MINISTRY OF EDUCATION AND TRAINING
HCMC UNIVERSITY OF TECHNOLOGY AND EDUCATION
FAUCULTY OF INTERNATIONAL EDUCATION

FINAL PROJECT REPORT:

IT PROJECT

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Acknowledgment

We would like to express my sincere gratitude to Dr. Nguyen Dang Quang, our esteemed instructor, whose guidance and expertise have played a pivotal role in shaping our understanding and skills in the field of web application development.

Dr. Nguyen Dang Quang's dedication to imparting knowledge, fostering a collaborative learning environment, and providing invaluable insights into the intricacies of web application design have significantly contributed to the success of our collaborative whiteboard project.

His unwavering support, encouragement, and commitment to our academic and professional growth have been instrumental throughout the duration of this course. We are truly grateful for the opportunity to learn from such an accomplished and inspiring instructor.

Sincerely thanks.

Preface

This report marks the culmination of our training journey, where our primary goal was to gain practical skills in introducing a web application. Within the limited timeframe, we not only developed the confidence to present our collaborative whiteboard app but also acquired fundamental IT knowledge essential for thriving in today's competitive landscape.

This effort represents a partial fulfillment of the course requirements. The report systematically organizes and presents the extensive program content, with each topic given its due prominence in individual chapters. By employing citation methods, we ensure the integrity of our references and recognize the insights shared by experts in web application development.

Our collective hope is that this report, with its structured chapters and content, proves to be a valuable resource for readers, particularly those interested in collaborative whiteboard web applications. Through this succinct preface, we express gratitude to our instructor and the broader community, anticipating that our work will contribute to the collective knowledge in the field.

Catalog

I. Project description

1. *Objectives*

Collaborative board web applications are becoming increasingly popular in today's world, where remote work is becoming more common. These applications allow users to collaborate on a virtual whiteboard in real-time, making it easier to share ideas and work together on projects.

In this report, we will be discussing the design of a collaborative board web application written on ReactJS and NodeJS. We will start by outlining the requirements of the program, including the data that will be used. We will then move on to designing the objects that will be used in the program, such as the objects on the canvas and how they will be managed to serve the purpose of saving and loading the canvas. We will also consider how the application server will connect with the client, and what technology we plan to use to achieve this. Additionally, we will consider how the client will transmit drawing data to the server, and how the server will broadcast this data to other clients.

After outlining the requirements and designing the objects, we will choose the front-end and back-end technologies that we will use to develop the application. We will then begin developing the application itself.

Finally, we will consider any challenges that we may face during the development process and how we plan to overcome them.

2. *Technologies Stack :*

a) ReactJS :

- Reusable Components: React enables the creation of reusable UI components, enhancing code maintainability and ensuring consistency across the project.
- Efficiency: Utilizes a virtual DOM, updating only the components that have changed in the real DOM, resulting in a more efficient and faster updating process.

- Real-time Updates: Ideal for real-time collaboration as data is transmitted to the server with each element update.

b) NodeJS:

- Speed: Known for its speed, Node.js ensures a quick response time for web applications, contributing to overall application quality.
- Single Code Base: Developers write JavaScript for both client and server, simplifying data transfer and synchronization between them.
- Real-time Capabilities: Excellent for building scalable and high-throughput real-time web applications.
- Data Streaming: Provides faster data streaming without the need for buffering, enhancing overall performance.

c) Vite:

- Fast Development Environment: Offers a faster and leaner development environment with instant server start-up and real-time updates reflected in the browser without full page reloads.
- Optimized Builds: Transforms source code into directly runnable formats, avoiding unnecessary bundling steps and optimizing build processes.
- Rich Features: Out-of-the-box support for TypeScript, JSX, CSS pre-processors, and more, enhancing development capabilities.

d) Overall Impact

- Robust and Efficient Environment: The combination of ReactJS for dynamic UI, NodeJS for server-side efficiency and real-time capabilities, and Vite for a fast and optimized development environment creates a robust and efficient foundation for building a real-time collaborative board website.
- Project-Specific Considerations: The choice of technologies depends on the specific requirements of the project, ensuring that the selected stack aligns with the goals and objectives of the collaborative board web app.

