16:332:567 - Software Engineering I

STOCK MARKET INVESTMENT FANTASY LEAGUE

REPORT 3

Group 6

Jia Ding

Nikhila Lavu

Pratyusha Nandamuri

Vaishnavi Kakumani

Zhiyue Wang

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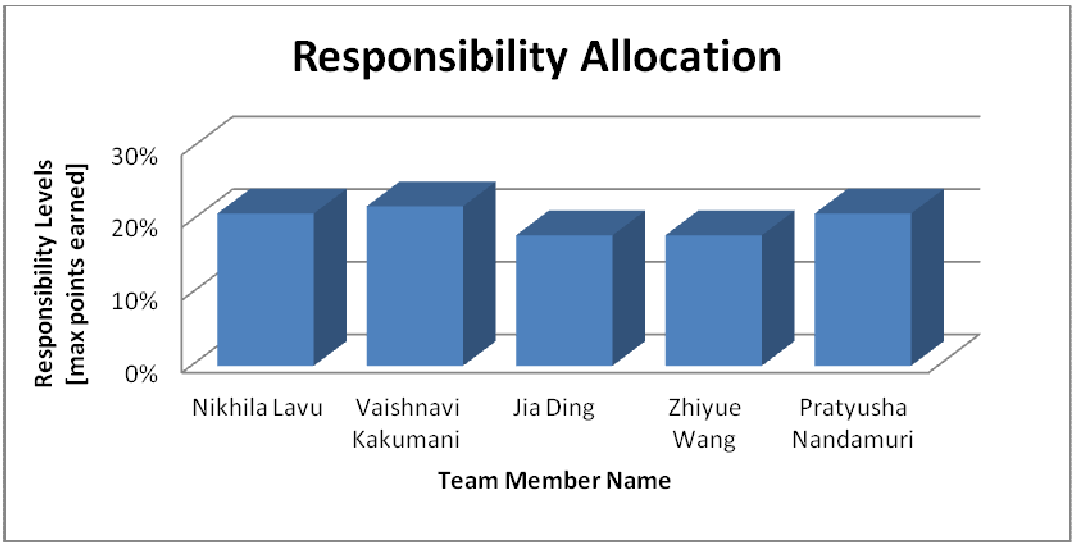
1. INDIVIDUAL CONTRIBUTIONS BREAKDOWN:

The effort breakdown for all team members is shown in the following responsibility matrix and responsibility allocation chart.

Responsibility Levels	Team Member Name				
	Nikhila Lavu	Vaishnavi Kakumani	Jia Ding	Zhiyue Wang	Pratyusha Nandamuri
Project management	30%	40%			30%
Cover Page and Individual Contributions Breakdown			100%		
Table of Contents					100%
Summary of changes	100%				
Customer statement of Requirements	70%			30%	
Glossary of terms		20%	80%		
Functional Requirement specification					100%
Non Functional Requirements	50%			50%	
Effort estimation using use case points					100%
Domain Analysis		100%			
Interaction Diagrams		30%		10%	60%
Class Diagram and Interface Specification		100%			
System Architecture and System Design	80%		20%		
Algorithms and Data Structures		100%			
User Interface Design and Implementation	100%				
History of Work & Current Status of Implementation		100%			
Conclusion and Future work	100%				
References		100%			


Responsibility Allocation
Responsibility Levels [max points earned]
30%
20%
10%
0%
Nikhila Lavu
Vaishnavi Kakumani
Jia Ding
Zhiyue Wang
Pratyusha Nandamuri
Team Member Name

2. TABLE OF CONTENTS:

3. SUMMARY OF CHANGES

- Revised Customer Statement of Requirements
- Added a another requirement –Staying in financial loop
- Edited Glossary
- Added 10 more use cases to complement the system
- Revised Use Case Diagram to reflect changes in Use Cases
- System sequence diagrams and interaction diagrams were changed according to the new changes in use cases
- Causal and detailed descriptions were edited
- Class Diagram was completely redone to accommodate newly added classes
- Added Use Case Points Section
- Cohesion matrix has been computed for all the classes using SCOM, CC/LSCC, CAMC
- Updated traceability matrix to accommodate new requirements and use cases
- Added new breakdown of responsibilities, future work, history of work
- Domain model revamped according to the new implementation
- Persistent Data Storage section updated with newly added tables
- Design patterns are now included
- Updated User Interface Design section with new screen shots, added conclusion and recommendations.

4. CUSTOMER STATEMENT OF REQUIREMENTS

To whom it may concern,

I write on the behalf of my trading partners who require a platform where they can either learn at first hand the techniques required to invest in a stock market or hone their existing skills of trading. In the past years we trained the traders by letting them trade in the actual market itself by giving them small amounts of money and watching closely the techniques that they use to make the investments. In the present situation of market debacles, this idea seemed to be a very expensive taking into account the number of traders that our company is hiring right now. Another reason that is hindering the actual investments is the current nature of the market. In the time when the trading gurus are experiencing losses, it is not a safe idea to let loose the traders who are novice at the art of investing. Yet another reason for the want of this type of platform is that we need a place where even the most experienced traders can try and practice the new techniques that they may have before they use them in the actual markets.

What I have in my mind right now is a virtual stock market web application which will allow the investors to buy and sell the stocks virtually without entering the actual market itself. This idea of virtual stock market as you may know is not a new technique. There are a lot of web-sites that offer this kind of service to both amateur traders and trading gurus. This will be used not only to train the new traders but will also be a testing platform for advanced traders where they can practice new strategies, improve their decision making skills along with watching market from outside it. What the existing stock market games lack is a bit of sophistication that actual markets have and the too much of advertising which is taking away the sense of importance of the game. What I propose right now will be called TradeFun! For future references and will give the traders a chance to trade virtually here in the company itself.

Our aim is to make TradeFun! an interactive website based system which will simulate the real world stock market. It make the game very convenient to the returning users, we will be required to have a quick and easy registration process wherein the user will be able to choose his personalized username and password. From the time of registration, we will have to address

the user as a trader to continue the game spirit. Each trader will be given certain amount of virtual money at the time of the registration completion and the trader is free to use this money to make transactions. An upper cap can be placed to the amount of stocks that he/she can buy in certain amount of time. TradeFun! should keep track of all the transactions that the trader does and have them ready for any future references. It should also update the trader portfolios timely to ensure transparency of the system. Moreover, our site should conduct real-time, internal updates to regularly determine both the value of a trader's portfolio and the value of each stock in the virtual market. This can be achieved by subscribing to the real time date from trusted and updated vendors like Yahoo! Finance.

To personalize the game according to the traders choice, TradeFun! should have the ability to track his past trades and post comments on them. For this purpose, we are required to setup a module that is something like a trade diary where the system updates the trades and the trader will have a chance to put his/her personal comments and additional plans. For the purpose of teaching game to the beginners, there will be a quick links tab in the home page which will be redirecting to external websites with relevant information to the game.

Finally, to encourage the top scoring traders the website will award ranks to the traders depending on the amount of money that they are able to earn through balanced or strategic trading. Trader with first rank will be awarded more money by the website to keep up the spirit and his name will be displayed as the "TOP PLAYER OF WEEK/MONTH" in all the traders' home pages.

At the end of this narrative, a few comments that I would like to add are that TradeFun! should not only be a platform for the traders to buy and sell stocks as it may appear but it should also teach the traders the pitfalls of the current stock markets. By playing the game, they should be able to improve their strategic decision making, smart trading skills along with learning the basics of trading. After conducting a series of interviews with the investors and taking note of their individual requirements and what they would like to see in a web-based stock market fantasy league application, a majority of responses advised eight important requirements. I have attached these requirements below.

I wish you and your team all the very best for the development of the TradeFun! and would like to answer any questions that you may have in the future.

Sincerely,
Stanley Jobs
Trading League LLC

List of Requirements:

REQ 1: TradeFun! Website

Traders are requesting for a virtual stock market website where they can trade stocks and practice their existing and new strategies. Website should be able to provide stock information and give a chance to invest in the stock market. It should be tailored to the user's individual needs.

REQ 2: Staying in Financial loop

TradeFun! should update the users time to time with latest information on the stock market and trading. This can be achieved by displaying financial news in the homepage(This news comes from external sources like CNBC, Reuters), giving user an idea of the top gaining companies and losing companies, stocks that have the highest volumes. This information should be updated whenever page is updated.

REQ 3: Graphical User Interface (GUI)

User interface is what stands between trader and back end. So a decent look is expected with not too much of pictures and advertisements. Any required task should be done with a few number of mouse clicks.

REQ 4: Reliability

Regular maintenance is required to keep the website up to date and it should be able to withstand decent amount of traffic. Stock data should be updates as quickly as possible.

REQ 5: Trader Portfolios

Each investor will have to register to play TradeFun! Once registered, a profile should be created. An investor portfolio must also be maintained, including previous and current stock transactions and amounts of money earned and lost.

REQ 6: Monitoring activities

Administrator should be there to resolve any issues that traders might have and perform updates maintenances. This monitoring playing a crucial role in maintaining Forum, which requires the information should be pertaining to stock market and no personal discussions should be allowed.

REQ 7: Automatic trading based on the thresholds

Users should have the option of setting threshold amounts. If price of the stock drops or rises beyond this threshold, then, the application should either buy or sell according to the set options of the user. He/she should be informed about the success/failure of the trade by sending an email notification.

REQ 8: Updating stock prices

Continuous update of the stock prices should be provided for decent reliability. Most important thing is that the prices should be accurate and should be within a limit of 15 minutes. Too much of lag between the real time data and the system data is not appreciated.

REQ 9: Ranking and Rewards

Ranking should be given to the traders based on the performance and best player of the week should be awarded with an incentive.

5. GLOSSARY

- **ASK PRICE:** The price that a security holder is willing to sell a security, at a given time.
- **BID PRICE:** The price that a buyer is willing to pay for a security.
- **COMMISSION:** The fee a broker charges for administering a trade, also known as brokerage fees.
- **CHANGE IN %:** change is the difference between the last closing price and the current price (Last trade).Change percent signifies the profit per share made by the company.
- **EXPIRATION DATE:** The last day upon which an option or futures contract can be exercised or traded.
- **LEADERBOARD:** The users weekly rankings will be displayed on the leaderboard.
- **LIMIT ORDER:** An order given to a broker by a customer where the order is not executed until the price reaches that price limit set by investor. Limits buy sets a price ceiling whereas limit sell sets a price floor for the investment price.
- **MARKET ORDER:** An order for immediate execution place with a broker to buy or sell.
- **STOP ORDER:** An order given to a broker by a customer where the order is not executed until the price reaches that stop price set by investor. Stop buy sets a price floor whereas stop sell sets a price ceiling for the investment price.
- **TICKER SYMBOL:** A ticker symbol is a combination of letters that identifies a stock, bond, option or the future contract.
- **VOLUME:** Volume reflects the supply and demand for stocks.Volume measures market liquidity by counting the number of shares that are traded over a given period.If the volume of a stock is less,which means that the company has some problems going on. As a result, selling an illiquid stock quickly can be difficult or impossible without accepting the lower bid price.

6. FUNCTIONAL REQUIRMENTS SPECIFICATION

a. STAKEHOLDERS

i. Internal Stakeholders

- **Owner**: A person who is legally allowed to own the web application. His interests are profits, expenditure, customer satisfaction and competitors.
- **Manager**: A person who overlooks the expenditure, resources, maintenance and development of the web application. His interests include customer satisfaction, expenditure, performance, employees, maintenance and development.
- **Website Administrator**: The person responsible for putting up the web application initially and then maintaining it and providing support when necessary. His interests are working conditions, job stability, salary and benefits.

ii. External Stakeholders

- **User or Customer**: The person who plays the game. His interests may include pleasure in online fantasy games, trying to get an idea of how trading and stock market works and trying out various investment strategies to see if they actually work.
- **Educator**: An educator is someone who may use the game to teach his students about trading and stocks. His interests are imparting knowledge to his students, simulating their interest.

b. ACTORS AND GOALS

- **User**: The person who uses the website to play the game.

  Type: Initiating

  Goal: Register an account, login, maintain his profile, buy and sell stocks.
- **Administrator**: The person who designs and maintains the website.

  Type: Initiating

  Goal: Website maintenance and rank the players weekly depending on their monetary values.

- **Database**: A place where the various stocks being offered are stored as well as their current prices. Database also has the list of users currently enrolled apart from their profile information.

  Type: Participating

  Goal: None
- **Yahoo Finance**: The external source from which the stock quotes are picked up periodically.

  Type: Participating

  Goal: None

c. USE CASES

i. Casual Description

USE CASE:1 LOGIN

Once a user hits our URL, he will be prompted for his login details-username and password which are then authenticated by our system. This authentication is to make sure every user can access only his account and his trade.

USE CASE 2: REGISTRATION

A new user can join the game at any time by registering his details with the system. The login page has a sign for registration in case he hasn't before.

USE CASE 3: LOGOUT

Once a user finishes playing the game, he gets an option to log out thereby making sure nobody else can access his trade on that particular computer.

USE CASE 4: EDIT MY PROFILE

Once logged in, a user will be able to access his profile and make changes to it. He can even delete his profile if he doesn't need it anymore. Once a profile is deleted, the respective user information will be stored in a separate table for security reasons

USE CASE 5: VIEW TRADING HISTORY

This process with provide the user the ability to look at his past trade transactions. The My Trading History tab will provide a complete list of all the transactions till date. The user can also enter any comments he wishes to make about a trade.

USE CASE 6: VIEW LEADER BOARD

Players are ranked weekly depending on their portfolio values at the end of the week. To enter the ranking, a player's portfolio value must be greater than the average portfolio values of all the users. Also, he should have a minimum of fifteen completed transactions in his history. These decisions were taken to ensure fair play. Winner of each week is given 250$ incentive as virtual money.

USE CASE 7: MARKET ORDER: BUY

This process involves buying stocks using Market Order. The user will be provided with a drop down box which has the names of the stocks offered and their ticker symbols. When the user decides on a stock, the stock information like its buy price, sell price etc are displayed. The user can then purchase any number of stocks he can afford to. Confirmation is displayed and an email notification is sent once the transaction has been made.

USE CASE 8: MARKET ORDER: SELL

This process involves buying stocks using Market Order. The user will be provided with a drop down box which has the names of the stocks offered and their ticker symbols. When the user decides on a stock, the stock information like its buy price, sell price etc are displayed. The user

can then purchase any number of stocks he can afford to. Confirmation is displayed and an email notification is sent once the transaction has been made.

USE CASE 9: LIMIT ORDER: BUY

This process involves buying stocks using Limit Order. The user will be provided with a drop down box which has the names of the stocks offered and their ticker symbols. When the user decides on a stock, the stock information like its buy price, sell price etc are displayed. The user can enter a limit threshold value below which automatic purchase of the stock will be made by the system and an email notification will be sent informing the user about the transaction. If the user doesn't have sufficient funds at this point, an email notification is sent saying that he doesn't have enough funds and the order is deleted from the table.

USE CASE 10: . LIMIT ORDER: SELL

This process involves selling stocks using Limit Order. The user will be provided with a drop down box which has the names of the stocks offered and their ticker symbols. When the user decides on a stock, the stock information like its buy price, sell price etc are displayed. The user can enter a limit threshold value above which automatic selling of the stock will be made by the system and an email notification will be sent informing the user about the transaction. If the user doesn't have sufficient stocks at this point, an email notification is sent saying that he doesn't have enough stocks and the order is deleted from the table.

USE CASE 11: STOP ORDER: BUY

This process involves buying stocks using Stop Order. The user will be provided with a drop down box which has the names of the stocks offered and their ticker symbols. When the user decides on a stock, the stock information like its buy price, sell price etc are displayed. The user can enter a stop threshold value above which automatic purchase of the stock will be made by

the system and an email notification will be sent informing the user about the transaction. If the user doesn't have sufficient funds at this point, an email notification is sent saying that he doesn't have enough funds and the order is deleted from the table.

USE CASE 12: STOP ORDER: SELL

This process involves selling stocks using Stop Order. The user will be provided with a drop down box which has the names of the stocks offered and their ticker symbols. When the user decides on a stock, the stock information like its buy price, sell price etc are displayed. The user can enter a stop threshold value below which automatic selling of the stock will be made by the system and an email notification will be sent informing the user about the transaction. If the user doesn't have sufficient stocks at this point, an email notification is sent saying that he doesn't have enough stocks and the order is deleted from the table.

USE CASE 13: POST IN FORUM

This process involves allowing the user to start a new thread or reply to an existing one in the forums. Each thread in the forum has its own subject and each post has the username who made the comment.

USE CASE 14: VIEW MY GAME PORTFOLIO

This process provides the user the ability to look at his current portfolio- the stocks he has in it, the current value of the portfolio as well as his account balance.

USE CASE 15: ADD TO WATCHLIST

This process allows the user to watch his favorite stock prices 24X7. The user can add and delete companies to his watch list and the system displays latest stock information about those companies every time the user refreshes the page.

USE CASE 16: VIEW TOP FIVE GAINERS/LOSERS

Using this process, the user can see a list of top five price-gaining and losing companies from our current database of 20 companies. These are the top five companies in the database that have the highest and lowest percentage change in the stock price. The percent change is calculated using the yesterday's closing price and the price at which the latest trade has been made.

USE CASE 17: VIEW MOST ACTIVE COMPANIES

Using this process, the user can see a list of top five active companies which are the companies that have the highest liquidity (volume of stocks) from our current database of 20 companies.

ii. Fully Dressed Description

USECASE1: LOGIN
Related Requirements: REQ 1,4 Initiating Actor: User Actor's Goal: To log into Tradefun. Participating Actor: Database Pre-conditions: 1. The database is non-empty 2. The user has an active account Post-conditions: User successfully logs into his account.

Flow of Events for Main Success Scenario:

1. ← System prompts the user for his details: username and password

2. → User enters them.

3. ← System verifies them.

4. ← System informs the user they are valid and logs him in.

Flow of Events for Extensions (Alternate Scenario 1):

2a. User forgot his password.

1. System asks him a security question he has entered while registration.

2. Checks if the answer entered is correct.

3. Sends an email containing the Reset Password link to the registered email ID

Flow of Events for Extensions (Alternate Scenario 2):

2a. User enters invalid password.

1. System informs the user about the invalid entry.

2. Prompts him to enter the correct information.

USECASE 2: REGISTRATION

Related Requirements: REQ 1

Initiating Actor: User

Actor's Goal: To create an account with Trade fun

Participating Actor: Database

Pre-conditions: The database is empty

Post-conditions: 1. User successfully creates an account.

2. He is given a portfolio to start the game.

Flow of Events for Main Success Scenario:

1. → User prompts the system to create an account.

2. ← System starts the registration process.

3. → User enters the required information and submits it.

4. ← System enters this information into the database.

5. ← System adds a new portfolio into the database.

6. ← System informs the user that his account has been created and he can now play the game.

Flow of Events for Extensions (Alternate Scenario 1):

3a. User already has an account.

1. System cancels the registration process.

2. System informs the user about his existing account.

3. Prompts him to enter the details of that account.

Flow of Events for Extensions (Alternate Scenario 2):

3a. User enters invalid information.

1. System informs the user about the invalid entries.

2. Prompts him to enter the correct information.

USE CASE 3: LOGOUT
Related Requirements: REQ 1, 4 Initiating Actor: User Actor's Goal: To log out of Tradefun. Participating Actor: None Pre-conditions: The user is logged in Post-conditions: User successfully logs out of his account. Flow of Events for Main Success Scenario: 1. → User instructs the system to log him out using the 'Logout' link. 2. ← System clears his session, logs him out and redirects to the login page

USE CASE 4: EDIT MY PROFILE
Related Requirements: REQ 1,4 Initiating Actor: User Actor's Goal: To edit his profile. To delete it when necessary. Participating Actor: Database Pre-conditions: 1. The database is non-empty 2. The user has an active account Post-conditions: User has successfully edited his profile. Flow of Events for Main Success Scenario: 1. → User asks the system to edit his profile. 2. ← System displays his current profile. 3. → User makes required changes. 4. ← System updates the changes into the database. 5. ← System informs the user that the changes have been made. Flow of Events for Extensions (Alternate Scenario 1): 1a. User requests profile deletion. 1. System asks him for confirmation. 2. User confirms. 3. System deletes him and his portfolio from the current table and puts them in a separate non-existing users' table. 4. Informs the user about his account deletion.

USE CASE 5: VIEW TRADING HISTORY
Related Requirements: REQ 1,5 Initiating Actor: User Actor's Goal: To view his previous trade transactions Participating Actor: Database Pre-conditions: The user has an active account and past trade transactions Post-conditions: User's trading history has been displayed Flow of Events for Main Success Scenario: 1. → User asks the system to display his previous trade transactions. 2. ← System displays them.

USE CASE 6: VIEW LEADER BOARD
Related Requirements: REQ 1,5 Initiating Actor: User Actor's Goal: To view the weekly ranking listed in the Leader board Participating Actor: Database Pre-conditions: 1. The user has an active account Post-conditions: The website's leader board has been displayed Flow of Events for Main Success Scenario: 1. → User asks the system to display the leader board. 2. ← System calculates them depending on the users' portfolio values and displays them.

