

CS7CS3 Advanced Software Engineering Group

Project Functional and Technical Architecture

Project Name: *Virtual Library*

Group: Group 6

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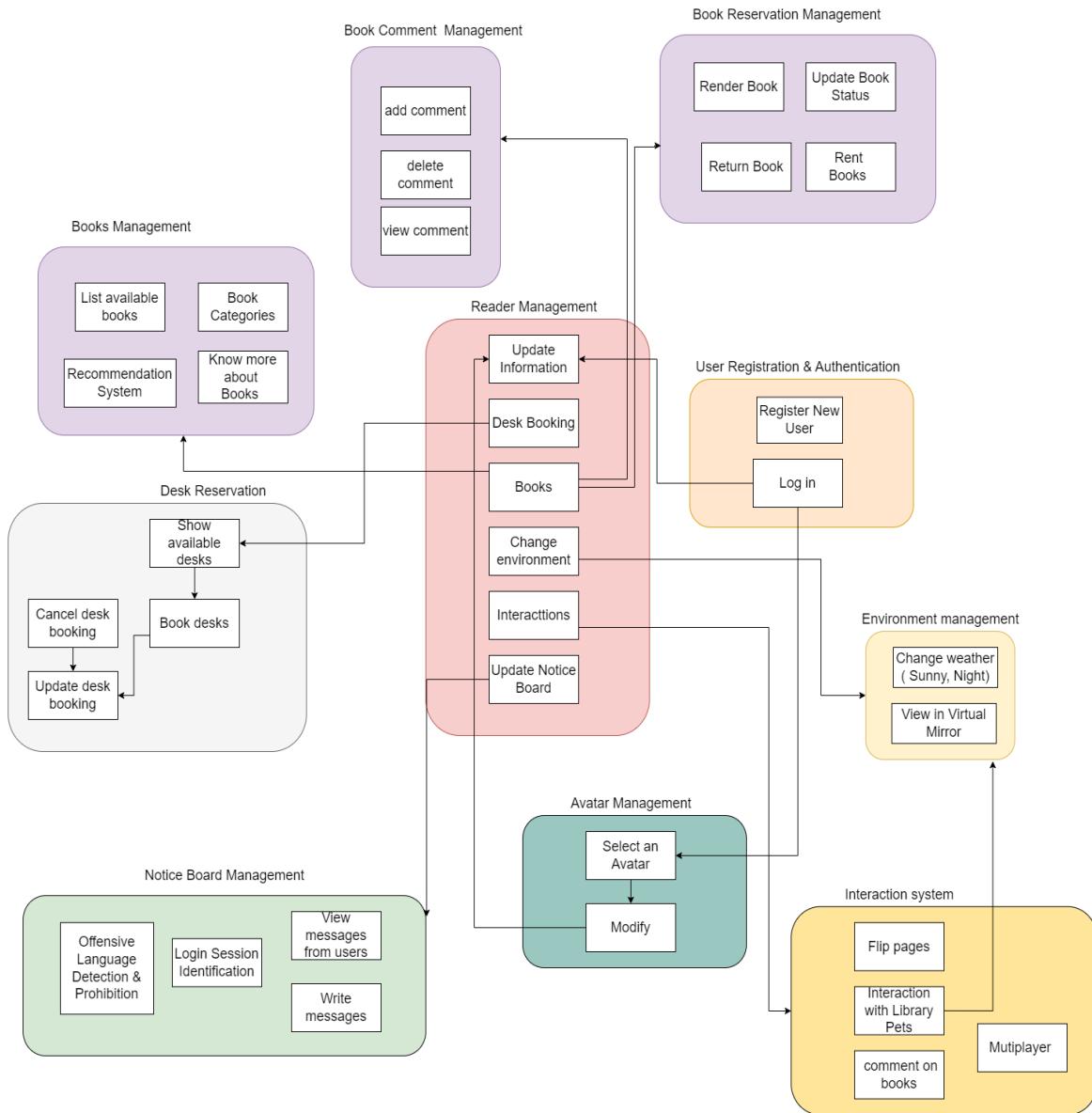
Long Pan

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1. Functional Architecture

1.1 Diagram



1.2. Component Descriptions

Different Components used are as follows:

1. User Registration System

2. Reader management
3. Avatar management
4. Book management
5. Book Comment Management
6. Book Reservation management
7. Desk reservation management
8. Environment management
9. Noticeboard management
10. Interaction system

1.2.1 User Registration System

It allows users to create an account or login if they already have an account.

Responsibilities:

- Users can create accounts.
- Users can login if they already have an account.

1.2.2 Reader Management

It is responsible for updating and storing all the details related to users such as login details, desk bookings, reading books, commenting, changing the environment, and updating the notice board.

Responsibilities :

- Users can update their information.
- Users can book a desk and rent a book.
- Users can manage their bookings.

- Users can change the environment and interact with the environment.

1.2.3 Avatar Management

It is responsible for Avatar creation and management. Responsibilities :

- Selecting a new avatar.
- Modifying the selected avatar.

1.2.4 Books Management

It is responsible for books, listing all the available books, and recalling the given books.

Responsibilities :

- Show users to see the list of all the available books.
- Show category book list
- Show Book details
- Recommend books

1.2.5 Desk Reservation Management

It is responsible for all the things that are related to desk bookings.

Responsibilities :

- Shows the available desks.
- Allows users to book desks.

- Allows users to update booked reservations.

1.2.6 Environment Management

It is responsible for the library environment.

Responsibilities :

- Allows the user to change the weather outside the window.
- Allows users to check themselves in the Virtual mirror

1.2.7 Noticeboard Management

It is responsible for activities related to the notice board.

Responsibilities :

- Displays the messages from other users along with their login names.
- Allows multiple users to interact in real time.
- Has Integration with Offensive Language Detector to prevent inappropriate messages from being posted by issuing warnings instead of posting messages.

1.2.9 Book Comment Management

It is responsible for activities related to the book comments.

Responsibilities :

- Displays comments added by the users.
- Users can add a comment

- Users can delete their comments

1.2.10 Interaction System

It is responsible for the interaction between users and the environment.

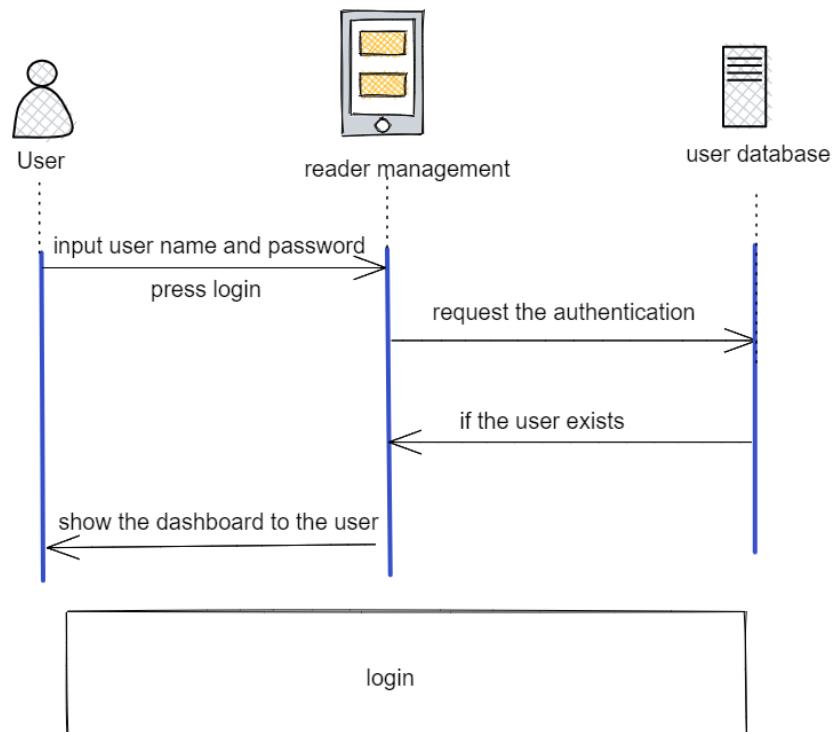
Responsibilities :

- Allows users to flip the pages of the books.
- Reading Books
- Allows users to pet the cats.
- Multiplayer