3. User Benefits

Similar to other drawing applications, Collaborative Board empowers users with a range of features, enabling them to draw, manipulate, and interact with graphic elements. The essential drawing functions include:

- Undo: The ability to revert to the previous action, providing a safety net for creative experimentation.
- Change Color: Users have the flexibility to alter colors using HSB, RGB, and Web formats, allowing for precise and customized color selections.
- Adjust Stroke Thickness: Users can modify the thickness of a stroke or adjust the border width of a shape, tailoring the visual appearance of their creations.
- Erase: The eraser function clears everything in its path, offering users control over their canvas. Additionally, users can adjust the size of the eraser for finer control.
- Pen: A versatile tool for free-form drawing strokes directly onto the canvas, facilitating artistic expression.
- Shape: Users can draw both rectangles and ellipses, enhancing the variety of elements that can be created on the artboard.
- Redo: Users can redo previously undone actions, allowing for greater flexibility and control in the creative process.

Beyond individual creativity, Collaborative Board distinguishes itself by offering internet connectivity, allowing users to invite one or more friends to collaborate on drawing projects. Once connected, users and their friends can engage in real-time chat, fostering communication and idea-sharing before collaboratively bringing their visions to life on the canvas. This collaborative aspect adds a social dimension to the drawing experience, making Collaborative Board a dynamic and interactive platform for creative expression.

4. Use case diagram

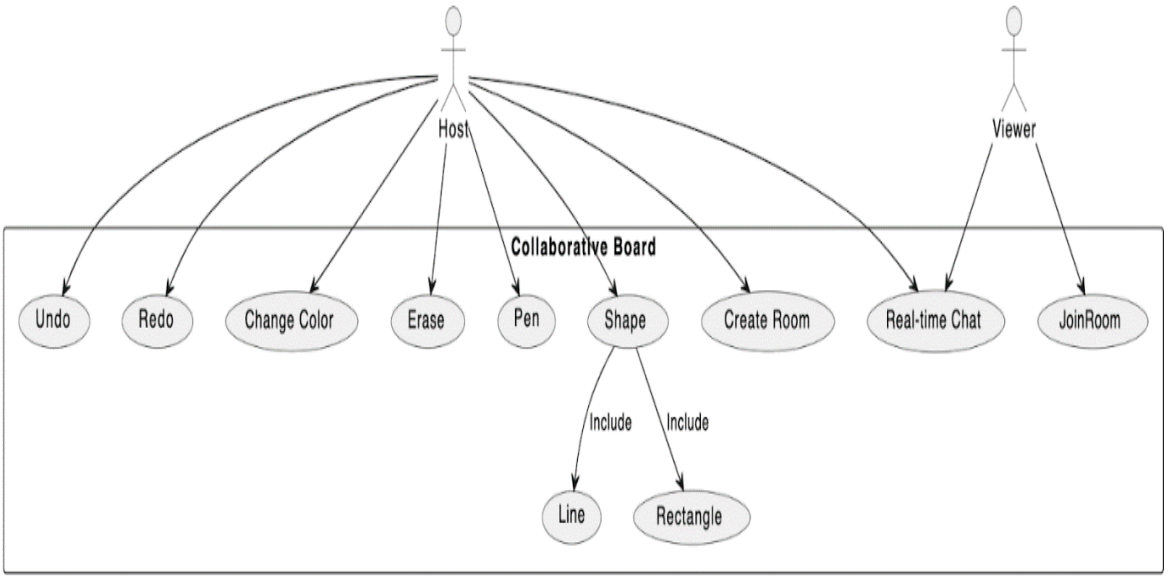


Image 1 – Use Case Diagram

5. Use case description tables

Table 1 – Use case Draw Shape description

Use case name	Shape
Description	Allows host to draw a rectangle or a line on the board
Actor	Host
Preconditions	Click the Shape button and choose a specific shape
Conditions affecting termination outcome	

Table 2 – Use case Pen description

Use case name	Pen
Description	Allows host to draw freely on the board
Actor	Host
Preconditions	Click Pen button
Conditions affecting termination outcome	

Table 3 – Use case Eraser description

Use case name	Eraser
Description	Allows host to erase anything on the board
Actor	Host
Preconditions	Click Eraser button
Conditions affecting termination outcome	The server is running, the connection is established successfully The server is terminated, connection failed

