

# COMP90015: Distributed Systems

## Assignment 2: Distributed Shared White Board

Name: Mingzhen Wang

Login ID: mingzhen

Student ID: 1041579

### 1 Summary

This project aims to implement a distributed shared whiteboard system. And everyone who joins the whiteboard system can concurrently edit the same whiteboard. Users in the system can draw their ideas with some basic whiteboard operations, such as line, circle and rectangle. And everyone in the whiteboard system can have a view about all online users with the unique identifying username. There are two roles in this system, one is a manager and the other is an ordinary user. One whiteboard system only has one manager, and the manager is in charge of the system. The a user wants to join in the whiteboard, the manager have the right to accept or deny the request. The manager can also create a new whiteboard, save the whiteboard picture, and even shut down the application. What's more, the manager can kick out any user in the system.

### 2 System Architecture:

#### 2.1 RMI

RMI(Remote Method Invocation) is the key element in the system. RMI performs like an interface. The client can call the methods listed in RMI interface and get reply from the server. In RMI, when an object is transferred between server and client, it is actually transferred between JVM(Java Virtual Machine). the client virtual machine does not copy a remote object, but receives a stub of a remote object through RMI. This stub is a pointer to the remote object, it is actually a proxy to the remote object. The client end calls the stub method locally, which is equivalent to calling the method of the remote object. RMI packages the socket and thread, and programmer do not need to code socket and thread by yourself, which can simplify the application complexity. And when the server is set up, it will register and bind the object with an unique name. When a user wants to call the remote method, it needs to look up the object within the registry and then call it.

#### 2.2 Threads

A thread performs like a worker and can take a task from the processor. When a thread is assign for a task, it can concurrently run the task. So the thread technique helps the system achieve multiple tasks at the same time. For the whiteboard application, there are serval threads used for updating the whiteboard and user list.

Since each client in the system needs to constantly obtain the latest version of the whiteboard, the download thread is used to help users synchronize the whiteboard.

And whenever the user modifies the whiteboard, the upload thread will upload the modified whiteboard to server. Besides, the client needs to see users who are editing the whiteboard at the same time. The updateUserList thread is responsible for that and this thread is used for updating the user list to show clients online.

## **3 Implementation Details**

### **3.1 Server**

When the server is established, the server will first register the RMI registry and then bind the remote object with a unique name. When RMI is set up, it will listen to the clients' requests and reply them. And the programmers do not need to consider how they are communicated. The remote callable methods are defined in the remote servant file.

There are some objects maintain in the server. One is the shared whiteboard. The whiteboard is actually an image. And the server will always get the latest version of this image because once a client modifies the whiteboard, the client will upload the modified whiteboard to the server and the server will distribute the latest version to all online clients. The other object maintained in the server is the online user list. Since every client needs to have a view about users online. So whenever a client joins or quits from the whiteboard system, the user list maintain in the system will update.

### **3.2 Client**

When a client is established, it will look up the registry and create RMI connection with the server. And in this shared whiteboard system, there are two kinds of clients, manager client and user client. And there is only one manager client in the system and the manager is in charge of the whiteboard application. The system allows multiple users to join in but it is worth noting that the manager client must join first and then the user client can join the application. Both manager client and user client can edit the whiteboard, such as line, circle and text operation, the only difference is that managers have greater authority.

#### **3.2.1 Manager Client**

After the server is established, the manager should first joins the whiteboard application in order to get control of the application. Manager client has the following authority.

(1)Open a new whiteboard page

The manager client can open a new whiteboard page by pressing the "New" button. And then the whiteboard will be replaced by a new image page with white background. The upload thread inside manager client will upload the new whiteboard page to the server and all online user clients will download it from the server. After that, all online user clients will update its own whiteboard page with new image.

(2) Save the whiteboard page

The manager client can save or save as the whiteboard page by pressing the “Save” and “Save as” button. And the manager client will stop the download thread in order to get the image when the button is pressed and exclude interference from other user clients during the saving process.

(3) Permission to allow users to join in the application

When a user client wants to join the whiteboard application, it will wait for the permission from manager client. And only when the manager allows the user client to join in the whiteboard application, the user client can access the current state of whiteboard, otherwise the user client window will be shut down. As for the implementation detail about this authority, the user client will send a request to the server by using the remote methods when user client is established. And the server will pass the request to the manager client and the manager client can choose to allow or deny the user client to join in the application. And the server will also pass the reply that comes from manager client to user client.