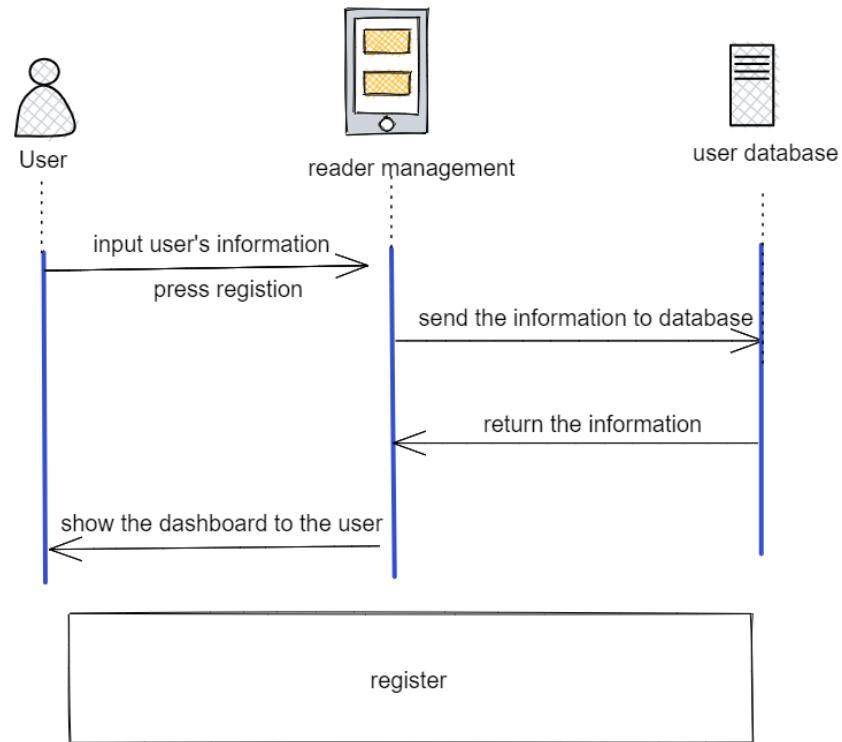
1.3. Component interactions

UML Diagrams:

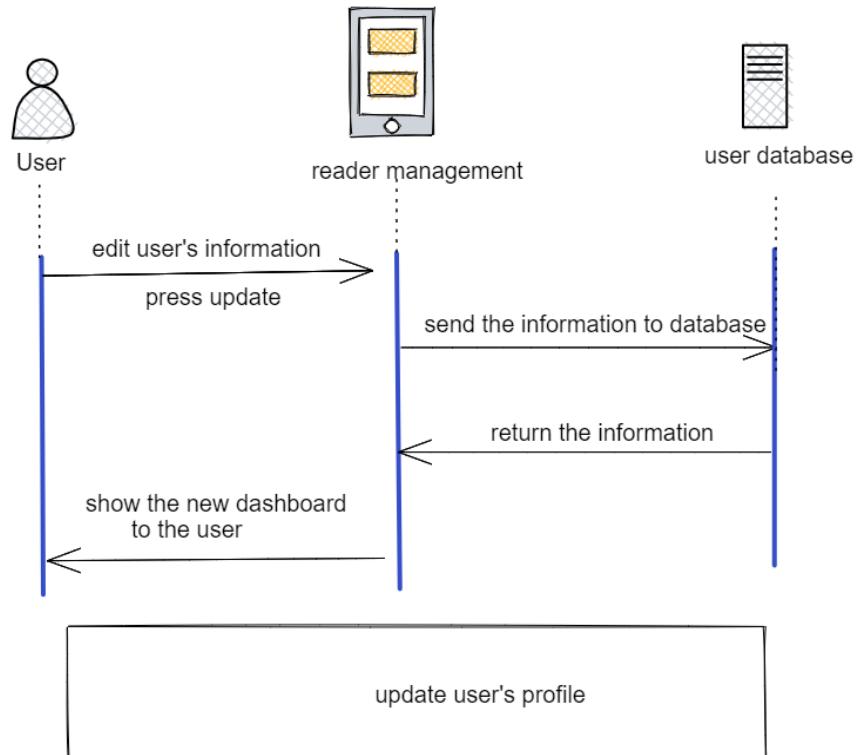
Login



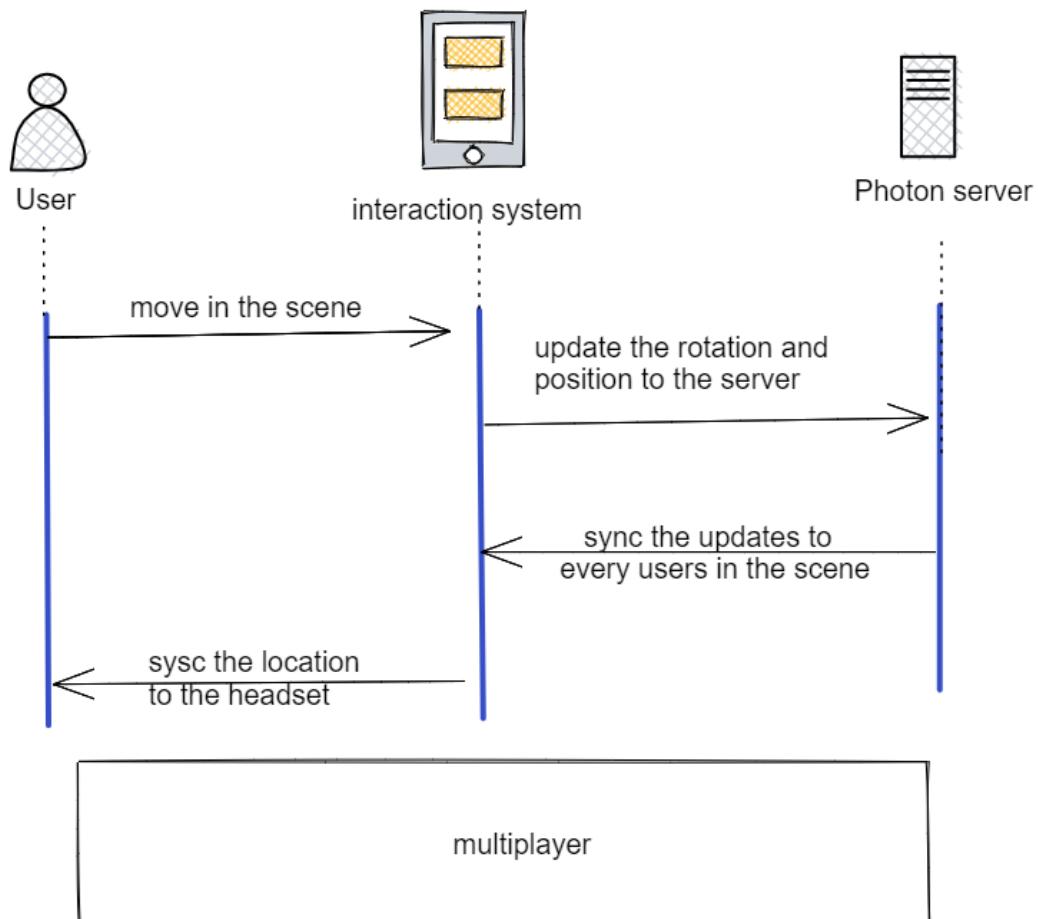
Register



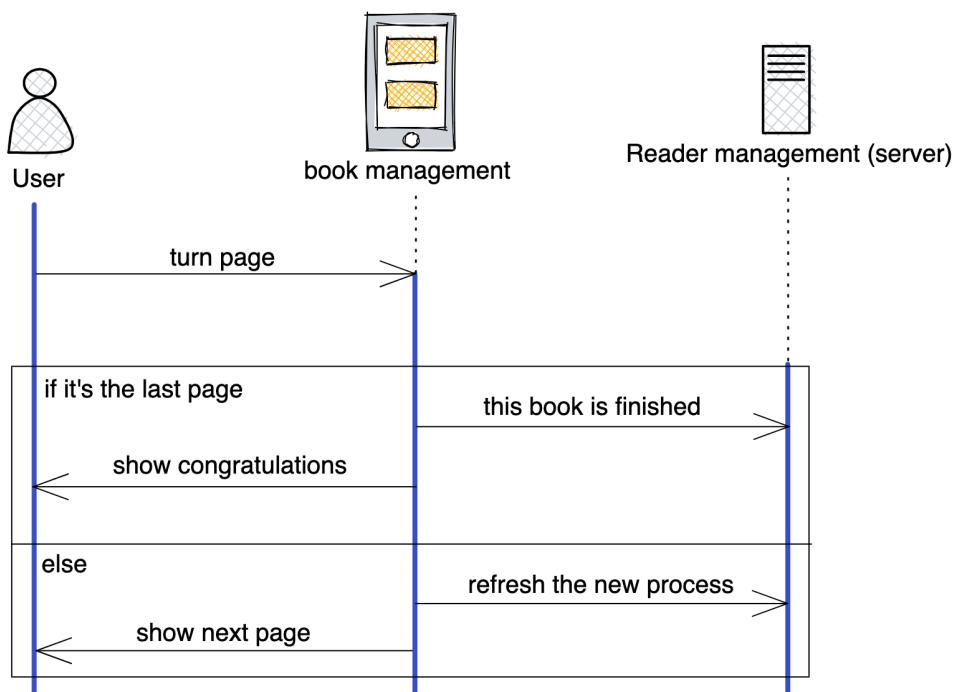
Update user's profile



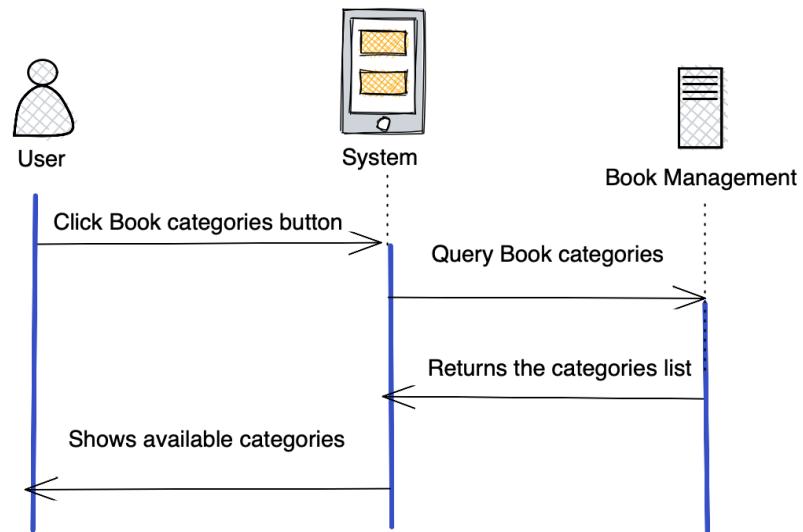
Multiplayer



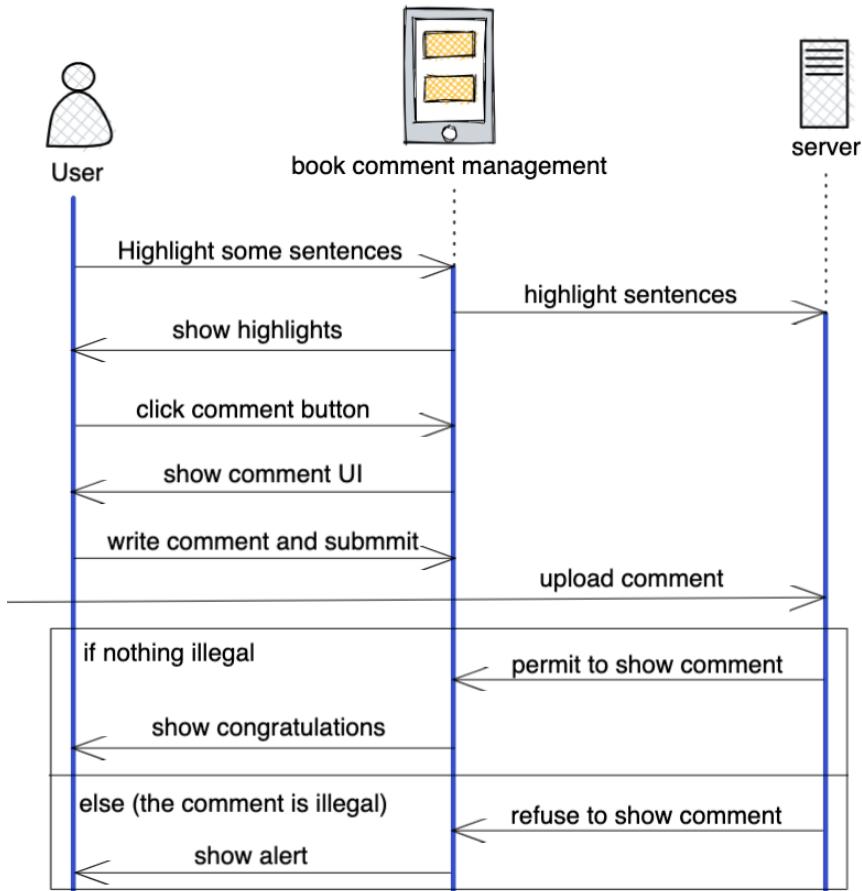
Turn pages



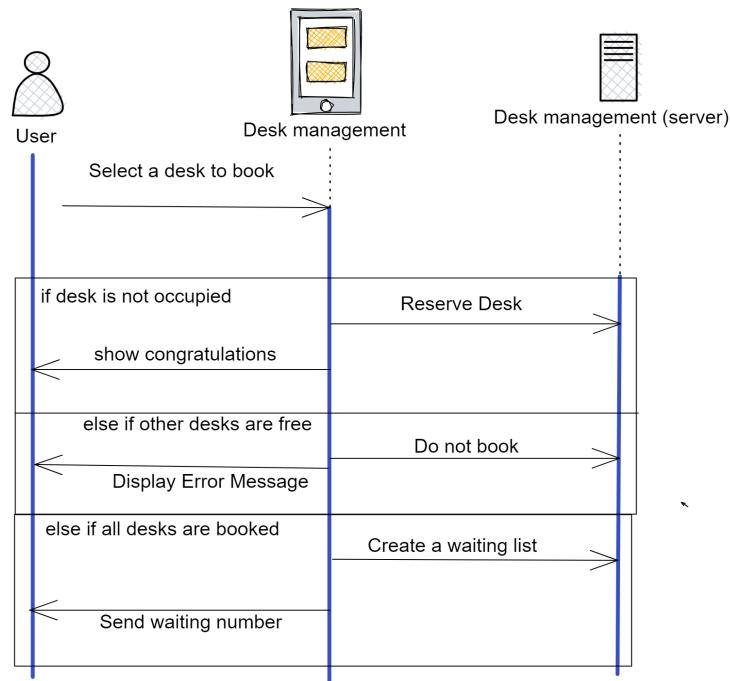
Book by Category