Table 4 – Use case Undo/Redo description

Use case name	Undo/Redo
Description	Allows host to undo/redo the latest action on the board
Actor	Host
Preconditions	Click Undo/Redo button
Conditions affecting termination outcome	

Table 5 – Use case Change Color description

Use case name	Change Color		
Description	Allows host to change color of the brush		
Actor	Host		
Business event	No.	Agent	System
	1	Click Pen button	
	2		Open color dialog
Preconditions			

Conditions affecting termination outcome	

Table 6 – Use case Create Room description

Use case name	Create Room		
Description	Create a room for host		
Actor	User		
Business event	No.	Agent	System
	1	Click Create button	
	2		A connection is established between host and server.
	3		The server create ID for host and room ID, set host = true and presenter = true.
	4		The server redirect to the room page
Preconditions	Server is running		
Conditions affecting termination outcome	The server is running, the connection is established successfully. The server is terminated, connection failed.		

Use case name	Real-time Chat		
Description	Allow users to communicate with each other		
Actor	Host, viewer		
Business event	No.	Agent	System
	1	Enter the message to a text box	
	2	Click Send button	
	3		Send the message to the server to broadcast to other people that are connected to the same artboard
	4		Display the message to the chatbox

Preconditions	User is connected to the server
Conditions affecting termination outcome	

Table 8 – Use case Join Room description

Use case name	Join Room		
Description	Join a room for viewer		
Actor	viewer		
Business event	No.	Agent	System
	1	Click Join button	
	2		A connection is established between viewer and server.
	3		The server create ID for viewer and room ID, set host = false and presenter = false.
	4		The server redirect to the room page
Preconditions	Server is running		
Conditions affecting termination outcome	The server is running, the connection is established successfully. The server is terminated, connection failed.		

II. Task Assignment

Table 9 – Work Plan

Student's name	Evaluate contribution	Task
Le Bui Huu Phuc	100%	Undo mode Redo mode Pencil mode Eraser mode
Le Bui Huu Phuc	100%	Create Room, Join Room Form UI and Controller
Le Bui Huu Phuc	100%	User privilege (host or viewer)

Nguyen Khac Huy	100%	Change color mode Shape mode
Nguyen Khac Huy	100%	White Board Form UI and controller
Nguyen Khac Huy	100%	Real-time Chat function

Table 10 – Work Assignment

Building an Remote Draw software using Java										
Goal	Schedule									
Define Requirements	o	o								
Set Up Project Structure	o	o								
Server-Side Development (Node.js)		o	o	o						
Frontend Development (React.js)		o	o	o						
Implement Collaborative Board Features		o	o	o						
User Privilege			o	o						
Testing			o	o	o					
Continuous Improvement					o	o	o	o	o	
Testing							o	o	o	o
Write report							o	o	o	o
Day	28/09/2023	05/10/2023	12/10/2023	19/10/2023	26/10/2023	02/11/2023	09/11/2023	16/11/2023	23/11/2023	30/11/2023
Week	1	2	3	4	5	6	7	8	9	10
Note	o – Begin o – Complete 50% o – Complete 100%									

III. Design

1. *Process description*

1.1. Controller protocols

Table 11 – Controller protocols

Object	Event	Explaination
CreateRoom Form	handleRoomJoin	This function is responsible for handling the room joining process. When triggered, it sends an event named "userJoined" to the server, containing room data, including name, roomId, userId (randomly generated from the uuid() method declared in App.jsx file), host set to true, and presenter set to true. This event signifies that a user has joined the room.
	userJoined	Upon receiving the "userJoined" event, the server processes the data and acknowledges the user's presence by sending the event "userIsJoined" back. Additionally, it includes information about the room, such as name, roomId, userId, host status, and presenter status. The user is then navigated to the designated whiteboard room using the navigate(/${roomId}) method.
JoinRoom Form	handleRoomJoin userJoined	The JoinRoom Form follows a similar protocol to the CreateRoom Form, with the distinction that the host and presenter attributes are set to false when sending the "userJoined" event to the server.
App Components	userIsJoined	After the server receives the "userJoined" event from both the CreateRoom Form