USE CASE 7: MARKET ORDER: BUY
Related Requirements: REQ 1,8 Initiating Actor: User Actor's Goal: To buy stocks of a company Participating Actor: Database, Yahoo! Finance Pre-conditions: 1. The user is logged into his account. 2. The account has sufficient funds Post-conditions: 1. User successfully buys the new shares. 2. Changes are reflected in the transaction. Flow of Events for Main Success Scenario: 1. → User enters the name of the stock. 2. ← System looks up the price and other information of this stock and displays them. 3. → User enters the quantity of shares he wants to purchase and hits 'buy'. 4. ← System calculates the total money including commission fee that the user must pay. 5. ← System checks the balance of the user's account if he has enough money to pay for it. 6. ← System adds the purchased shares into user's account, displays confirmation and sends email notification Flow of Events for Extensions (Alternate Scenario 1): 5c. User doesn't have enough money in his portfolio 1. User enters the quantity of shares he wants to buy. 2. System informs the total cost including commission fee. 3. System shows an error warning that the balance of his portfolio is unaffordable for purchase.

USE CASE 8: MARKET ORDER: SELL
Related Requirements: REQ 1,8 Initiating Actor: User Actor's Goal: To sell stocks of a company

Participating Actor: Database, Yahoo! Finance

Pre-conditions: 1. The user is logged into his account.

2. The account has sufficient stocks.

Post-conditions: 1. User successfully sells the shares.

2. Changes are reflected in the transaction.

Flow of Events for Main Success Scenario:

1. → User enters the name of the stock.

2. ← System looks up the price and other information of this stock and displays them.

3. → User enters the quantity of shares he wants to sell and hits 'sell'.

4. ← System calculates the total money including commission fee that the user will gain.

5. ← System checks the portfolio of the user's account if he has enough stocks to sell.

6. ← System removes the sold shares from user's account, adds the money gained from transaction into his account, displays confirmation and sends an email notification

Flow of Events for Extensions (Alternate Scenario 1):

5c. User doesn't have enough stocks in his portfolio

1. User enters the quantity of shares he wants to sell.

2. System shows an error warning that his portfolio doesn't have enough number of stocks to sell.

USE CASE 9: LIMIT ORDER: BUY

Related Requirements: REQ 1,7

Initiating Actor: User

Actor's Goal: To buy stocks of a company using Limit Order

Participating Actor: Database, Yahoo! Finance

Pre-conditions: 1. The user is logged into his account and the threshold is set.

2. The account has sufficient funds

Post-conditions: 1. User successfully buys the new shares.

2. Changes are reflected in the transaction.

Flow of Events for Main Success Scenario:

1. → User enters the name of the stock.

2. ← System looks up the price and other information of this stock and displays them.

3. → User enters the limit threshold below which he wants the stock to be brought and the quantity of stocks.

4. ← System looks up the price of the stock every 15 minutes, and once it goes below the threshold, checks the user's account balance and purchases the stock in the event of sufficient funds.

5. ← System adds the purchased shares into user's account and sends an email notification.

Flow of Events for Extensions (Alternate Scenario 1):

4c. User doesn't have enough money in his portfolio

1. User enters the quantity of shares he wants to buy and sets the threshold.

2. System monitors the stock price and when the price drops below the threshold, checks user's balance. In the event of insufficient funds, an email notification is sent to the user informing him the same and the order is deleted.

USE CASE 10: LIMIT ORDER: SELL
Related Requirements: REQ 1,7 Initiating Actor: User Actor's Goal: To sell stocks of a company using Limit Order Participating Actor: Database, Yahoo! Finance Pre-conditions: 1. The user is logged into his account and the threshold is set. 2. The account has sufficient stocks. Post-conditions: 1. User successfully sells the shares. 2. Changes are reflected in the transaction.

Flow of Events for Main Success Scenario:

1. → User enters the name of the stock.

2. ← System looks up the price and other information of this stock and displays them.

3. → User enters the limit threshold above which he wants the stock to be sold and the quantity of stocks.

4. ← System looks up the price of the stock every 15 minutes, and once it goes above the threshold, checks the user's portfolio and sells the stock in the event of sufficient number of stocks existing.

5. ← System deducts the sold shares from user's account, adds the amount gained during the transaction and sends an email notification.

Flow of Events for Extensions (Alternate Scenario 1):

4c. User doesn't have enough stocks in his portfolio

1. User enters the quantity of shares he wants to sell and sets the threshold.

2. System monitors the stock price and when the price goes above the threshold, checks user's portfolio. In the event of insufficient stocks, an email notification is sent to the user informing him the same and the order is deleted.

USE CASE 11: STOP ORDER: BUY

Related Requirements: REQ 1,7

Initiating Actor: User

Actor's Goal: To buy stocks of a company using Stop Order

Participating Actor: Database, Yahoo! Finance

Pre-conditions: 1. The user is logged into his account and the stop threshold is set.

2. The account has sufficient funds

Post-conditions: 1. User successfully buys the new shares.

2. Changes are reflected in the transaction.

Flow of Events for Main Success Scenario:

1. → User enters the name of the stock.

2. ← System looks up the price and other information of this stock and displays them.

3. → User enters the stop threshold above which he wants the stock to be brought and the quantity of stocks.

4. ← System looks up the price of the stock every 15 minutes, and once it goes above the threshold, checks the user's account balance and purchases the stock in the event of sufficient funds.

5. ← System adds the purchased shares into user's account and sends an email notification.

Flow of Events for Extensions (Alternate Scenario 1):

4c. User doesn't have enough money in his portfolio

1. User enters the quantity of shares he wants to buy and sets the stop threshold.

2. System monitors the stock price and when the price goes above the threshold, checks user's balance. In the event of insufficient funds, an email notification is sent to the user informing him the same and the order is deleted.

USE CASE 12: STOP ORDER: SELL

Related Requirements: REQ 1,7

Initiating Actor: User

Actor's Goal: To sell stocks of a company using Stop Order

Participating Actor: Database, Yahoo! Finance

Pre-conditions: 1. The user is logged into his account and the stop threshold is set.

2. The account has sufficient stocks.

Post-conditions: 1. User successfully sells the shares.

2. Changes are reflected in the transaction.

Flow of Events for Main Success Scenario:

1. → User enters the name of the stock.

2. ← System looks up the price and other information of this stock and displays them.

3. → User enters the stop threshold below which he wants the stock to be sold and the quantity of stocks.

4. ← System looks up the price of the stock every 15 minutes, and once it goes below the threshold, checks the user's portfolio and sells the stock in the event of sufficient number of stocks existing.

5. ← System deducts the sold shares from user's account, adds the amount gained during the transaction and sends an email notification.

Flow of Events for Extensions (Alternate Scenario 1):

4c. User doesn't have enough stocks in his portfolio

1. User enters the quantity of shares he wants to sell and sets the stop threshold.

2. System monitors the stock price and when the price drops below the threshold, checks user's portfolio. In the event of insufficient stocks, an email notification is sent to the user informing him the same and the order is deleted.

USE CASE 13: POST IN FORUM
Related Requirements: REQ 1,6 Initiating Actor: User Actor's Goal: To post comments in the forum Participating Actor: Database Pre-conditions: The user has an active account Post-conditions: User successfully posts his comments in the forum Flow of Events for Main Success Scenario: 1. → User tells the system he wants to start a new thread in the forum. 2. ← System creates a new thread and puts the user as the owner of the thread. 3. → User mentions subject and content of the thread. 4. ← System puts this in as the thread subject and body respectively and makes the thread available for all the users

Flow of Events for Extensions (Alternate Scenario 1):

1c. User replies to an existing thread in the forum

1. User chooses the thread he wants to comment on and posts his reply to it.

2. System stores this post and makes it available for all the users'.

USE CASE 14: VIEW MY GAME PORTFOLIO
Related Requirements: REQ 1,5,8 Initiating Actor: User Actor's Goal: To view his game portfolio Participating Actor: Database Pre-conditions: The user has an active account and an active game portfolio Post-conditions: User's game portfolio has been displayed Flow of Events for Main Success Scenario: 1. → User asks the system to display his game portfolio. 2. ← System displays the stocks he currently holds, his portfolio value as well as his account balance.

USE CASE 15: ADD TO WATCHLIST
Related Requirements: REQ 1,2,8 Initiating Actor: User Actor's Goal: To add companies to the Watch list Participating Actor: Database, Yahoo! Finance Pre-conditions: The user has an active account and is logged in Post-conditions: The company has been added to the Watch List and the system displays updated stock information about the company

Flow of Events for Main Success Scenario:

1. → User asks the system to add his favorite company to the Watch List.

2. ← System adds the requested company and returns it's most updated stock information.

Flow of Events for Extensions (Alternate Scenario 1):

1a. User wants to delete a company from the Watch List

1. User informs the system about the company he wishes to delete from the list.

2. System deletes the company from the list and shows the user the updated list.

USE CASE 16: VIEW TOP FIVE GAINERS/LOSERS
Related Requirements: REQ 1,2 Initiating Actor: User Actor's Goal: To view the top five gaining and losing companies Participating Actor: Database Pre-conditions: The user has an active account and is logged in Post-conditions: The list of top five gaining and losing companies has been displayed Flow of Events for Main Success Scenario: 1. → User asks the system to display the top five gainers/losers. 2. ← System returns those five companies that have the highest and lowest percentage change in the stock price.

USE CASE 17: VIEW MOST ACTIVE COMPANIES
Related Requirements: REQ 1,2 Initiating Actor: User

Actor's Goal: To view the list of most active companies

Participating Actor: Database

Pre-conditions: The user has an active account and is logged in

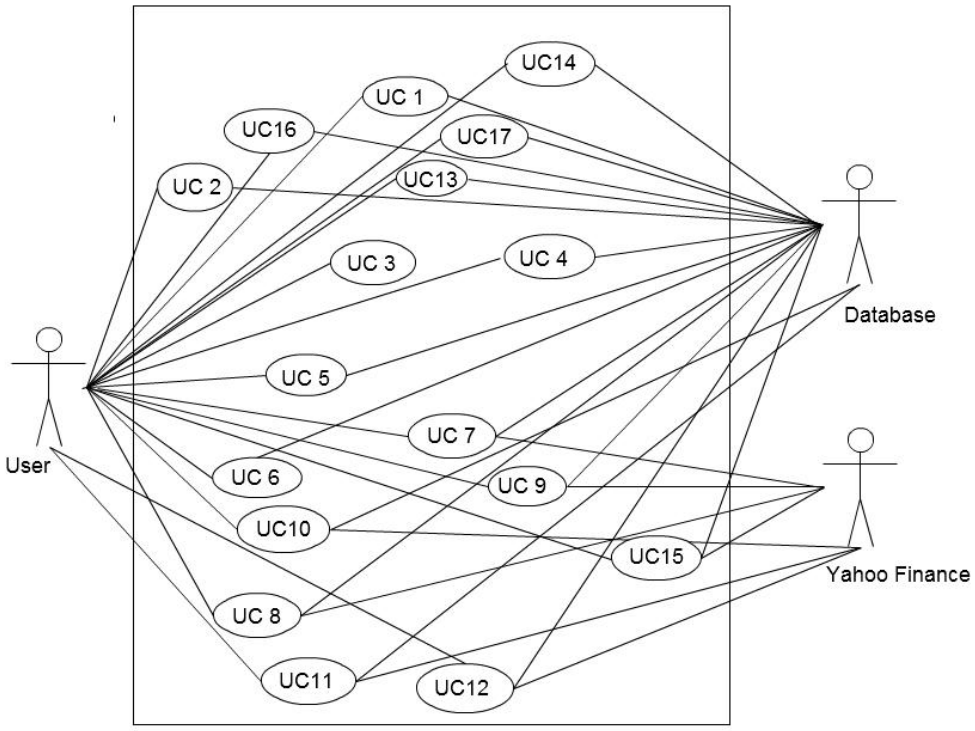
Post-conditions: The list of most active companies has been displayed

Flow of Events for Main Success Scenario:

1. → User asks the system to display the list of most active companies

2. ← System returns those five companies that have the highest liquidity (volume of stocks).

iii. Use Case Diagram



iv. System Requirements - Use Case Traceability Matrix

This is the traceability matrix for the requirements listed earlier:

Req.	Requirement Description	Related Use Cases	Implementation Status
1.	TradeFun! Website	ALL	Complete
2.	Staying in the Financial Loop	US- 15,16,17	Complete
3.	Graphical User Interface (GUI)	N/A	Complete
4.	Reliability	US- 1,3,4	Complete
5.	Trader Portfolios	US-5,6,14	Complete
6.	Monitoring activities	US- 13	Complete
7.	Automatic trading based on the thresholds	US- 9,10,11,12	Complete
8.	Updating Stock Prices	US- 7,8,14,15	Complete
9.	Ranking and Rewards	US- 6	Complete

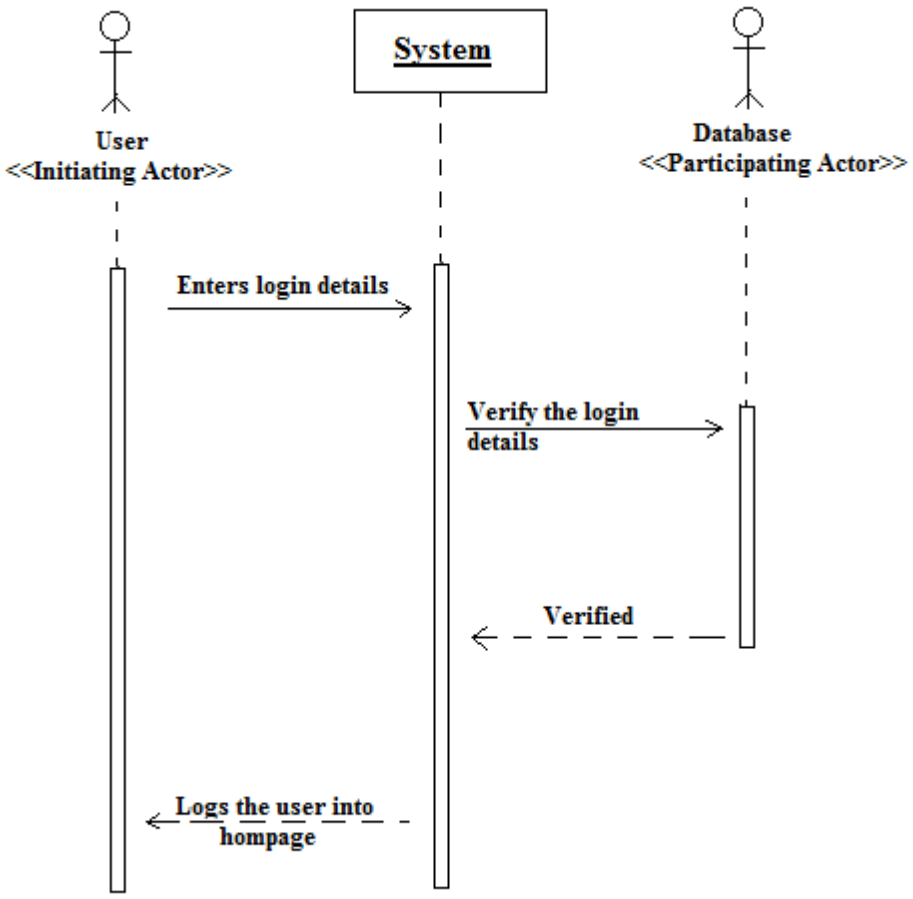
d. System Sequence Diagrams

1. Login

SYSTEM SEQUENCE DIAGRAM:

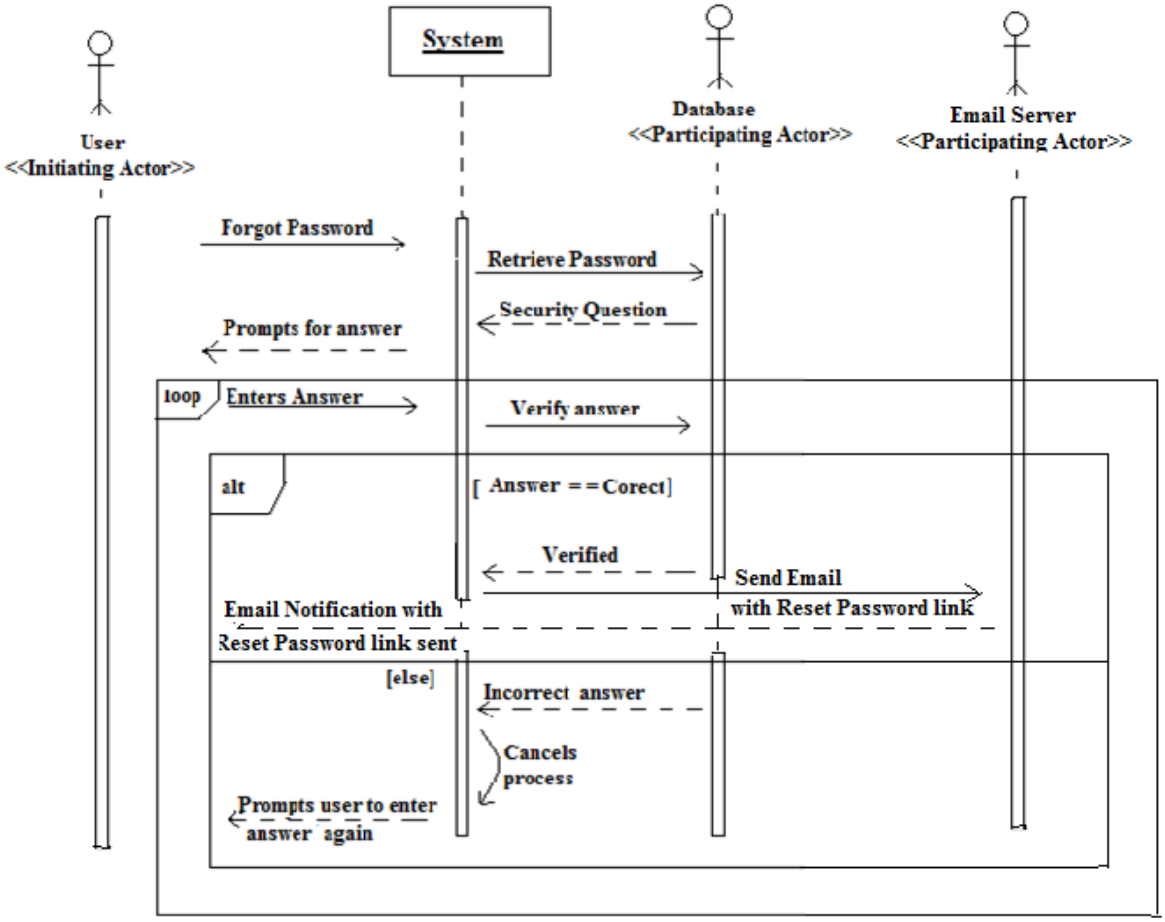
Main Success Scenario:

The user here initiates the log in process by entering his login details- username and password. The system asks the database to verify the login details. Once the login details are found to be correct, the system directs the user to the homepage of Trade Fun !



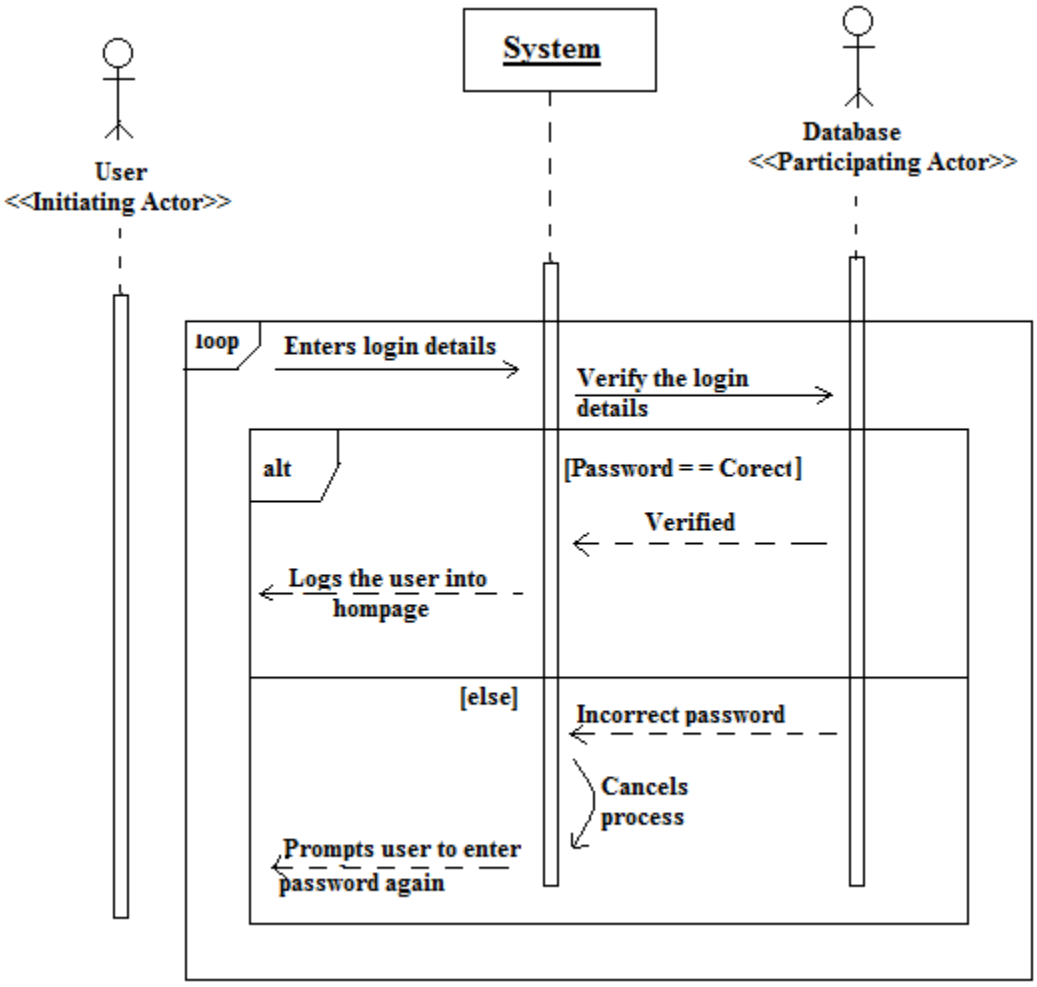
Alternate Scenario I (Forgot Password):

This product provides solution for forgotten passwords. The user can click on the 'Forgot Password?' tab on the login screen. This will prompt the system to retrieve the security question from the database. Once the user answers it correctly, he is sent an email which contains a link to Reset the password.



