## 1.2 Project Overview

**Introduction:**
Finding a seat at 'Nava Nalanda', Thapar's main library can be challenging. The library seat search project is an innovative initiative aimed at enhancing the efficiency and convenience of finding available seats in the library. With the increasing number of students and limited seating capacity in libraries, it has become challenging for students to find a suitable place to study or work.

This project aims to address this issue by implementing a live monitoring system that allows students to search for available seats in real-time. By utilizing such technology and a user-friendly interface, students can easily locate and reserve seats based on their preferences, such as proximity to power outlets or quiet areas. This project not only improves the overall experience of using library facilities but also optimizes the utilization of resources by efficiently managing seat occupancy.

Through this project, students can save time and effort in searching for seats, allowing them to focus more on their studies and research.

Additionally, it provides valuable data to library staff regarding seat occupancy patterns, helping them make informed decisions regarding space management and allocation.

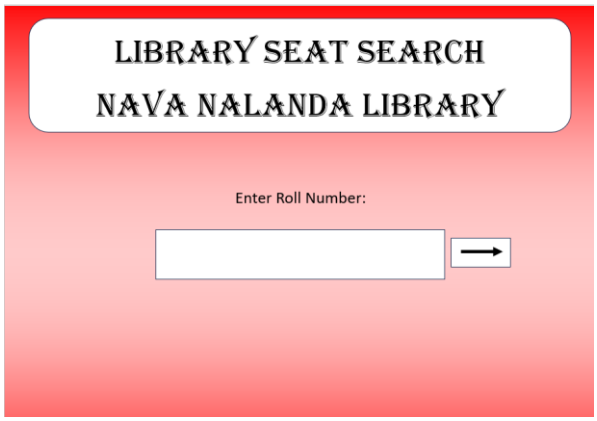
**USP:**
One of the key USPs of this project is its ability to provide real-time information about the availability of seats in the library. This feature allows students and researchers to plan their study sessions more efficiently, as they can easily check for vacant seats on entering the library.

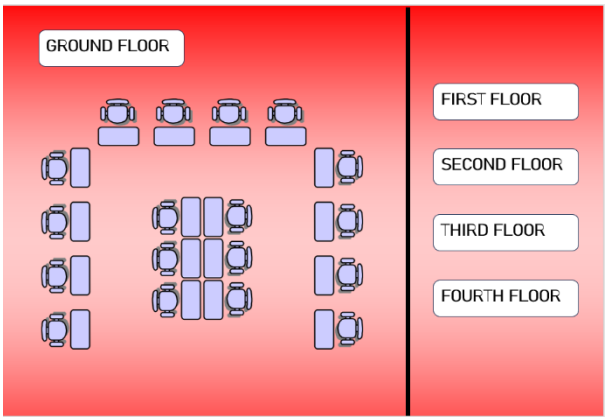
**Objective (how to achieve the goal):**
The objective of the Library Seat Search Project is to develop a system that helps library users find available seats efficiently and enhance the library's overall user experience by minimizing the time individuals spend searching for an appropriate seat which helps to reduce unnecessary disturbance. It ensures that seating capacity is effectively utilized.

**Outcome:**
The Library Seat Search Project aims to enhance user experience by providing real-time access to library seat occupancy status. This feature enables users to conveniently choose seats, ultimately saving them time. Additionally, the project offers academic institutions a tool to manage library space more efficiently. The system generates valuable data on seat occupancy, usage patterns, and user preferences, empowering libraries to make informed decisions about resource planning and facility improvements.

**Look and feel/Product perspective:**
To implement this project, we propose installing monitoring screens with a touch system, where users can enter their roll number/scan their ID card. The system will display the entire layout of the library depicting the seating arrangement. A floor filter will be available for users to navigate the layout easily.

Unoccupied seats will be highlighted in green, while selected seats will turn red. Upon the user's departure from the library, confirmed through scanning their ID card, the seat will automatically be marked as unoccupied (green) and become available for others to use. This approach reduces disturbance and chaos, as individuals can proceed directly to their chosen seat.




**Scope of Application:**

The system authenticates users by comparing ID card/Roll Number with the database, followed by checking library status and presenting user options. To keep track of users, the system writes information in two places: the main database and a backup server. This way, every time a user swipes their card, the system keeps a complete record. Initially we plan to implement these functionalities for the first floor with an intended user of 100 students. The scope of this system is not just limited to the university campus only as the same mechanism can be reused in other campuses as well.

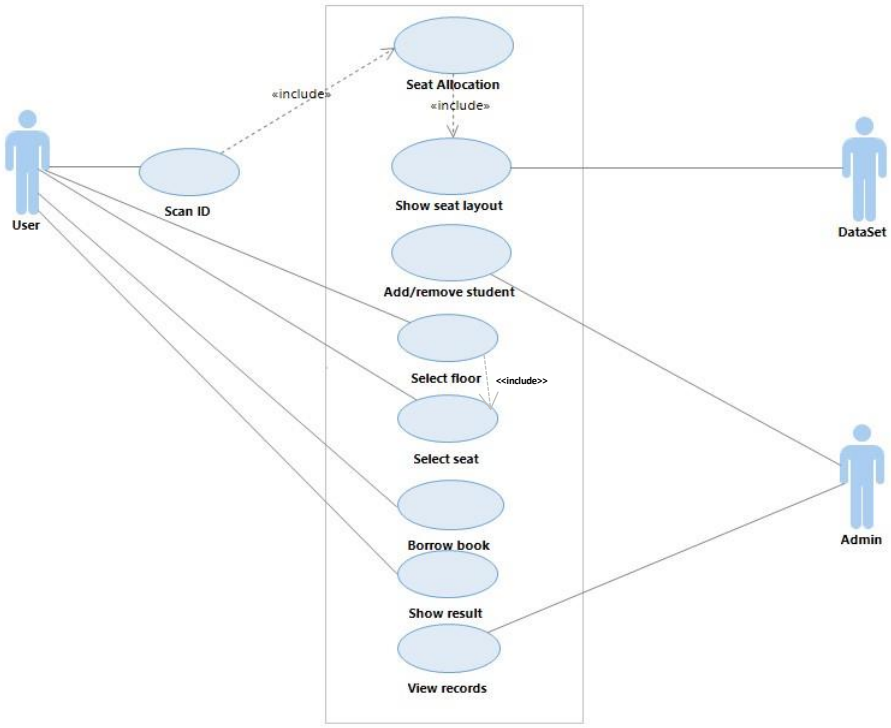
**Timeline:**

| Work Tasks | January | | | | February | | | | March | | | | April | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | W1 | W2 | W3 | W4 | W1 | W2 | W3 | W4 | W1 | W2 | W3 | W4 | W1 | W2 | W3 | W4 |
| Problem Statement | | | | | | | | | | | | | | | | |
| Software Bid | | | | | | | | | | | | | | | | |
| Write Up | | | | | | | | | | | | | | | | |
| SRS | | | | | | | | | | | | | | | | |
| Use case scenario and diagram, class diagram | | | | | | | | | | | | | | | | |
| GUI, raw UML diagrams | | | | | | | | | | | | | | | | |
| E-R diagram for database design | | | | | | | | | | | | | | | | |
| State Chart diagram, Component and Deployment diagram | | | | | | | | | | | | | | | | |
| Coding Phase | | | | | | | | | | | | | | | | |
| Test Plan | | | | | | | | | | | | | | | | |
| Test report generation | | | | | | | | | | | | | | | | |
| Deployment Plan | | | | | | | | | | | | | | | | |

# 2. Analysis Phase

## 2.1 Use Cases

### 2.1.1 Use-Case Diagrams




### 2.1.2 Use-Case Templates

| | |
|---|---|
| 1. Use Case Title | Select Seat |
| 2. Abbreviated Title | Select Seat |
| 3. Use Case ID | 5 |
| 4. Actors | Student |