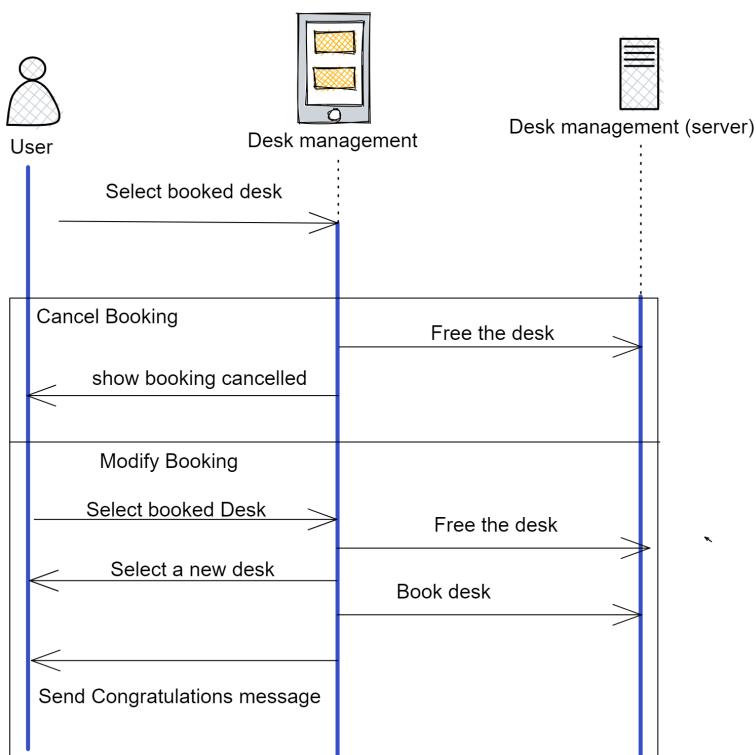
Comment books



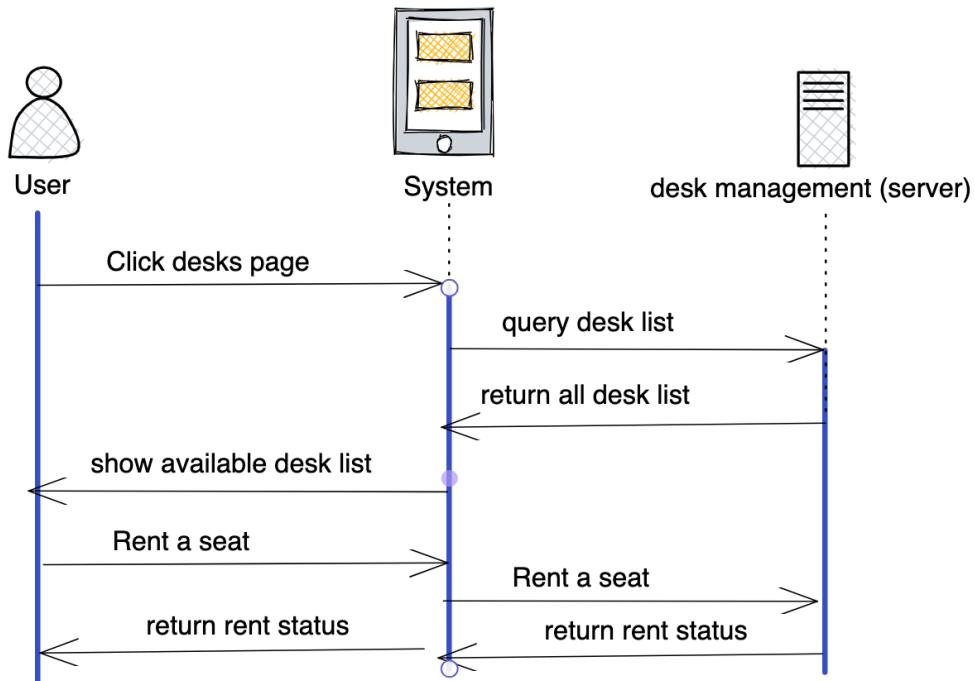
Book Desktop



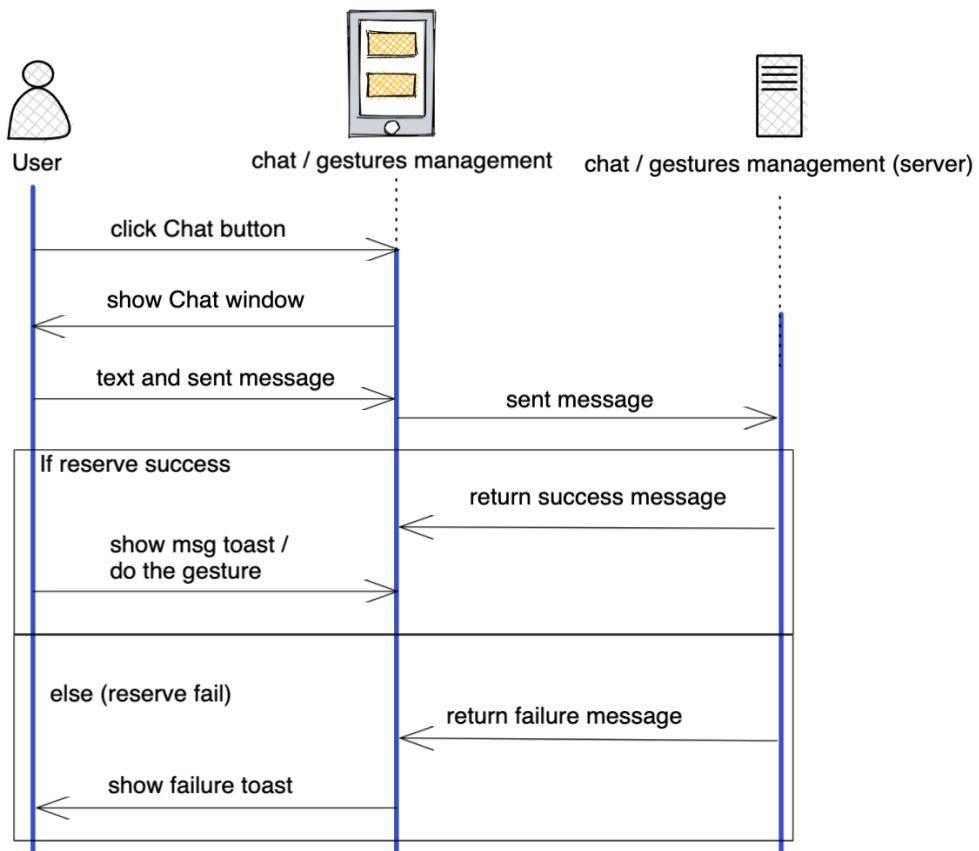
Change / Delete desk



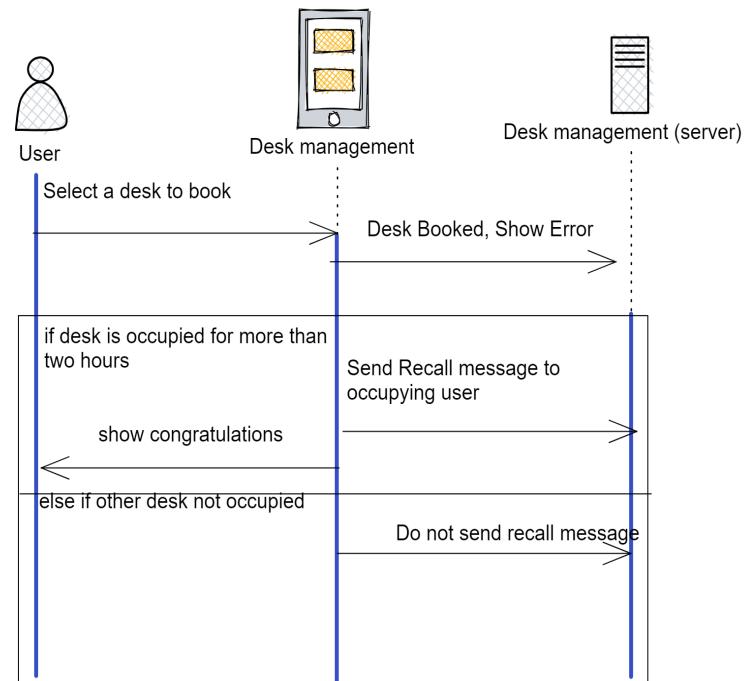
Rent a seat



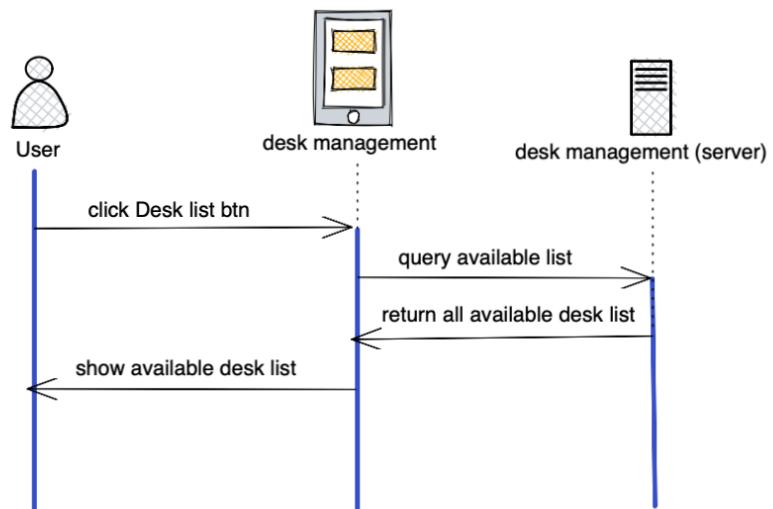
Chat with Others



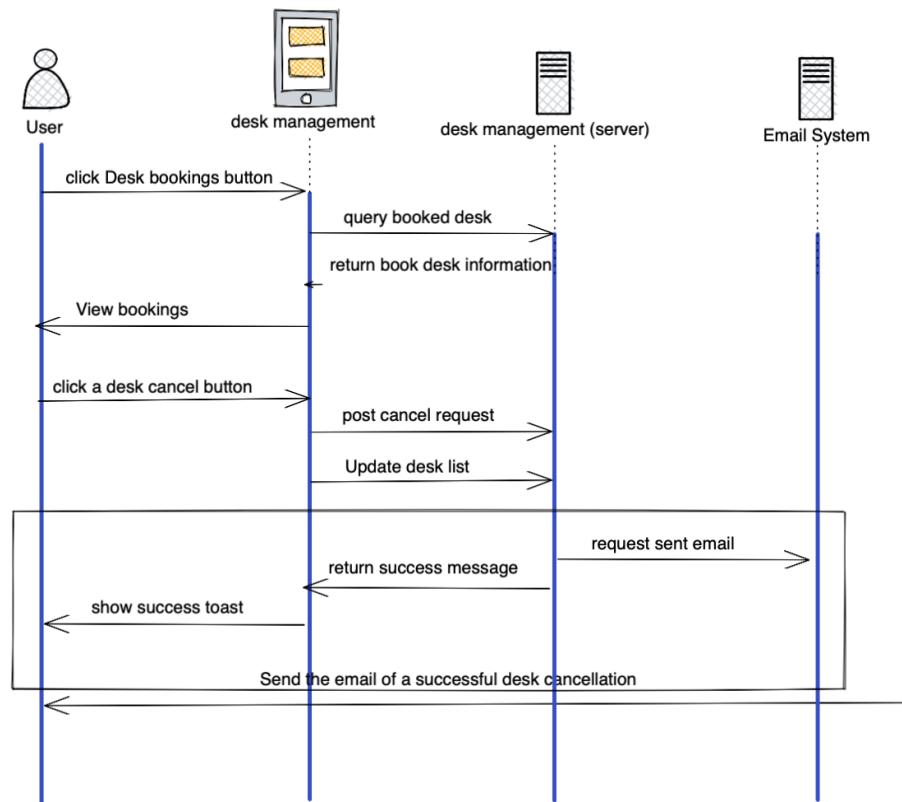
Recall/ Request Booked Desk