Alternate Scenario II (Invalid Password):

Sometimes, it may so happen that a user enters an invalid password. In this case, once the database verifies it as invalid, the system cancels the process and prompts the user to enter the password again.

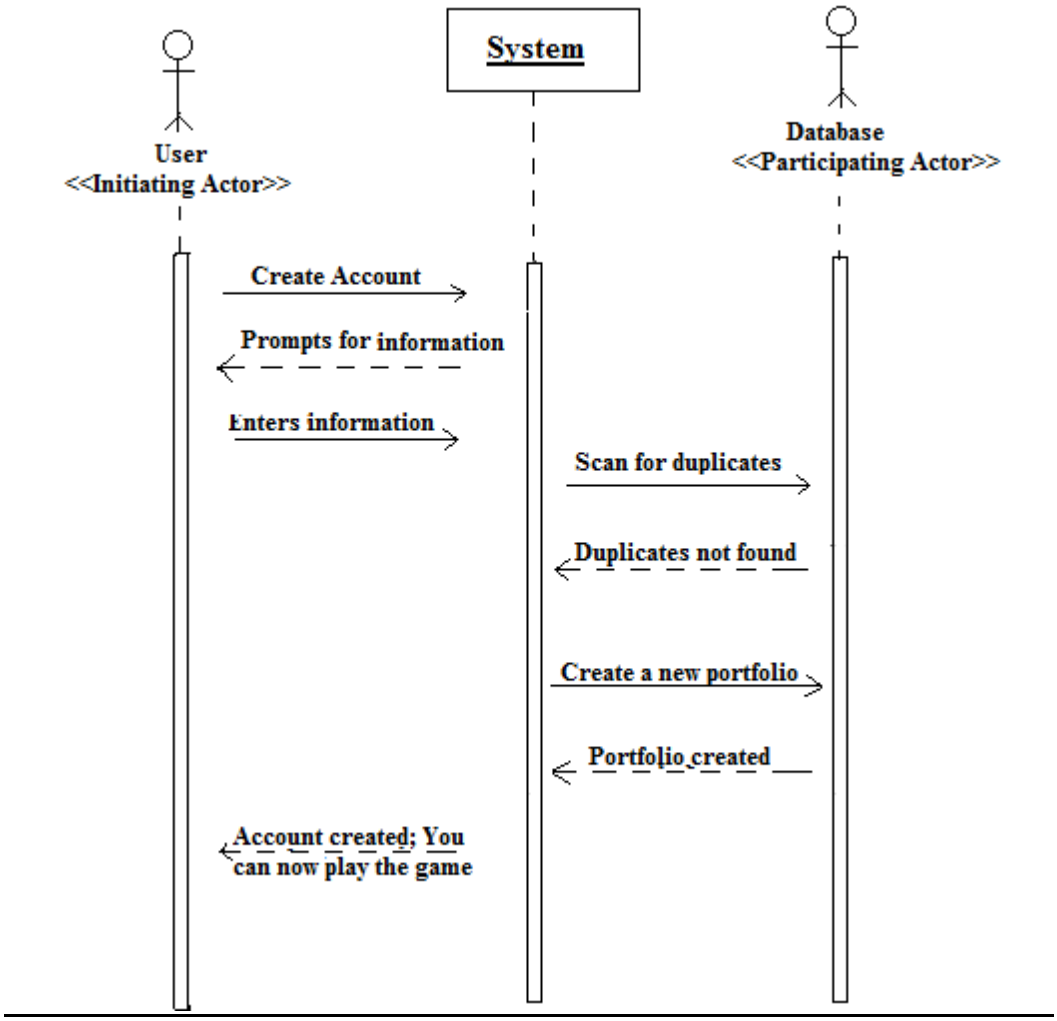


2. Registration

SYSTEM SEQUENCE DIAGRAM:

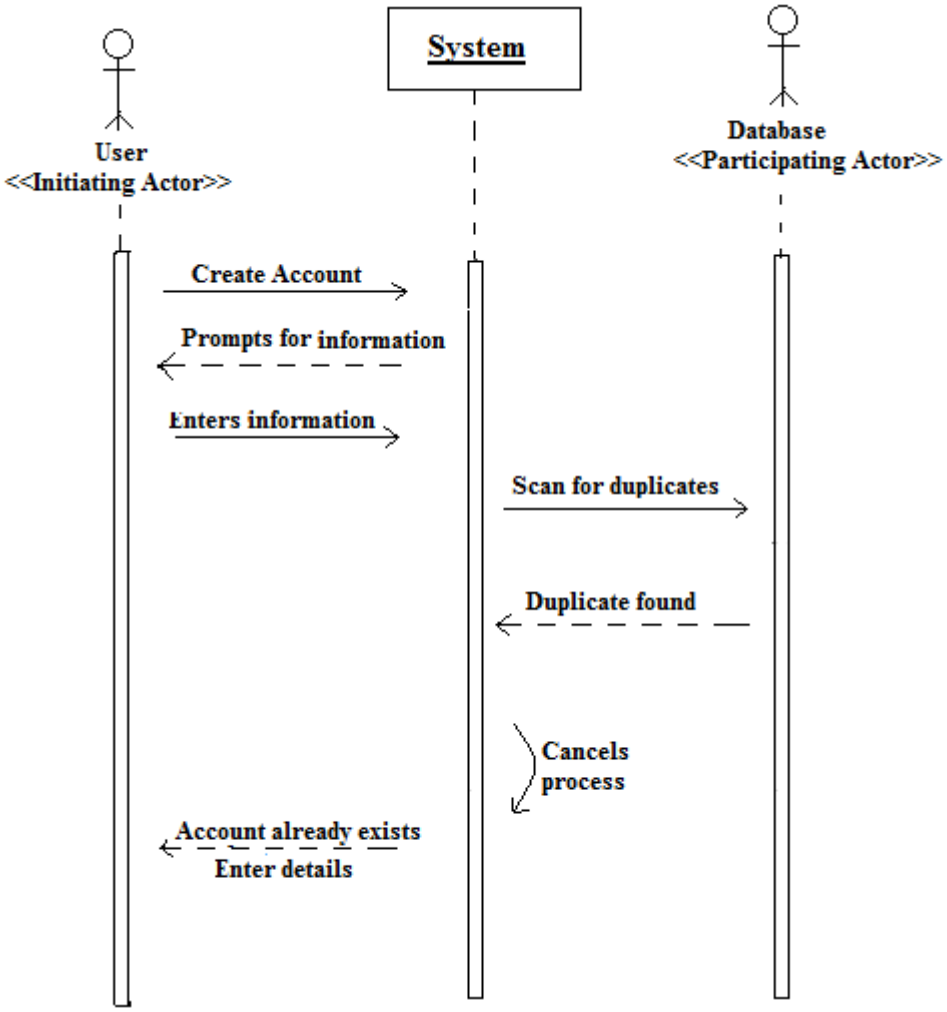
Main Success Scenario:

The Registration process is initiated by the user. He prompts the system to create an account. The system then asks him for some information. Once all the information is submitted by the user, the system requests the database to scan for duplicates. In the absence of any, the database is asked to create a new portfolio for the user. Once this is done, the user is informed of it and is allowed to play the game.



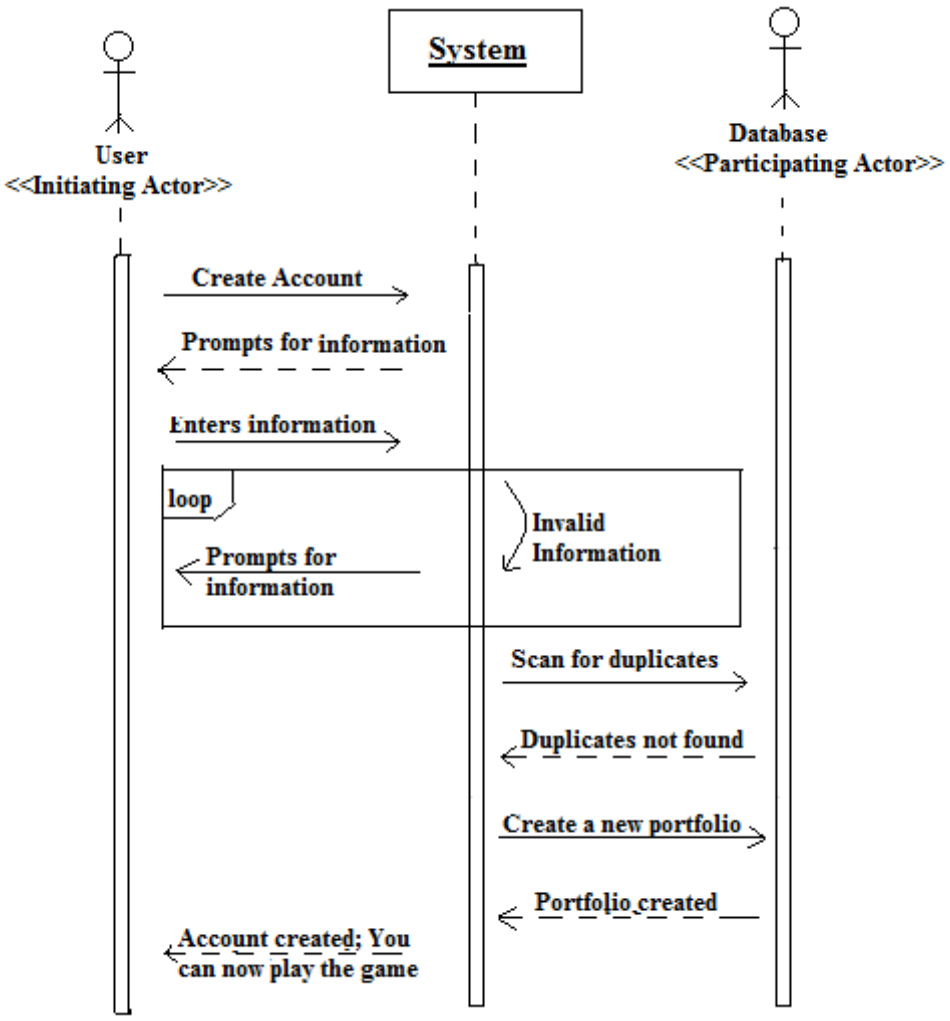
Alternate Scenario I (User already has an account):

Once the user submits his information, the system requests the database to scan for duplicates. If there is any, the process is cancelled, the user is informed of this and is prompted to enter his existing account details.



Alternate Scenario II (Invalid Information):

If the user submits any invalid information during his registration, the system identifies and notifies him immediately. Once he corrects them, the registration will continue.

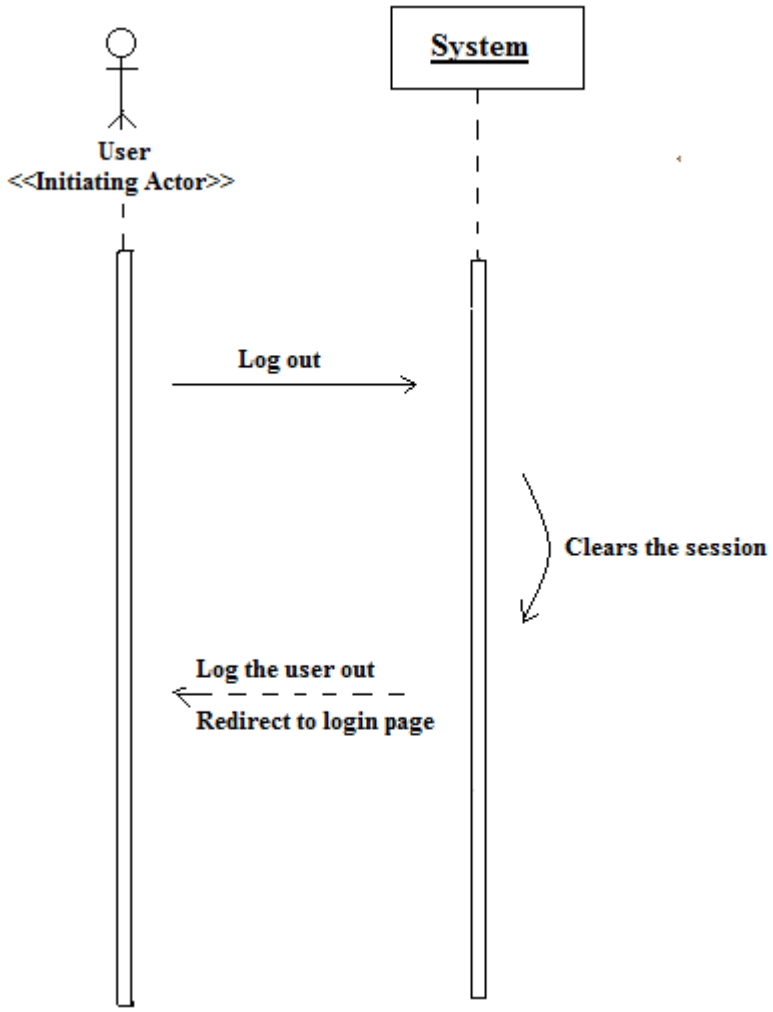


3. Logout

SYSTEM SEQUENCE DIAGRAM:

Main Success Scenario:

The user here initiates the logout process by clicking on 'Logout'. The system then clears his session and logs him out.

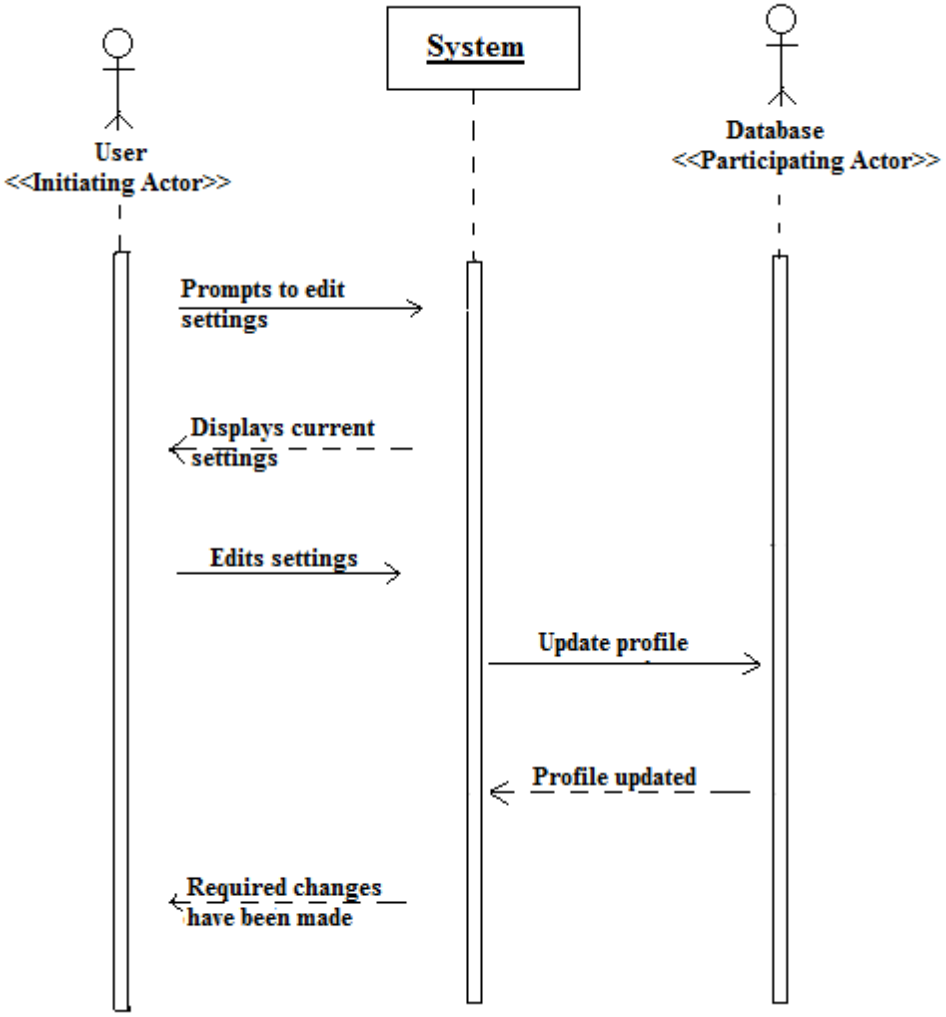


4.Edit my profile

SYSTEM SEQUENCE DIAGRAM:

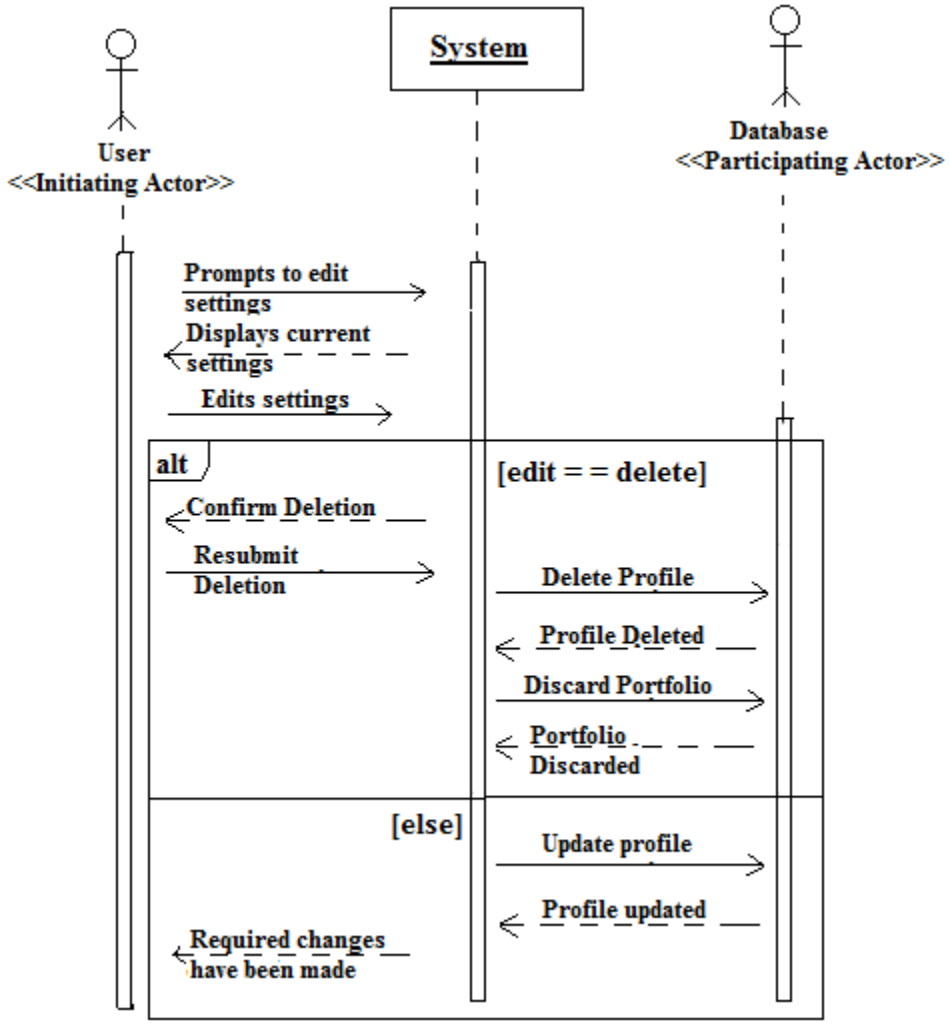
Main Success Scenario:

When the user wants to make any changes, he prompts the system to edit his profile. The system displays his current profile. Once the required changes have been made, the system uploads them to the database and informs the user about it.



Alternate Scenario I (Delete Profile):

Sometimes when a user feels like he no longer needs a profile with Trade Fun !, he can use the delete profile option available. When this happens, the system asks the user for confirmation. Once it is confirmed, the system prompts the database to remove the profile and portfolio and then informs the user of the outcome.