(4) Close the whole whiteboard application

If the manager client close the whiteboard application, all user clients will be shut down with a notification message. When the manager client shuts down the application, the manager client will send a shut down message to the server, and the message will be distributed to the user clients by the server. When the user clients receive the shut down message, the corresponding application will be shut down.

(5) Kick out a certain user client

The manager can kick out an online user client. The manager client can choose a certain user name from the online user list and press the “Kick” button. It will send the kicked user name to server and pass it to user client. If the user client with the certain username receive the kick message, it will be kicked out the application with a notification message.

### 3.2.2 User Client

The whiteboard application allows multiple users to join in the system as long as they can get the permission from the manager. Every user in the application can see other online users who are editing the same whiteboard page. The basic operation for users includes shape operations (line, circle and rectangle) and text inputting. All users in the application will have a same whiteboard whenever they join in the application. And as long as one user modifies the image of whiteboard, the modified image will be distributed to all online users. As a result, all users will get the modified whiteboard within acceptable time delay.

The authority management message transfer is implemented by updateUserList thread. This thread is not only for maintaining the user list and update it, it is also responsible for sending request to server, getting reply from server and checking the kicked user name.

## 4.Design Diagram

### 4.1 Class Design

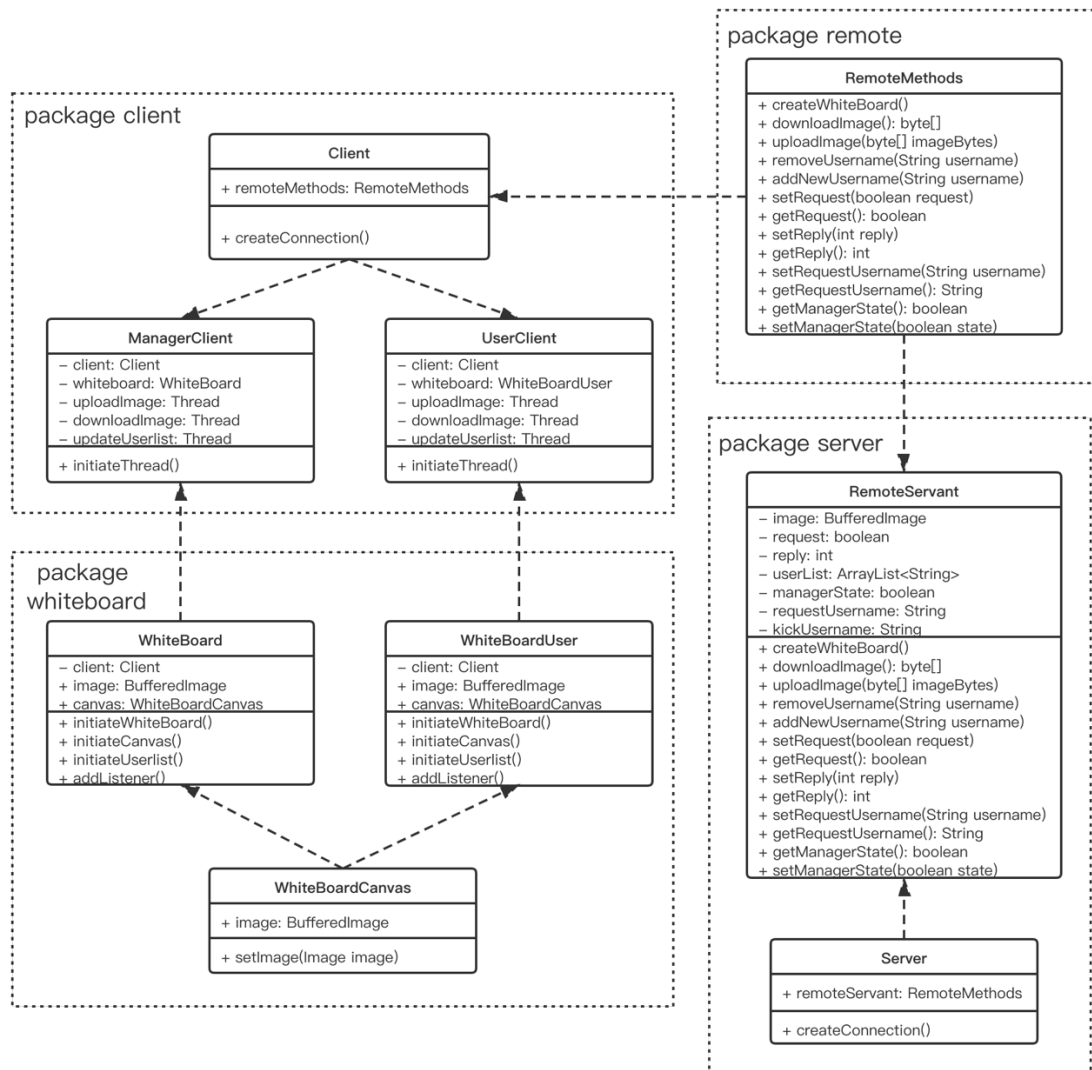


Figure 1: overall class design

## 4.2 interaction diagram

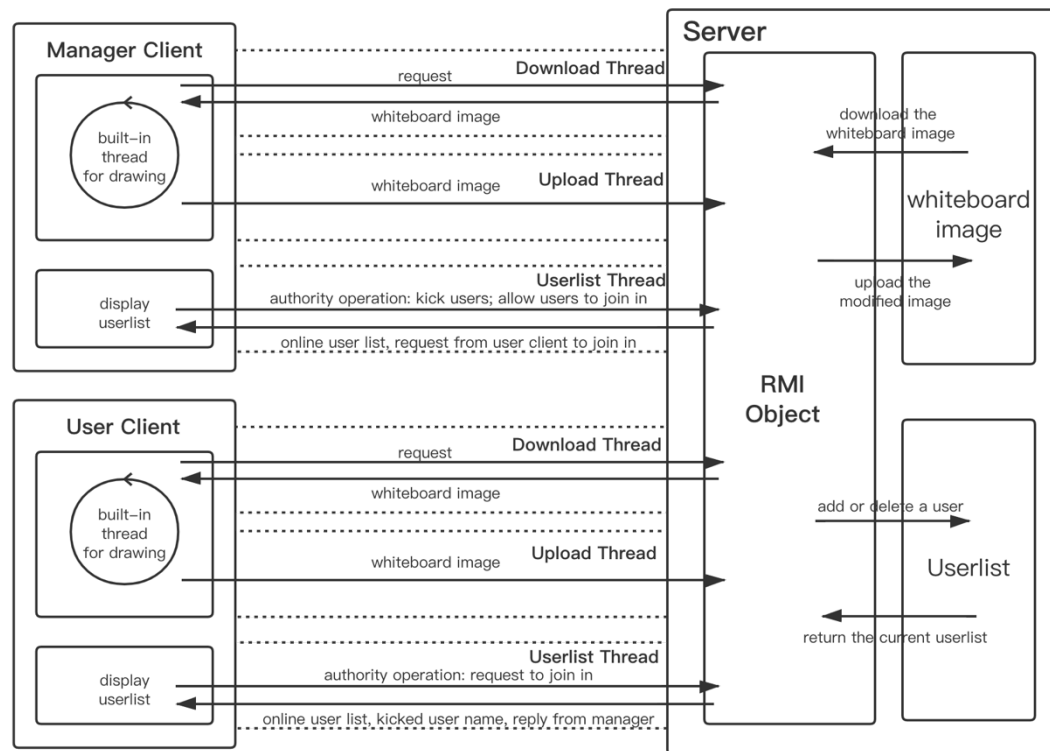


Figure 2: interaction diagram

## 5. New Innovations

The basic whiteboard allows users to express their ideas by shapes(line, circle and rectangle) and input text, which is not enough. And the new feature is that the whiteboard provides users with many shapes like oval and square.

## 6. Feature Improvement

The whiteboard can add more elements, such as changing the image color, editing the line color and even filling in a shape with a certain color. And the communication could also be improved by adding a chatting box, which allows users can not only draw their ideas but also chat with others.