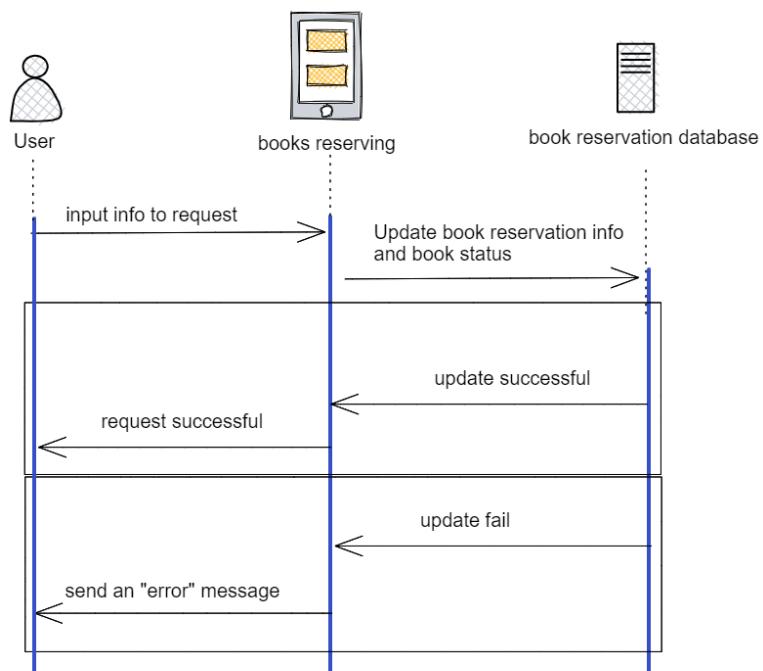
View Desk list



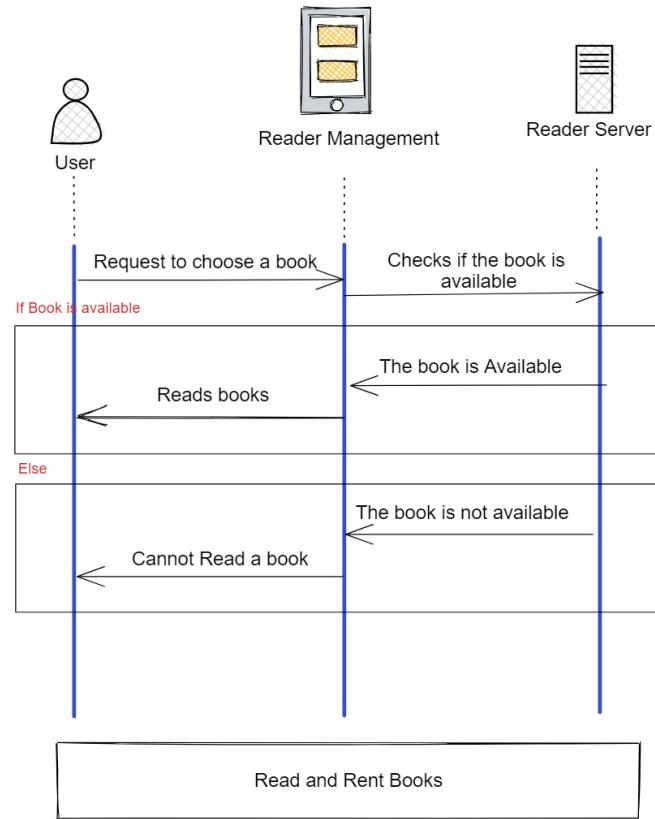
Cancel Booked Desk



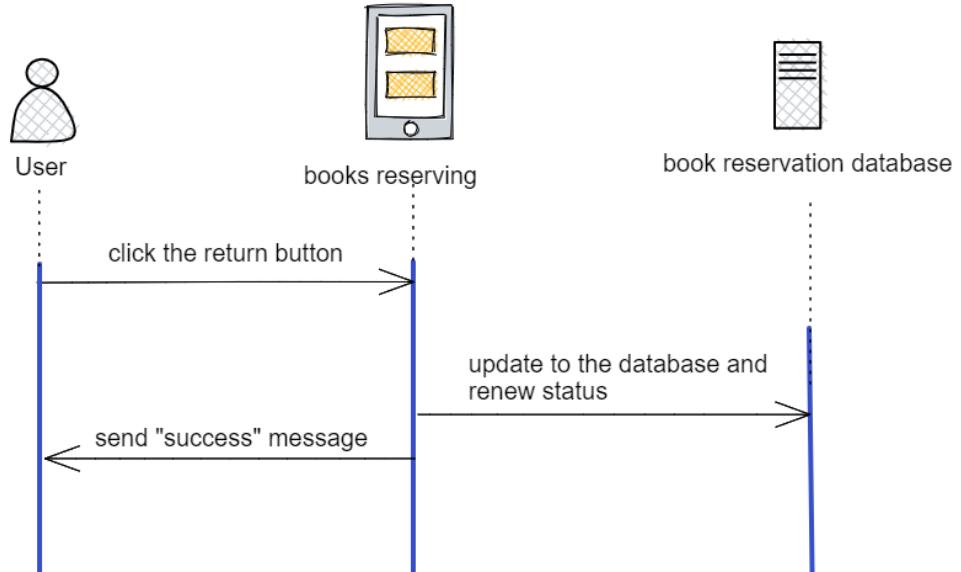
Rent a book



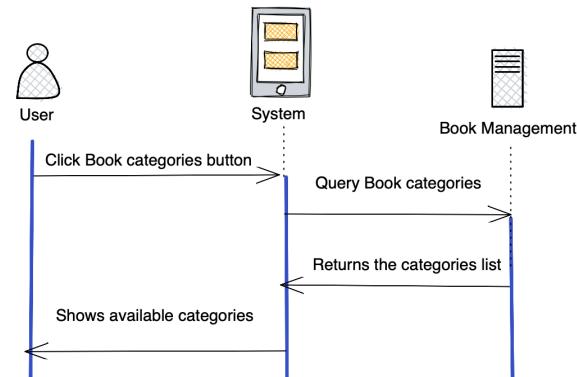
Read and Rent Books



Return the book

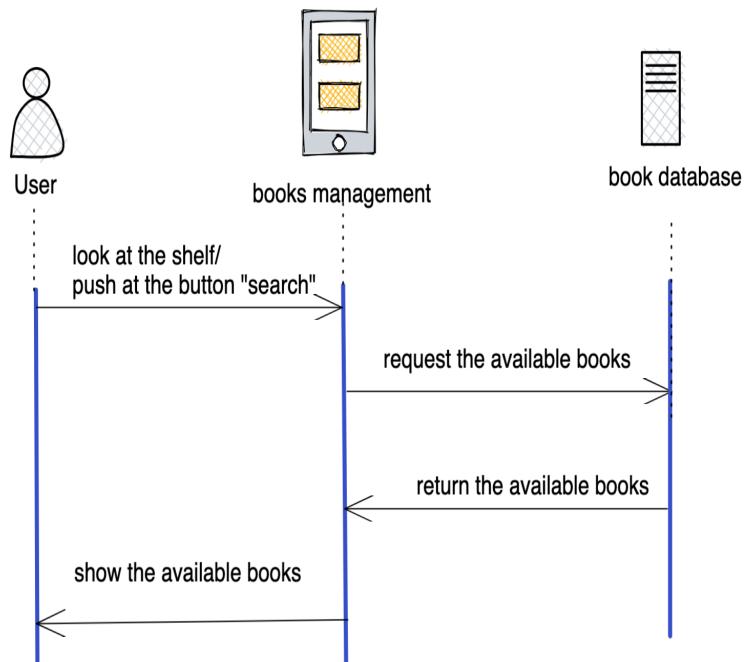


Book categories

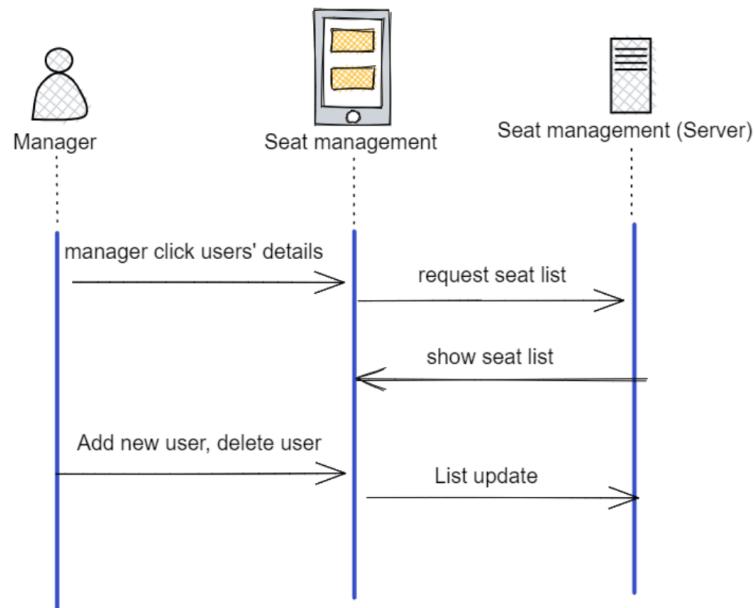