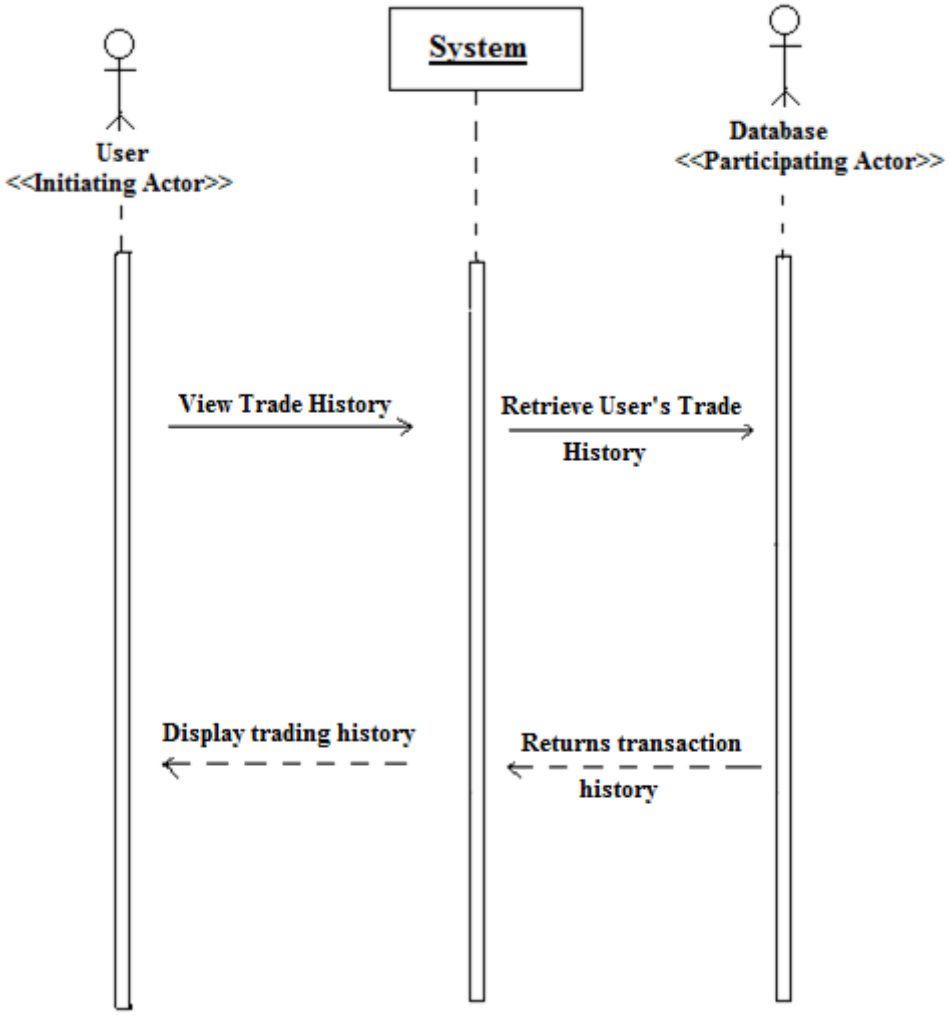


5. View trading history

SYSTEM SEQUENCE DIAGRAM:

Main Success Scenario:

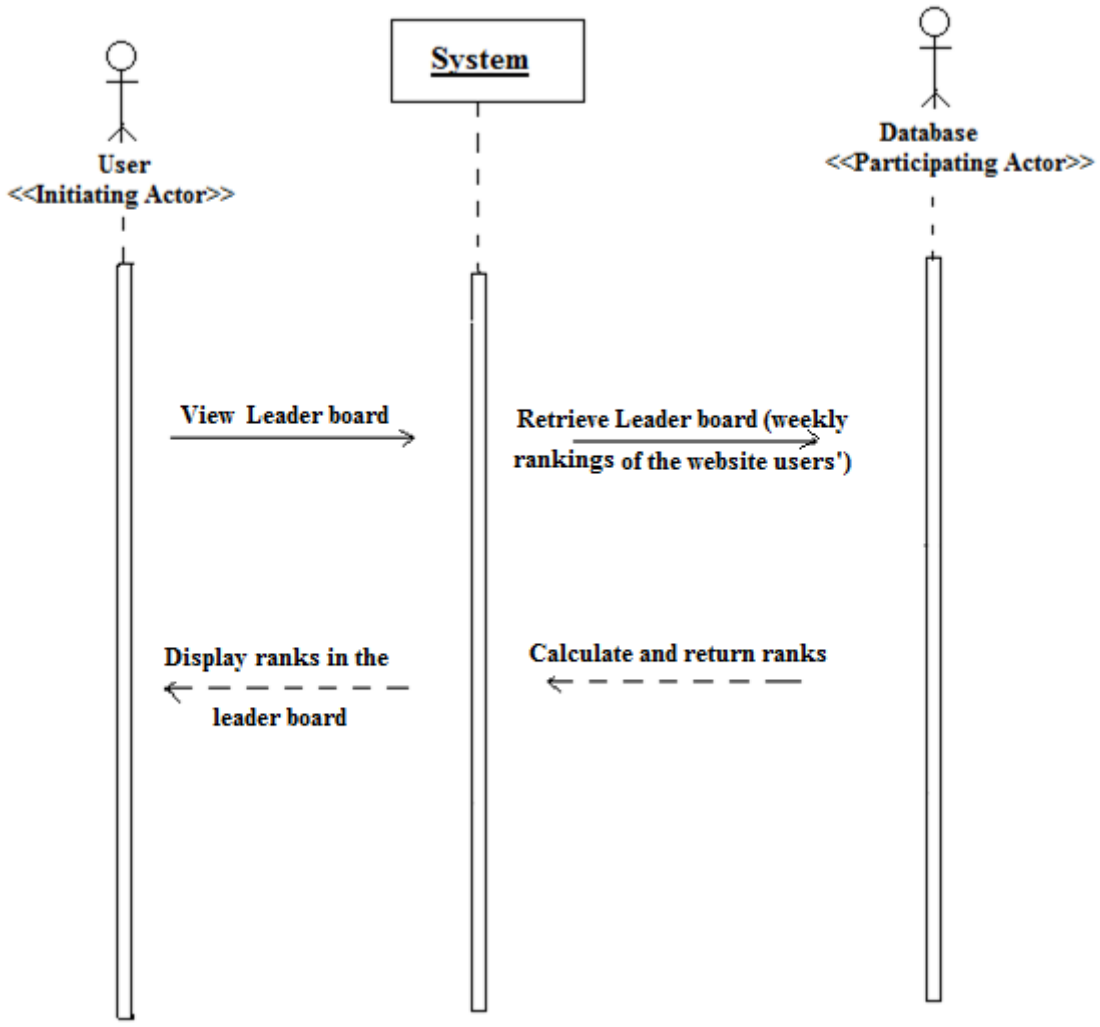
When the user wants to view his past trade transactions, he prompts the system to display his trade history. The system then retrieves all his previous transactions from the database and displays them.



6. View Leader Board

Main Success Scenario:

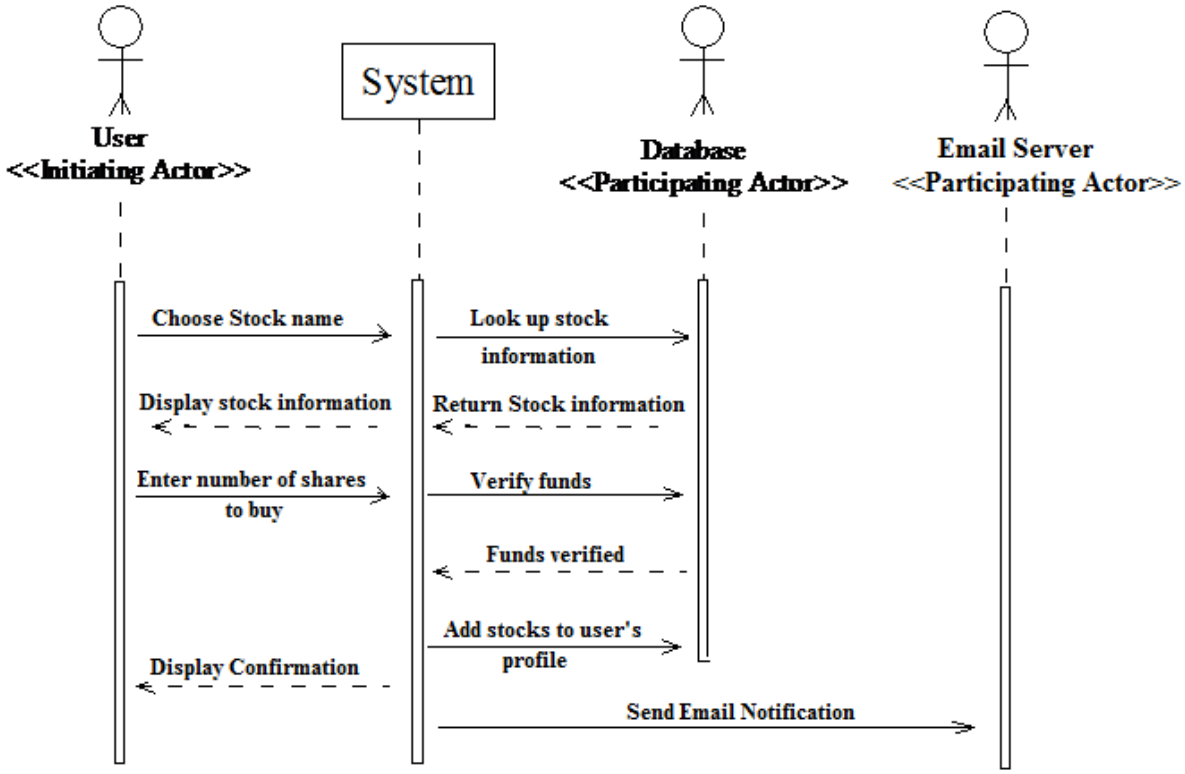
When the user wants to view the weekly rankings of the game, he prompts the system to display the leaderboard. The system then calculates the players' weekly rankings depending on their portfolio values and ranks them from the top ten highest to the lowest.



7. Market Order: Buy

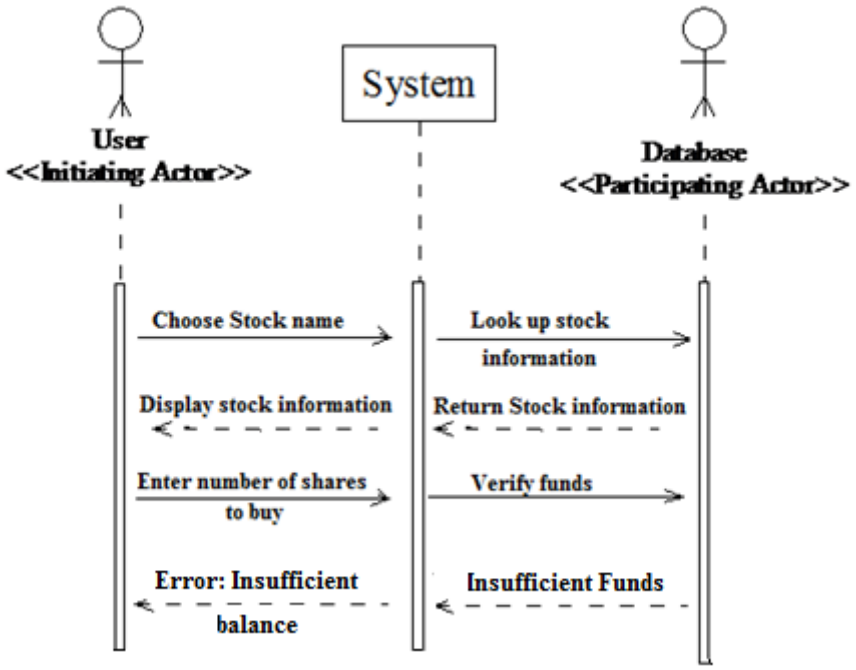
Main Success Scenario:

The user chooses a stock name initially, after which the system displays the respective stock information. The user then decides the number of stocks he wants to buy. The system verifies if his account has sufficient funds, and if yes adds the stocks to the user's profile, displays confirmation and instructs the email server to send an email notification.



Alternate Scenario 1 (Insufficient Funds in the account):

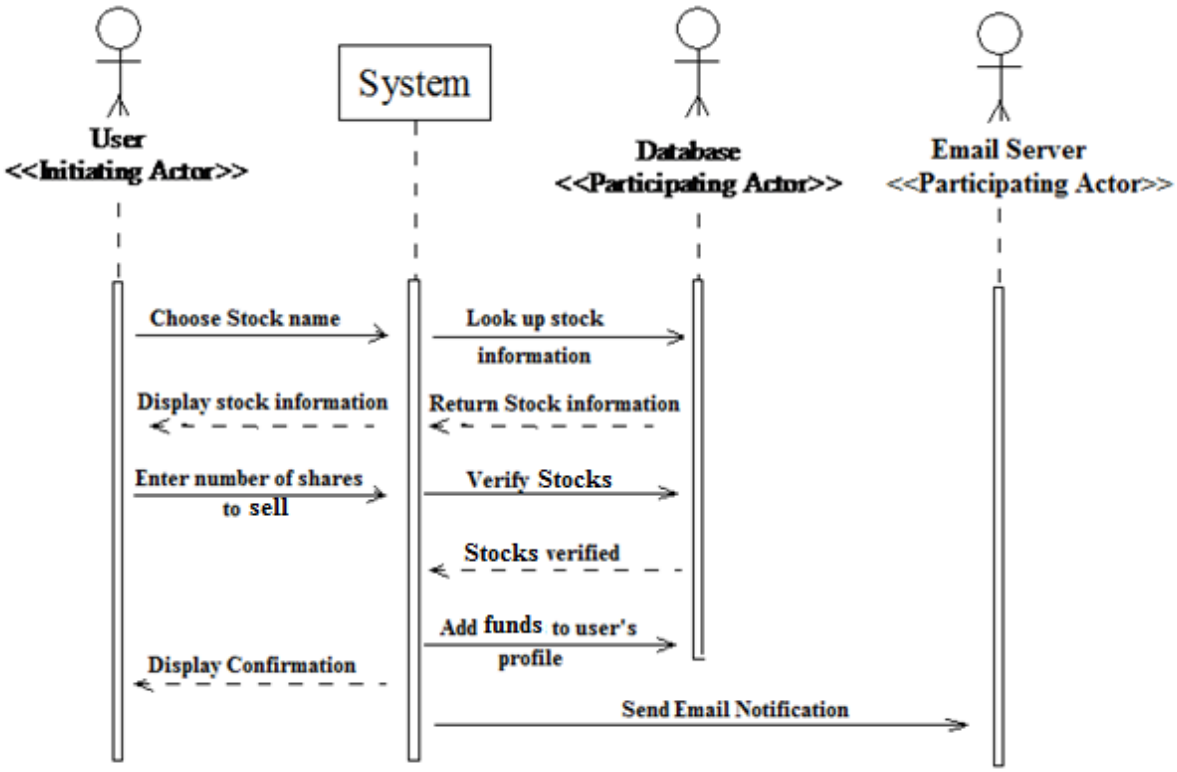
When the user enters the number of shares he wishes to buy, the system checks if his account has sufficient funds. In the case of insufficient funds, the system displays an error.



8. Market Order: Sell

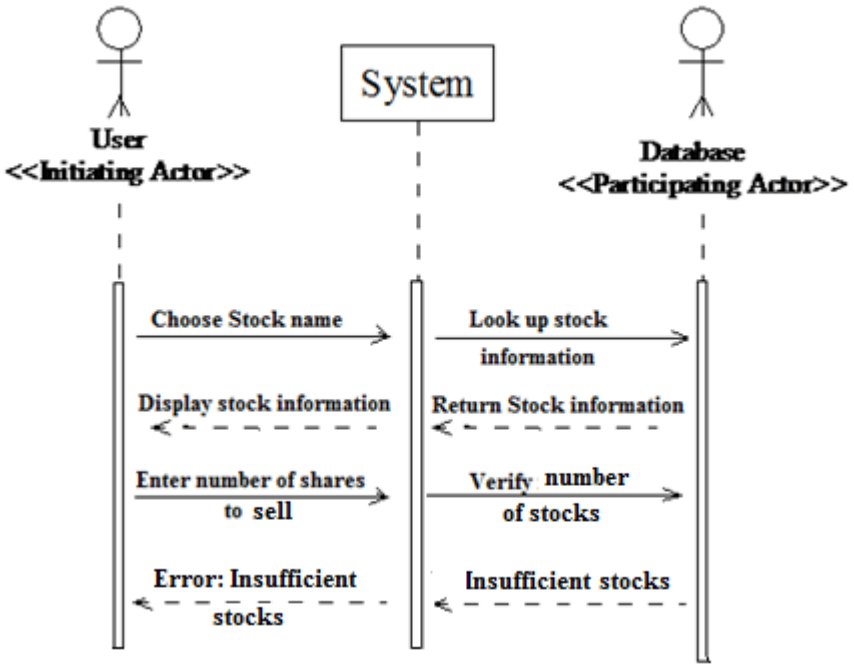
Main Success Scenario:

The user chooses a stock name initially, after which the system displays the respective stock information. The user then decides the number of stocks he wants to sell. The system verifies if his account has sufficient stocks, and if yes deducts the stocks from his portfolio, adds the funds to the user's profile, displays confirmation and instructs the email server to send an email notification.



Alternate Scenario 1 (Insufficient Stocks in the account):

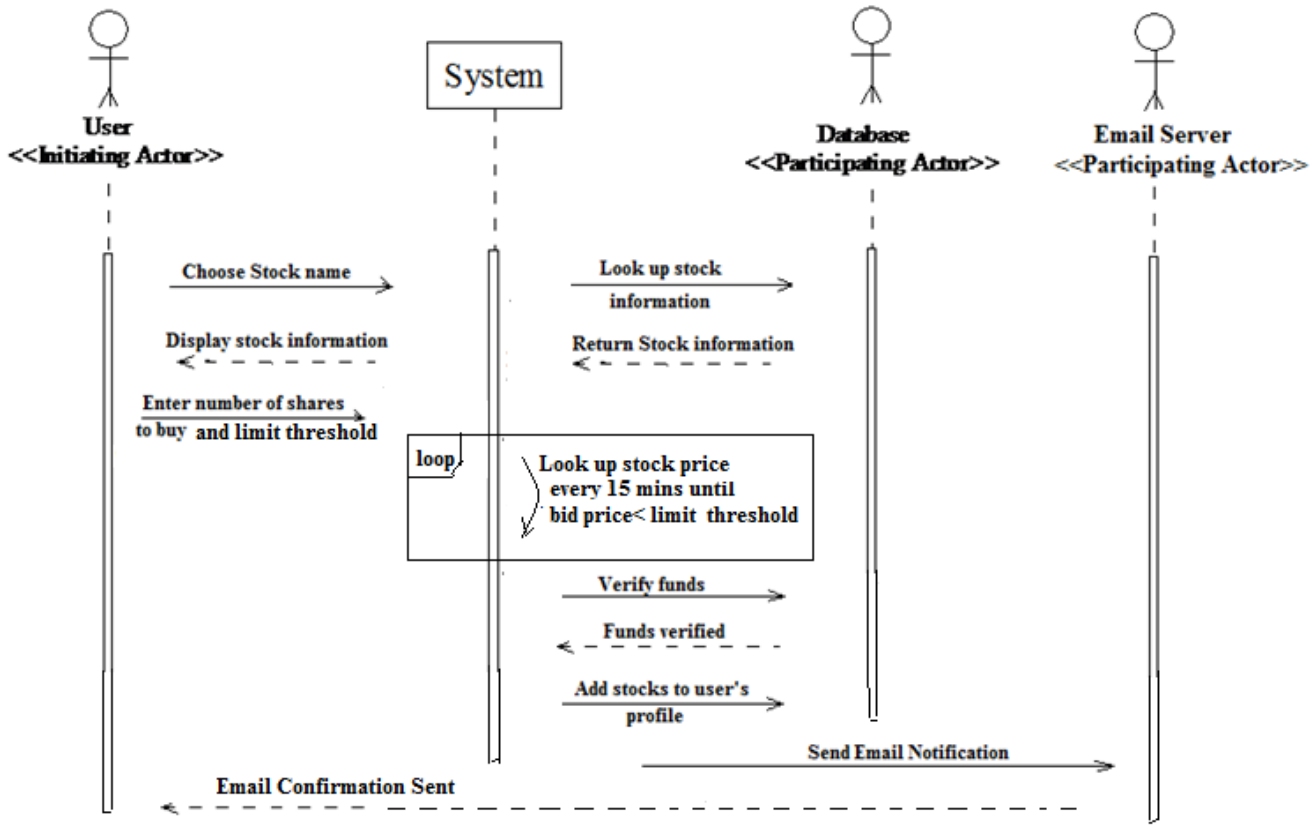
When the user enters the number of shares he wishes to sell, the system checks if his account has sufficient stocks. In the case of insufficient stocks, the system displays an error.



