UE21CS352B - Object Oriented Analysis & Design using Java

Mini Project Report

"Secure File Sharing System"

Submitted by:

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INTRODUCTION

A safe file sharing system is an essential tool in today's communication and collaboration. It enables individuals and organisations to securely exchange files and information over the internet while safeguarding sensitive data from unauthorised access, modification, or theft.

The primary goal of a secure file sharing system is to ensure the shared data's confidentiality, integrity, and availability. The protection of data from unauthorised access is referred to as confidentiality. The term "integrity" refers to the fact that the data remains unchanged during transmission or storage. The availability of data means that authorised users can access it when they need it.

A secure file sharing system achieves these goals by combining encryption, access controls, authentication, and other security mechanisms. Encryption ensures that the data is unreadable and unusable to anyone who does not have the correct key. Access controls limit authorised users' access and prevent unauthorised access. The authentication process ensures that only authorised users have access to the data.

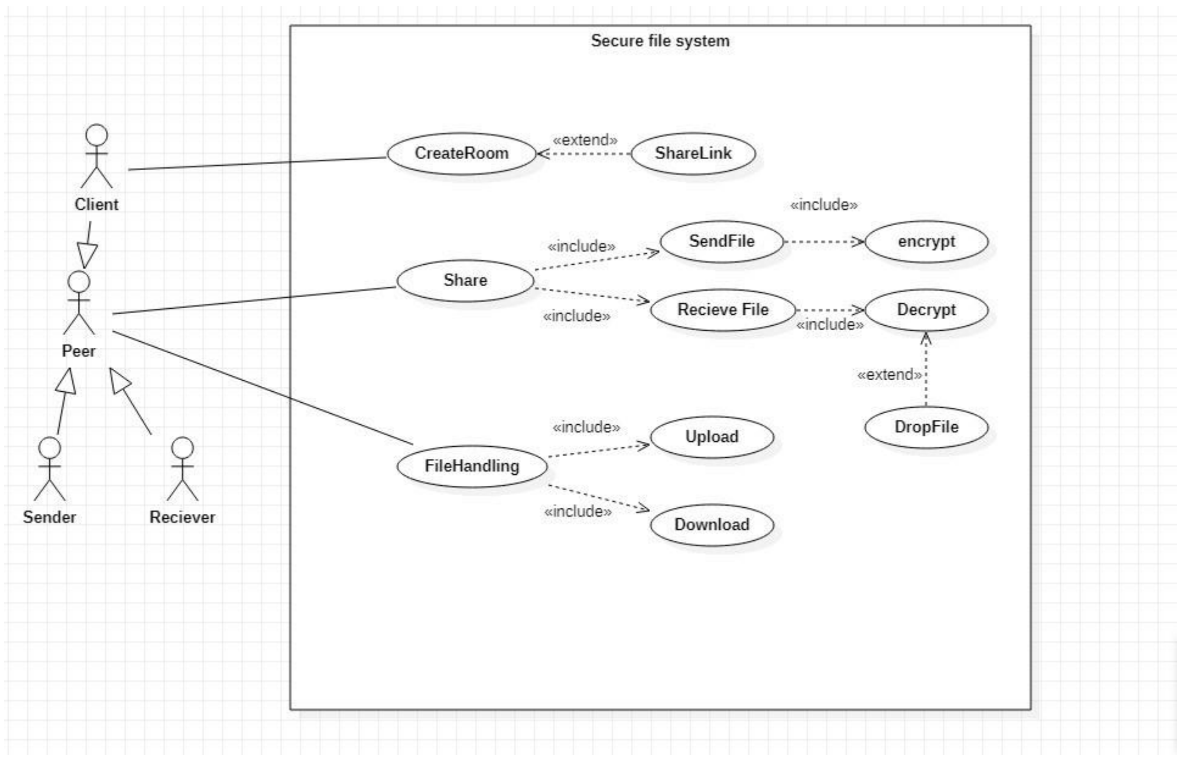
Project Description

The aim of the project is to build an end-to-end secure file sharing system which mimics the P2P architecture. Files are shared via a room which is created by the client. The invite link of the sharing platform which in this case is a room is created for the peers who want to access and download files. The link has to be submitted by each peer to join the network to send or receive the files. The files being sent are encrypted with AES (Advanced Encryption Standard) encryption algorithm. On the sender side the file is encrypted using the secret key before sending the file.

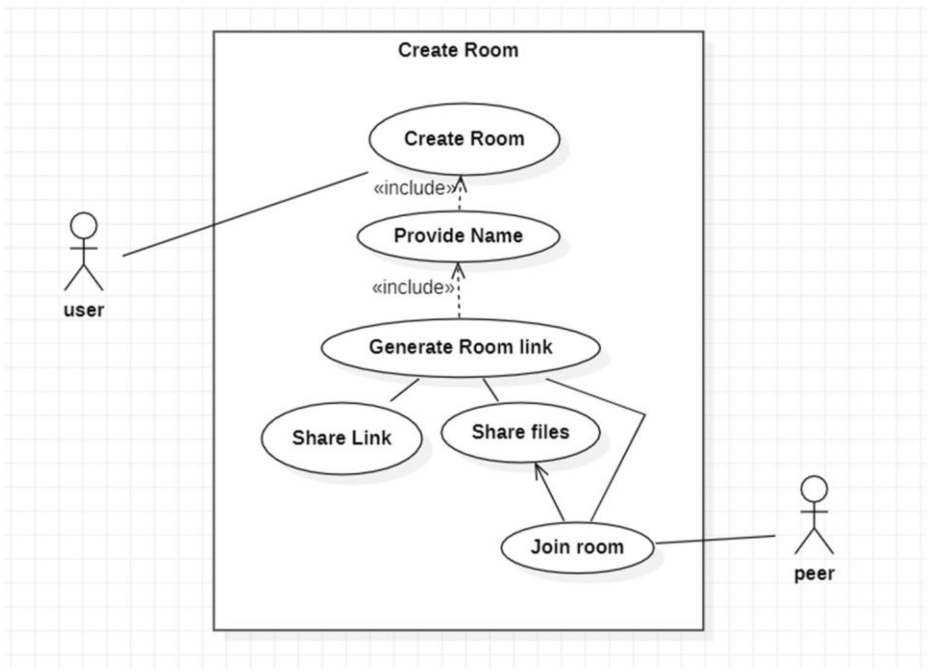
The encrypted files are decrypted on the receiving end using the secret key available in the room to validate the file. After the decryption the file is downloaded on the receiving end. In order to account for the file not being corrupted, the concept of checksum is used to verify the integrity of the file. The encrypted file here is being sent to the peers in the room using different sockets in the local system presently. All the files being sent/transmitted in the room are stored in the mongodb database for future reference of the ongoing session. Each user is assigned a database to keep track of his files used in the session.

Analysis and Design Models

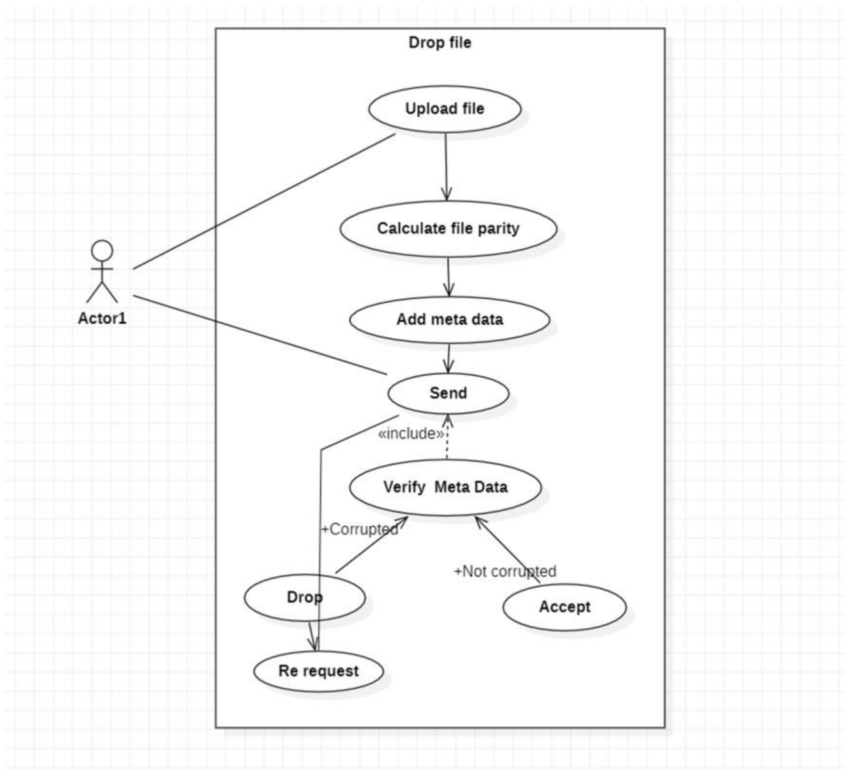
1. Use Case Diagram:



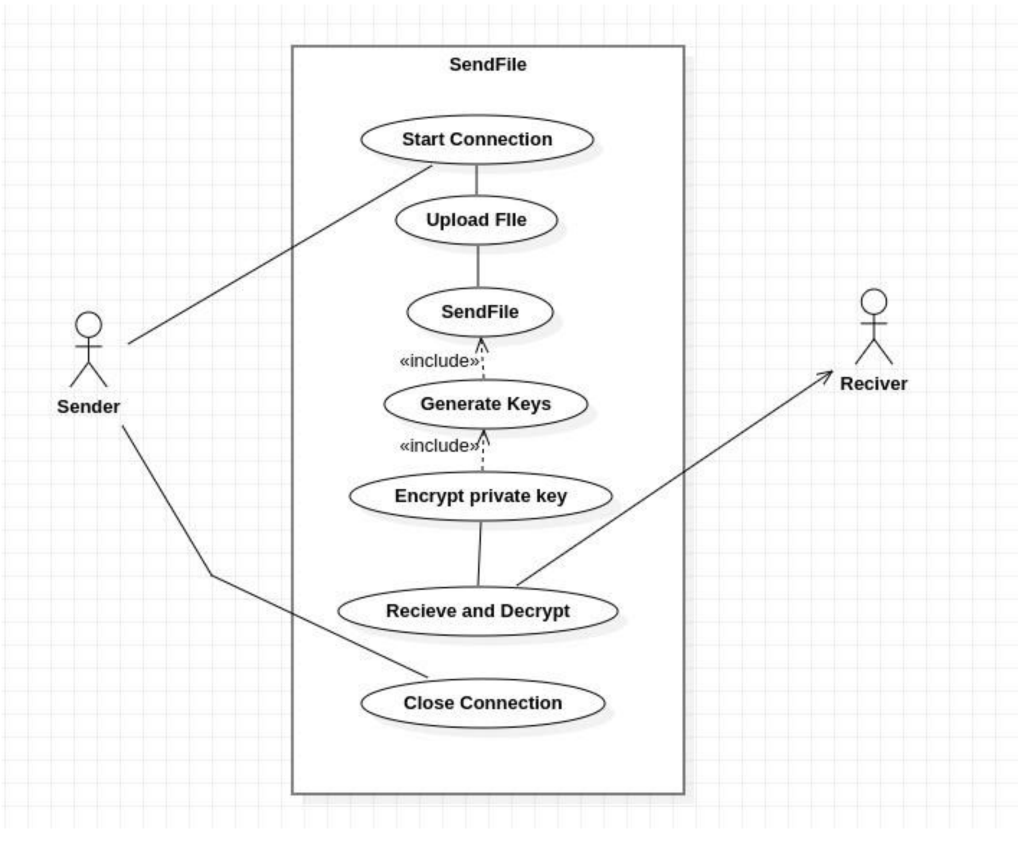
(a) Create Room Use Case:



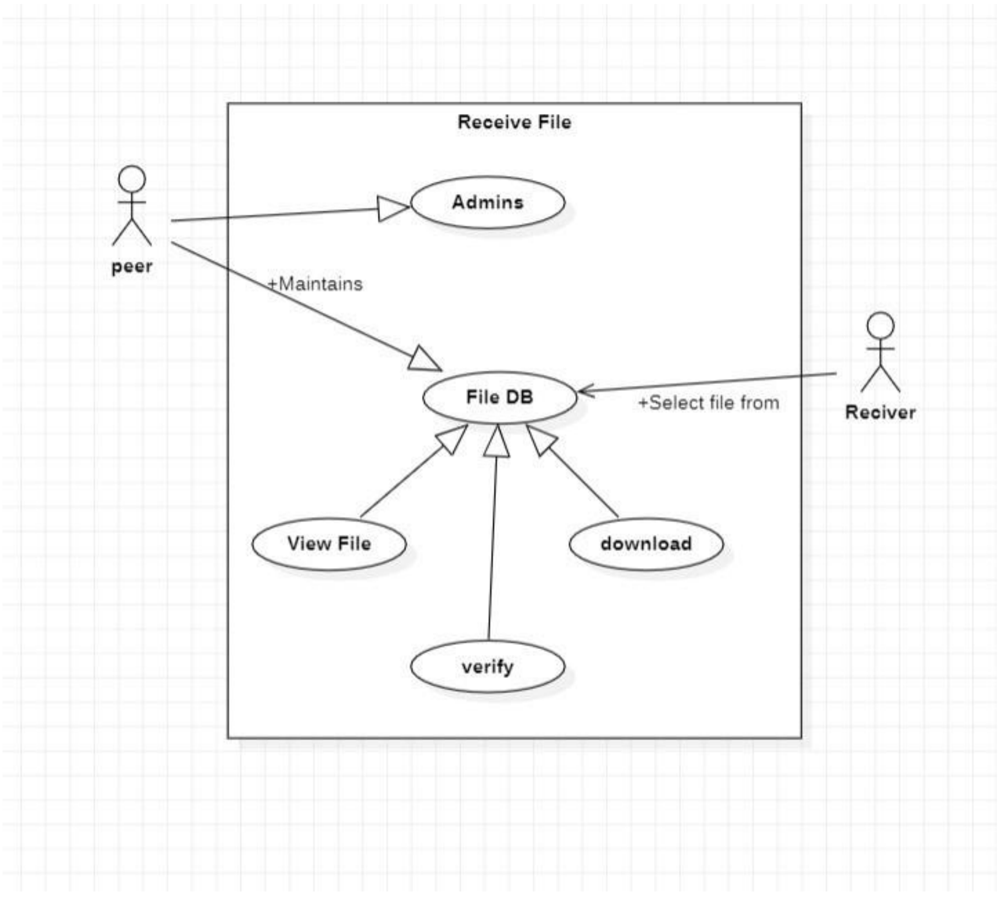
(b) Drop File Use Case:



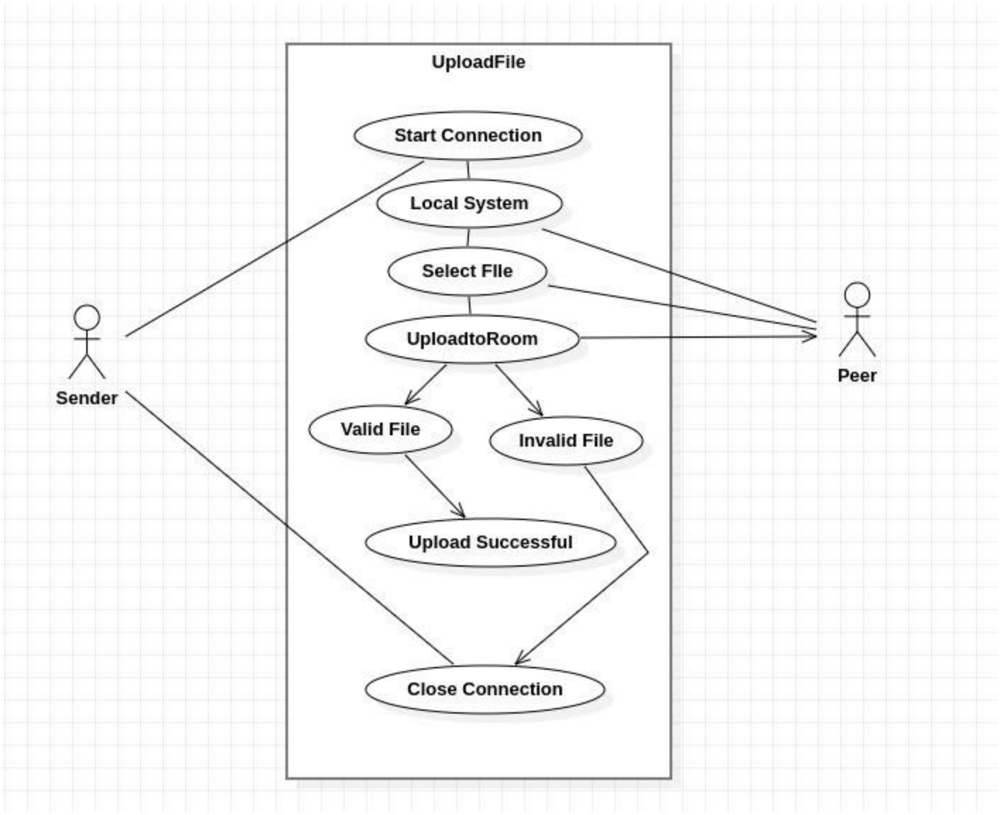
(c) Send File Use Case:



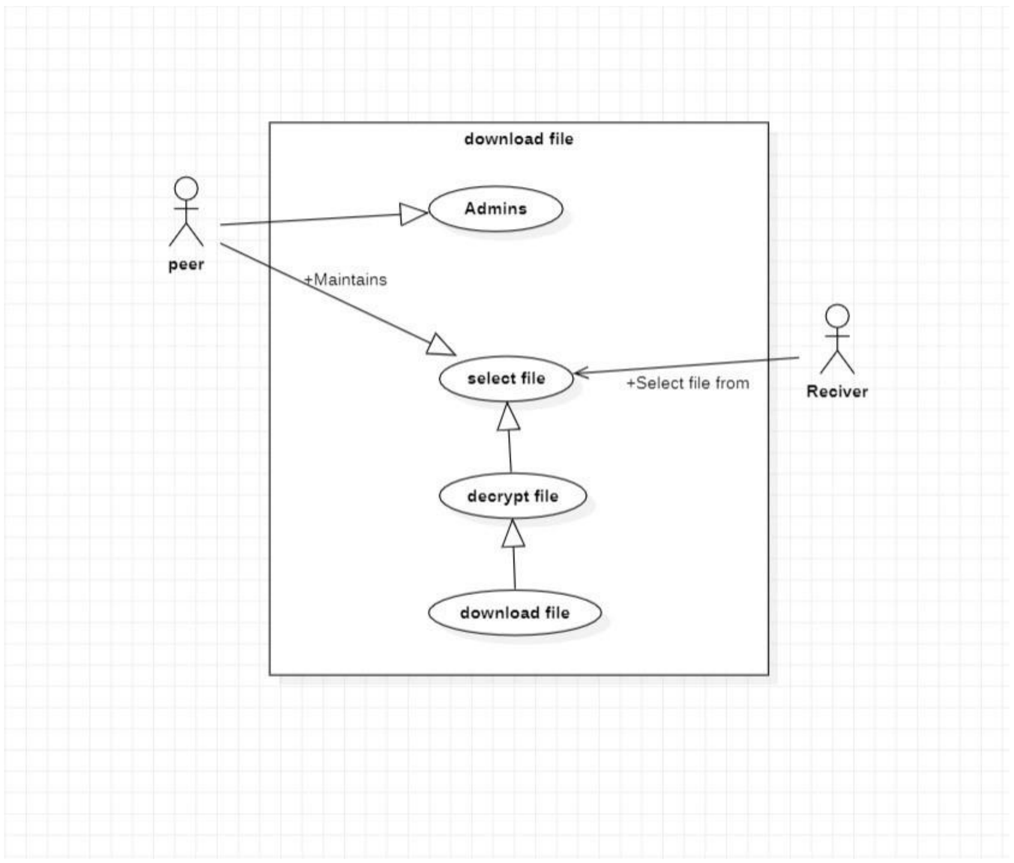
(d) Receive File Use Case:



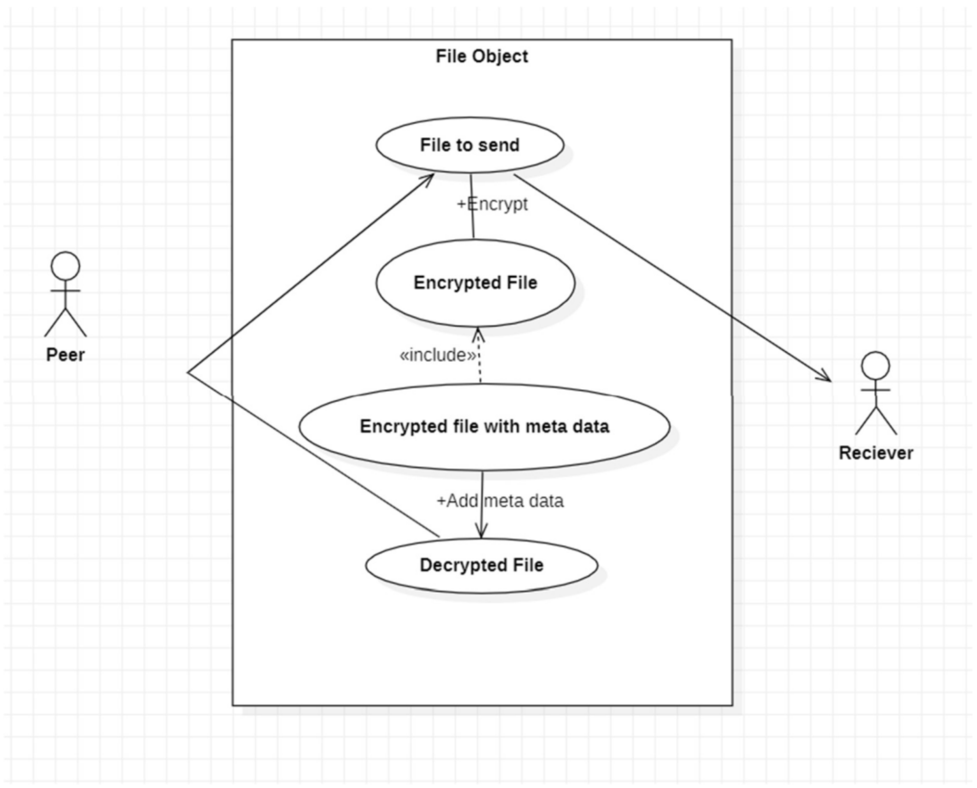
(e) Upload File Use Case:



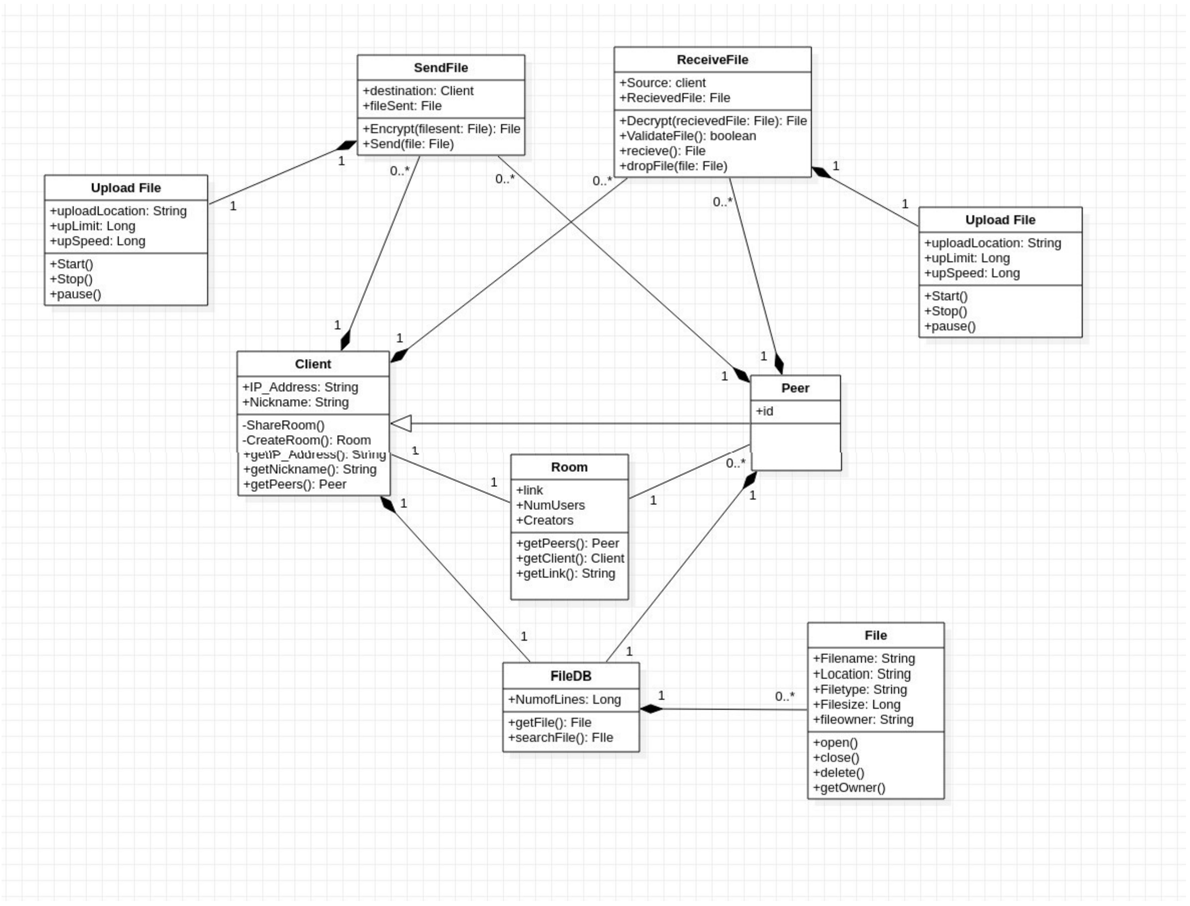
(f) Download File Use Case:



(g) File Object

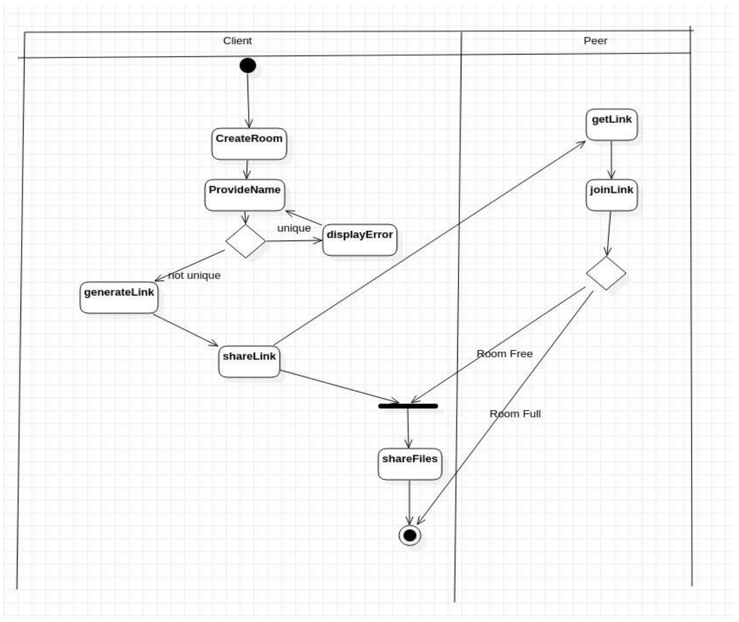


2. Class Modelling diagram:



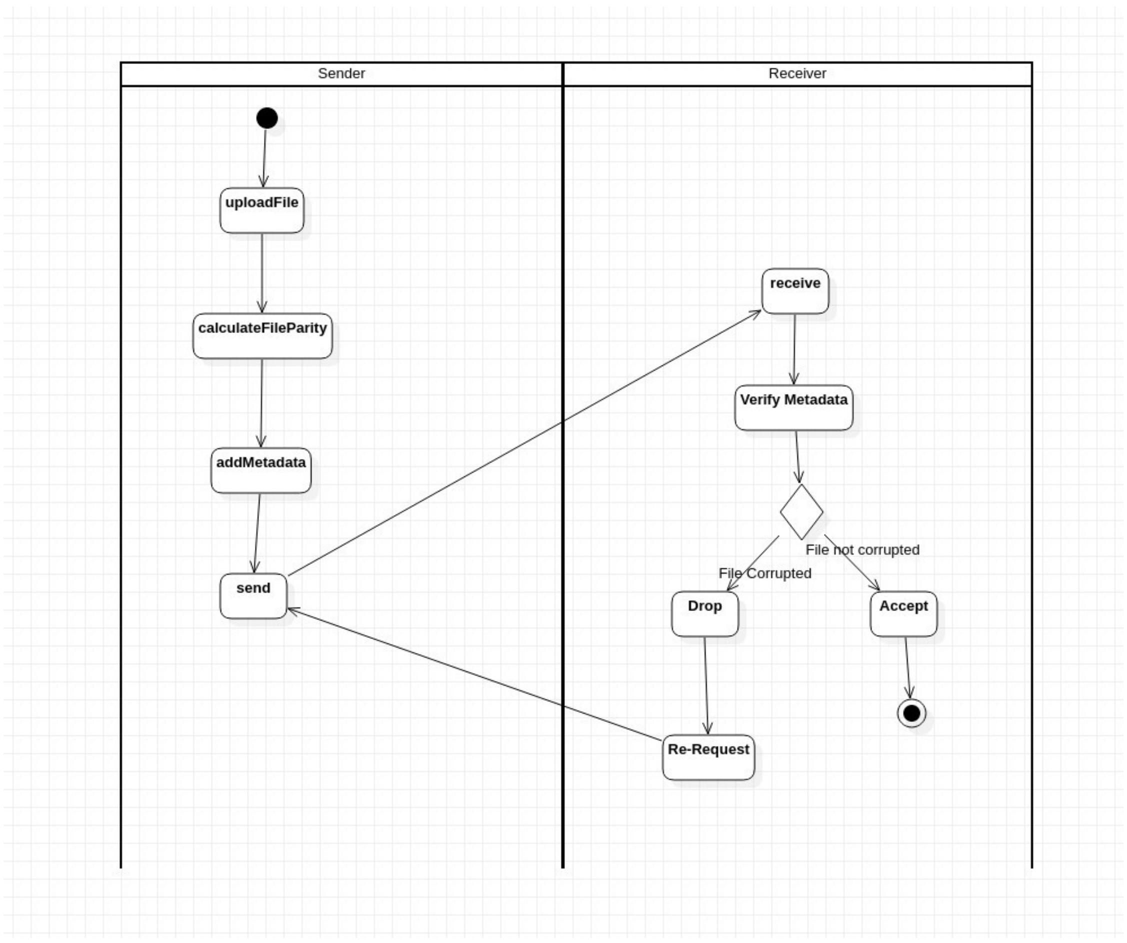
3. Activity diagram for the use-cases implemented

(a) Create Room Use Case:



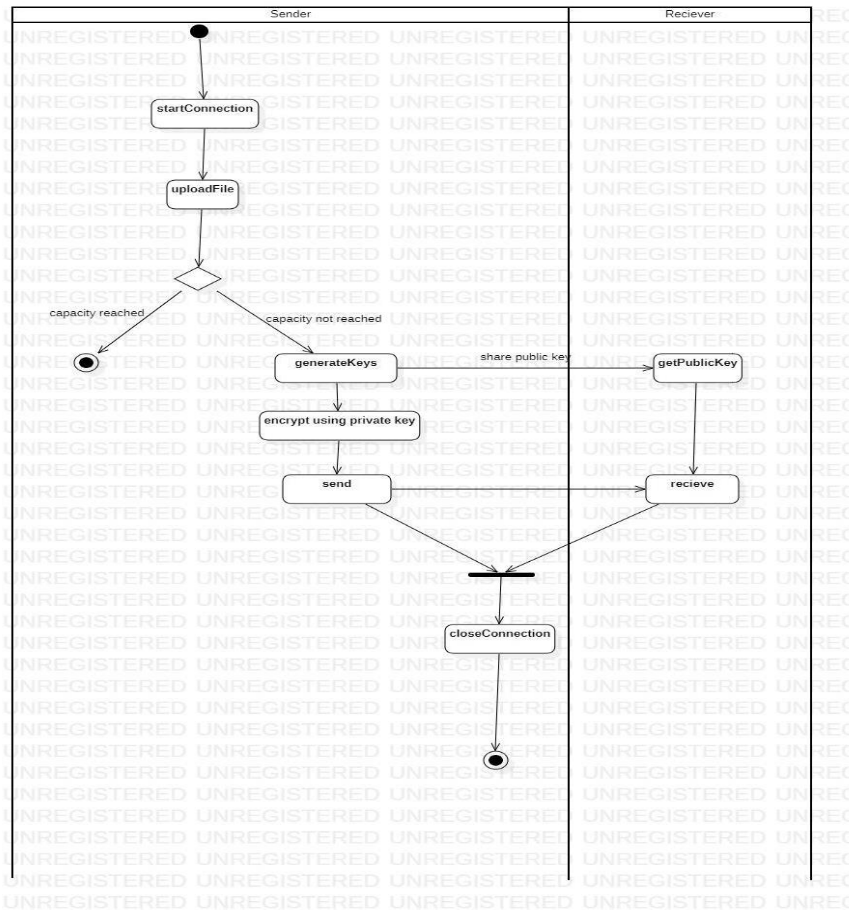
1. Name: CreateRoom
2. Summary:Create a room where peers can share files
3. Actor:Client/Peer
4. Preconditions: The Client has entered the platform
5. Description:
    - Click on "create room"
    - Click on "generate room link"
    - Click on "share link" and share it with other peers and the peers can join the room if the room limit has not been exceeded
6. Exceptions: The room limit exceeds
7. Post-condition: Peers can join and share files

(a) Drop File Use Case



1. Name: DropFile
2. Summary: On receiving the file, drop the file if it was corrupted during transfer.
3. Actor: Receiver/Peer
4. Preconditions: File is uploaded and is ready to be sent over the network
5. Description:
    - Calculate the file parity at the sender side, which upon received at the receiver side is used to verify the integrity of the file
    - It is added as metadata of the file
    - It is encrypted, sent over the network and received on the other side, and decrypted.
    - The metadata appended to the file is used to check the integrity of the file
    - If the file is found to be tampered, it is dropped immediately and a new request to resend the file goes to the sender, else accept the file.
6. Exceptions: The file doesn't reach the receiver side
7. Post-condition: Receiver can download the files