		and JoinRoom Form, it responds by sending the "userIsJoined" event back to the respective clients. This event serves as an announcement, informing the user whether they have successfully joined the room or encountered an error during the process.
	allUsers	The App component receives the "allUsers" event from the server, containing data about all users present in the room. This information is then combined with the existing "data" state using the useEffect() method. This ensures that the application maintains an updated record of all users within the room.
	userJoinedMessageBroadcasted & userLeftMessageBroadcasted	These two events are utilized for user announcements. When a user joins or leaves the room, the server broadcasts these events. The App component listens for these events and displays toastify popups, providing real-time notifications of user activities.
Whiteboard Component	whiteBoardData	The Whiteboard Component sends data to the server with the message "whiteBoardData." The transmitted data includes an image of the elements present on the canvas board. Upon receiving this data, the server broadcasts it to all users (excluding the host).
	whiteBoarDataResponse	This component listens for the data response of the whiteboard from the server. Upon receiving the response, it updates the data

		state of the image, ensuring that all users have synchronized whiteboard content.

1.2. Drawing

Table 12 – Drawing method

Attribute/Function	Explanation
‘const [isDrawing, setIsDrawing] = useState(false);’	State variable isDrawing is initialized to false, indicating that the user is not currently drawing.
'const handleMouseDown = (e) => {...}'	This function is triggered when the mouse button is pressed. It captures the initial position (offsetX and offsetY) for drawing based on the selected tool (pencil, line, or rectangle). Depending on the tool, a new element is added to the elements state array with relevant properties.
‘const handleMouseMove = (e) => {...}’	This function is invoked when the mouse is moved. If drawing is in progress (isDrawing is true), it updates the drawing path, width, or height based on the selected tool. For example, when using the pencil tool, it appends the current position to the path; for the line tool, it updates the endpoint coordinates; and for the rectangle tool, it adjusts the width and height.
‘const handleMouseUp = (e) => {...}’	This function is called when the mouse button is released, signifying the end of the drawing process. It sets isDrawing to false, indicating that the user has finished drawing.

This drawing logic enables users to interactively create and modify elements on the canvas based on the selected tool, facilitating a dynamic and collaborative drawing experience on the whiteboard.