9. Limit Order: Buy

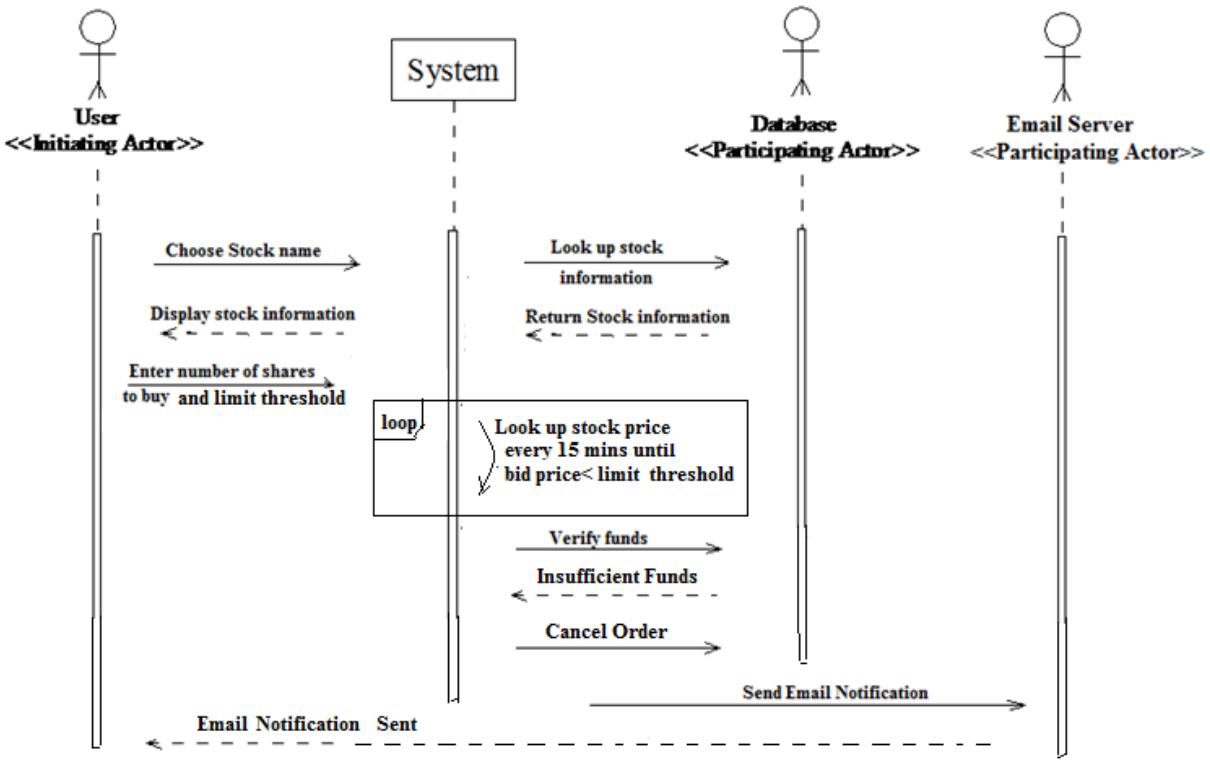
Main Success Scenario:

The user chooses a stock name initially, after which the system displays the respective stock information. The user then decides the number of stocks he wants to buy and also specifies the limit threshold below which he wants to buy the stock. The system checks the stock price every 15 minutes, and once the bid price falls below the limit price, verifies if his account has sufficient funds, and if yes adds the stocks to the user's profile, displays confirmation and instructs the email server to send an email notification.



Alternate Scenario 1 (Insufficient Funds in the account):

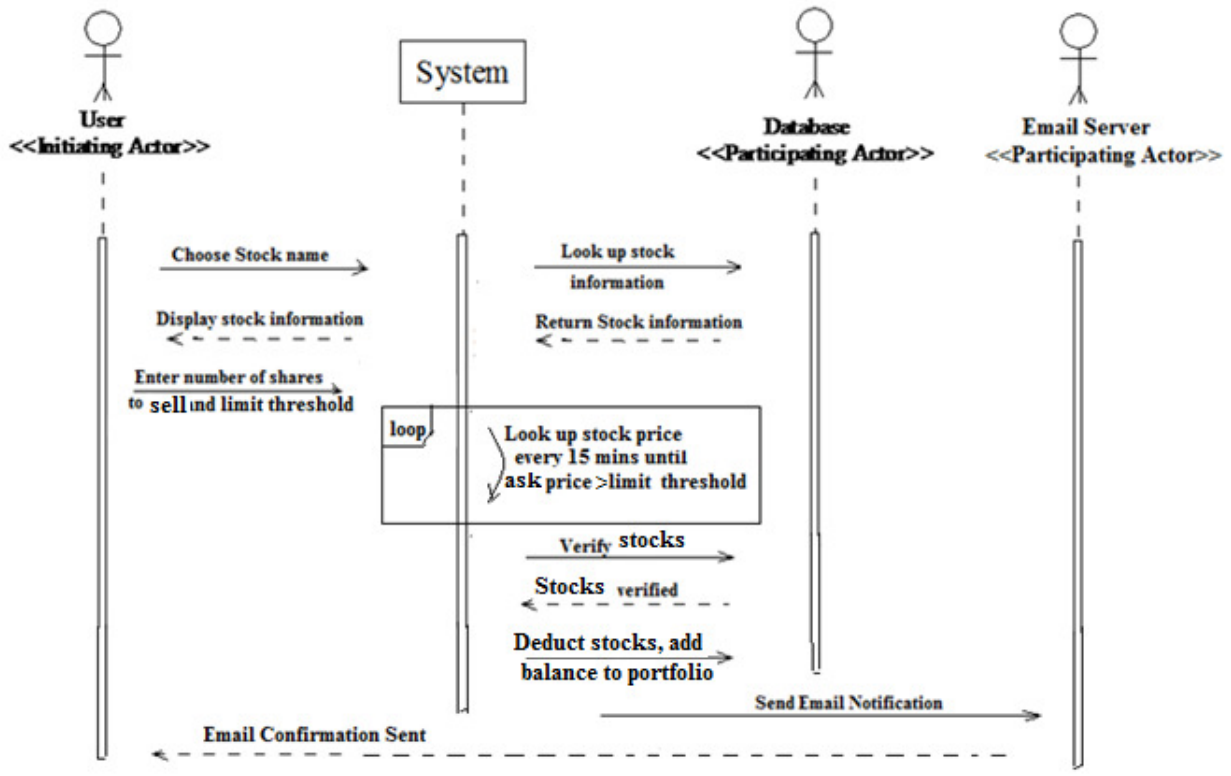
When the bid price falls below the limit price, the system checks if the user has sufficient funds to fulfill the order. In the absence of sufficient funds, an email notification is sent to the user informing the same and the order is cancelled.



10. Limit Order: Sell

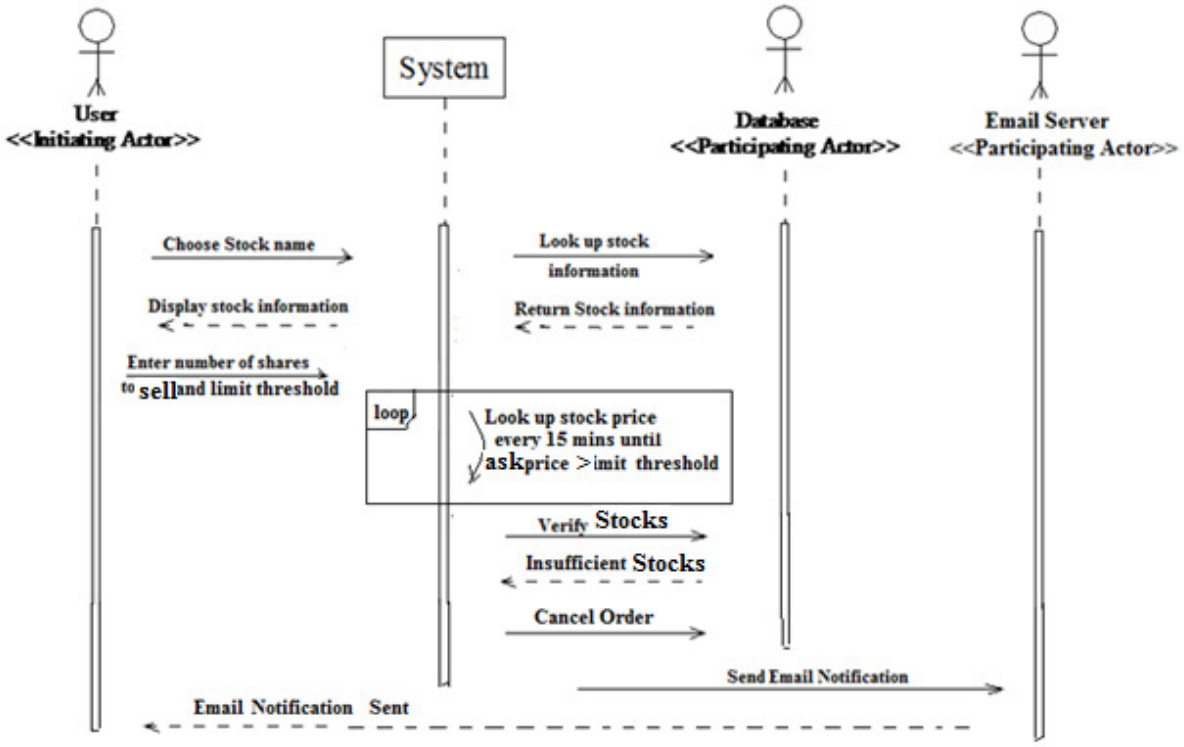
Main Success Scenario:

The user chooses a stock name initially, after which the system displays the respective stock information. The user then decides the number of stocks he wants to sell and also specifies the limit threshold above which he wants to sell the stock. The system checks the stock price every 15 minutes, and once the ask price rises above the limit price, verifies if his portfolio has sufficient stocks, and if yes deducts the stocks from the user's profile, adds the balance gained, displays confirmation and instructs the email server to send an email notification.



Alternate Scenario 1 (Insufficient Stocks in the account):

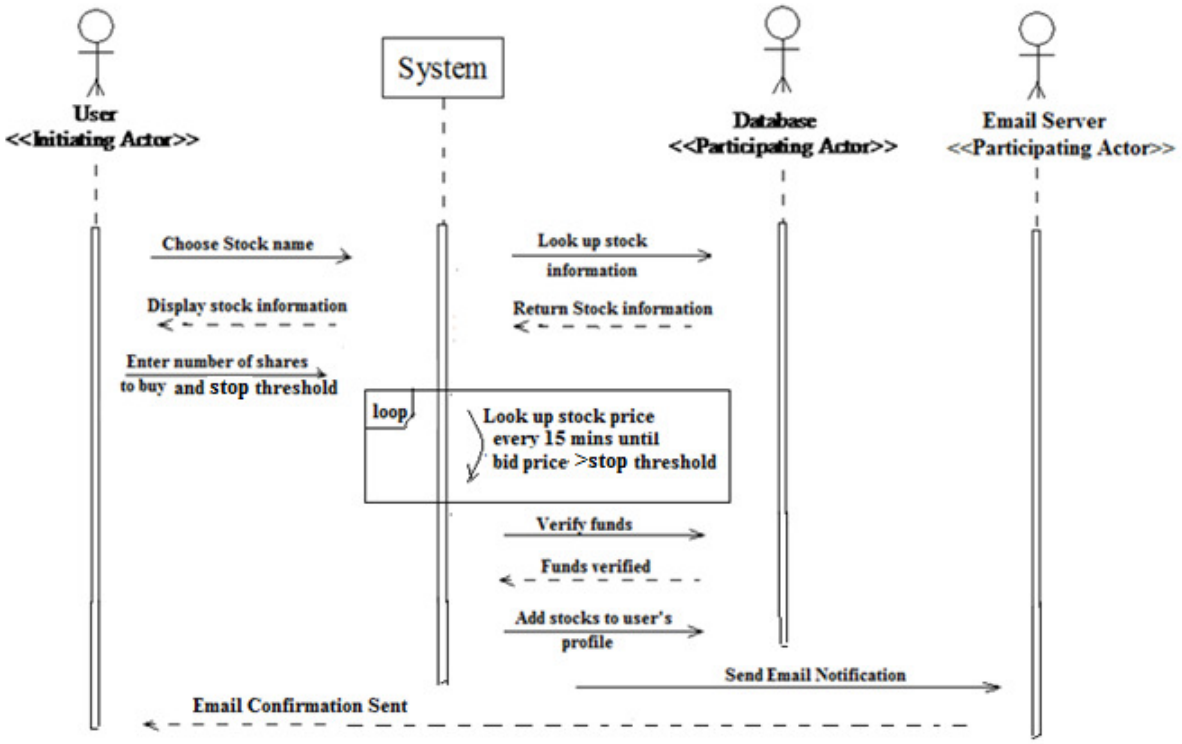
When the ask price rises above the limit price, the system checks if his account has sufficient stocks. In the case of insufficient stocks, an email notification is sent to the user informing the same and the order is cancelled.



11. Stop Order: Buy

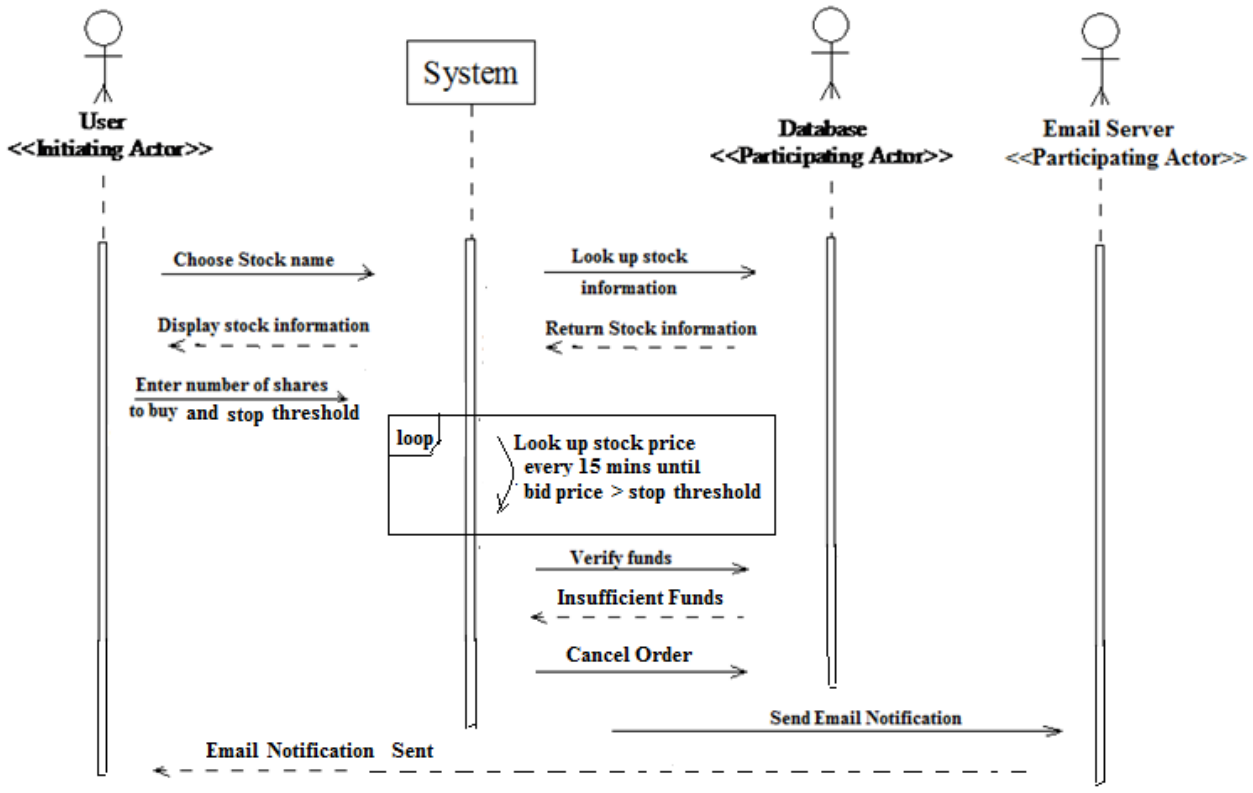
Main Success Scenario:

The user chooses a stock name initially, after which the system displays the respective stock information. The user then decides the number of stocks he wants to buy and also specifies the stop threshold above which he wants to buy the stock. The system checks the stock price every 15 minutes, and once the bid price rises above the limit price, verifies if his account has sufficient funds, and if yes adds the stocks to the user's profile, displays confirmation and instructs the email server to send an email notification.



Alternate Scenario 1 (Insufficient Funds in the account):

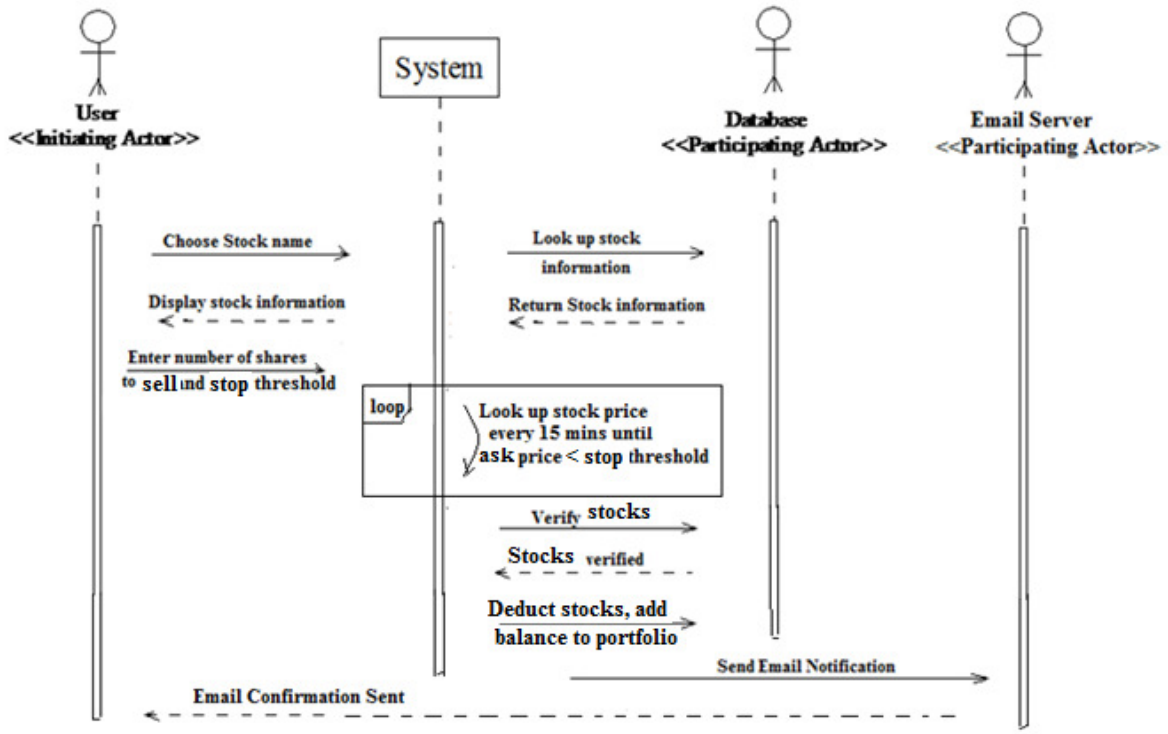
When the bid price rises above the limit price, the system checks if the user has sufficient funds to fulfill the order. In the absence of sufficient funds, an email notification is sent to the user informing the same and the order is cancelled.



12. Stop Order: Sell

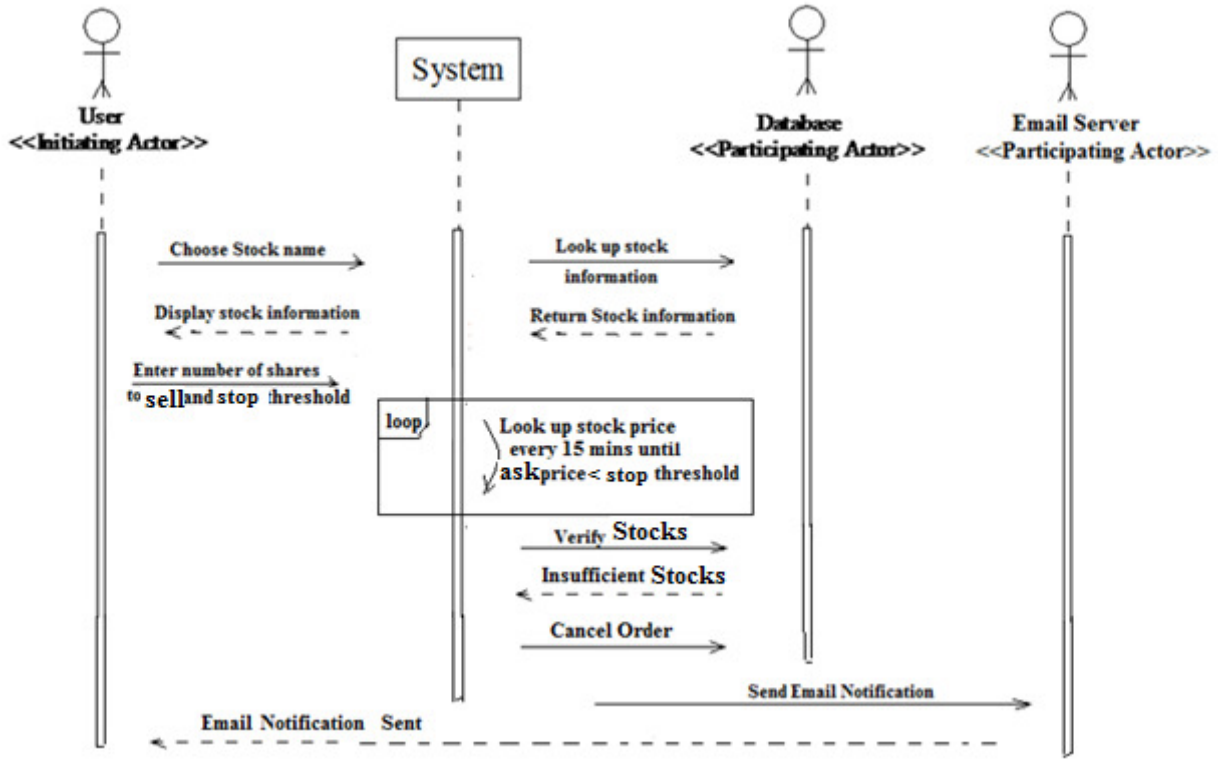
Main Success Scenario:

The user chooses a stock name initially, after which the system displays the respective stock information. The user then decides the number of stocks he wants to sell and also specifies the stop threshold below which he wants to sell the stock. The system checks the stock price every 15 minutes, and once the ask price falls below the stop price, verifies if his portfolio has sufficient stocks, and if yes deducts the stocks from the user's profile, adds the balance gained, displays confirmation and instructs the email server to send an email notification.