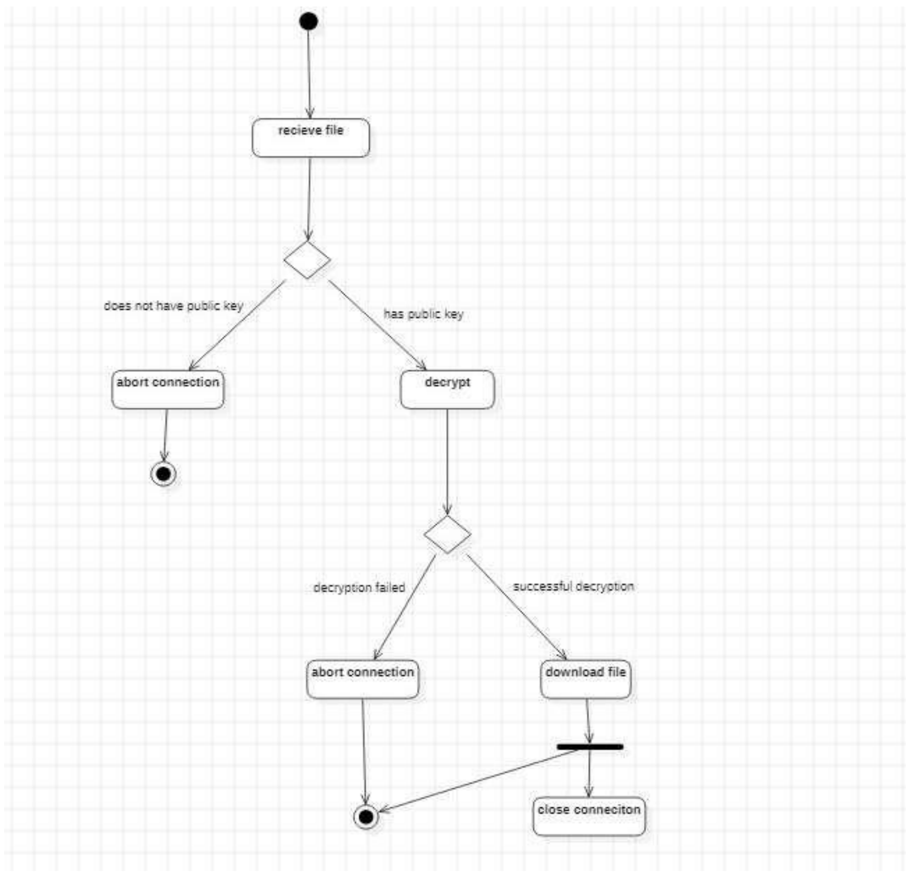
Send File Use Case:



1. Name: SendFile
2. Summary: Prepare the file to be sent over the network
3. Actor: Sender/Peer
4. Preconditions: The file is uploaded onto the platform
5. Description:
    - On starting the connection, keys generated for secure transmission i.e encryption
    - Share the public key to the receiver
    - Encrypt the file with the key already generated
    - Send the file to the receiver
    - Receive at the receiver side
    - Close connection
6. Exceptions: File doesn't exist in the DB

Post-condition: Receiver can receive the sent file

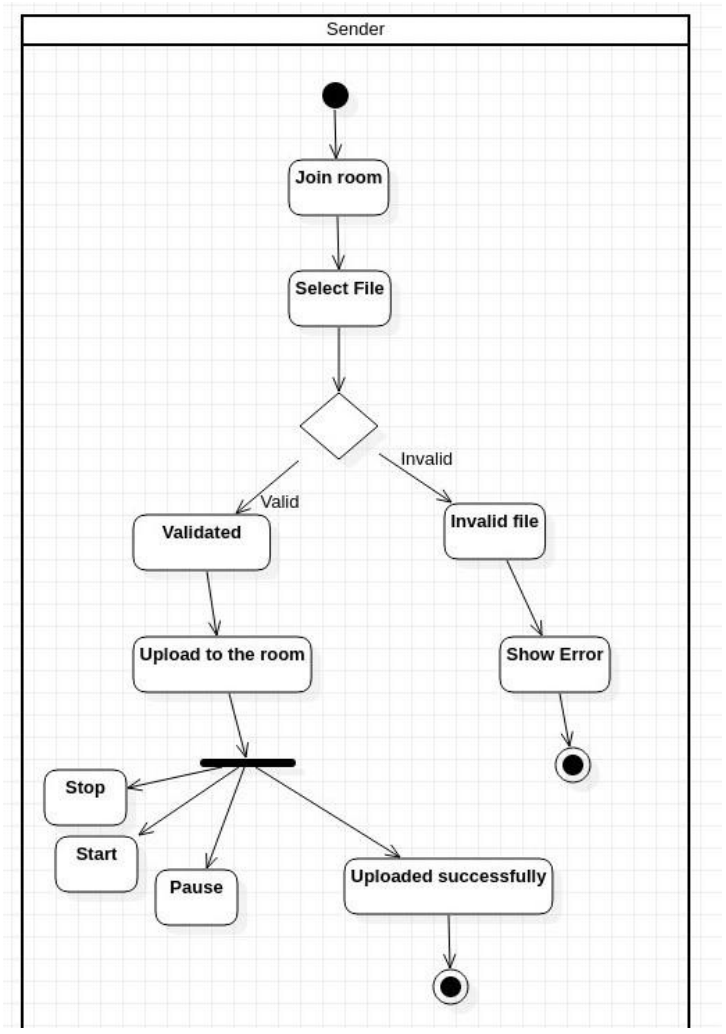
Receive File Use Case:



1. Name: Receive File
2. Summary: Receive the file sent over the network.
3. Actor:Peer/Receiver
4. Preconditions: The Sender has pushed a file to the fileDB
5. Description:
    - Click on “receive” file
    - Click on “verify” to verify the contents of the file by decrypting the file using the public key of the sender.
    - Click on “download” to download the file after successful verification.
6. Exceptions: Verification fails.

Post-condition: The file can now be downloaded by the receiver.

Upload file use case:



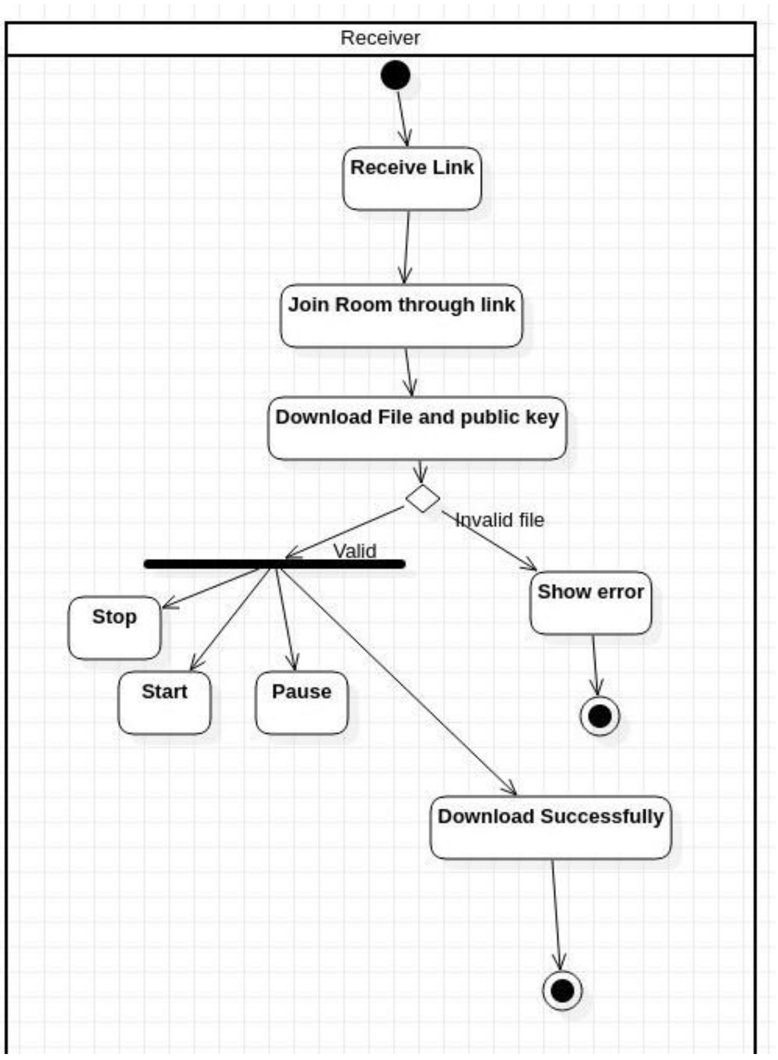
1. Name: Upload File use case
2. Summary: Select the file and upload the file in the FileDB
3. Actor: Client/Peer
4. Pre-conditions: The Client has entered the platform
5. Description:

- Click on “upload” to upload the file -Select the file from the peer local system.
- Click on “OK” to start uploading.
- The uploading actions have start, pause and stop options.

6. Exception - File is invalid or corrupted.

Post-condition - Send the file for encryption.

Download File use Case:

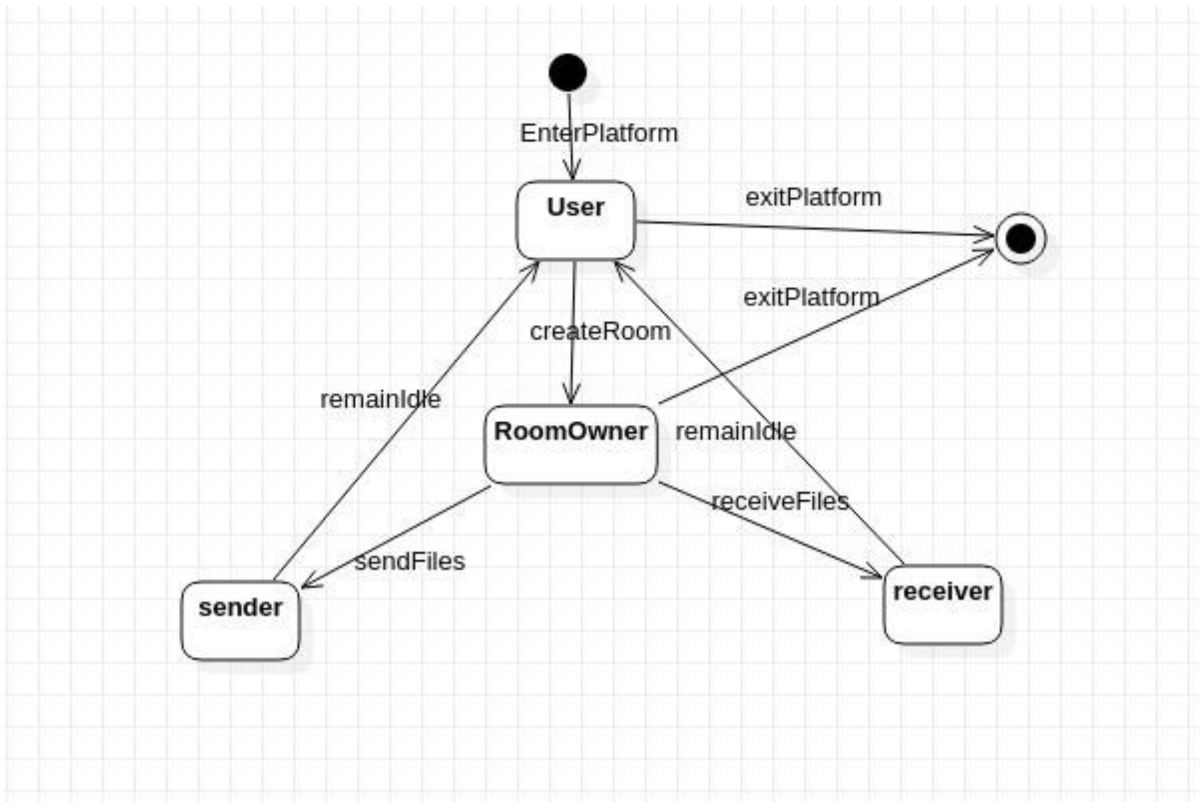


1. Name: Download File use case
2. Summary: Download the shared file in the room
3. Actor: Receiver/Peer
4. Pre-conditions: The file had been received and verified by decryption.
5. Description:

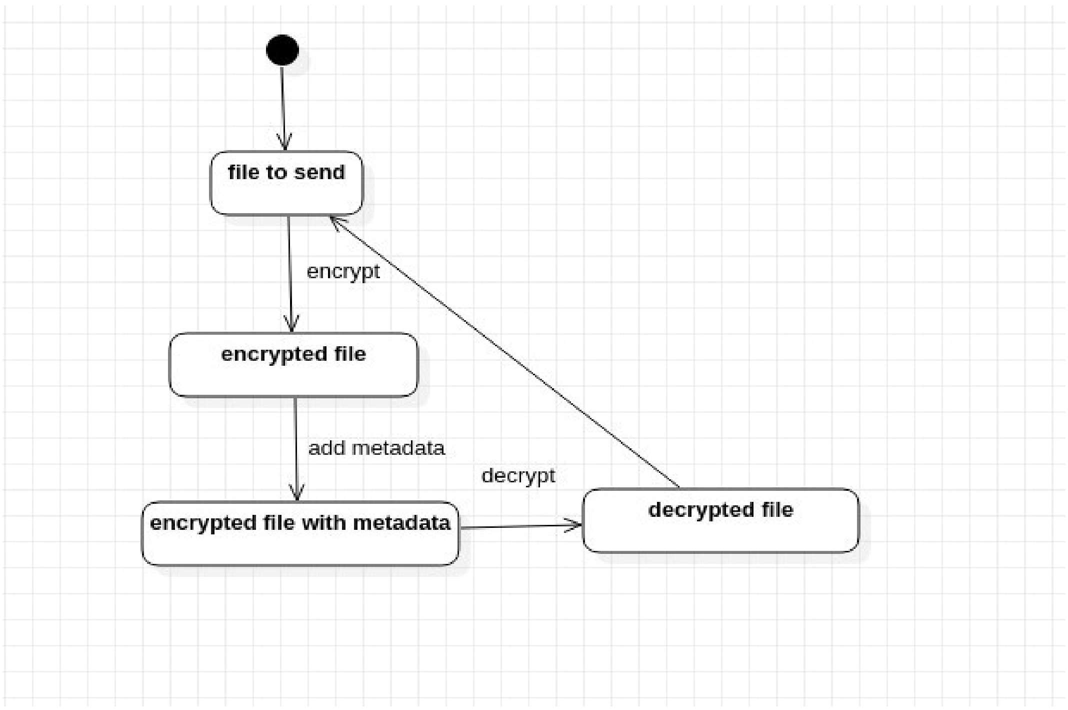
- Click on “download” to download the file.
- Select the destination to download in the peer’s local system.
- Click on “OK” to start downloading.
- The downloading actions have start, pause and stop options.