Book categories

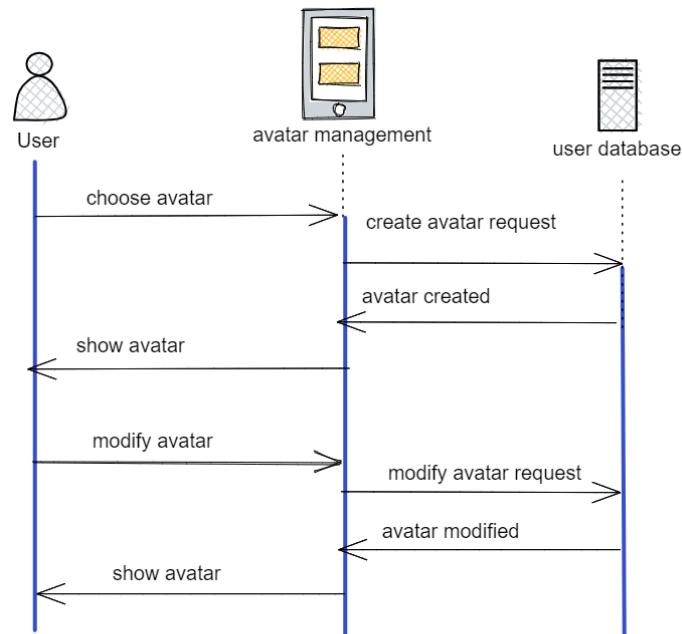
Search available books



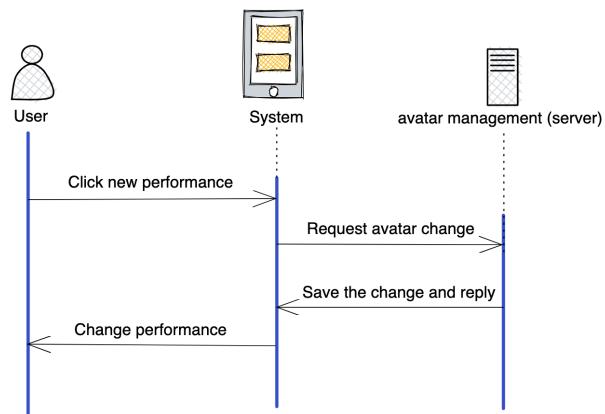
Add/ Delete User



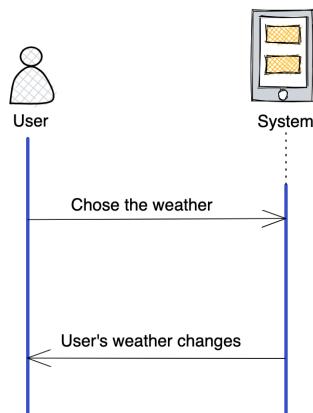
Create/Modify Avatar(Web)



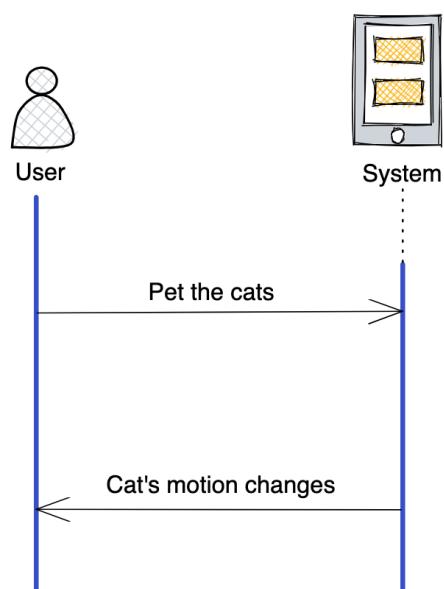
Change avatar (Unity)



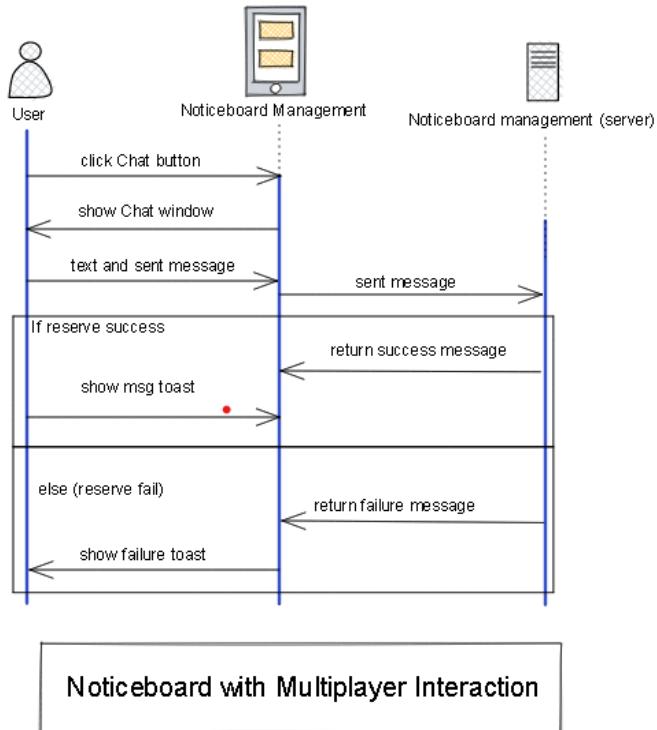
Change weather (Unity)