Alternate Scenario 1 (Insufficient Stocks in the account):

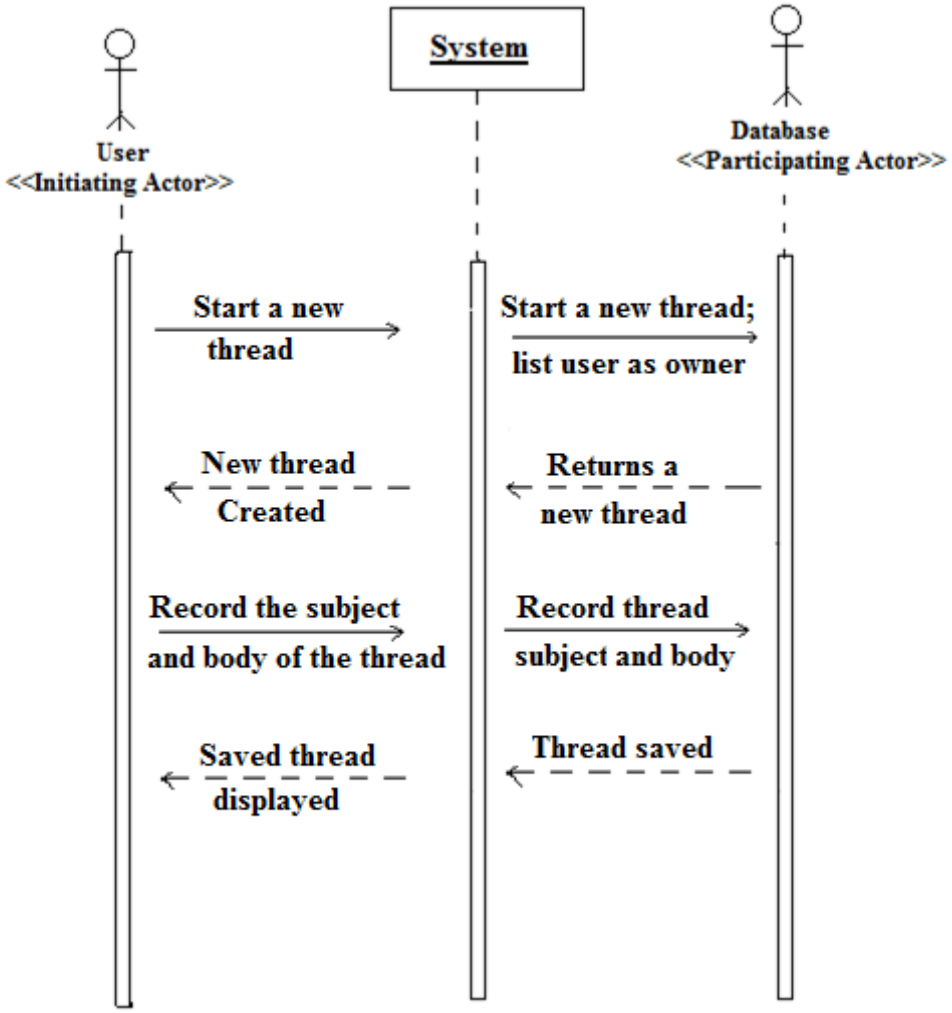
When the ask price falls below the stop price, the system checks if his account has sufficient stocks. In the case of insufficient stocks, an email notification is sent to the user informing the same and the order is cancelled.



13. Post in Forum

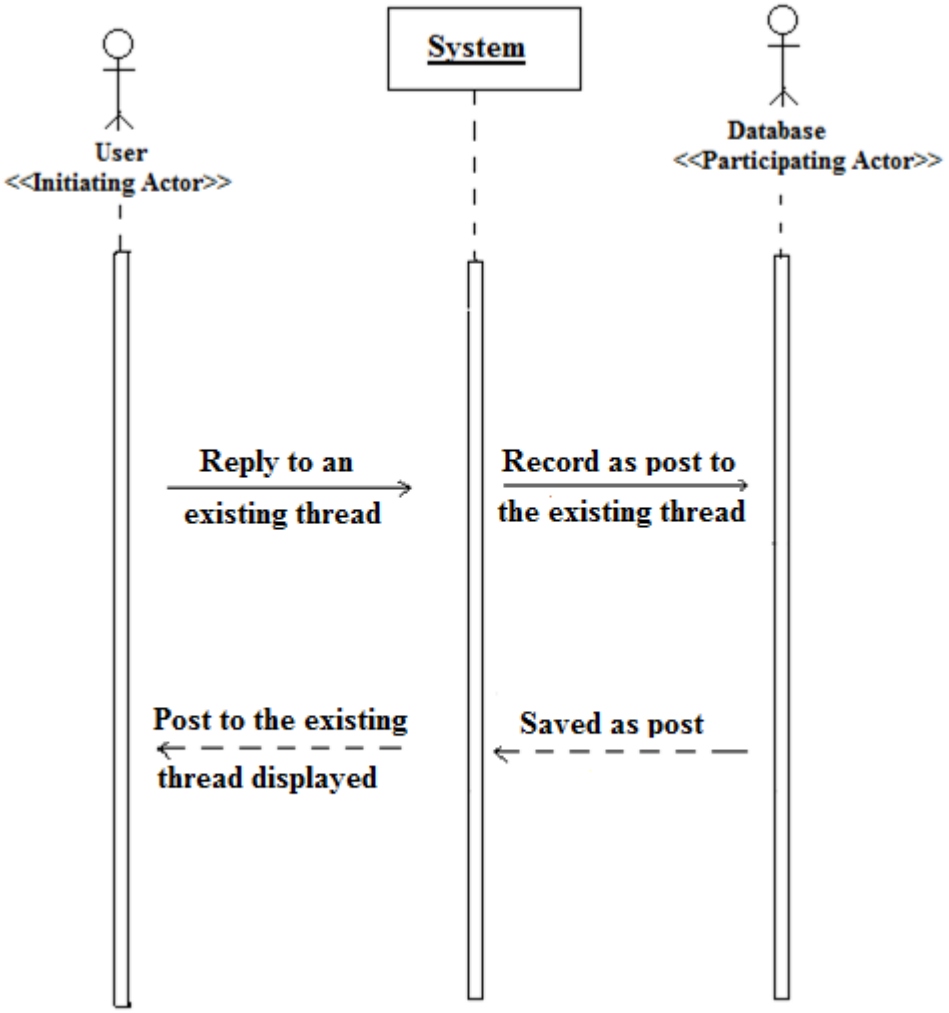
Main Success Scenario:

When the user wants to post in the forum, he prompts the system to start a new thread. The system starts a new thread and lists the user as the owner. The user can then enter the subject as well as content of the thread which are then recorded by the system.



Alternate Scenario 1 (Reply to an existing thread):

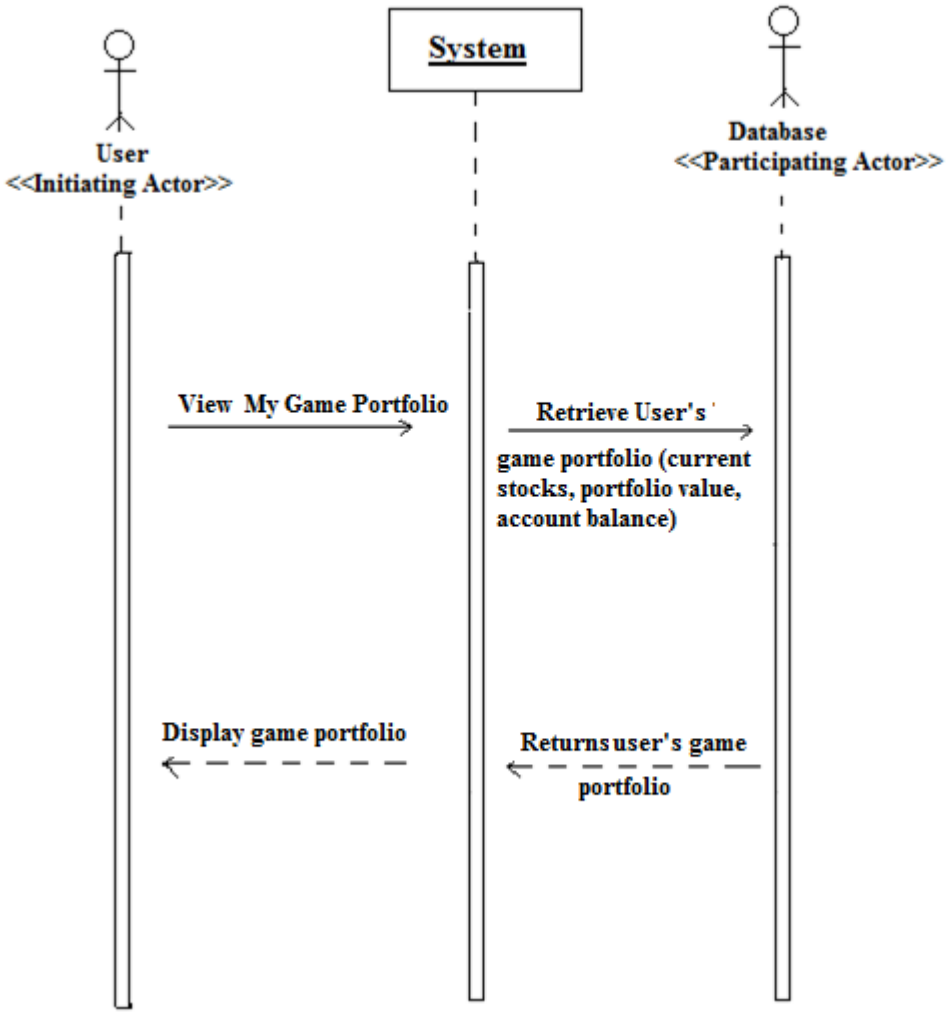
When the user wants to reply to an existing thread, he posts his reply, which is then saved by the system as a post to the existing thread.



14. View My Game Portfolio

Main Success Scenario:

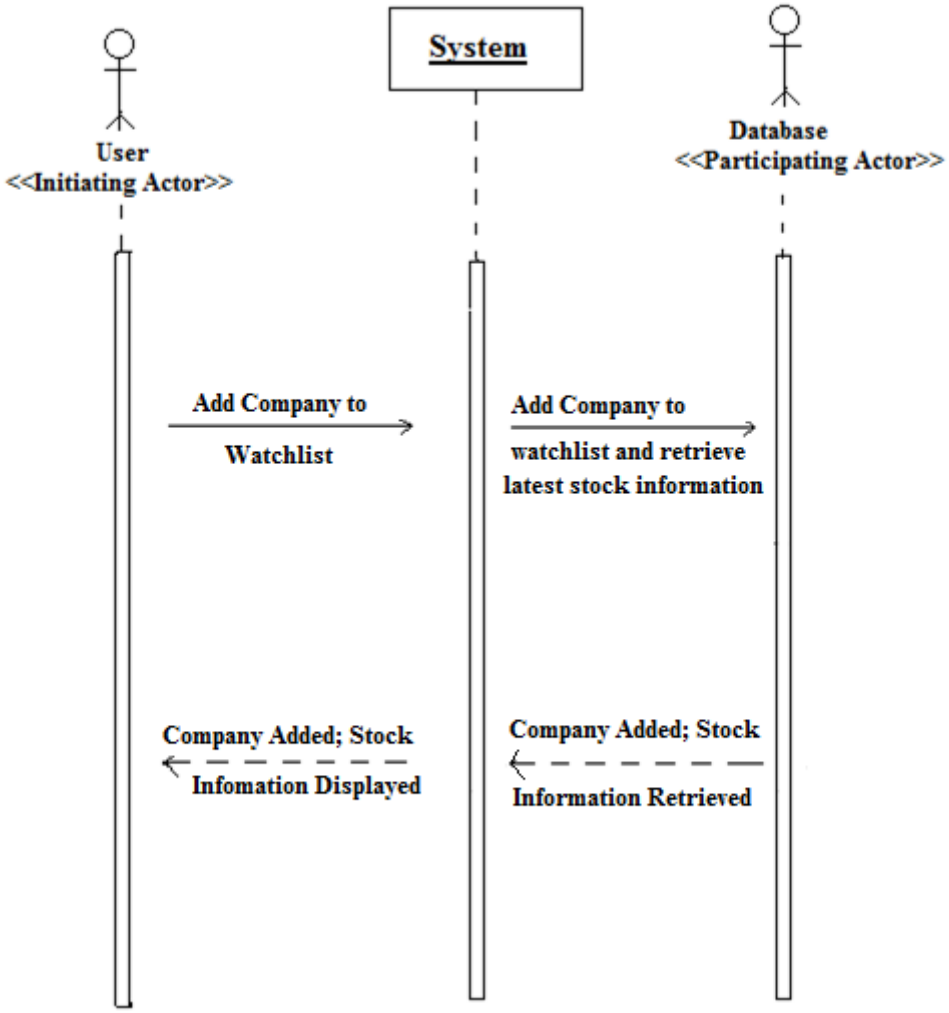
When the user wants to view his game portfolio, he prompts the system to display his game portfolio. The system then retrieves all the stocks he currently possesses, apart from the portfolio value and his current account balance.



15. Add to Watchlist

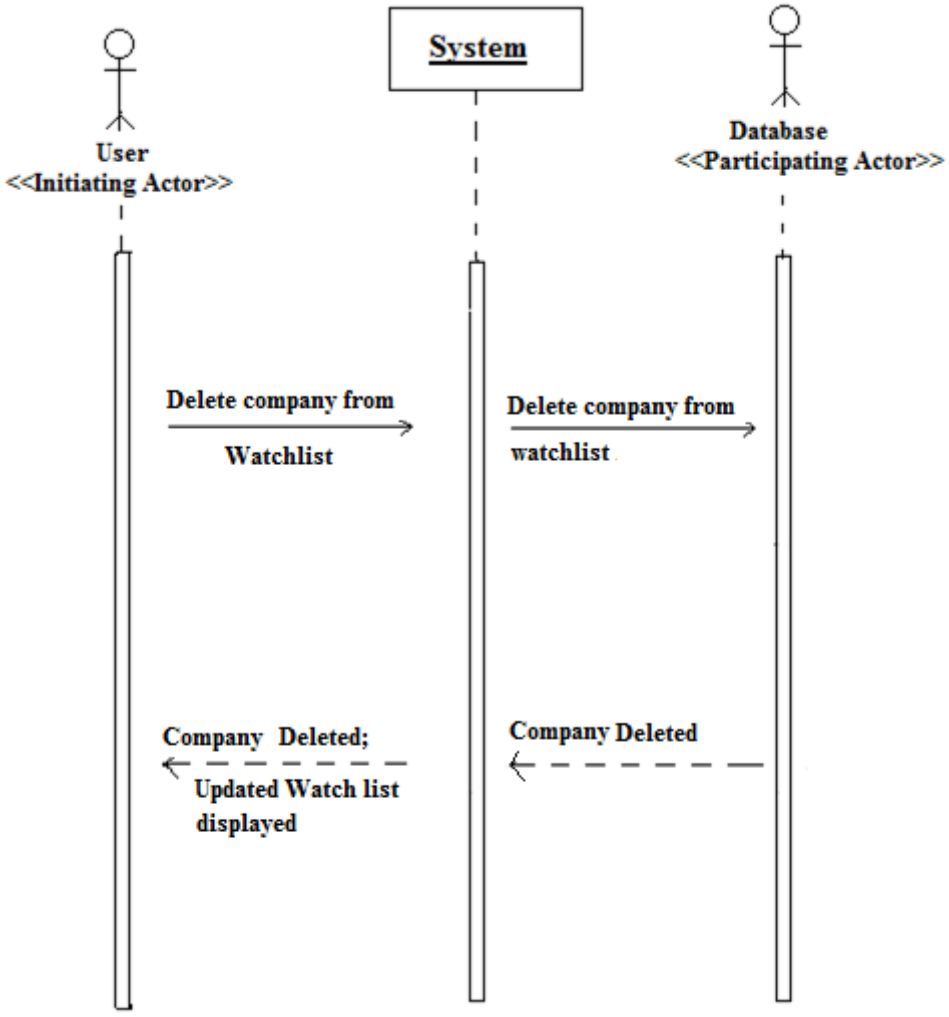
Main Success Scenario:

When the user wants add a company to his existing Watch list, he does so by informing the system. The system then instructs the database to add the company and retrieve the company's latest stock information which is then displayed to the user in his Watch list.



Alternate Scenario 1 (Delete company from the Watch list):

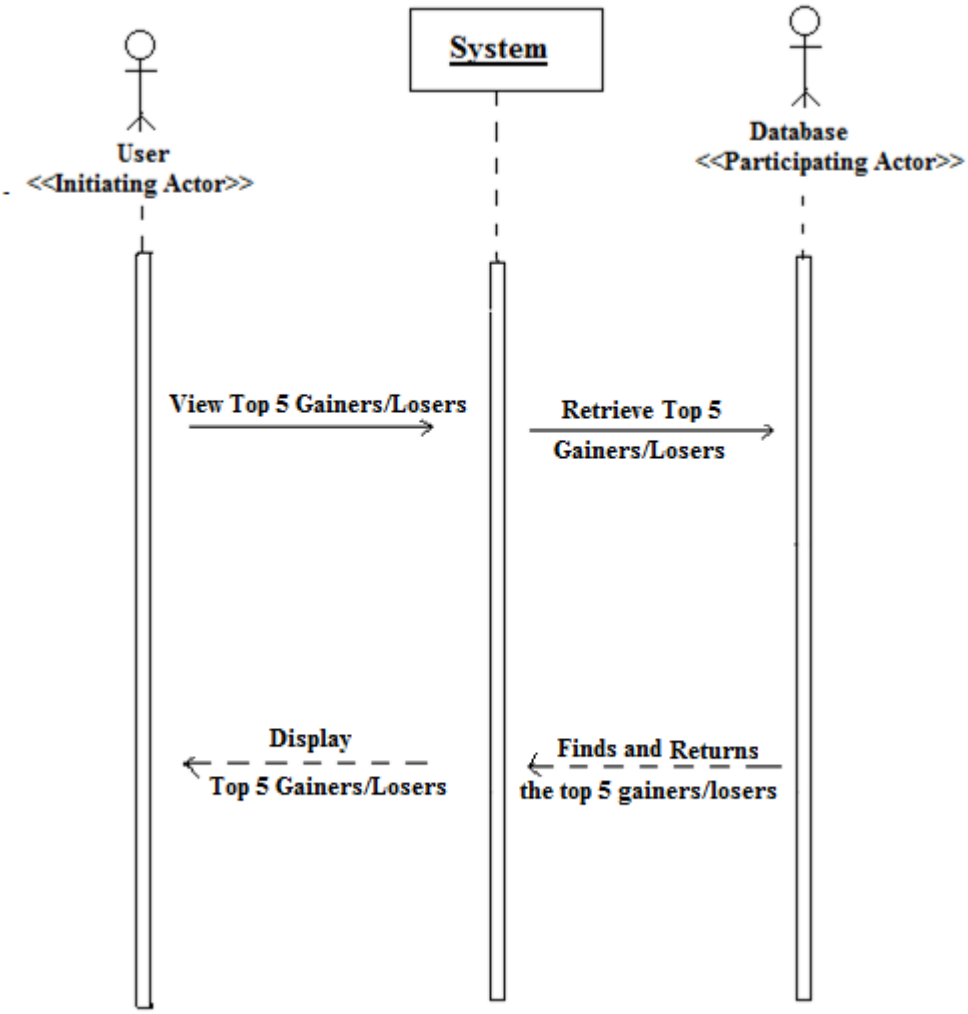
When the user wants to delete a company from his Watch List, he informs it to the system. The system in turn instructs the Database to remove the company from the user's list of companies and displays the updated table to the user.