6. Exception - File is invalid or corrupted (verification failed).
7. Post-condition - The peer can continue being in the room to share and receive files.

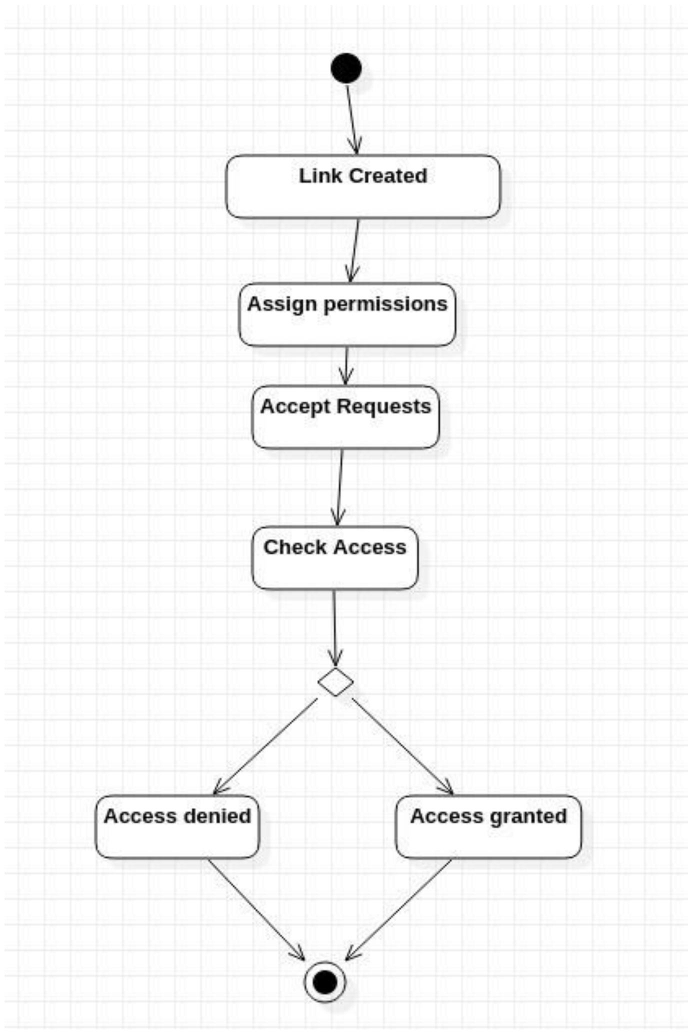
State diagram for the classes with temporal behaviour Client Object



File Object



Link accessibility



Tools and Frameworks Used:

1. **MVC: model-view-controller**

The Model-View-Controller (MVC) framework separates an application into three main logical components Model, View, and Controller.

Three important MVC components are:

- Model - It includes all the data and its related logic
- View - Present data to the user or handles user interaction
- Controller - An interface between Model and View components **Using: Spring MVC Framework -**

Model - Classes: - Client

- - Crypto
- - ReceiveFile
- - SendFile
- - Peer
- - Room

Controller - Classes

- - FileController

Views - HTML files with minimal vanilla javascript.

3. **Maven**

- Maven is used to handle the dependencies in the java project using POM (project object model).
- It helps in downloading the dependencies, which refers to the libraries or JAR files specific to the versions required in the project.

4. **Database - MongoDB**

- MongoDB is a NoSQL database that uses JSON-like documents with optional schemas.

- As a document database, MongoDB makes it easy for developers to store structured or unstructured data.
- In this project it is used to store the files. Each peer has a database that stores the file sent to him.

Design Principles and Design Patterns Applied:

1. **Design principles: The following SOLID principles were kept in mind while coding the project:**
   - **S - Single Responsibility Principle (SRP)**
     - All files in the model have only one logical responsibility. Eg: Classes like send File and receive File only take the responsibility of sending and receiving files respectively. Hence encrypting and decrypting is delegated to another class called Crypto.
   - **O - Open-Closed Principle (OCP)**
     - Class peer inherits the properties of client class by extending its properties.
     - Class Custom Multipart File implements Multipart File with additional functionalities.
   - **L - The Liskov Substitution Principle (LSP)**
     - A client object can be replaced with a peer object without any flaws.
   - **I - Interface Segregation Principle (ISP)**
     - There are no interfaces or classes with functionality which overburden them or ones which are not used by the client.
   - **D - Dependency Inversion Principle (DIP)**
     - There is no high-level class that directly depends on classes at lower levels

Design Patterns:

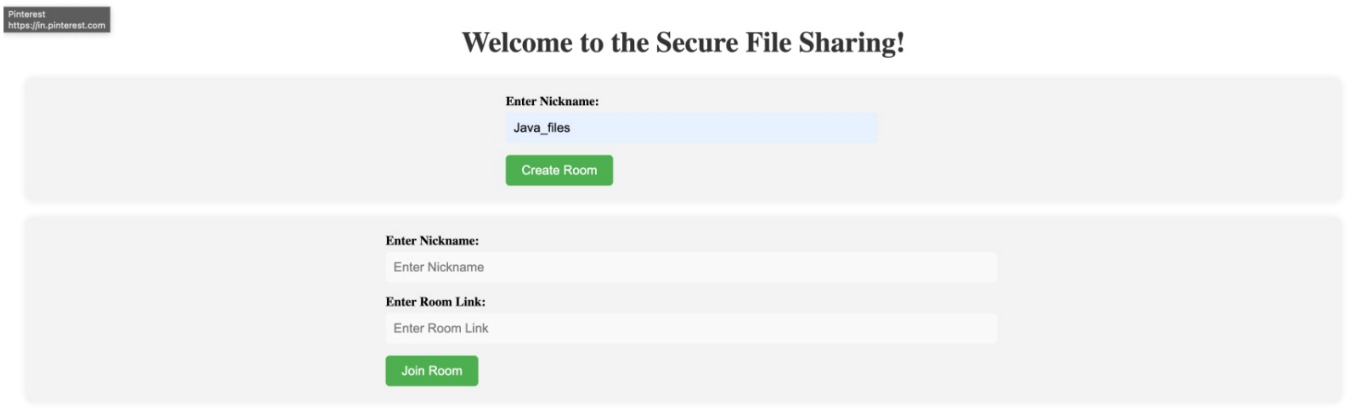
- **Singleton - classes that use singleton:**
  a. SendFile
  b. ReceiveFile
- **Factory -**
  a. UserFactory that creates:
  b. Peer
  c. Client

Implementation:

https://github.com/7Akshu77/PES2UG21CS312_315_329_921_Secure_File_Sharing_System

RESULTS SCREENSHOTS

Screenshot1

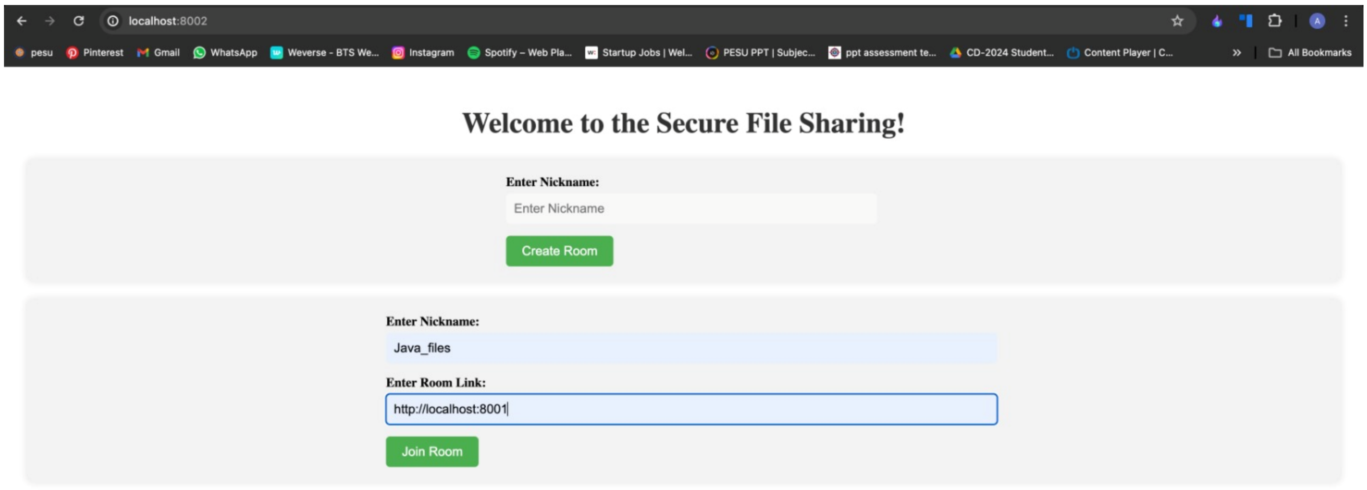

Pinterest
https://in.pinterest.com

Welcome to the Secure File Sharing!