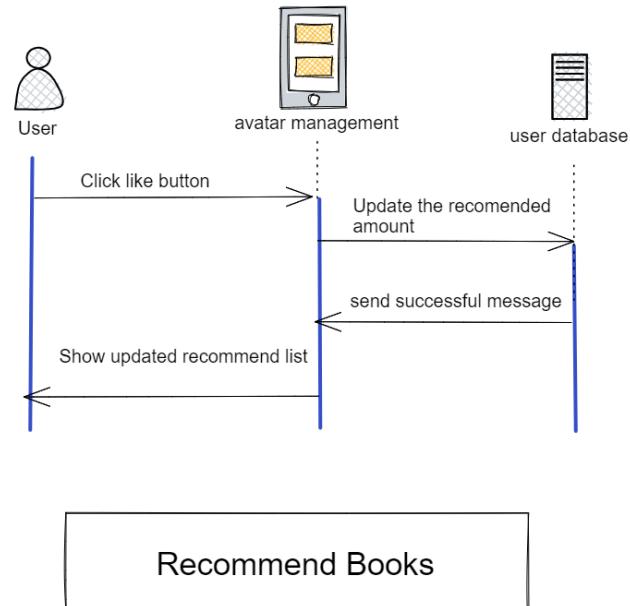
Pet cats (Unity)



NoticeBoard (Unity)



Recommend Books



1.4. Component APIs

11. User Registration System
12. Reader management
13. Avatar management
14. Book management
15. Book Comment Management
16. Book Reservation management
17. Desk reservation management
18. Environment management
19. Noticeboard management
20. Interaction system

1.4.1 User Registration System

- *Error or Success Message* signupApi(details)
This API is used to register a new user in the portal. Details are filled in the form and stored to create a new user. If the details are filled following the current criteria then a new user ID is registered successfully.
- *Error or Success Message* logInApi(username, password)
This API is used to authenticate the user with the user ID and password. Error message is sent when authentication fails. If the identity is authenticated successfully then the user can login to the portal.

1.4.2 Reader management

- *User Details Message* updateUserInfoApi(info)
This api is used to update the basic information of the user.
- *Error or Success Message* addUserModelApi(info)
This api is used to add the model information of the user, when the user is created for the first time.
- *Error or Success Message* updateUserModelApi(info)

This api is used to update the model information of the user when the user is modifying his / her model.

1.4.3 Book management

- *Error or Success Message updateRecommendAmountApi(info)*
This api is used to update a new recommended amount for a book, when the user is going to add a comment.
- *Error or Success Message getBookByIdApi(id)*
The api allows the user to get book detail by book id.
- *Error or Success Message getBookRecommendList()*
The api allows the user to get all recommended book lists.
- *Error or Success Message getAllBookApi()*
The api allows the user to get all book lists.

1.4.3 Book comment management

- *Error or Success Message addCommentByBookIdApi(info)*
This api is used to add a new comment for a book, when the user is going to add a comment.
- *Error or Success Message getAllCommentByBookIdApi(bookId)*
The api allows the user to get all comments of a specific book.
- *Error or Success Message updateCommentByIdApi(commentId)*
The api allows the user to update the comment of the user created before.

1.4.4 Book reservation system

- *Error or Success Message addBookReservationApi(info)*
The api allows the user to book a book in period [startTime, endTime].
- *Error or Success Message updateBookReservationApi(info)*
The api allows the user to update the user's book reservation.
- *Error or Success Message getUserBookReservationApi(info)*
This api is used to get the book reservation information of the user rented before.

1.4.5 Desk reservation system

- *Error or Success Message addDeskReservationApi(info)*
The api allows the user to book a desk in period [startTime, endTime].
- *Error or Success Message updateDeskReservationApi(info)*
The api allows the user to update the user's desk reservation.

- *Error or Success Message* getUserDeskReservationApi(info)
This api is used to get the desk reservation information of the user rented before.

1.4.6 Environment system

- *Error or Success Message* modifyEnv (Info)
The api allows the user to modify the environment of the room. And the management will change the surroundings according to the envId

1.4.7 Noticeboard Management

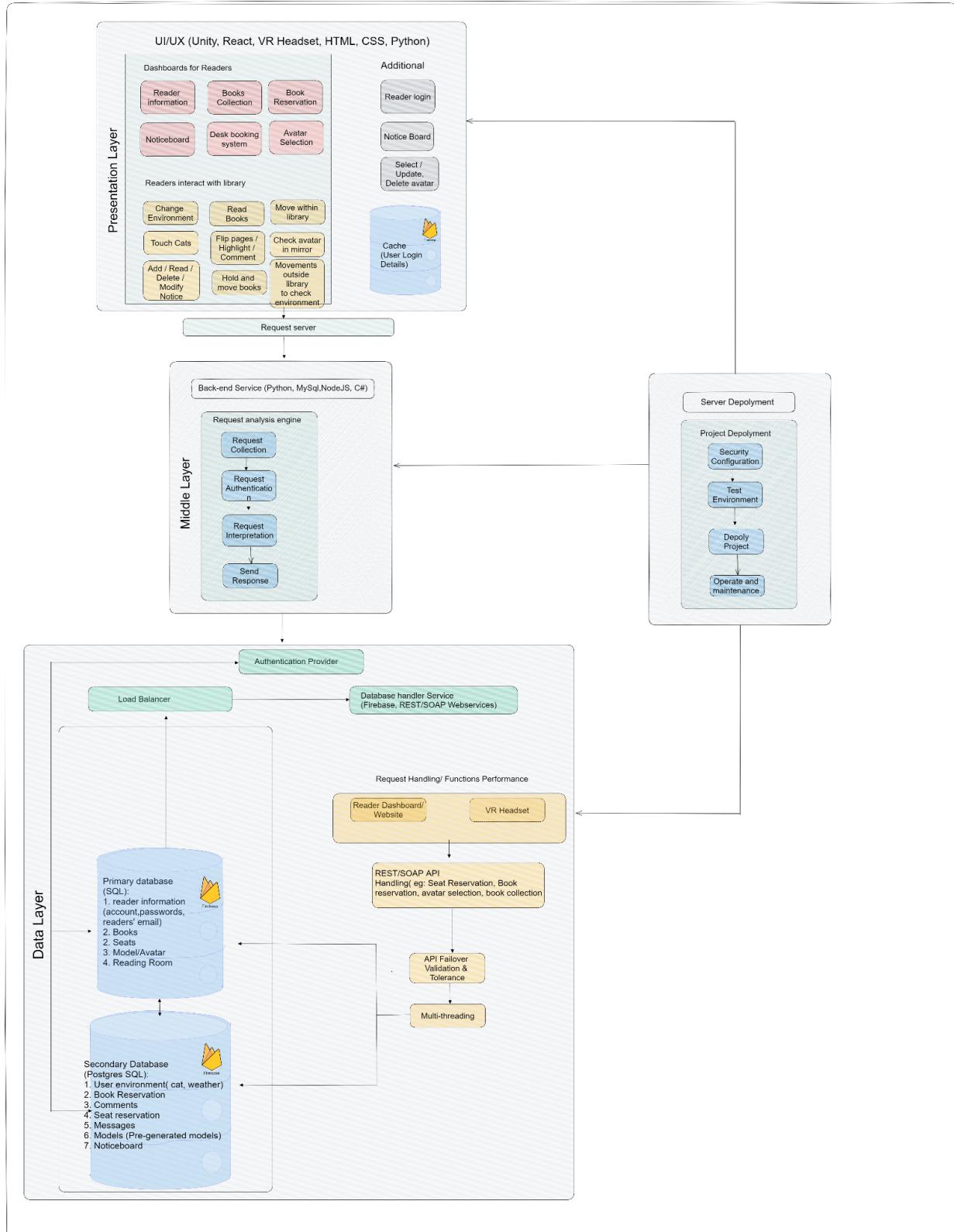
- *Error or success save notice and show notice addMessage(info)*
This API is used for readers and library managers who want to leave notice on our library's notice board. When they leave a notice, other readers and managers could read the notice
- *Error or success detect the offensive language offensiveLanguageDetector(info)*
This API is used for detecting offensive language on noticeboards. When someone try to upload his messages through noticeboards, the message will be judge first. So that other users will have a better reading environment
- *Error or success display notice getMessage(info)*
This API is used for readers and library managers who visit the noticeboard and want to read some notices. Brief notices would be shown directly on the noticeboard . If they chose a specific notice, the whole notice would be shown.
- *Error or success delete notice updateMessages(info)*
This API is used for readers who want to delete the notices they leave or library managers when they think some messages are not suitable to show. When they delete the notices, the notices would be deleted from the database and disappear from the noticeboard.