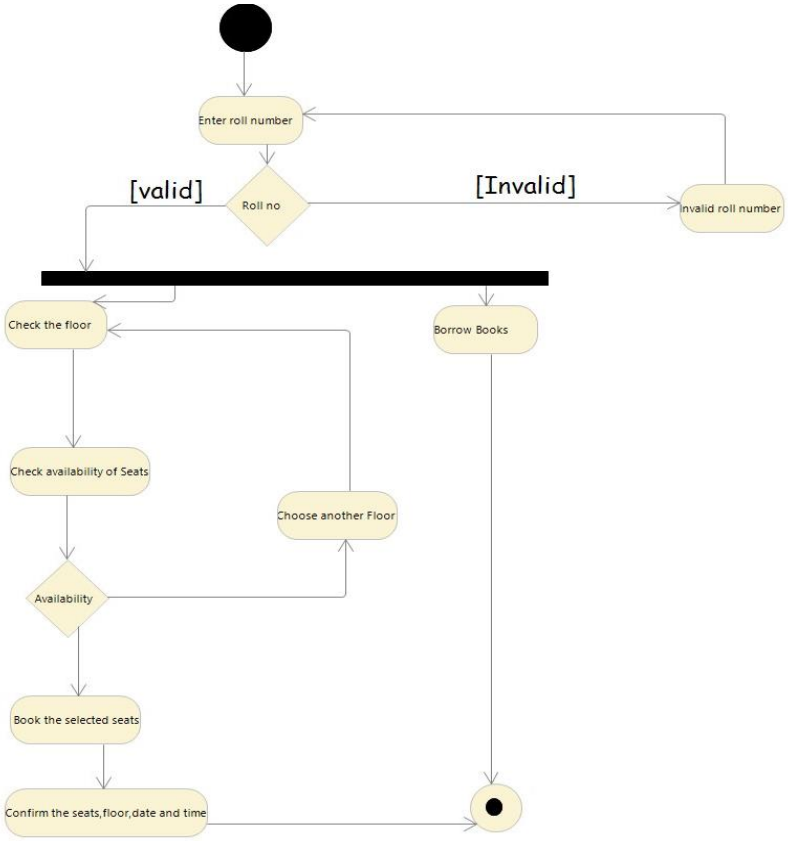
5. Description
With this facility, user can select any seat according to their convenience and requirement

5.1 Pre-Conditions: User must have scanned their ID card

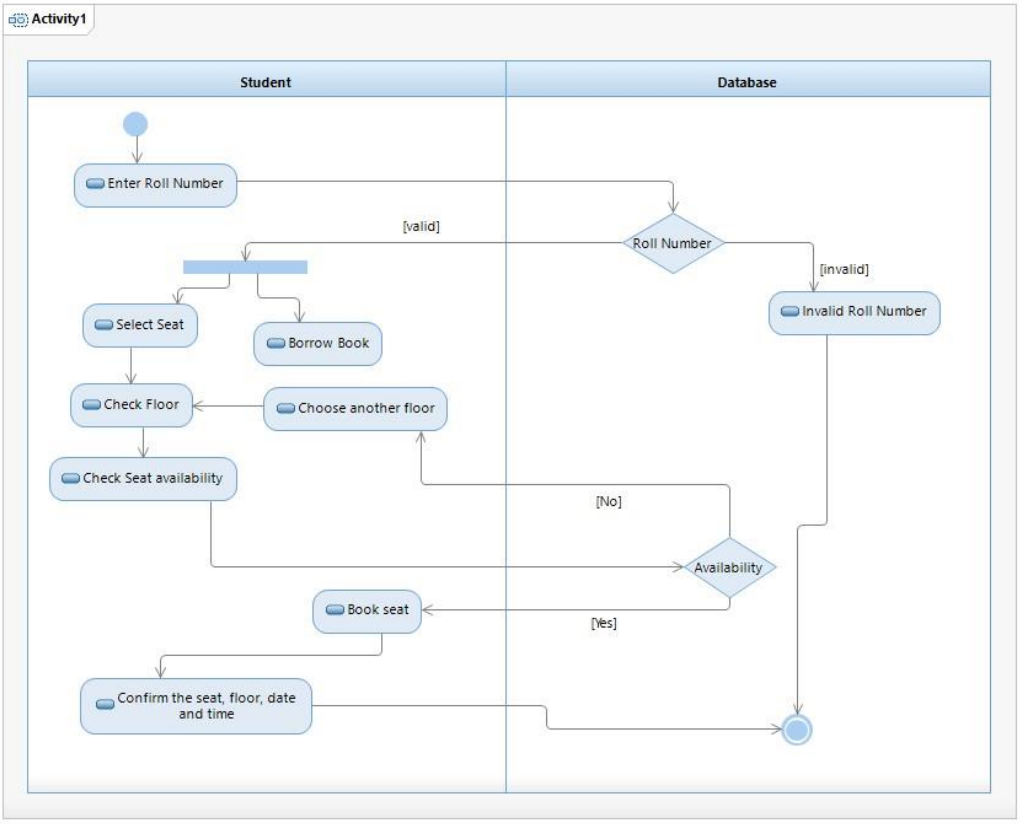
5.2 Task Sequence
1. Screen will display the list of floors.
2. On selecting the required floor, the seat layout will be displayed.
3. The user can select the seat of his/her choice.
4. Confirmation message will be displayed