16. View Top five gainers/losers

Main Success Scenario:

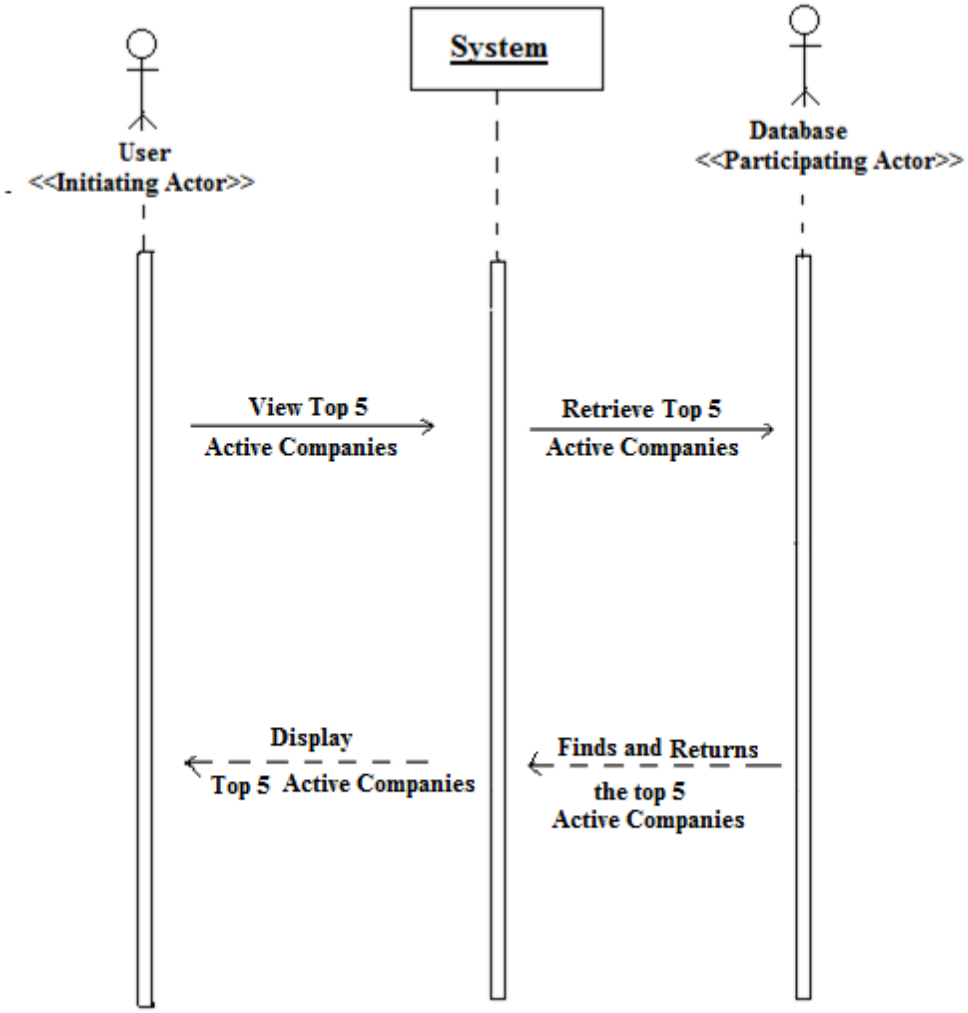
When the user wants to view the top five companies in the database that have the highest and lowest percentage change in the stock price, he prompts the system to display the Top 5 gainers/losers. The system then calculates this information from the database and displays it. As stated earlier, the percent change is calculated using the yesterday's closing price and the price at which the latest trade has been made.



17. View Top Active Companies

Main Success Scenario:

When the user wants to view the top five companies in the database that have the highest liquidity (volume of stocks), he prompts the system to display the Top 5 Active Companies. The system then calculates this information from the database and displays it.



7. NONFUNCTIONAL REQUIREMENTS (FURPS+)

- **Functionality**

Homepage will show all the options and links which is easy to operate and for the sake of trader's interest, there will be latest headlines from CNBC and Reuters. We will also have the most comprehensive stock information which is the same as those in the real world (Yahoo! Finance). Also, Username and password are required when an existing user wants to check his profile or portfolio which he already created. A first-time user who wants to try the game should register for the website first and confirm the email sent by our website. Since the

portfolios are stored in a data base, they are totally private that there is no way for other players to change information. Other services are also provided to protect access to certain resources or information. Additionally, we have “my trade diary” area which is a place for users to write something down about their stock trading, their thoughts on those trades and their predication for the markets.

- **Usability**

The program will take consideration of characteristics such as human factors, aesthetics and consistency in the user interface. All the operations are listed on the homepage which is easy to navigate for most visitors. Also, the website must be attractive and pleasing to catch the eyes. Most important, there will be a set of instructions on how to play the game and some useful quick links related to stock information.

- **Reliability**

If failure occurs between the program and connected website such as Yahoo! Finance or users’ transactions cannot go through, our program should be able to recover from these failures. We backup all the information includes users’ personal information in a database and updates accordingly so that we can call the data immediately. This also used to make sure the accuracy of system calculations.

- **Performance**

When searching the website, clicking buttons to jump to another links or doing stock trading, we hope that the website is as efficient as possible, which is concerned with characteristics such as throughput, response time, recovery time, start-up time, and shutdown time.

- **Supportability**

To setup a web server, we must consider that the website can be extended and improved in the future. With the data information updates every day, changes must be made to adapt to the

new requirements. Also, it is easier for administrators if the changes are not hard to implement and maintain.

- **+ (Others)**

The website should have a strict system to protect users' information and portfolios from being tampered by some invaders. The coding and construction of the system should meet the basic required standard and take consideration of its implementation.

8. EFFORT ESTIMATION USING USE CASE POINTS:

Unadjusted Actor Weight (UAW):

Actor Name	Description of relevant characteristics	Complexity	Weight
User	User interacts with the system via the Graphical User Interface (GUI)	Complex	3
Database	Database has all the required data needed to execute the system	Average	2
Yahoo! Finance	Yahoo! Finance is used as a source of all our financial data	Simple	1

UAW (Tradefun) = 1XSimple + 1XAverage + 1XComplex = 1X1 + 1X2 + 1X3 = 6

Unadjusted Use Case Weight (UUCW):

Use case	Description	Category	Weight
Login	Simple user interface	Simple	5
Registration	Simple user interface	Simple	5
Logout	Simple user interface	Simple	5
Edit My Profile	Average user interface	Average	10
View Trading History	Simple user interface	Simple	5
View Leader Board	Average user interface	Average	10
Market Order: Buy	Simple user interface	Simple	5
Market Order: Sell	Simple user interface	Simple	5
Limit Order: Buy	Average user interface	Average	10
Limit Order: Sell	Average user interface	Average	10
Stop Order: Buy	Average user interface	Average	10
Stop Order: Sell	Average user interface	Average	10
Post in Forum	Complex user interface	Complex	15
View My Game Portfolio	Simple user interface	Simple	5
Add to Watchlist	Simple user interface	Simple	5
View Top five gainers/losers	Simple user interface	Simple	5
View Top Active	Simple user interface	Simple	5

Companies			

UUCW (Tradefun) = 10XSimple + 6XAverage + 1XComplex = 10X5 + 6X10 + 1X15 = 125

UUCP = 6+125 = 131

Technical Complexity Factor (TCF):

Technical Factor	Description	Weight	Perceived Complexity	Calculated Factor
T1	Distributed web based system	2	3	2x3=6
T2	End user expects good performance	1	3	1x3=3
T3	End-user expects efficiency	1	3	1x3=3
T4	Complex internal processing	1	5	1x5=5
T5	Reusable design or code	1	5	1x5=5
T6	No installation involved	0.5	0	0.5x0=0
T7	Easy to use is moderately important	0.5	1	0.5x1=0.5
T8	Portable	2	1	2x1=2

T9	Easy to change minimally required	1	1	1x1=1
T10	Concurrent use is required	1	1	1x1=1
T11	Special security features	1	1	1x1=1
T12	No direct access for third parties	1	0	1x0=0
T13	No unique training needs	1	0	1x0=0
			Total	: 27.5

Constant-1 (C1) = 0.6

Constant-2 (C2) = 0.01

TCF = 0.6 + (0.01x27.5) = 0.875

Therefore, this results in a reduction of the UCP by 8.75%

Environmental factor	**Description**	**Weight**	Perceived Impact	Calculated Factor
E1	Moderate Familiar with the development process	1.5	3	1.5X3=4.5
E2	Moderate Application problem	0.5	3	0.5X3=1.5

	experience			
E3	Some knowledge of object-oriented approach	1	2	1X2=2
E4	Beginner Lead analyst capability	0.5	1	0.5X1=0.5
E5	High levels of Motivation	1	5	1X5=5
E6	Stable requirements expected	2	0	2X0=0
E7	No Part-time staff involved	-1	0	-1X0=0
E8	Average difficulty programming language	-1	3	-1X3=-3

Environmental Factor total: 10.5

Constant – 1 (C1) = 1.4

Constant – 2(C2)=-0.03

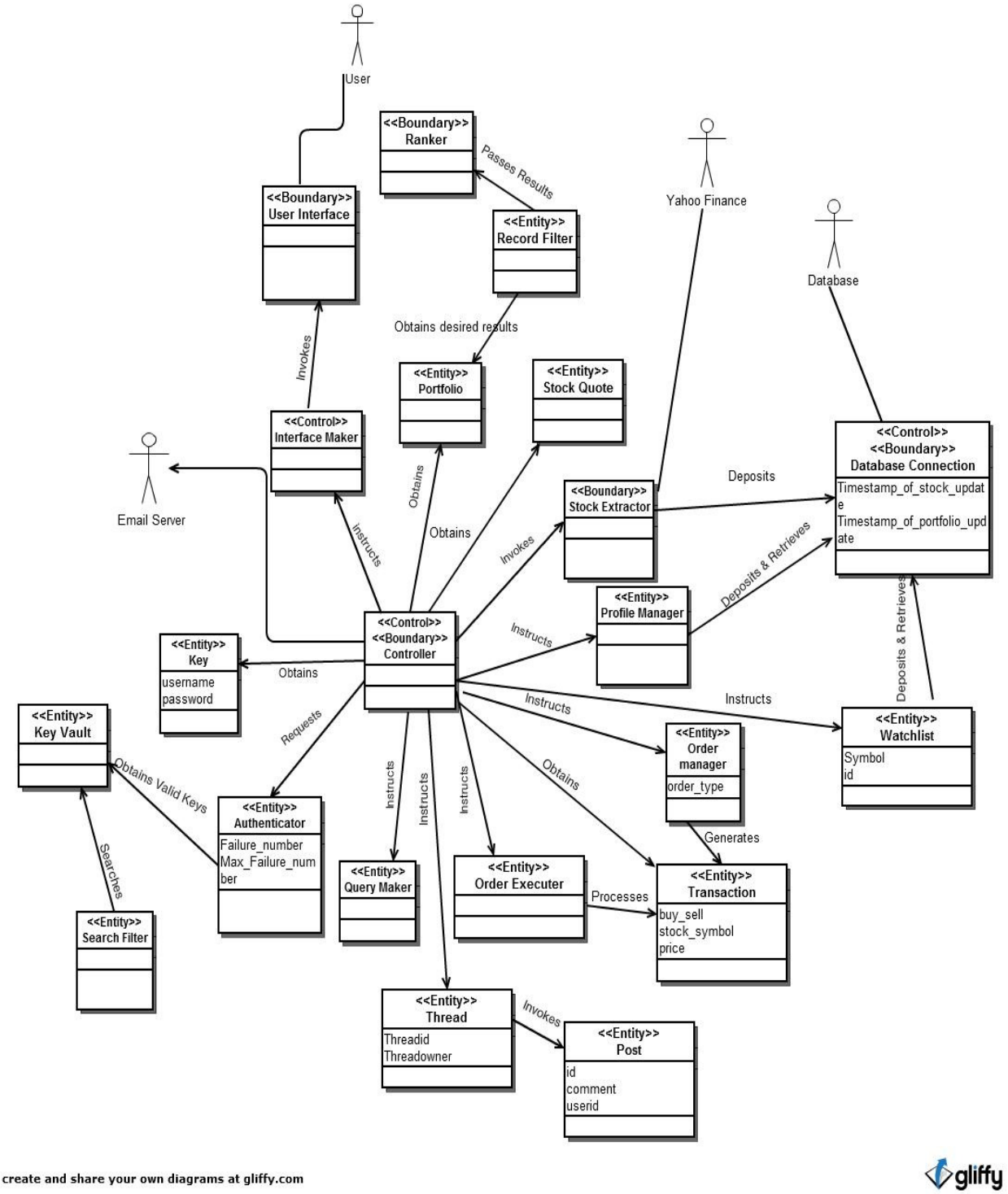
ECF = 1.4 + (-0.03x10.5) = 1.085

UCP = UUCP x TCF x ECF = (131) x (0.875) x (1.085) = 124.368 or 124 use case points

Expected Project Duration = 124*28=3472 hours

This overestimates the project duration by around 50 %, which leads us to conclude that a productivity factor of 28 is too high.

9. DOMAIN ANALYSIS



9. (i) Concept Definitions:

Responsibility type: ‘D’-Doing, ‘K’-Knowing

Serial Number	Concept Name	Type	Boundary	Responsibility
1.	Controller	D	No	Coordinates the functions of different concepts in the domain.
2.	Interface Maker	D	No	Displays the right user interface.
3.	User Interface	D	Yes	Interface for the user.
4.	Authenticator	D	No	It identifies the user who has a valid key
5.	Key	K	No	The username and password obtained from the user which is to be validated.
6.	Key Vault	K	No	It stores valid keys (Username, password) for both users and administrators.
7.	Stock Quote	K	No	Contains the stock information like symbol,price.
8.	Stock Extractor	D	Yes	Extracts stock quotes from yahoo finance.
9.	Search Filter	D	No	Passes the search parameters.

10.	Record Filter	D	No	Filters records retrieved according to the search criteria.
11.	Qu8ery Maker	D	No	Prepares the query according to the search parameters provided.
12.	Portfolio	K	No	It is stored in the database and contains the portfolios of users.
13.	Database connection	D	Yes	Stores data and retrieves data from the database.
14.	Ranker	D	Yes	Ranks the players according to their monetary values.
15.	Page Maker	D	Yes	Prepares a html document for webpage display.
16.	Order Manager	D	No	Generates the transaction.
17.	Profile Manager	D	No	Used to edit profiles of users and administrators.
18.	Transaction	K	No	Transaction of user which is to be processed.
29.	Order Executer	D	No	Processes the transaction
30.	Thread	D	No	Creates a thread and assigns a thread id.
31.	Post	D	No	Creates a post to the thread
32.	Watchlist	D	No	Adds or deletes a symbol from the user's watchlist

9. (ii) Association Definitions:

Concept	Relation (:⟶)	Concept
Controller	Instructs	Interface Maker
Controller	Instructs	Order Manager
Controller	Obtains	Portfolio
Controller	Instructs	Query maker
Controller	Instructs	Profile Manager
Interface Maker	Invokes	User Interface
Controller	Obtains	Key
Controller	Requests	Authenticator
Authenticator	Passes the key	Search filter
Search filter	Searches	Key vault
Authenticator	Obtains valid keys	Key vault
Controller	Obtains	Stock quote
Controller	Instructs	Order Executer
Order Manager	Generates	Transaction
Query Maker	Invokes	Record filter
Record filter	Obtains desired search results	Portfolio
Record filter	Passes the results	Ranker
Profile Manager	Passes keys	Key vault
Profile Manager	Passes data	Database connection
Order Executer	Processes	Transaction
Controller	Obtains	Transaction
Controller	Instructs	Watchlist
Controller	Instructs	Thread
Thread	Invokes	Post
Watchlist	Deposits & retrieves	Database Connection

9.(iii) Attribute Definitions:

Concept	Attributes
Controller	
Interface Maker	
User Interface	
Authenticator	1. Failure_number: Number of failed login attempts. 2. Max_failure_number: Maximum number of failed login attempts allowed.
Key	1. Username: login id 2.Password: Authentication key
Key Vault	
Order Executer	
Stock Extractor	
Search Filter	
Record Filter	
Query Maker	
Portfolio	
Database connection	1.Timestamp_of_stock_update: Represents time when stock database was updated 2.Timestamp_of_portfolio_update: Represents time when the users portfolios were updated
Ranker	
Page Maker	
Order Manager	1. order_type: specifies the type of order to be placed “market order” or “limit order”.
Profile Manager	
Transaction	1. Buy_sell: indicates whether it is a buy or sell stock transaction 2. Stock_symbol: indicates the symbol of the stock

	3. Price: specifies the stock price.
Stock Quote	
Thread	1.Threadid: Id of the thread 2.Threadowner: user's username who started the thread
Post	1.id: Id of the record 2.Comment: comment posted by the user 3.Userid
Watchlist	1.id: Id of the record 2.Symbol: stock symbol that is to be added or deleted

9. (b) SYSTEM OPERATION CONTRACTS:

OPERATION: USECASE1- LOGIN
Pre- Conditions: 1. User is not logged into the system. 2. The user has an active account.
Post-Conditions: 1.User successfully logs into his account.

OPERATION: USECASE 2- REGISTRATION
Pre- Conditions: 1.The database does not contain that particular user.
Post-Conditions: 1. User successfully creates an account. 2. He is given a portfolio to start the game

OPERATION: USE CASE 3: LOGOUT
Pre- Conditions: 1.The user is logged in

Post-Conditions:
1.User successfully logs out of his account.

OPERATION: USE CASE 4: EDIT MY PROFILE
Pre- Conditions: 1. The database is non-empty 2. The user has an active account
Post-Conditions: 1.User has successfully edited his profile.

OPERATION: USE CASE 5: VIEW TRADING HISTORY
Pre- Conditions: 1. The user has an active account and past trade transactions.
Post-Conditions: 1.User's trading history has been displayed.

OPERATION: USE CASE 6: VIEW LEADER BOARD
Pre- Conditions: 1. The user has an active account
Post-Conditions: 1.The website's leader board has been displayed

OPERATION: USE CASE 7: MARKET ORDER: BUY
Pre- Conditions: 1. The user is logged into his account.

2. The account has sufficient funds.
Post-Conditions: 1. User successfully buys the new shares. 2. Changes are reflected in the transaction.

OPERATION: USE CASE 8: MARKET ORDER: SELL
Pre- Conditions: 1. The user is logged into his account. 2. The account has sufficient stocks.
Post-Conditions: 1. User successfully sells the shares. 2. Changes are reflected in the transaction.

OPERATION: USE CASE 9: LIMIT ORDER: BUY
Pre- Conditions: 1. The user is logged into his account and the threshold is set.
Post-Conditions: 1. User's transaction is put as pending.

OPERATION: USE CASE 10: LIMIT ORDER: SELL
Pre- Conditions: 1. The user is logged into his account and the threshold is set.
Post-Conditions:

1. User’s transaction is put as pending.

OPERATION: USE CASE 11: STOP ORDER: BUY
Pre- Conditions: 1. The user is logged into his account and the stop threshold is set.
Post-Conditions: 1. User’s transaction is put as pending.

OPERATION: USE CASE 12: STOP ORDER: SELL
Pre- Conditions: 1. The user is logged into his account and the stop threshold is set.
Post-Conditions: 1. User’s transaction is put as pending.

OPERATION: USE CASE 13: POST IN FORUM
Pre- Conditions: 1.The user has an active account
Post-Conditions: 1. User successfully posts his comments in the forum

OPERATION: USE CASE 14: VIEW MY GAME PORTFOLIO
Pre- Conditions: 1.The user has an active account and an active game portfolio.

Post-Conditions:
1.User's game portfolio has been displayed.

OPERATION: USE CASE 15: ADD TO WATCHLIST
Pre- Conditions:
1.The user has an active account and is logged in.
Post-Conditions:
1.The company has been added to the Watch List and the system displays updated stock information about the company.