1.4.8 Interaction system

- *Error or Success Message Allows users to flip the pages of the books(info)*
The api allows the user to flip the page of the books
- *Error or Success Message Allows users to pet the cats(info)*
The api allows the user to change the status of cat

2. Technical Architecture

2.1. Diagram



2.2. Quality of Service Technical Requirements

Security Requirements

Security Requirement	<i>Impact on Project and how the Technical Architecture will address the impact</i>
Encryption - Do transactions need to be encrypted? - Level of encryption? (e.g., 40-bit encryption in US)	For password, we need Encryption Level of encryption: 40-bit encryption
User Identification - uid/pw, cookies, certificates, application-level? - Existing customer database that should be used to identify online visitors?	User Identification : uid/pw, we also should add cookies to the login session. We have a reader database, and it should be used to identify online visitors by an user_id.
Access to data - Do you need to restrict access to parts of the site? - What privacy rules should be applied to information provided by users	Yes, the reader management database should be restricted to access. Restrictions should be put on the book database. A user will not be able to view the book unless the book is rented.
What are the legal requirements and policies for auditing content, changes and transactions?	The copyrights of the books will remain with the author. Since our application is based in the EU all user data is protected by General Data Protection Regulation (GDPR).
Do you plan to use a secure demilitarised zone into which your project server code could be placed?	I think we don't need that. Just multiple place backup of data.

System Management

<i>System Management Requirement</i>	<i>Impact on Project and how the Technical Architecture will address the impact</i>
Do you have access to the infrastructure required to install and run your own server?	Yes, We would use free web hosting servers such as GitHub Pages
What are the response time targets?	Different priority incidents have different targeted response time. Targeted Response Time for Low priority incidents is 5 days, for General priority incidents is 2 days, for high priority incidents is 8 hours, and for Critical priority incidents is 4 hours.
Availability: <ul style="list-style-type: none"> - What hours should the service be available? - Is it acceptable to have any scheduled downtime for maintenance? - How important is it that the service be never interrupted, even for unscheduled component failures? - If interruptions do occur, what should be the target time for resuming service? 	<p>Every Monday 5:00-Sunday 24:00</p> <p>Yes, it provides many benefits with a low level of cost and difficulty to implement.</p> <p>It directly measures the reliability of the building system, and it is directly proportional to facility output and performance.</p> <p>Up to four hours for recovery, because it doesn't always directly correlate to lost revenue, as is the case when financial services go down.</p>
How should partial or total service failures be monitored and handled?	<p>Monitor:</p> <ol style="list-style-type: none"> 1. Conduct routine maintenance. 2. Regularly install updates. 3. Maintain strict access control and detailed event logs. 4. Monitor performance trends. 5. Develop a server contingency plan. 6. Design a disaster and data recovery plan. <p>Handle:</p> <ol style="list-style-type: none"> 1. Recover data with contingency plan enabled.

	<ol style="list-style-type: none"> 2. Utilize diagnostic software to narrow down possible causes. 3. Once we have identified the root cause, then we can switch to a backup server and take the requisite steps to repair the machine failure.
Do you need a recovery plan, or will it be covered by existing processes?	Yes, we really need a recovery plan to avoid the emergency incidents.
Tracking/Documenting: How should the architecture support the process of problem reporting, tracking and fixing?	We would create a support document including the most frequently reported bugs and their solutions. Also, a support form would be created to report existing bugs. We will also have a maintenance team performing periodic fixes and updates. The bugs will be fixed on priority basis, on the number of people and functionality affected.
What statistics do you need to keep about the site, and how will they be analyzed?	The number of people using it simultaneously so that the traffic does not crash the website. We will keep a state with the number of active users, desks and books as the user visits.
What instrumentation should be included in the design to measure performance, response times and availability?	Api response time/ graphic card usage of the system / headset. So if the utilization goes above a certain threshold, the inactive processes will be killed . We can make use of Grafana to track the responses.
Should the architecture include a repository for statistical data?	Yes, we can keep a record of the statistical data up to a period of one month to track the website performance.

Client-side Management

<i>Client-side Management Requirement</i>	<i>Impact on Project and how the Technical Architecture will address the impact</i>
Who is the customer? (Internet or Intranet) – affects browser choice	The customer will be the readers, Both internet (to browse books in the linked ebook platform) and intranet to perform inter-user communication
What is the level of the user's skill?	No skill needed
What languages should the site support?	English
What are the user's usage patterns? (search or browse)	The user will be able to search for specific book titles and browse through messages left and books uploaded by other users
How will the application maintain state?	For the dashboard, the state will be maintained using Redux. For AR/VR, we will be using the Animation State Machine by Unity.
Is there a need to distribute application code, and if so, how will it be done?	Yes we will have to distribute our code to each of the user device, for that we will deploy it to the server and it can be downloaded from there,
How will the choice of client affect end-to-end response? (HTML, JavaScript, AJAX, JQuery, VBScript?)	We would use JavaScript to implement the UI dashboard, which means the user just click some buttons by using their devices, and the system can make response through the backend.
What are the different user interfaces needed?	AR/VR interface and web dashboard

Network Management

<i>Network Management Requirement</i>	<i>Impact on Project and how the Technical Architecture will address the impact</i>
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<p>Will the solution involve the internet?</p> <p>What protocols will be used? (<i>HTTP? HTTPS? FTP? RMI? Messaging? Etc</i>)</p>	<p>Yes, nearly every function in our library needs the internet.</p> <p>I think we are using HTTPS.</p>
<p>What about data, object and application placement? <i>projected transaction volumes, amount of data, interaction?</i></p>	<p>The user information and books resource would be stored in our own server, the books resource data amount would be very large.</p> <p>Our virtual library would have an app and website.</p>
<p>What security functions are required/provided by the chosen protocol? <i>Level of encryption will affect this, and also performance!</i></p>	<p>Communications are encrypted by Transport Layer Security(TLS) provided by HTTPS. The security is handled using asymmetric public key infrastructure.</p>
<p>How does the network affect end-to-end response time?</p>	<p>Readers need to download books before reading, the waiting time depends on the network.</p> <p>And the real-time interaction would be influenced by the internet.</p> <p>The response time depends on the network status and the server's condition.</p>

Server-side Management

Server-side Management Requirement	Impact on Project and how the Technical Architecture will address the impact
Single server or multiple servers? Peer-to-Peer? Sensors?	We make use of a single Server since we are addressing a small number of people.
Geographic location for servers?	Dublin, because we would access Trinity Servers
End-user client to server, or server to server required also?	End-user client to server used. Server to server is not required as multiple servers are not used.
What security functions are required on the server?	Firewall, Regular Updates and backup, security software

How can impact of server on end-to-end response time be estimated, and catered for in the architecture?	Response time can be calculated using a website monitoring tool and we can optimize it by using a better database.
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Application Logic

<i>Server-side Management Requirement</i>	<i>Impact on Project and how the Technical Architecture will address the impact</i>
Will site use client-side executables? What are their connectivity requirements?	Yes, the Virtual Library and all the components of it will be rendered on their headset, along with the e-books that they rent or buy. The connectivity requirements will be good internet connection to connect to the server and the system and other users and a VR headset.
How will the application be split between client-side and server-side logic? (<i>affects communications for validation etc/performance?</i>)	Keeping the confidential and restricted information such as authentication or renting logic or booking logics, on the server side and limited UI logic will be accessed by the client side.
Additional access security required?	Since Virtual Reality applications are more vulnerable and contain a lot of personal information of the user, it is important to have additional access security.

Connectors

<i>Server-side Management Requirement</i>	<i>Impact on Project and how the Technical Architecture will address the impact</i>
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What external systems, applications and (sensor) data does your project need to access?	VR headsets, camera, microphone, speakers
How should data be transferred between different systems?	Data would be saved in the databases and uploaded over a server and then distributed to various systems.
How current does the information have to be? <i>Use caches?</i>	Using Caches would be ideal to keep the information up to date.
Is synchronous or asynchronous access required? <i>Off-line OK?</i>	Synchronous access is required. The application won't work offline.
Is access to different operating systems, network protocols, application environments required? <i>which connector?</i> <i>CICS?</i> <i>MQSeries?</i> <i>RPC?</i>	Yes, we would need access to servers and databases.
Are additional security policies required?	Yes, since VR applications store a lot of personal information of the users having access to the cameras and the microphones of the user. It is important to have additional security
Can scalability and performance requirements be predicted, and how will the project address these?	The project is scalable, depending on the user traffic if it increases, we will have to upgrade the server.