2. *Class Design*

Below is our overview of class design

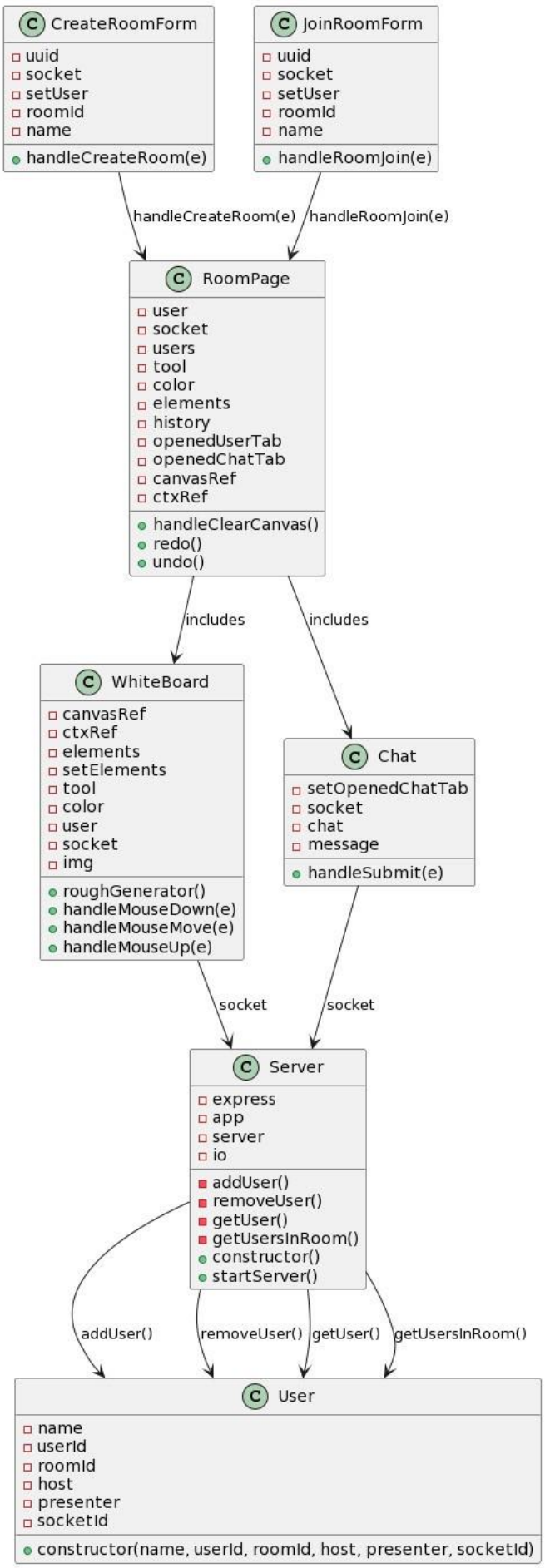

CreateRoomForm
uuid
socket
setUser
roomId
name
handleCreateRoom(e)
JoinRoomForm
uuid
socket
setUser
roomId
name
handleRoomJoin(e)
handleCreateRoom(e)
handleRoomJoin(e)
RoomPage
user
socket
users
tool
color
elements
history
openedUserTab
openedChatTab
canvasRef
ctxRef
handleClearCanvas()
redo()
undo()
includes
includes
WhiteBoard
canvasRef
ctxRef
elements
setElements
tool
color
user
socket
img
roughGenerator()
handleMouseDown(e)
handleMouseMove(e)
handleMouseUp(e)
Chat
setOpenedChatTab
socket
chat
message
handleSubmit(e)
socket
socket
Server
express
app
server
io
addUser()
removeUser()
getUser()
getUsersInRoom()
constructor()
startServer()
addUser()
removeUser()
getUser()
getUsersInRoom()
User
name
userId
roomId
host
presenter
socketId
constructor(name, userId, roomId, host, presenter, socketId)

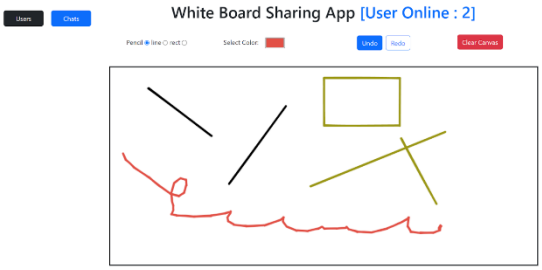
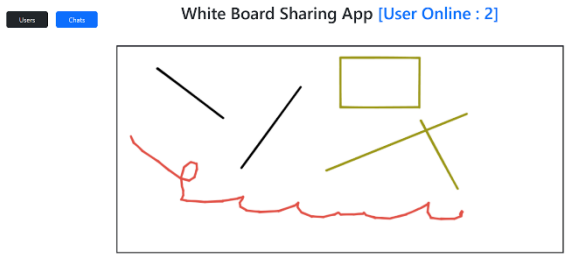
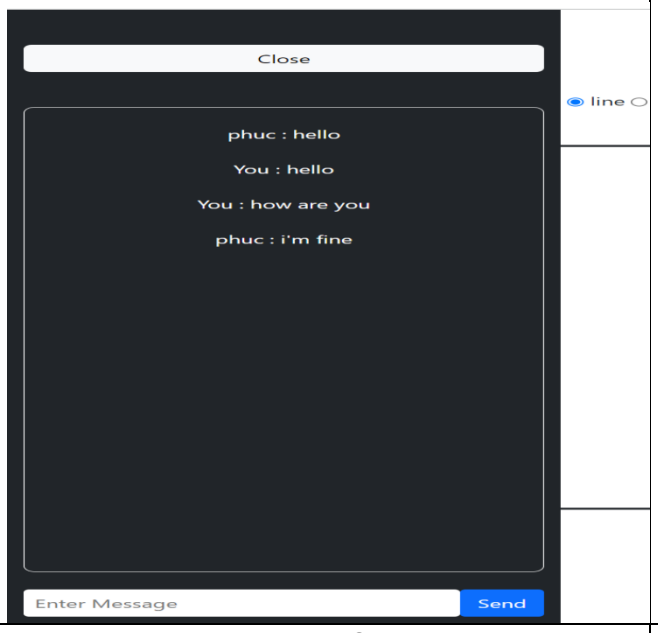
Table 13 – Class Design