5.3 Post Conditions:
1. Confirmation message will be displayed.
2. User can change his/her seat.

## 2.2 Activity Diagram and Swimlane Diagram



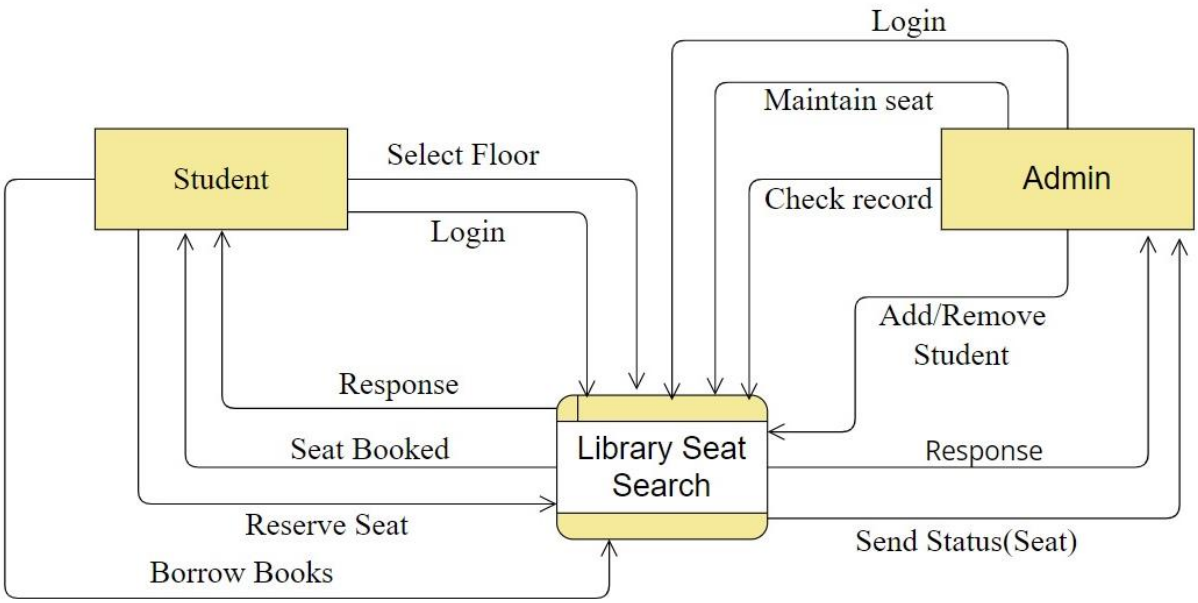

Activity Diagram



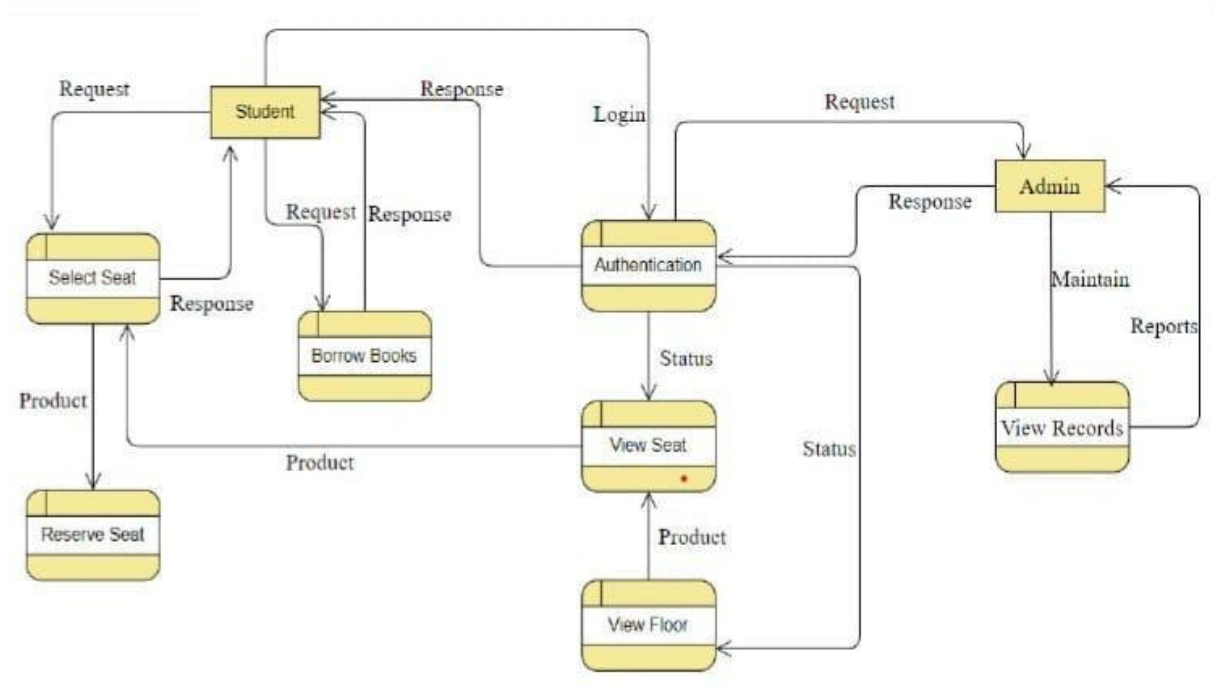

Swimlane Diagram

## 2.3 Data Flow Diagrams (DFD)

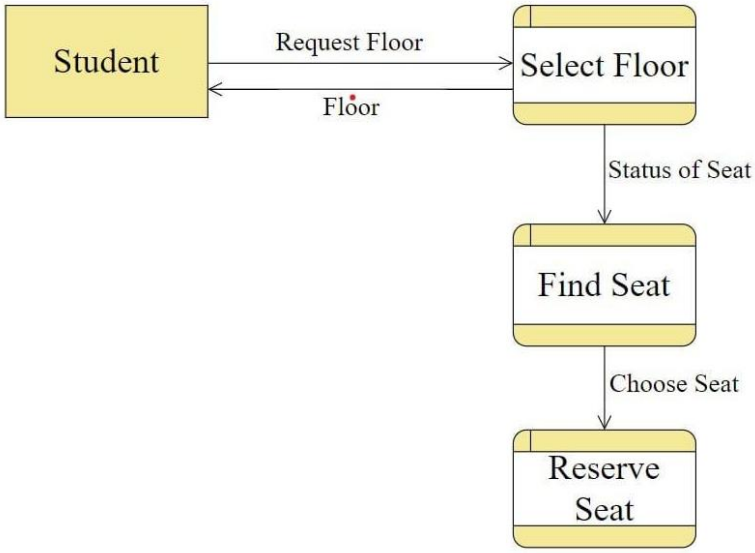
### 2.3.1 DFD Level 0




### 2.3.2 DFD Level 1



` **2.3.3 DFD Level 2**



# A CASE STUDY (IEEE Format)

# Software Requirements Specification Document

**Version 1.0**

***Library Seat Search***

# TABLE OF CONTENTS

# 1. Introduction

## 1.1 Purpose of this Document

The purpose of this SRS document is to provide a detailed overview of our software product, its parameters and goals. This document describes the project's target audience and its user interface, hardware and software requirements. **It defines how our client, team and audience see the product and its functionality.**

## 1.2 Scope of the Development Project

The goal is to design a software for a CSC based Seat monitoring System. In this system, the user will scan their ID card against the reader terminal in order to perform read transactions such as checking seat availability or write operations such as choosing a seat. To keep track of users, the system writes information in two places: the main database and a backup server on a daily basis so that cases of data loss are minimized in case of events such as power failure or link failure. This way, every time a user swipes their card, the system keeps a complete record.

The software must be able to perform the following operations:

1. **Identify and authenticate card:** It must be able to authenticate the card user by matching the ID no/ Roll no. and the access code (which in turn may be generated using some cryptographic algorithm) against the values stored in the database.
2. **Check seat status:** It must be able to check the seat status by querying the database for any seats blocked earlier. This function must be called immediately after the card has been validated and then a set of options must be offered to the user.
3. **Record user's presence:** It must be able to record the user's presence by writing the user's ID no./ Roll no. in the corresponding database table. Thus for one scan, two write operations will be performed: one into the main database and other into the backup database server.

   **Note:** A key point to be noted here is that the card has to be scanned every time a user is entering or exiting the library.
4. **Determine access privilege levels:** The software must be able to determine whether a particular user has been denied access from the library due to some policy violation.

Initially we plan to implement these functionalities for the ground floor of the library with an intended audience of 100 people as a part of the Pilot Phase. Once the Pilot Phase is successful then we plan to implement it for other floors in the library.

The scope of this system is limited to the university campus only but can be reused in other libraries as well by amending the layout.

## 1.3 Definitions, Abbreviations and Acronyms

Table 1: Definitions for most used terms

| | |
|---|---|
| Contactless Smart Card | A second type is the contactless smart card, in which the chip communicates with the card reader through RFID induction technology (at data rates of 106-848 kbit/s). These cards require only close proximity to an antenna to complete transaction |

Table 2: Full form for most used abbreviations.

| Sno. | Abbreviation | Full Form |
|---|---|---|
| 1. | CSC | Contactless Smart Card |
| 2. | SDET | Software Development Educational Training |

## 1.4 Overview

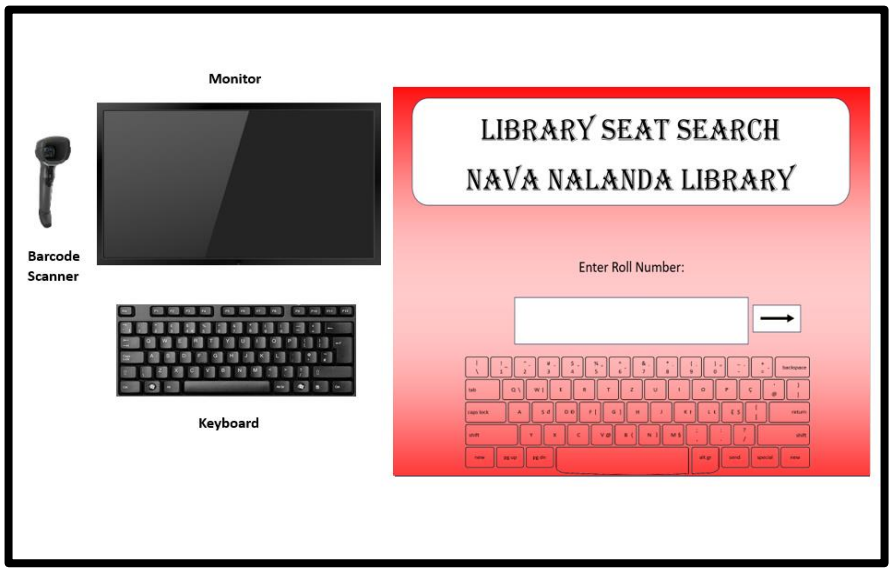
The remaining sections of this document provide a general description including characteristics of the users of this project, the product's hardware and the functional and data requirements of the product. General description of the project is discussed in Section 2 of this document. Section 2 gives the functional requirements, data requirements and constraints and assumptions made by designing the Seat Monitoring System. It also gives the user viewpoint of product use. Section 3 gives the specific requirements of the product. Section 3.0 also discusses the external interface requirements and gives detailed description of functional requirements.

# 2. Overall Description

## 2.1 Product Perspective

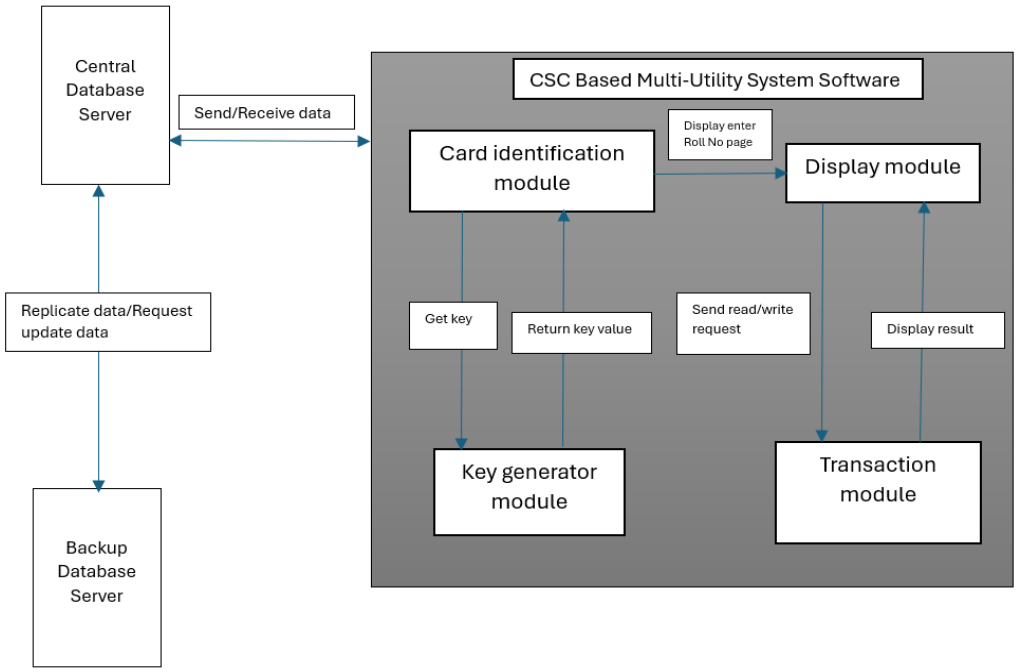
The product does not require use of a pointing device or keyboard but a touch screen allowing the user to enter his/her Roll No., select the floor and choose a desired seat.