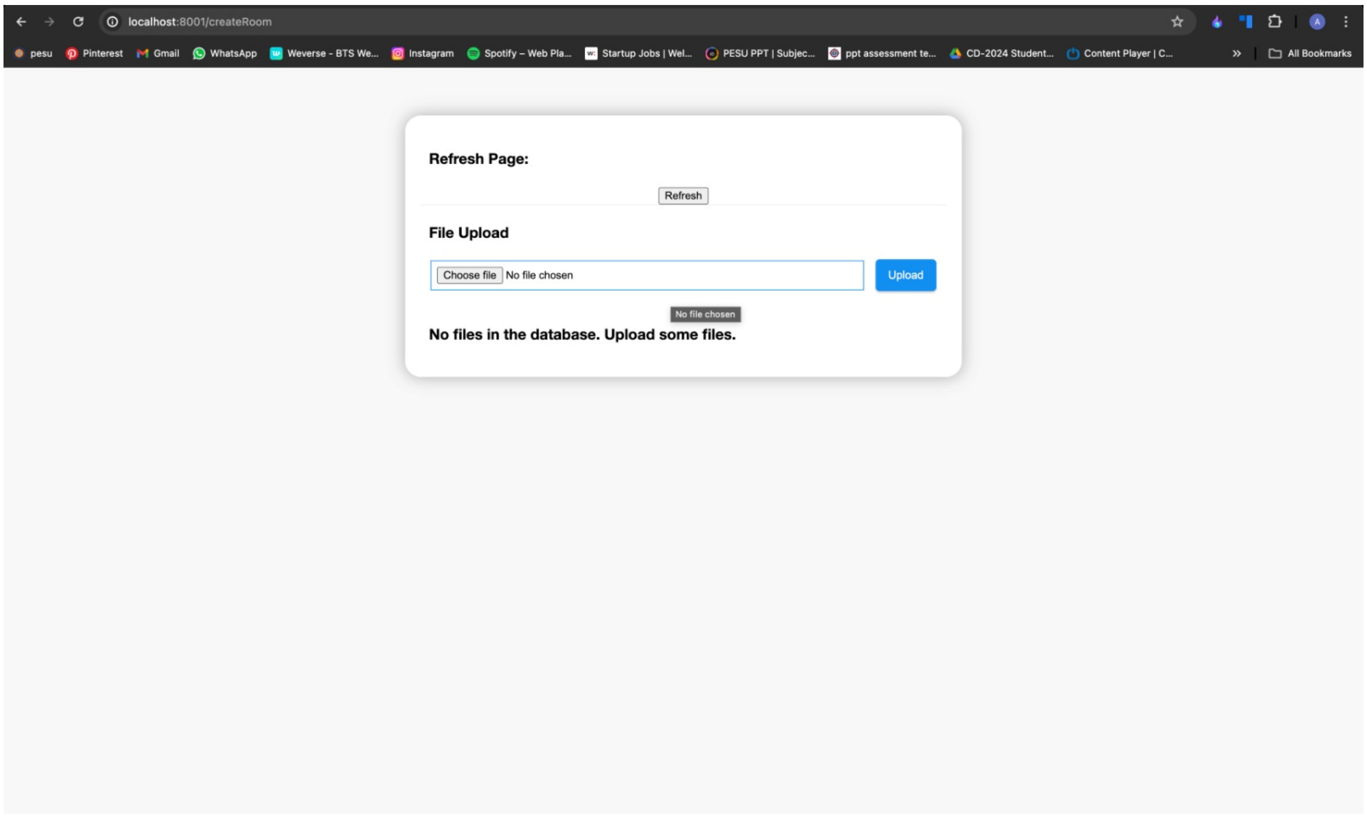
Enter Nickname:
Java_files

Enter Nickname:
Enter Nickname
Enter Room Link:
Enter Room Link

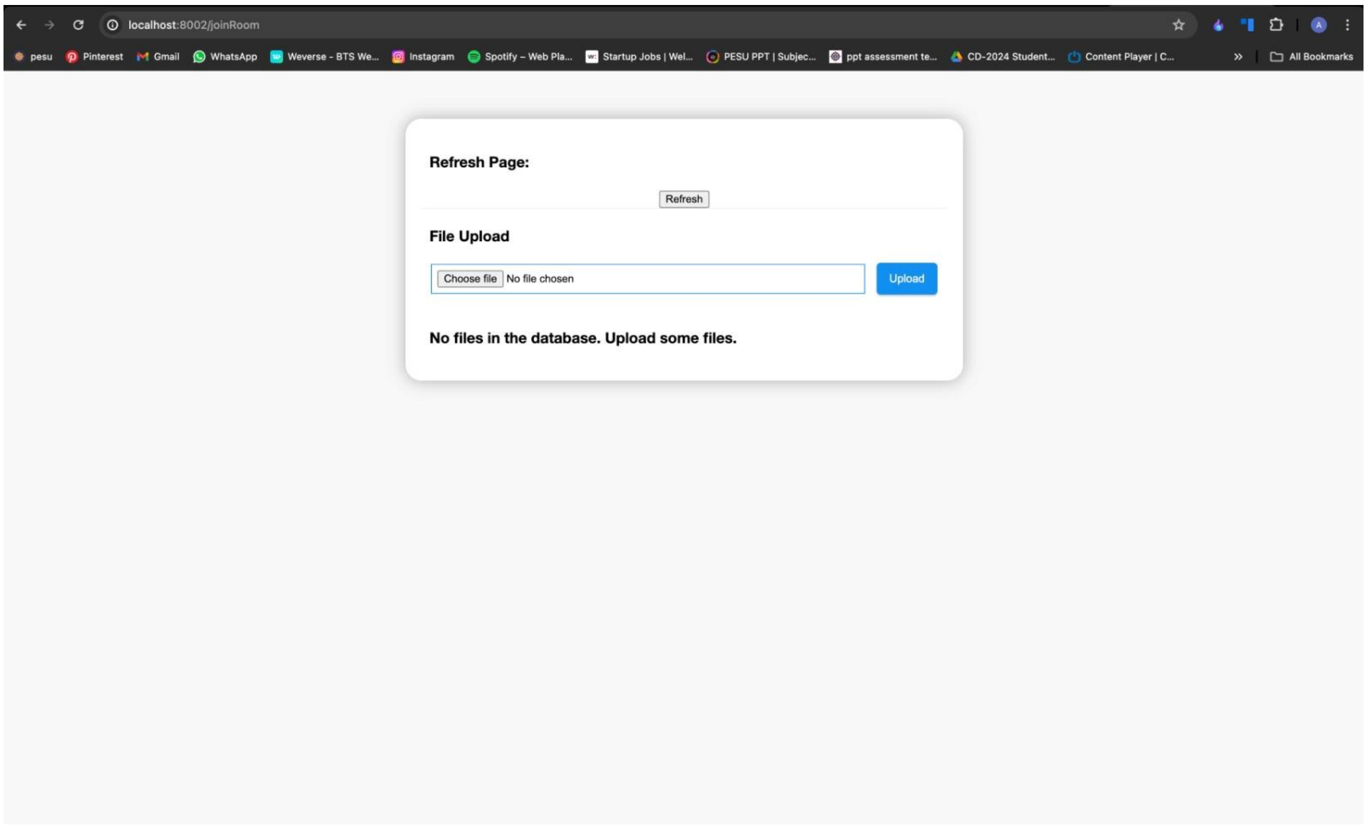
Screenshot2



Screenshot3



Screenshot4



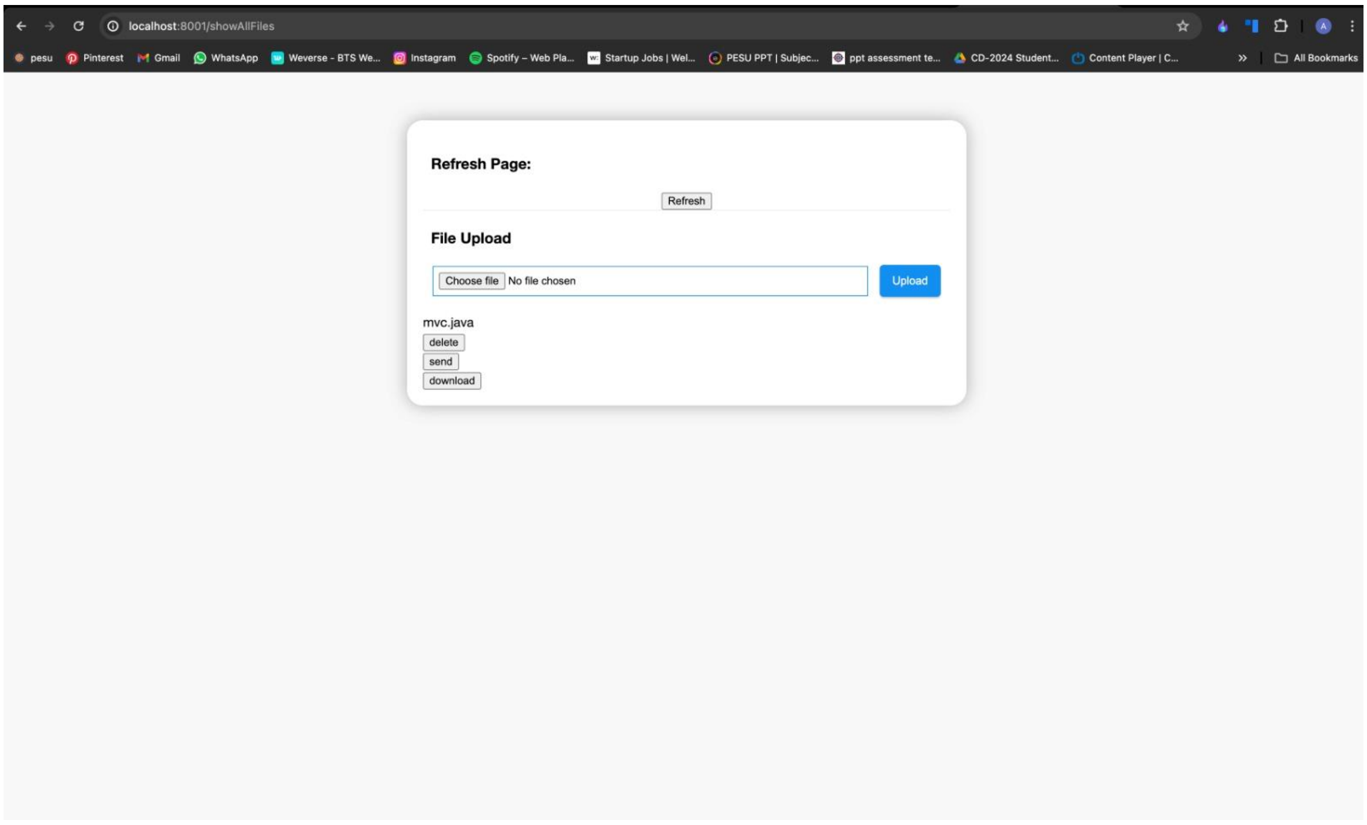
Refresh Page:

File Upload

No files in the database. Upload some files.

PEER1→PEER2

Screenshot5



Refresh Page:

Refresh

File Upload

Choose file No file chosen

Upload

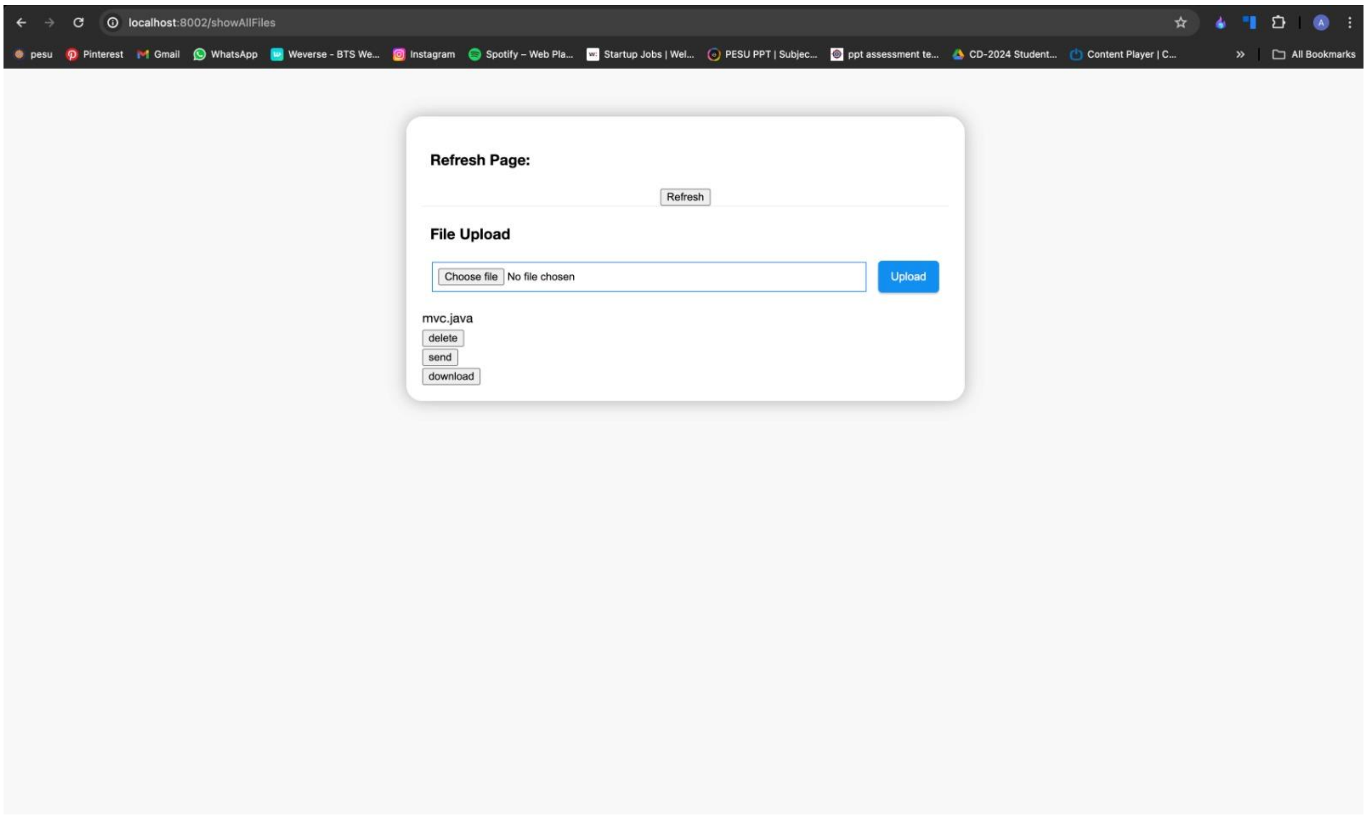
mvc.java

delete

send

download

Screenshot6



Refresh Page:

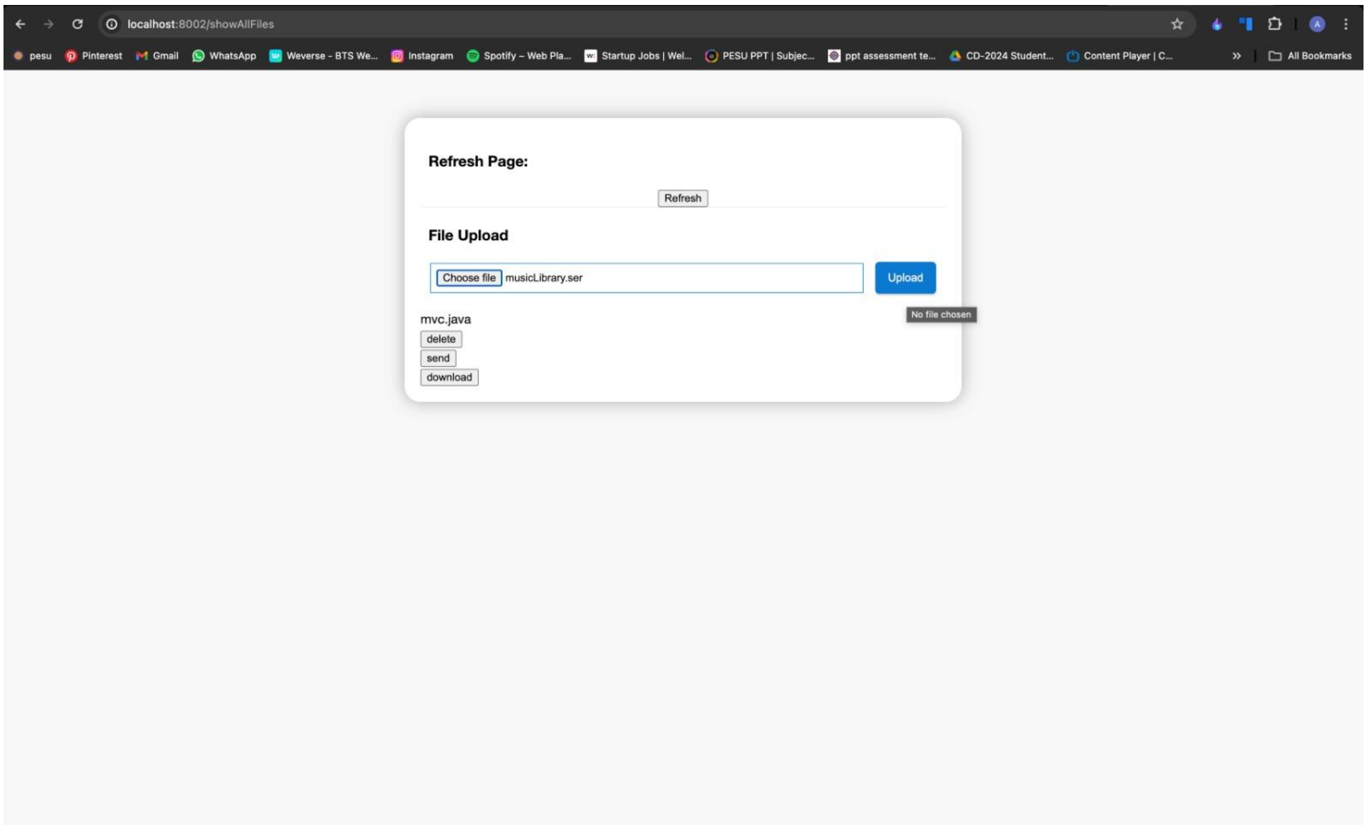
File Upload

No file chosen

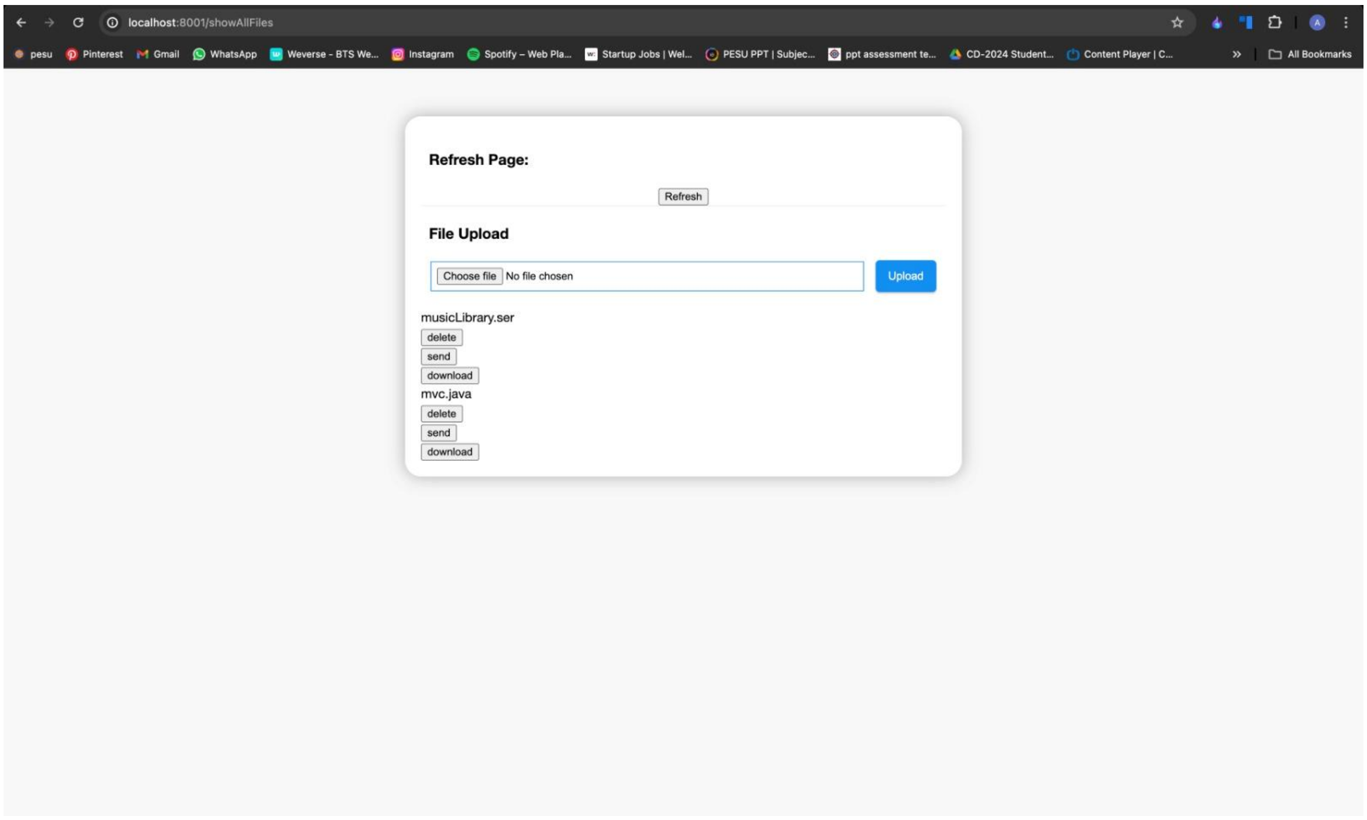
mvc.java

PEER2→PEER1

Screenshot7



Screenshot8


localhost:8001/showAllFiles

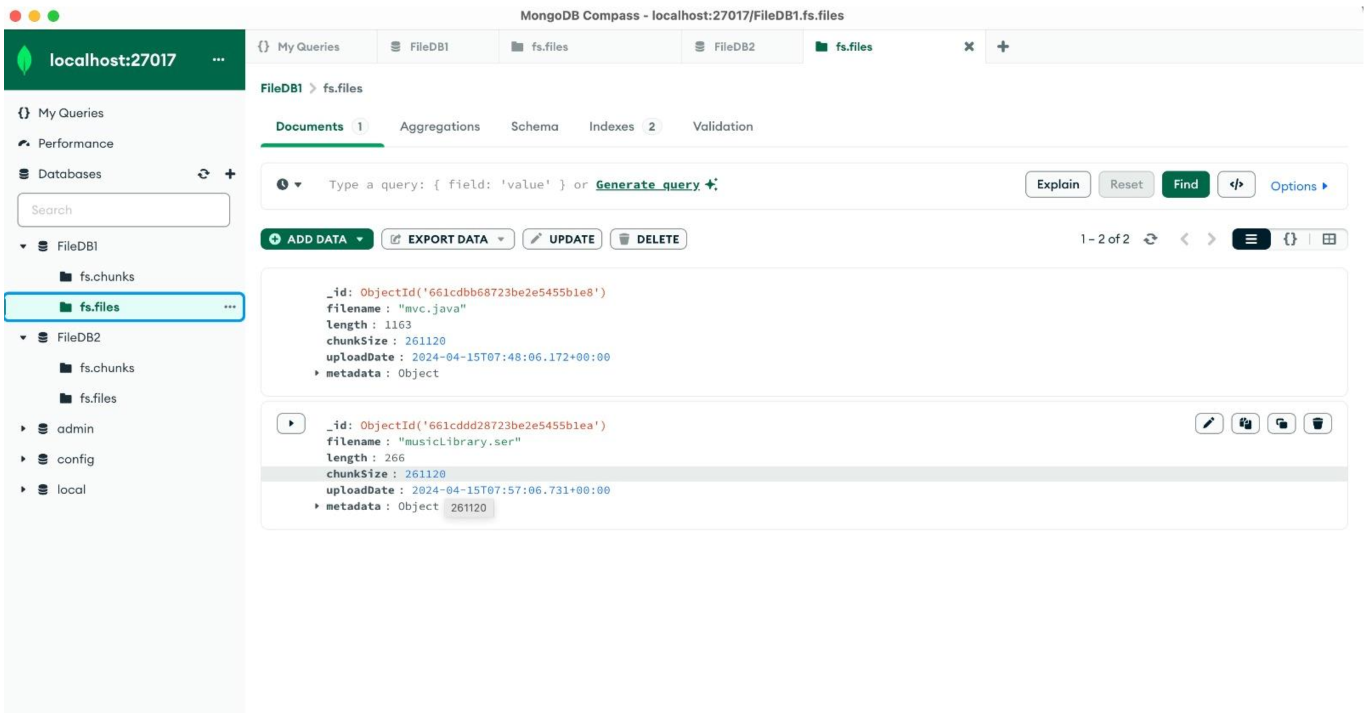
Refresh Page:

File Upload

musicLibrary.ser

mvc.java

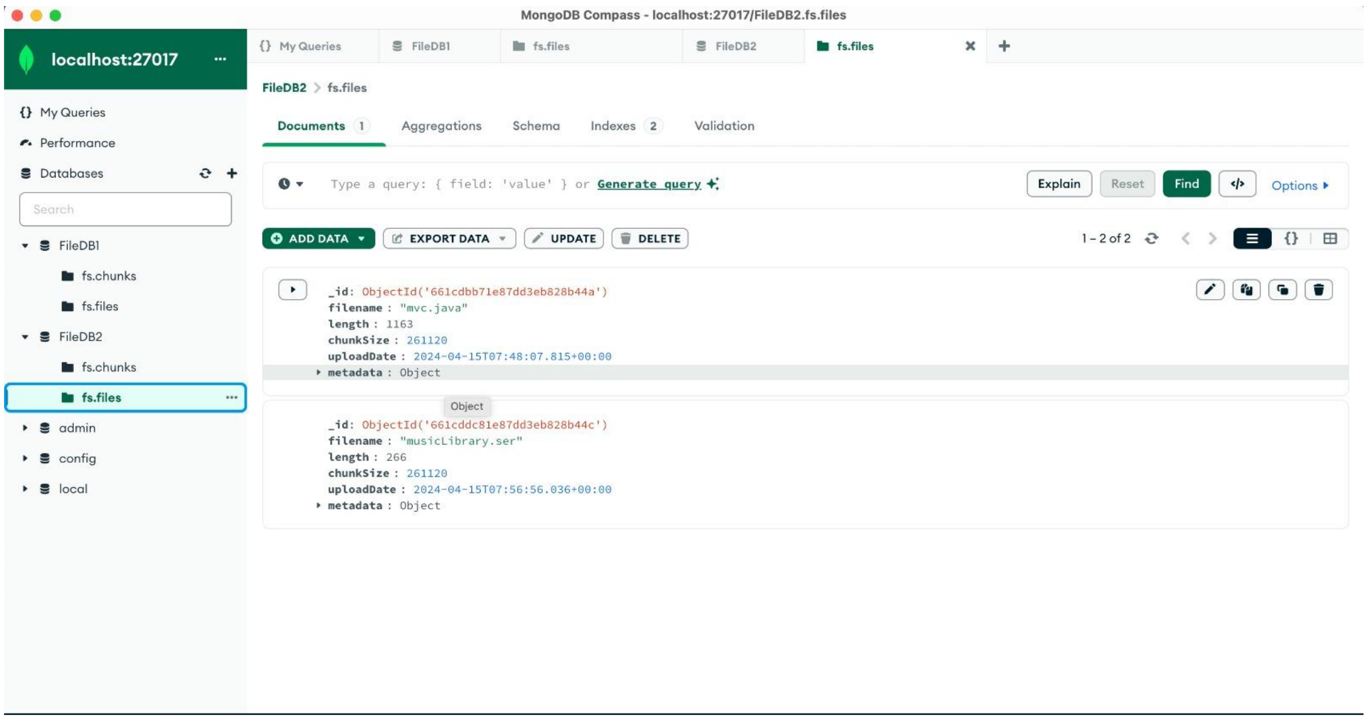
Screenshot9



```
_id: ObjectId('661cdbb68723be2e5455b1e8')
filename : "mvc.java"
length : 1163
chunkSize : 261120
uploadDate : 2024-04-15T07:48:06.172+00:00
metadata : Object
```

```
_id: ObjectId('661cddd28723be2e5455b1ea')
filename : "musicLibrary.ser"
length : 266
chunkSize : 261120
uploadDate : 2024-04-15T07:57:06.731+00:00
metadata : Object  261120
```

Screenshot10

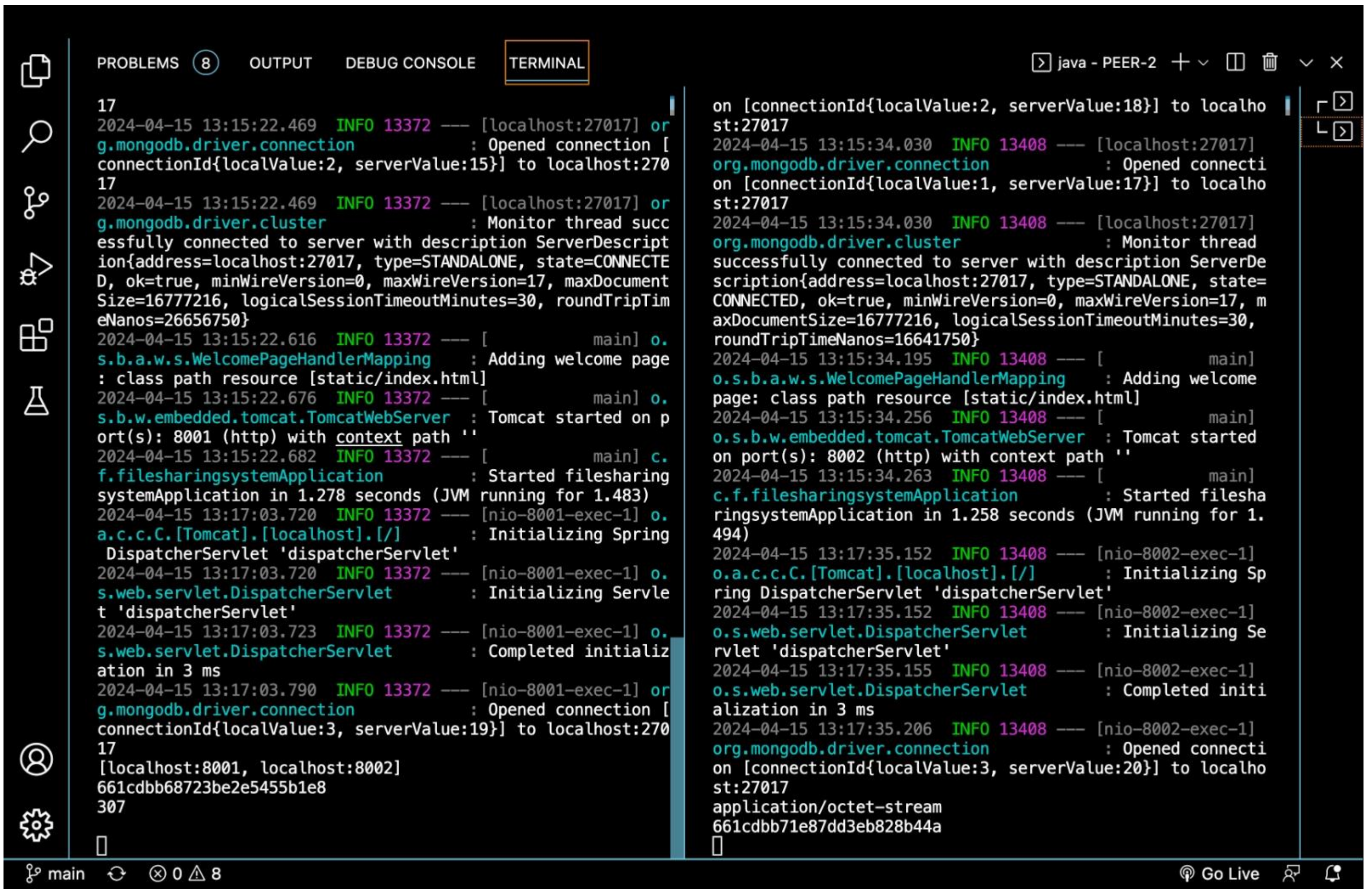


```
_id: ObjectId('661cdbb71e87dd3eb828b44a')
filename : "mvc.java"
length : 1163
chunkSize : 261120
uploadDate : 2024-04-15T07:48:07.815+00:00
metadata : Object
```

Object

```
_id: ObjectId('661cddc81e87dd3eb828b44c')
filename : "musicLibrary.ser"
length : 266
chunkSize : 261120
uploadDate : 2024-04-15T07:56:56.036+00:00
metadata : Object
```

Screenshot11



```
17
2024-04-15 13:15:22.469  INFO 13372 --- [localhost:27017] or
g.mongodb.driver.connection              : Opened connection [
connectionId{localValue:2, serverValue:15}] to localhost:270
17
2024-04-15 13:15:22.469  INFO 13372 --- [localhost:27017] or
g.mongodb.driver.cluster                 : Monitor thread succ
essfully connected to server with description ServerDescript
ion{address=localhost:27017, type=STANDALONE, state=CONNECTE
D, ok=true, minWireVersion=0, maxWireVersion=17, maxDocument
Size=16777216, logicalSessionTimeoutMinutes=30, roundTripTim
eNanos=26656750}
2024-04-15 13:15:22.616  INFO 13372 --- [           main] o.
s.b.a.w.s.WelcomePageHandlerMapping    : Adding welcome page
: class path resource [static/index.html]
2024-04-15 13:15:22.676  INFO 13372 --- [           main] o.
s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat started on p
ort(s): 8001 (http) with context path ''
2024-04-15 13:15:22.682  INFO 13372 --- [           main] c.
f.filesharingsystemApplication           : Started filesharing
systemApplication in 1.278 seconds (JVM running for 1.483)
2024-04-15 13:17:03.720  INFO 13372 --- [nio-8001-exec-1] o.
a.c.c.C.[Tomcat].[localhost].[/]         : Initializing Spring
 DispatcherServlet 'dispatcherServlet'
2024-04-15 13:17:03.720  INFO 13372 --- [nio-8001-exec-1] o.
s.web.servlet.DispatcherServlet          : Initializing Servle
t 'dispatcherServlet'
2024-04-15 13:17:03.723  INFO 13372 --- [nio-8001-exec-1] o.
s.web.servlet.DispatcherServlet          : Completed initializ
ation in 3 ms
2024-04-15 13:17:03.790  INFO 13372 --- [nio-8001-exec-1] or
g.mongodb.driver.connection              : Opened connection [
connectionId{localValue:3, serverValue:19}] to localhost:270
17
[localhost:8001, localhost:8002]
661cdbb68723be2e5455b1e8
307
▯
```

```
on [connectionId{localValue:2, serverValue:18}] to localho
st:27017
2024-04-15 13:15:34.030  INFO 13408 --- [localhost:27017]
org.mongodb.driver.connection              : Opened connecti
on [connectionId{localValue:1, serverValue:17}] to localho
st:27017
2024-04-15 13:15:34.030  INFO 13408 --- [localhost:27017]
org.mongodb.driver.cluster                 : Monitor thread
successfully connected to server with description ServerDe
scription{address=localhost:27017, type=STANDALONE, state=
CONNECTED, ok=true, minWireVersion=0, maxWireVersion=17, m
axDocumentSize=16777216, logicalSessionTimeoutMinutes=30,
roundTripTimeNanos=16641750}
2024-04-15 13:15:34.195  INFO 13408 --- [           main]
o.s.b.a.w.s.WelcomePageHandlerMapping    : Adding welcome
page: class path resource [static/index.html]
2024-04-15 13:15:34.256  INFO 13408 --- [           main]
o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat started
on port(s): 8002 (http) with context path ''
2024-04-15 13:15:34.263  INFO 13408 --- [           main]
c.f.filesharingsystemApplication           : Started filesha
ringsystemApplication in 1.258 seconds (JVM running for 1.
494)
2024-04-15 13:17:35.152  INFO 13408 --- [nio-8002-exec-1]
o.a.c.c.C.[Tomcat].[localhost].[/]         : Initializing Sp
ring DispatcherServlet 'dispatcherServlet'
2024-04-15 13:17:35.152  INFO 13408 --- [nio-8002-exec-1]
o.s.web.servlet.DispatcherServlet          : Initializing Se
rvlet 'dispatcherServlet'
2024-04-15 13:17:35.155  INFO 13408 --- [nio-8002-exec-1]
o.s.web.servlet.DispatcherServlet          : Completed initi
alization in 3 ms
2024-04-15 13:17:35.206  INFO 13408 --- [nio-8002-exec-1]
org.mongodb.driver.connection              : Opened connecti
on [connectionId{localValue:3, serverValue:20}] to localho
st:27017
application/octet-stream
661cdbb71e87dd3eb828b44a
▯
```