS workstations. Upon receiving a request to query the LMS’ database from one of these sources, the database manager will query the database on behalf of the requester and return the data set which was retrieved from the database to the originator of the request. All requests for information from the LMS will be handled by the database manager, and the database manager is responsible for properly encrypting and decrypting the information which it processes.

**Database**

The LMS’ database contains all of the data which is maintained by the LMS. The database has only one connection which is dedicated to communicating with the database manager. This is to ensure that the database cannot be directly accessed without meeting the LMS’ security protocols.

**Architectural Component Structure**

Below diagram 3 illustrates how the various components of the LMS are structured and interact with each other. The diagram is followed by the explanations of each block.

Internet

Welcome

Web Browser

Workstation

GUI

Account Management

Browse Collection

Network Interface

Librarian Login

Queries

Response Processing

View

Controller

Model

Workstation

Web Server

Database Manager

Database

Website

**Diagram 3: LMS Specific Component Interaction**

**Workstation**

The workstation is a program which allows librarians and administrators to perform their specific tasks. A workstation operates on a computer which is physically independent of the LMS’ dedicated server. Therefore, to complete the required tasks the workstation will communicate with the LMS’ server over the internet. The workstation is the avenue through which the librarians and administrators have access to the main functionality of the LMS.

**Workstation GUI**

The GUI for the workstation application implements the Model-View-Controller design pattern. This allows the acquisition of requests from users to be collected and validated before being sent through the rest of the LMS’ components. The exact behaviors of the View, Controller, and Model components are discussed in the following paragraphs of this document.

**View**

The View component of the workstation’s GUI directly interacts with the Controller and Model components. The View component evaluates the current state of the Model component to determine what functions and data are currently available. The View component then updates the display shown to the user to indicate the workstation’s current status and capabilities. Upon updating the display shown to the user, the View component then waits for the user to indicate what action should be taken. After receiving the user’s request, the View component will transfer this request to the Controller component of the workstation’s GUI.

**Controller**

The Controller component of the workstation’s GUI receives user requests from the View component and applies those requests to the GUI’s model component. Once a user request has been received from the View component, the Controller component ensures that all of the information needed to complete the request is present. If the information is incomplete, an error message is returned to the View component which indicates that an error has occurred and the operation is cancelled. However, if everything needed to execute the operation is present, the Controller component will change the state of the Model component to reflect the user’s request.

**Model**

The Model component is the gateway from the workstation’s GUI to the rest of the LMS. The Model component directly interacts with many other components which comprise the workstation application such as the: View, Controller, Librarian Login, Query, and Response Processing components. The Controller component will modify the state of the Model based on user requests. Depending on the user requests, these modifications may require the Model component to utilize the Librarian Login, Queries, or Response Processing components of the workstation. After finishing the operations with all of the necessary component, the Model will finalize its change of state. Once its state is finalized, the Model component will notify the View component that the user’s request has been completed.

**Librarian Login**

The librarian login component involves all of the functionality for the LMS to know when a librarian is logged in. If a librarian is not logged in, the user will have an option to log in. If a librarian is logged in, the LMS will check their administrative status and provide them the appropriate functionality.

**Queries**

A librarian using a workstation will require information about books and users. This component allows a workstation to submit queries to the LMS’ dedicated server to retrieve this information for the librarians.

**Response Processing**

A workstation will process the information returned by the LMS’ dedicated server. After the information is processed, it is returned to the workstation’s Model component to be displayed to the librarian.

**Network Interface**

The network interface will listen for messages from other LMS components over the internet. It will handle the encryption of outgoing messages, the decryption of incoming messages, and will make sure that the messages arrive at the proper destination.

**Website**

The main method of interaction between the patrons and the LMS will be through a website. The website will allow the users to log in and check their account details or browse their library’s selection of books.

**Web Browser**

As mentioned earlier in this document, the web browser is an application on the user’s computer that will allow them to access the LMS’s website.

**Welcome**

The LMS’s website will have a welcome page that presents patrons with options for browsing the library’s collection of books as well as logging into there account where they will be able to manage their account settings. Each of these two actions are contained in different sections of the LMS’ website

**Browse Collection**

The LMS’s website will have a section which allows users to browse the library’s collection of books. The users will be able to search for a specific book using information such as ISBN number, author name, or title. The browse collection section will display information about the books based on the Google Books API.

**Account Management**

Patrons will be able to manage their account settings in the third section of the LMS’ website. Account settings that a user will see on the account management page include: username, password, book checkout history, and book review history. Users will also be able to change their password, their contact information (email and/or phone number), and their opt-in status for email notifications. All of these modifications are performed through the LMS’ web server.

**Web Server**

The LMS’ web server component operates on the LMS’ dedicated server. The web server is responsible for handling all requests related to the LMS’ website. If a request requires information from LMS’ database, the web server is responsible for obtaining this information from the Database Manager component.

**Internet**

While not contained inside the LMS, the Internet plays a critical role in allowing the LMS to properly function. Librarians and administrators access the LMS’ database from their individual workstations via the Internet, and patrons are able to access the LMS via their web browsers. Therefore, the Internet is a critical component in the LMS’ architecture.

**Database Manger**

The LMS’ Database Manager is responsible for creating, maintaining, and querying all of the data available to the LMS. The database manager component receives requests for information from either the web server component or the networking component. Upon receiving these requests, the database manager verifies that all of the information needed to complete the request is present. If the information provided is insufficient, the database manager will indicate to the requesting component that the operation has been cancelled. If there is enough information to complete the operation, the database manager will gather the requested information from the database. Once all the information from the database has been collected, the database manager will send the information back to the component which requested it.

**Database**

The Database component of the LMS contains all of the information maintained by the LMS. The database only communicates with the database manager. This is to ensure that the database cannot be directly accessed without meeting the LMS’ security protocols.