Figure 1 shows the layout for the library with seat select system placed at the library entrance.




Here the user will have to scan his/her ID card against the reader-writer terminal and once the terminal identifies the card user by matching the cryptographic key generated by the software with one generated by the card. The software inside the terminal will check whether the user has been denied access to the library due to some official reason. If the user has been denied access, then the software will send the message "Access Denied" onto the screen. Otherwise the ground floor layout is displayed by default.

The above mechanism can be explained in a better way with the help of the following figure (Figure 2).




Here the CSC based Multi-Utility System including Access Control and Seat Monitoring has been depicted as a Black box that in turn contains four major modules:

1.Card Identification

2.Key Generator

3.Display

4.Transaction

Upon scanning the ID card against the scanner, the Card Identification Module will authenticate the card user by matching the ID No. and the access code against the values stored in the central database server.

The Card Identification Module in turn will call the Key Generator Module to obtain the key. The Key Generator Module will compute the key using some cryptographic algorithm and will return the value to the Card Identification Module.

Once the card has been successfully identified the user will see a page where the user should enter his/her Roll No similar to the message displayed in Fig 1 above. The Card Identification Module will thus send the card user's name to the Display Module that will in turn show the enter Roll No. page on the screen. Depending on the operation requested by the user the Display Module will call the Transaction Module with the respective operation.

Here I have defined a transaction as simple read/write operation where the data to be read/written may differ with each request. Thus a user trying to reserve a seat can be used a write transaction whereas the user seeing the seats already reserved will be considered as a read transaction. The Transaction Module will thus process the read/write transaction and display the appropriate page back to the display screen by passing the message to the Display Module.

In addition to the four modules , a Central database server and a Backup database server will also be used to order a read/write data onto the repository. The central database server will periodically update the Backup database server so that in case of server so that in case of failure it can restore the data by retrieving the records stored in the Backup database server's tables. I have enclosed the four modules in a grey rectangle in order to indicate that these 4 modules comprise the major components of the CSC based Multi-Utility System software. And by showing a single arrow between the software and central database server, I wish to convey the point that at a given point of time only one module within the software will communicate with the database server. This is the card identification module and the transaction modules will not access the database at the same time as first a card has to be authenticated, following which the transactions can be processed.

## 2.2 Product Functions

The product should be able to perform the following operations:

1. It must be able to authenticate the card user by matching the ID no. and the access code against the value stored in the database.
2. It must be able to check the available seats by querying the database for any seats blocked.
3. The user will be able to select a seat of his/her choice on entering the library.
4. It must be able to record the user's presence by writing the user's ID no. in the corresponding database table. Thus for one scan, two write operations will be performed: one into the main database and other into the backup database server. For each scan, the time in/out will also be recorded.
5. The software must be able to determine whether a particular user has been denied access from the library due to some policy violation. The results of this operation will be viewable by security officer only.

## 2.3 User Characteristics

The goal is to design a software for a CSC based Seat Monitoring System for different users. These user types are listed below as follows:

1. Student
2. Staff
3. Student cum Staff
4. Dean
5. Director
6. Security Officer
7. Chief Medical Officer
8. Chief Accountant

As one can see from the list, each user will have different educational background and expertise level in using the system. Our goal is to develop a software that should be easy to use for all types of users including the security officer. Thus, while designing the software one can assume that each user type has the following characteristics:

- The user is computer-literate and has a little or no difficulty in using ID card to access information about the seats.
- In order to use the ID card, it is not required that a user be aware of the internal working of the ID card but he/she is expected to know what happens when the card is scanned against the reader.

## 2.4 General Constraints, Assumptions and Dependencies

The following list presents the constraints, assumptions, dependencies or guidelines that are imposed upon implementation of the CSC based Seat monitoring System

- The software has to be integrated onto the reader-writer terminal that has an extremely small form factor and has support for limited capability APIs only.
- The product must have a user-friendly interface that is simple enough for all types of users to understand.
- Response time for loading the software and for processing a transaction should be no longer than five seconds.
- A general knowledge of basic computer skills is required to use the product.
- The central database server and backup database server should be updated regularly. This updating and replication of data from central database server and backup database server can introduce additional latency in the working of the system.
- The replication of data from the central to the backup server has to be Asynchronous as Asynchronous solutions also provide a greater amount of protection by extending the distance between the primary and secondary locations of the data. Increased distance can provide protection from local events such as loss of the power grid.

## 2.5 Apportioning of requirements

The CSC based Seat Monitoring System is to be implemented using the following two phases:

i. Pilot Phase: Here the CSC based Seat Monitoring System will be implemented for the ground floor of the library with an intended audience of 100 users. Initially, we will be providing access privileges to the students as they will be the ones most involved in this phase.

ii. Institute wide deployment: Following the successful completion of the pilot phase, we plan to deploy the same for all the floors with access privileges to all the users.

Here, the same functionalities will be implemented in each phase; the only difference will be the number of transactions being carried out and the scale of implementation.

# 3. Specific Requirements

## 3.1 External Interface Requirements

The following list presents the external interface requirements:

- The product requires very limited graphics usage with just a simple touchscreen including a virtual keyboard for taking the input from the user.
- The product does not require usage of sound and animation. The hardware and operating system require a screen resolution not more than 1280 x 720 pixels.

## 3.2 Detailed Description of Functional Requirements

The table shows a template that I'll be using to describe functional requirements for a user(student) as one can easily deduce the functional requirements for the other user types with this template.

**Table 3: Template for describing functional requirements**

| | |
|---|---|
| **Purpose** | A description of the functional requirements and its reasons |
| **Inputs** | What are the inputs; in what form will they arrive; from what sources can the inputs come; what are the legal domains of each input. |
| **Processing** | Describes the outcome rather than the implementation; includes any validity checks on the data, exact timing of operation (if needed), how to handle unexpected or abnormal situations |
| **Outputs** | The form, shape, destination and volume of output; output timing; range of parameters in the output; unit of measure of the output; process by which output is stored or destroyed; process for handling error message produced as output. |

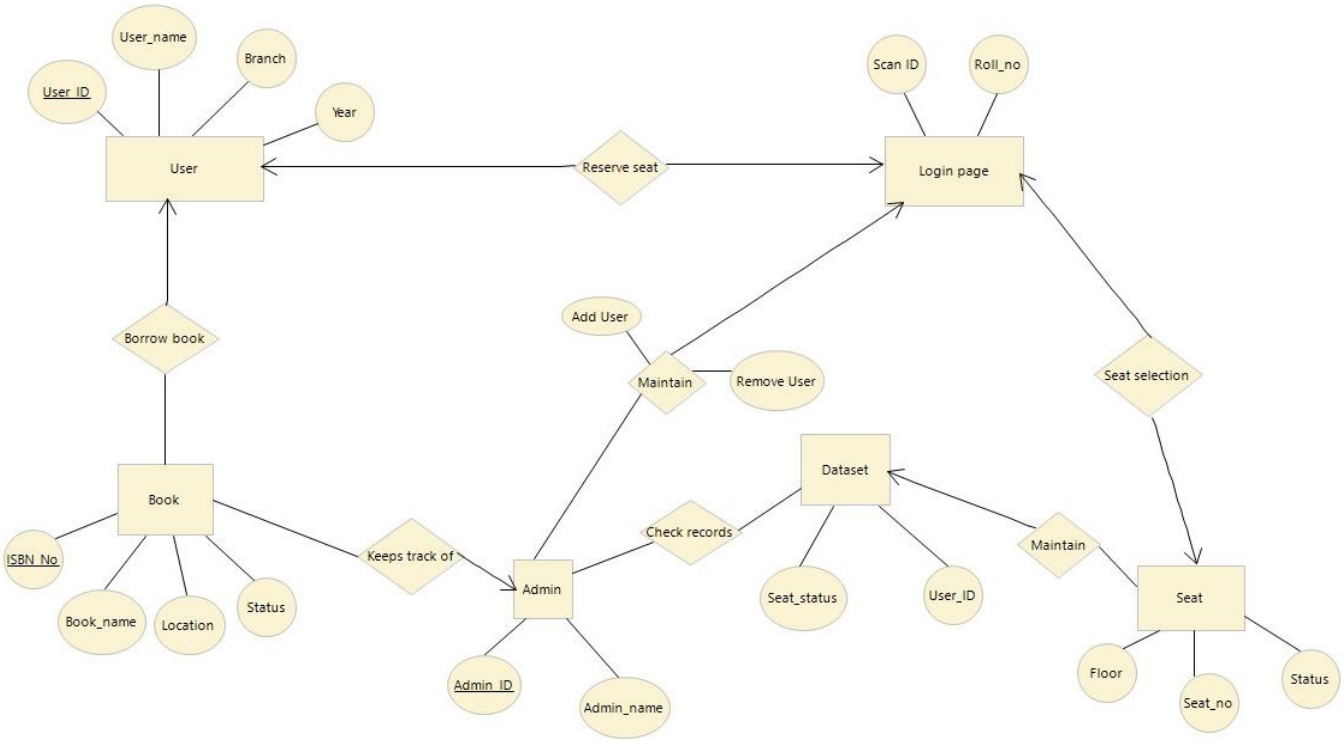
### 3.2.1 Functional Requirements for student welcome screen