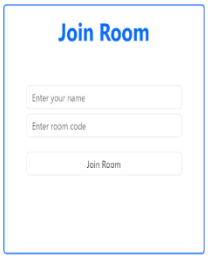
Class	Properties	Methods	Relationships
RoomPage	- user: Represents the user associated with the room page. - socket: Socket connection for real -time communication. - users: List of users in the room. - tool: Current drawing tool selected. - color: Current drawing color selected. - elements: List of drawing elements on the whiteboard. - history: History of drawing actions. - openedUserTab: Flag indicating whether the user tab is open. - openedChatTab: Flag indicating whether the chat tab is open. - canvasRef: Reference to the whiteboard canvas. - ctxRef: Reference to the whiteboard canvas context	-handleClearCanvas(): Method to clear the whiteboard. - redo(): Method to redo the last drawing action. - undo(): Method to undo the last drawing action.	Includes WhiteBoard, Chat

CreateRoomForm	- uuid: Utility for generating unique IDs. - socket: Socket connection for real-time communication. - setUser: Method for setting the user. - roomId: ID of the room being created. - name: Name associated with the room.	- handleCreateRoom(e): Method to handle the creation of a room and redirect to the RoomPage.	Redirects to RoomPage
JoinRoomForm	- uuid: Utility for generating unique IDs. - socket: Socket connection for real-time communication. - setUser: Method for setting the user. - roomId: ID of the room being joined. - name: Name associated with the user joining the room.	- handleRoomJoin(e): Method to handle joining a room and redirect to the RoomPage.	

3. Graphic User Interface

Table 14 – GUI explanation

No.	GUI	Purpose	Brief Explanation
1	**Room Form** • *Host :*  • *Viewer :*  	The main room window consist of whiteboard and functions	This is the main form of our project which in dividing into two mode (host and viewer). The host can completely use the whiteboard while the viewer only can views and chats.
2	**Chat box**  	Communicating	Generally, user can type in the textbox and then press enter to send to others. The message will be displayed as log form.
3	**Join and Create Room form**	Allow user to create a new room or join an existing room	For creating : user can create a room with a code generated randomly by our format defined function then user will be redirected to main

	 		Room with full of control. For Joining : user after entering the code of existing room, they can join the board room with viewer mode then.

IV. Conclusion

1. *Limitations:*

- Minor bugs :

  - Refresh the web page can cause lost host control

  + This is because we still haven't save the session yet -> create a session saver for saving the session of whiteboard that prevent lost host key

  - Due to the lack of saving the session, it also lead to error in user online management

- We still not deploy the project on the cloud network.

- The restriction of knowledge about coding also make our project still isn't optimized (the some part of code not clean)

2. *Difficulties*

- Learning new technology is a problem for us because it slows down the project progress
- Multi-threading programming is also a problem because we do not have enough knowledge and practice.

3. *Development ideas*

- Increased Line Thickness and Additional Shapes: Enhance the drawing experience by incorporating thicker lines and introducing more shapes to the whiteboard.

- Export Whiteboard Content to PNG: Enable users to export the content on the whiteboard to a PNG format, providing a convenient way to save and share their work.

- Apply CSS for Improved User Interface: Utilize Cascading Style Sheets (CSS) to improve the user interface, applying styles and layouts to enhance the overall visual appeal and user experience.

- Implement User Registration and Login with Database: Establish a database system to facilitate user registration and login functionality. This allows users to create accounts, log in with a username, and securely save their progress.

- Host-Controlled Viewer Permissions on Whiteboard: Introduce a feature where the host has the ability to grant or restrict viewer permissions to draw on the whiteboard. This enhances control and customization over collaborative drawing session.

References

We developed this project inspired of this guy's project :

https: //github.com/RamanSharma100/mern-sockeio-realtime-board-sharing-app

Reactjs and Nodejs Documentation :

https://devdocs.io/react/

https://nodejs.org/en/docs

Socket.io controller Documentaion :
https://socket.io/docs

Class Diagram :
https://www.plantuml.com