| | |
|---|---|
| Purpose | This screen thus provides information specific to each student upon the successful identification of the ID no. |
| Inputs | A student can view a page of information by scanning their ID card or entering their roll no. with the help of a simple keyboard. |
| Processing | The menu responds to the user ID no. entered by displaying a page of options to choose between borrowing a book or selecting a seat. |
| Outputs | Output consists of a screen of information common to all students. For example: as shown in figure 1, upon choosing the option of select floor, a student may be able to see the list of floors. |

## 3.3 Performance Requirements

- The software is designed for the reader-writer terminal and cannot run from a standalone desktop PC.
- Only numeric information will be handled by the software.
- For normal conditions, 95% of the transactions should be processed in less than five seconds.

## 3.4 Logical Database Requirements



### 3.5 Quality Attributes

The product is target towards a wide variety of users such as Student, Staff, Student cum Staff, etc. The product must load quickly. It must also tolerate a wide variety of input possibilities from a user, such as incorrect responses or unforeseen keystrokes.

### 3.6 Other Requirements

None at this time

## 4. Change History

| | |
|---|---|
| 200209 | Version 1.0 – Initial Release |
| | |
| | |

## 5. Document Approvers

SRS for CSC based Seat Monitoring System approved by:

_____

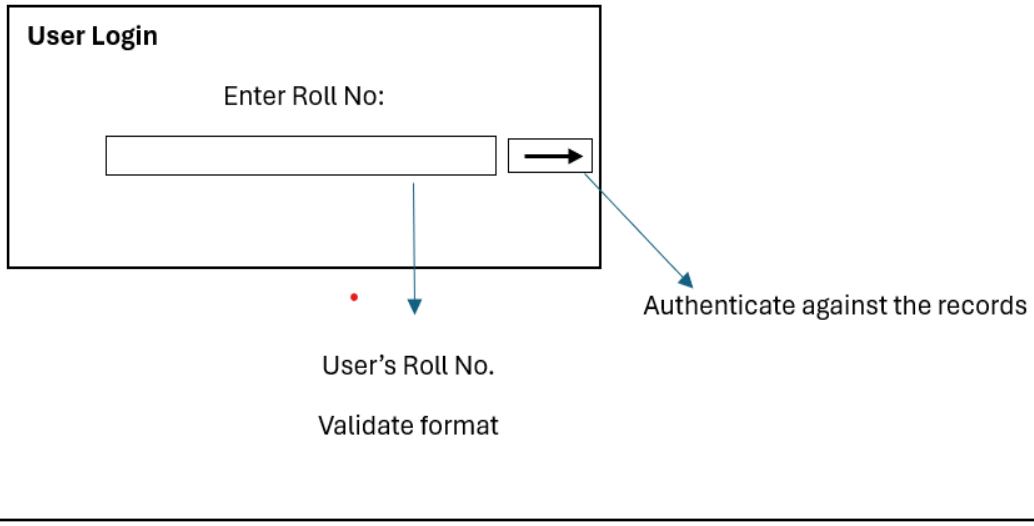
**(name)**
**Designation:**
**Date:**

## 2.5 User Stories and Story Cards

### Front of the card

| #0001 | USER LOGIN | Fibonacci Size # 3 |
|---|---|---|

As a [registered user], I want to [log in], so I can [reserve a seat in the library].




### Back of the card

**Confirmation**

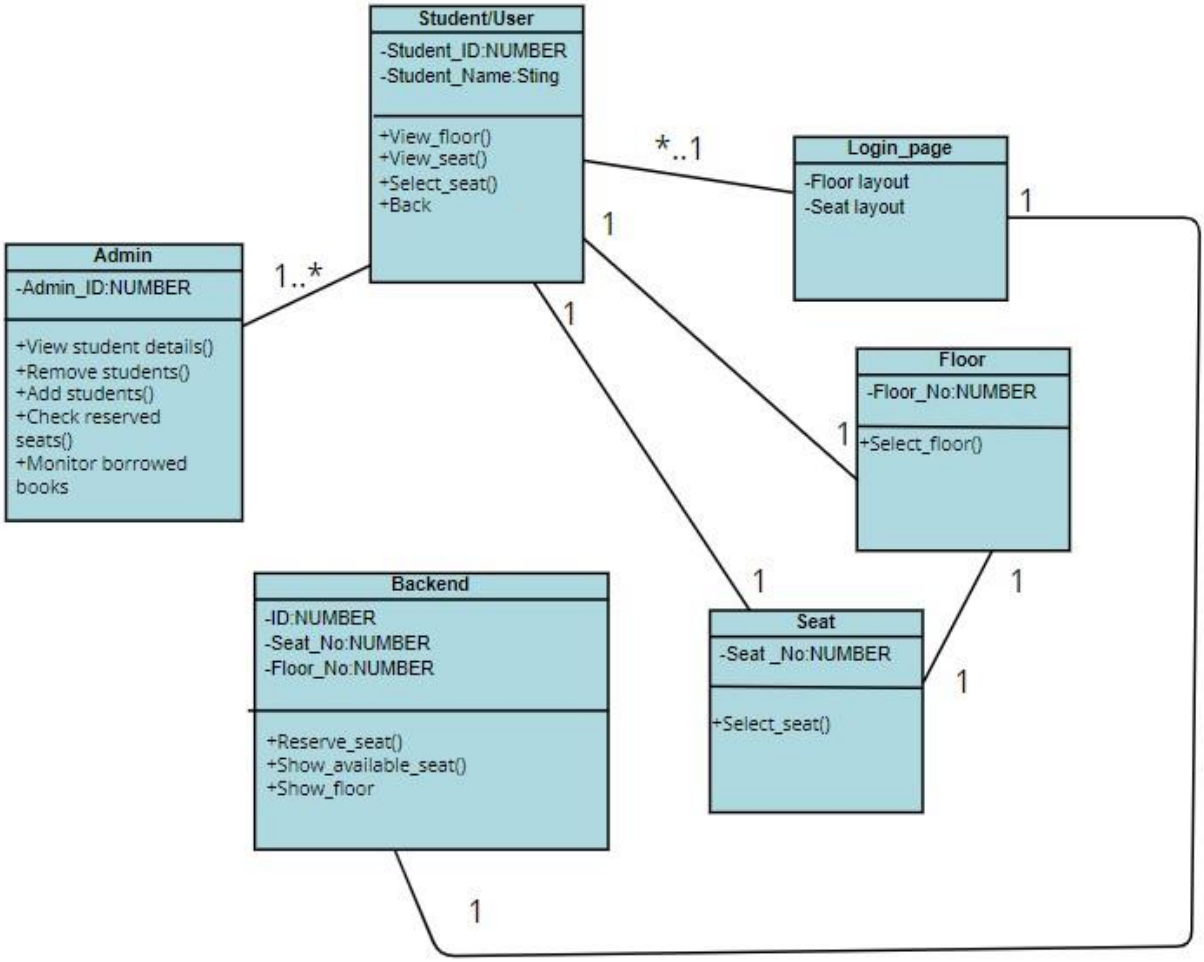
1. Success- valid user logged in and referred to floors view page.

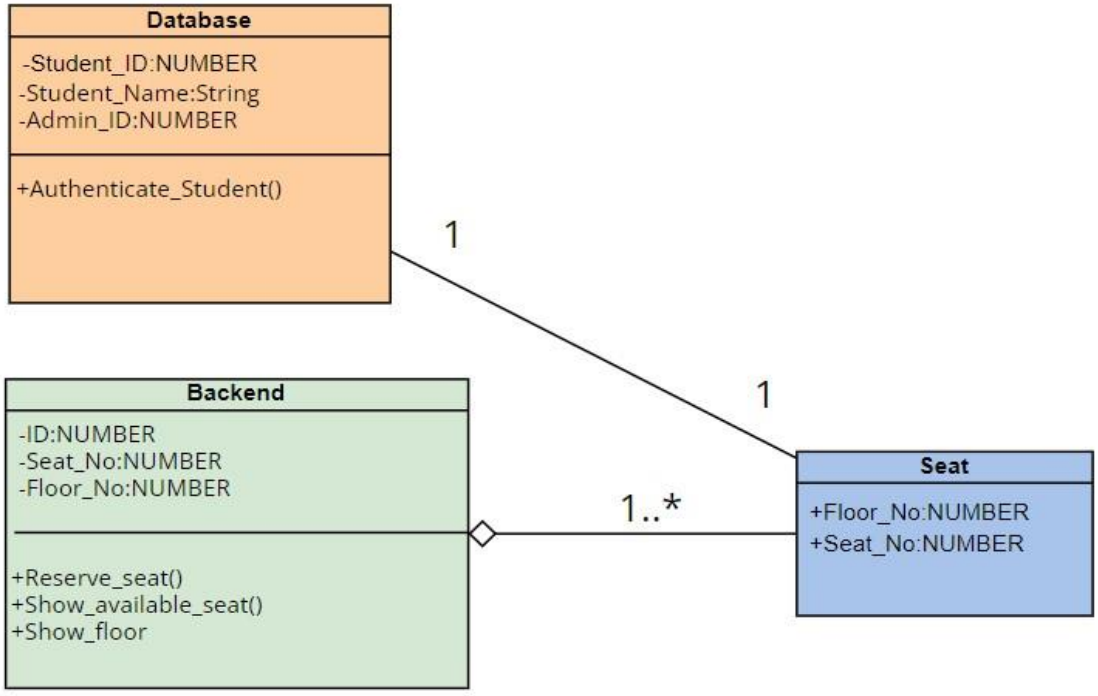
2. Failure- display message:

a) "Roll No is incorrect"
b) "Account blocked"
c) "Account has expired"

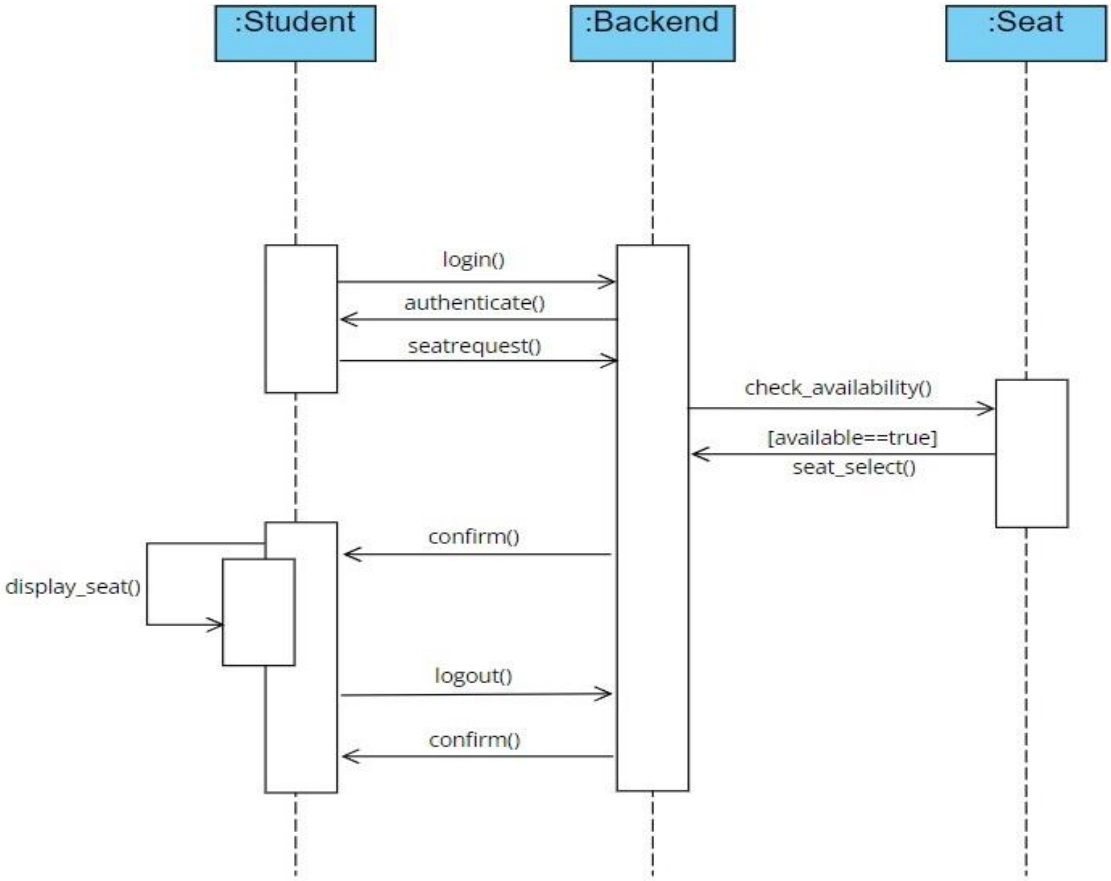
# 3. Design Phase

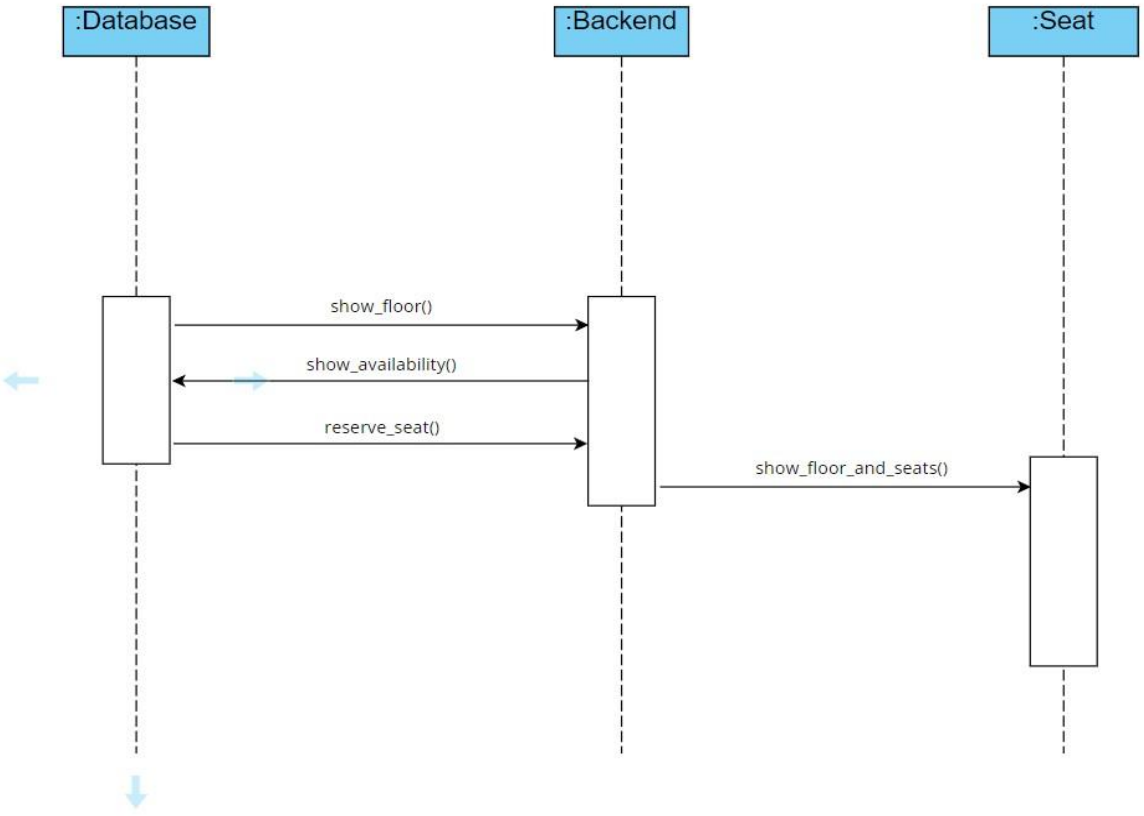
## 3.1 Class Diagram



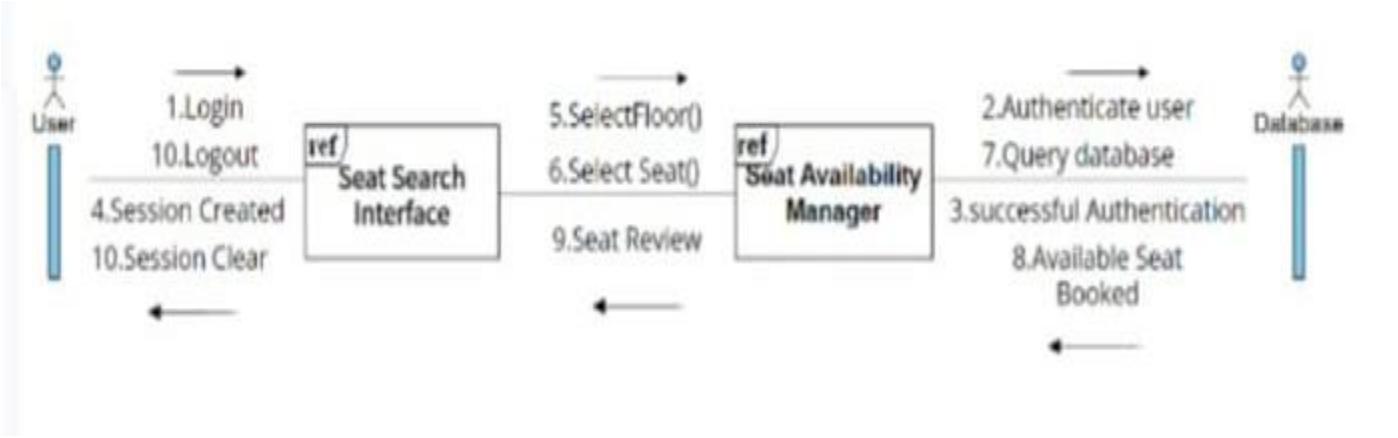



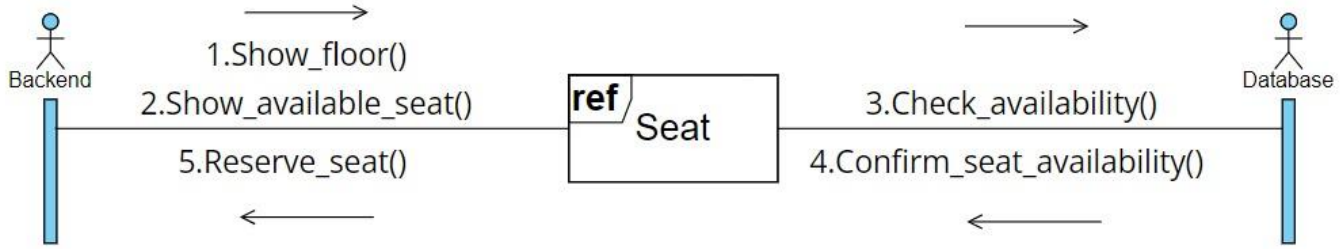
## 3.2 Sequence Diagram



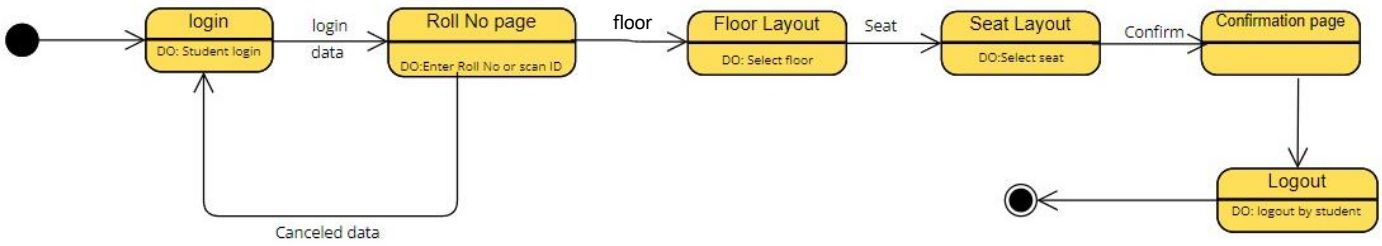



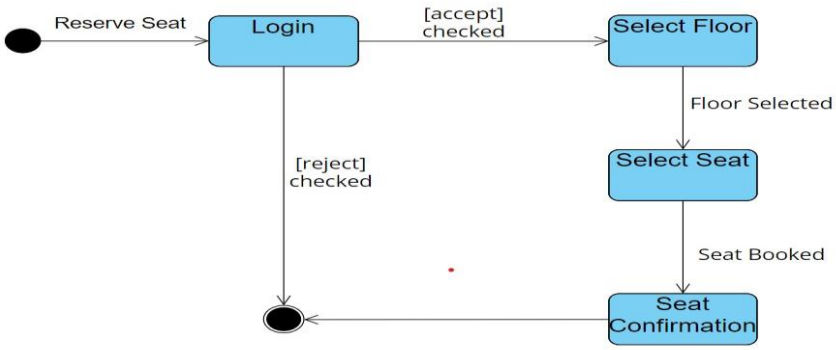
## 3.3 Collaboration Diagram



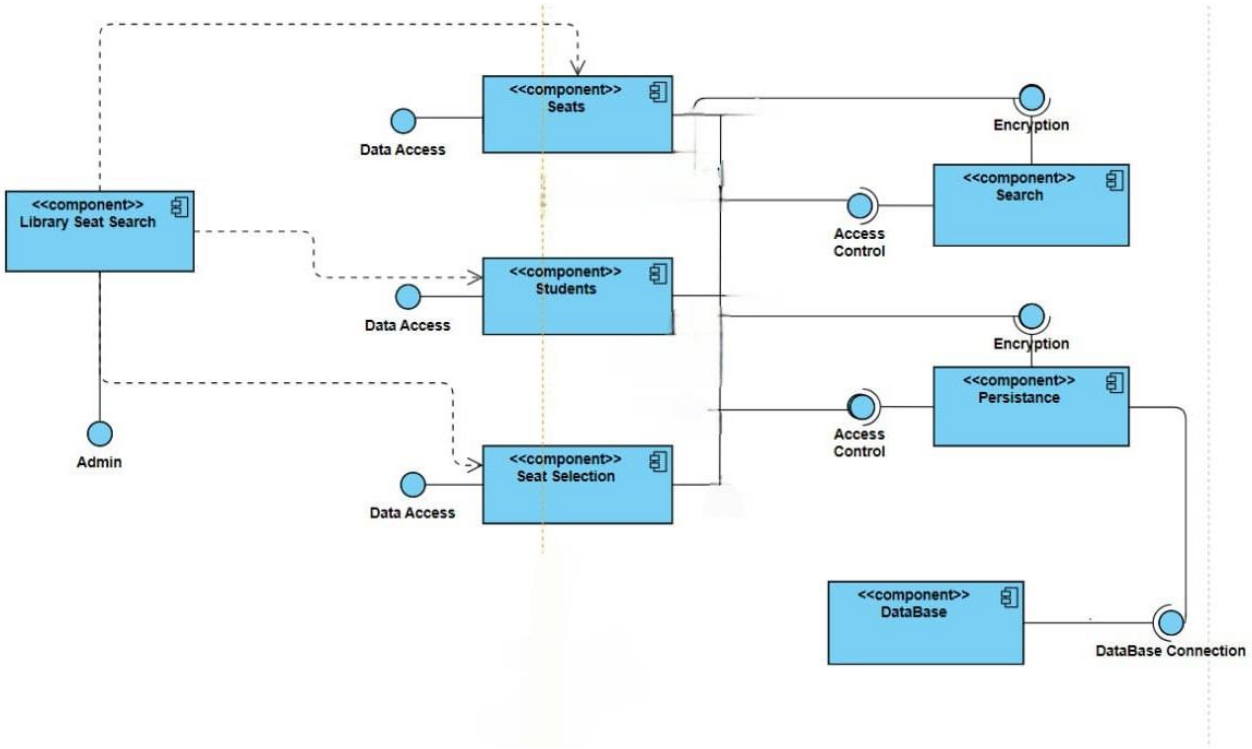

## 3.4 State Diagram



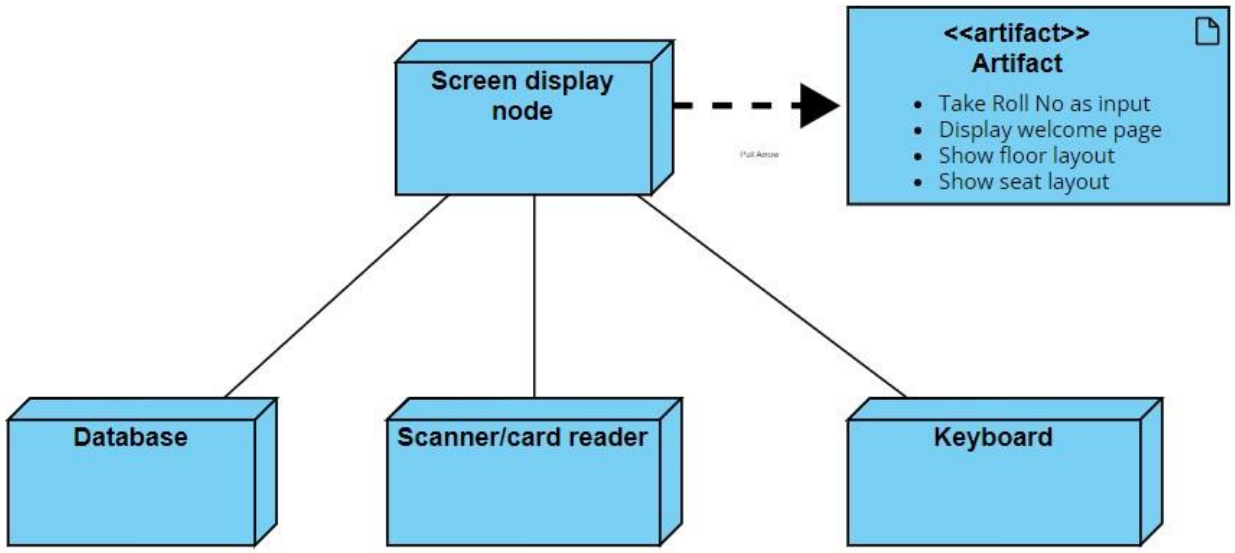



# 4. Implementation

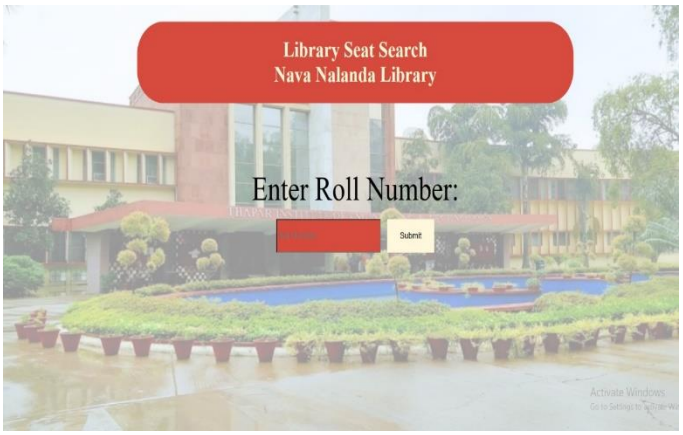
## 4.1 Component Diagram

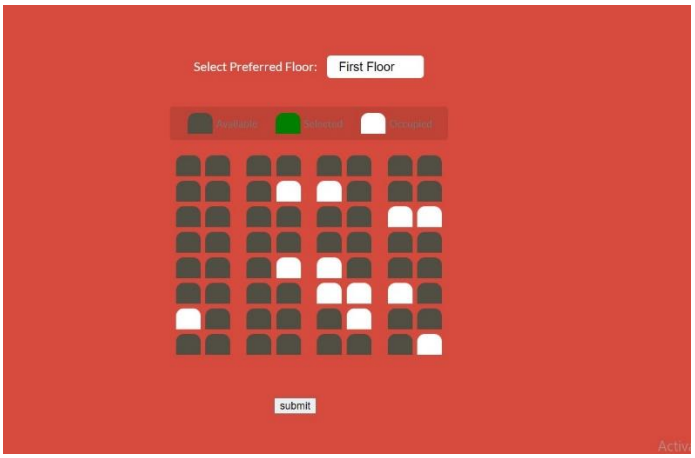


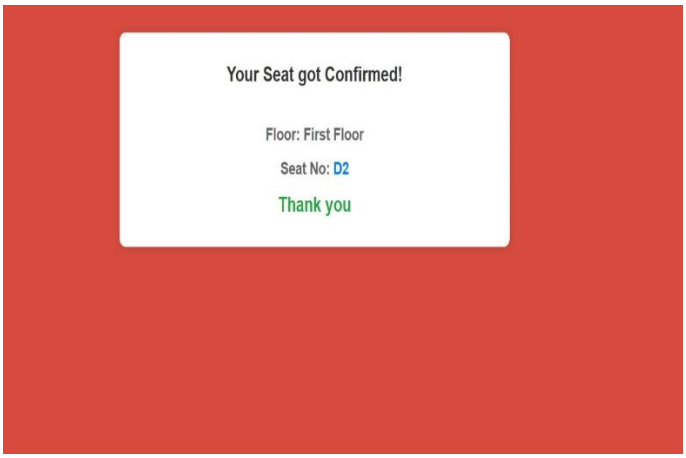

## 4.2 Deployment Diagram



### 4.3 Screenshots

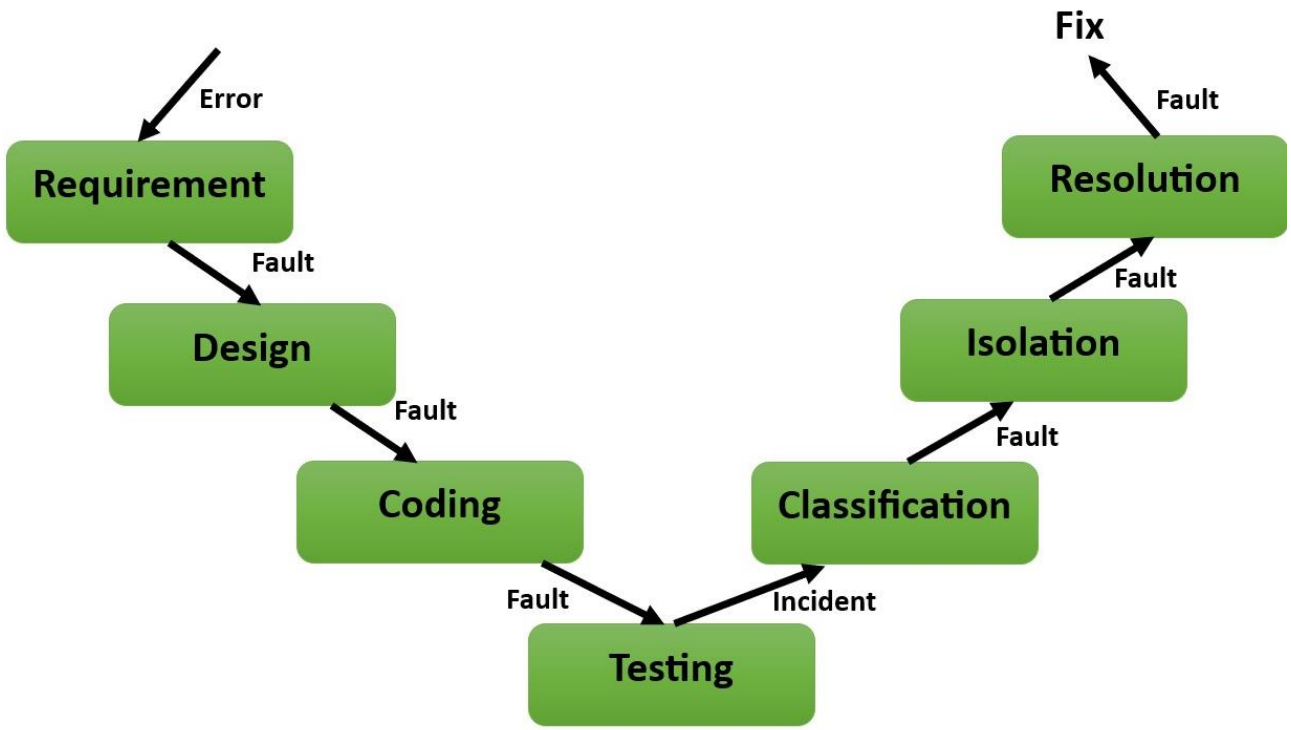




## 5. Testing

### 5.1 Test Plan



## 5.2 Test Case

| | |
|---|---|
| Test Case#:1 | Test Case Name: Reserve seat |
| System: Library Management System | Subsystem: Seat |
| Designed by: ABC | Design Date: 2/4/2024 |
| Executed by: | Execution Date: |
| Short Description: Reserve a seat in the library. | |

Pre-conditions

1. The user has a valid ID card. The user has either scanned his/her ID or entered their roll no to enter the library.
2. The user hasn't been denied access by the admin.
3. The system displays the welcome page and floor layout.

| Step | Action | Expected System Response | Pass/Fail | Comment |
|---|---|---|---|---|
| 1. | User scans ID card or enters Roll No. | The system displays a welcome message and asks the user to select a floor. | | |
| 2. | Selects a floor. | The system asks the user to select a seat. | | |
| 3. | Selects a seat. | The system displays a confirmation message with the details of the student, the selected floor and reserved seat. | | |
| 4. | Logout by scanning ID card or entering Roll No. | Display OUT message. | | |