OPERATION: USE CASE 16: VIEW TOP FIVE GAINERS/LOSERS
Pre- Conditions:
1.The user has an active account and is logged in
Post-Conditions:
1.The list of top five gaining and losing companies has been displayed

OPERATION: USE CASE 17: VIEW MOST ACTIVE COMPANIES
Pre- Conditions:
1.The user has an active account and is logged in.
Post-Conditions:
1.The list of most active companies has been displayed

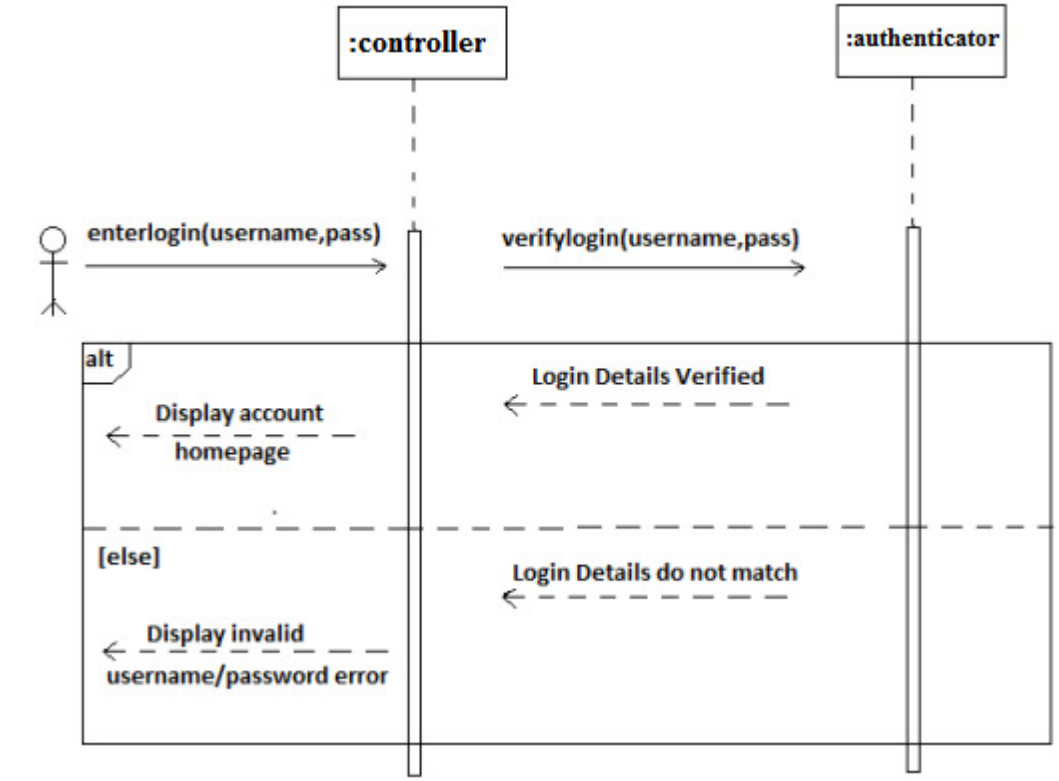
10. INTERACTION DIAGRAMS:

(a) List of Implemented Use Cases:

- Login
- Registration
- Logout
- Edit My Profile
- View Trading History
- View Leader Board
- Market Order: Buy
- Market Order: Sell
- Limit Order: Buy
- Limit Order: Sell
- Stop Order: Buy
- Stop Order: Sell
- Post in Forum
- View My Game Portfolio
- Add to Watchlist
- View Top five gainers/losers
- View Top Active Companies

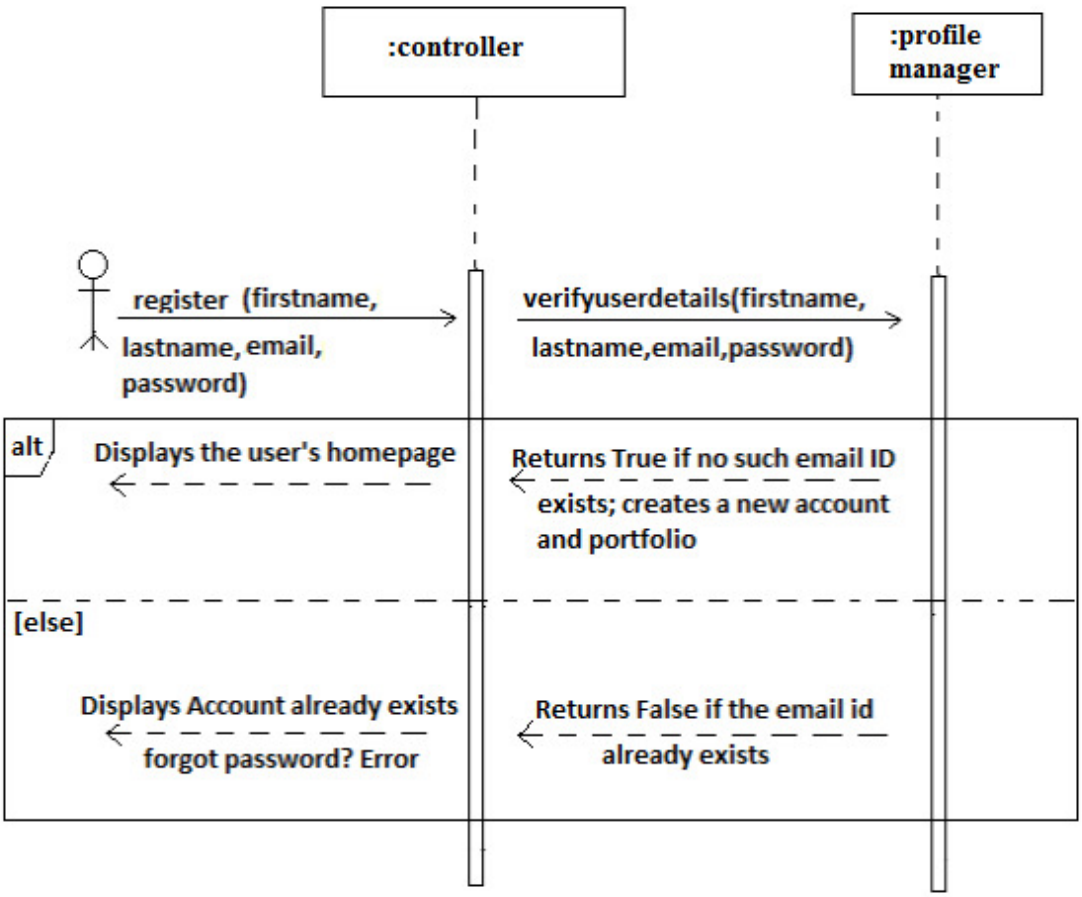
(b) Diagrams for Implemented Use cases:

1. LOGIN



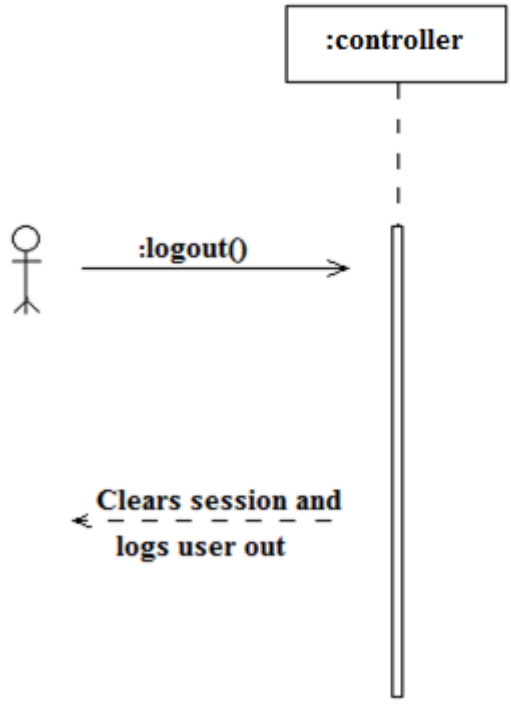
This interaction sequence diagram represents the **USE CASE 1: LOGIN**. The user initiates the login process by entering his username and password to the controller. The controller sends a 'verifylogin' query to the authenticator with username and password as input parameters. If the login details are found to be correct, a session is opened and the user is taken into his personalized account homepage. In case of a mismatch, 'Invalid username/password' error is displayed.

2. REGISTRATION



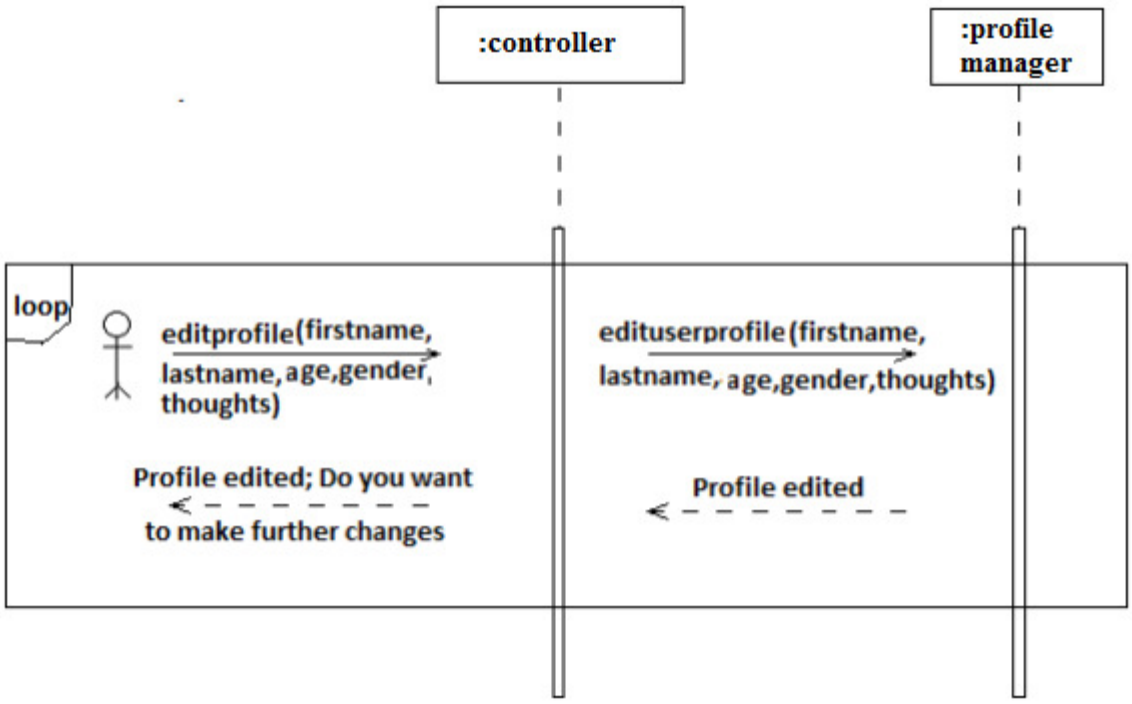
This interaction sequence diagram represents the **USE CASE 2: REGISTRATION**. The User initiates the process by entering his firstname, lastname, email and password to the controller. The controller poses a 'verifyuserdetails' query to the profile manager to check if the user's details already exist in the database. If no such email ID exists, the query returns true. A new account and a new portfolio are created for the user and he is directed to his personalized homepage. In case the email ID already exists in the database, the query returns false and the controller displays 'Account already exists; Forgot Password?' error.

3. LOGOUT



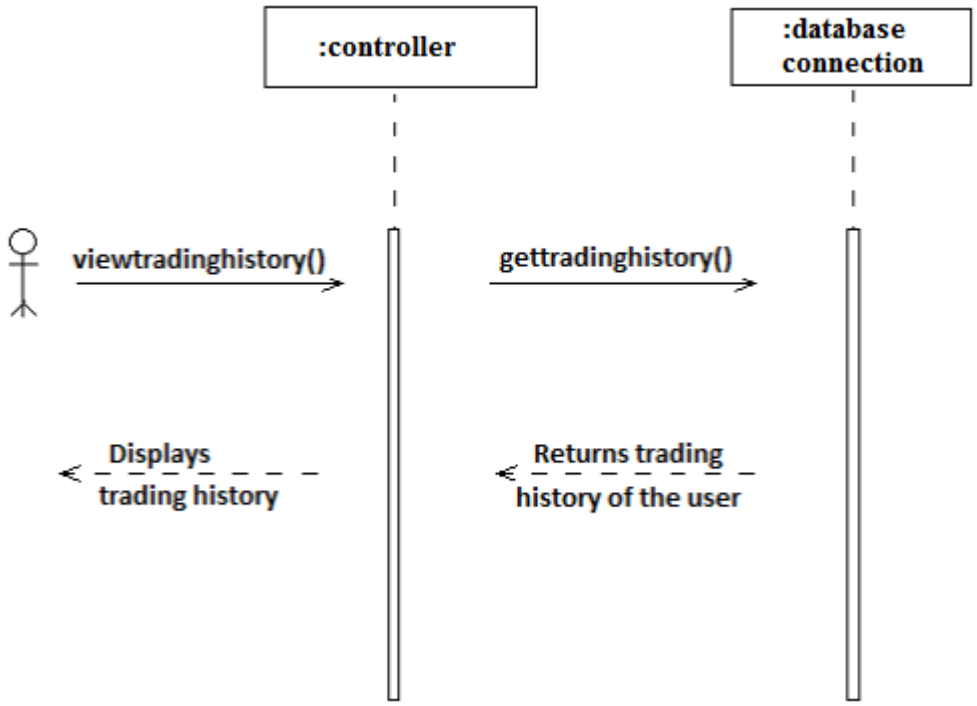
This interaction sequence diagram represents the **USE CASE 3: LOGOUT**. The User initiates the process by using logout() function. The controller clears the user's session and logs him out.

4. EDIT MY PROFILE



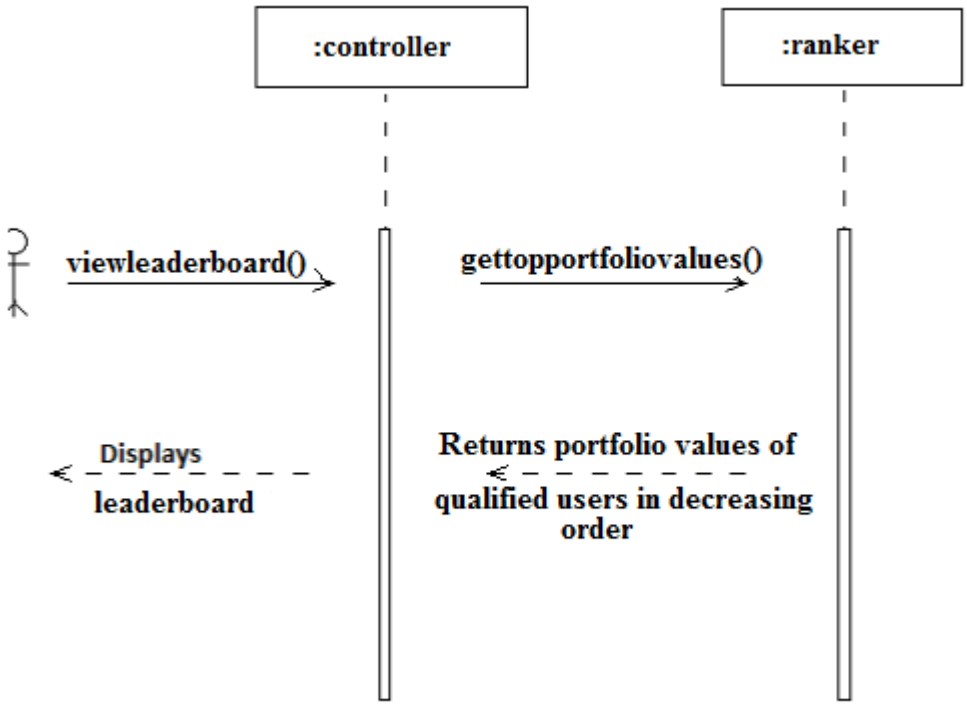
This interaction sequence diagram represents the **USE CASE 4: EDIT MY PROFILE**. The user initiates this process using the 'editprofile()' function call. The columns he wants to edit will be the input parameters. The controller then instructs the profile manager to edit the user record according to the information provided by the user. Once the changes are made, the user is intimidated and he is allowed to make further changes. This process is a loop and continues until the user is satisfied with his profile.

5. VIEW TRADING HISTORY



This interaction sequence diagram represents the **USE CASE 5: VIEW TRADING HISTORY.** When the user wants to see a history of his past transactions he can initiate this process using the 'viewtradinghistory()' function call to the controller. The page then requests all the user history from the database connection and displays it to the user.

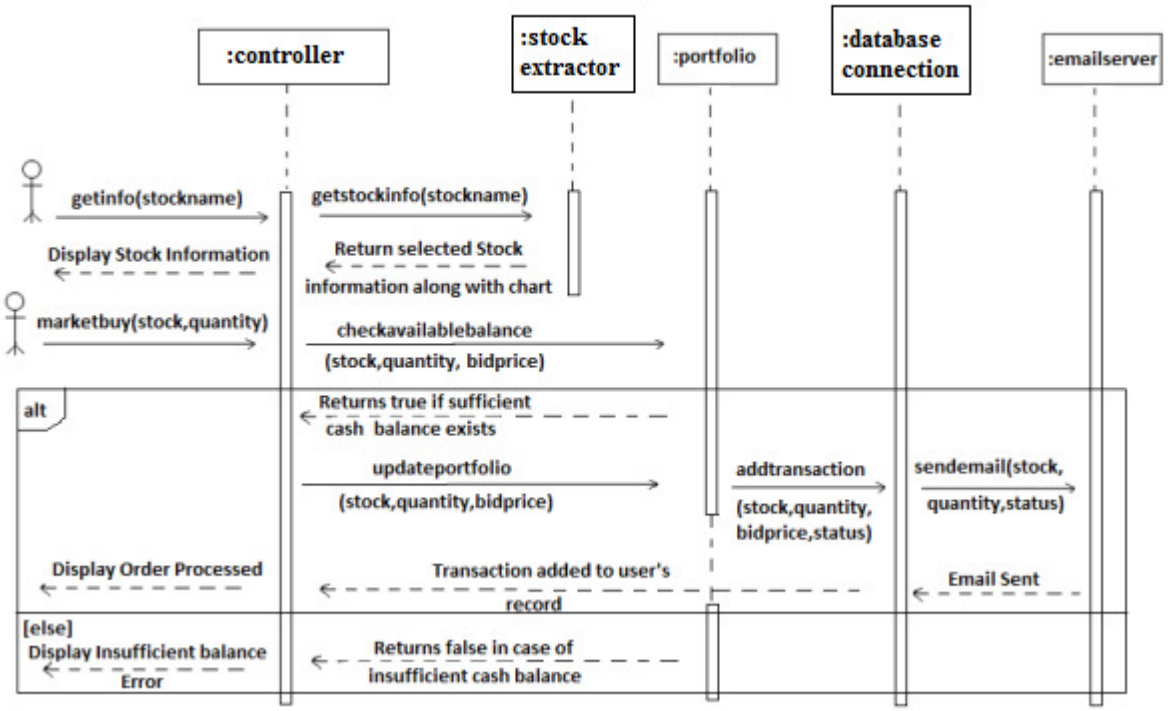
6. VIEW LEADER BOARD



This interaction sequence diagram represents the **USE CASE 6: VIEW LEADER BOARD.** When the user wants to see the leader board he can initiate this process using the 'viewleaderboard()' function call to the controller. The controller then asks the ranker to get the portfolio values of all the qualified users in decreasing order which are then displayed as the leader board to the user.

* *Qualified user is described as the one whose profile has satisfied the conditions we have laid out to enter the ranking process. These conditions have been described in the detailed description of this use case*

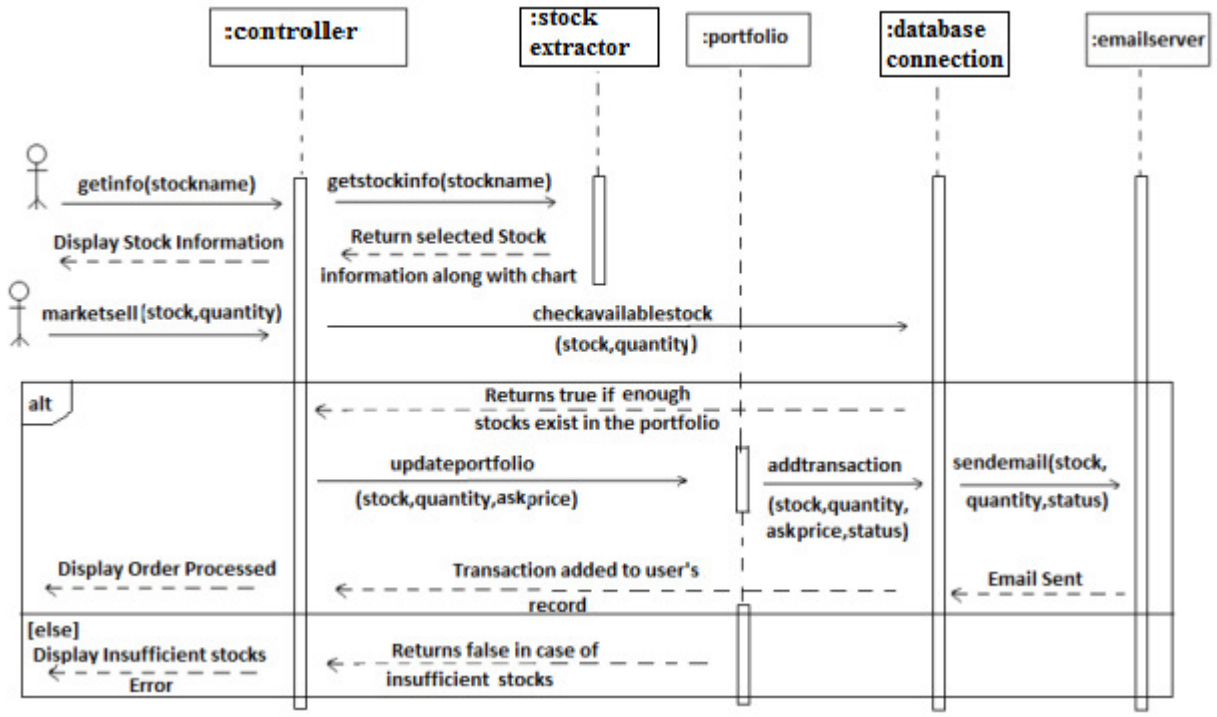
7. MARKET ORDER: BUY



This interaction sequence diagram represents the **USE CASE 7: MARKET ORDER - BUY**. When the user wants to buy a stock (market order), he initiates this process using the 'getinfo(stockname)' function call to the controller where, 'stockname' is the stock he chooses to buy. The controller then gets the current information about the stock like it's ask price, bid price etc. along with a five day chart from the stock extractor. The stock extractor fetches this information from Yahoo! Finance whenever a query is made. The user can then decide on the quantity of the stocks based on the information he sees.
'marketbuy(stock,quantity)' then asks the portfolio table to check if the user has sufficient cash balance to make this transaction. If yes, the portfolio table is updated, the transaction is added to the database connection and an email notification is sent. If not, the user is informed about theinsufficient cash balance scenario.

We have used the Publisher-Subscriber design pattern in this interaction diagram. The orders concept is the subscriber here which subscribes to the email server (the publisher) to send an email. It is unconcerned about the methods the server uses to accomplish this. This design reduces the complexity of the orders table functioning.

8. MARKET ORDER: SELL

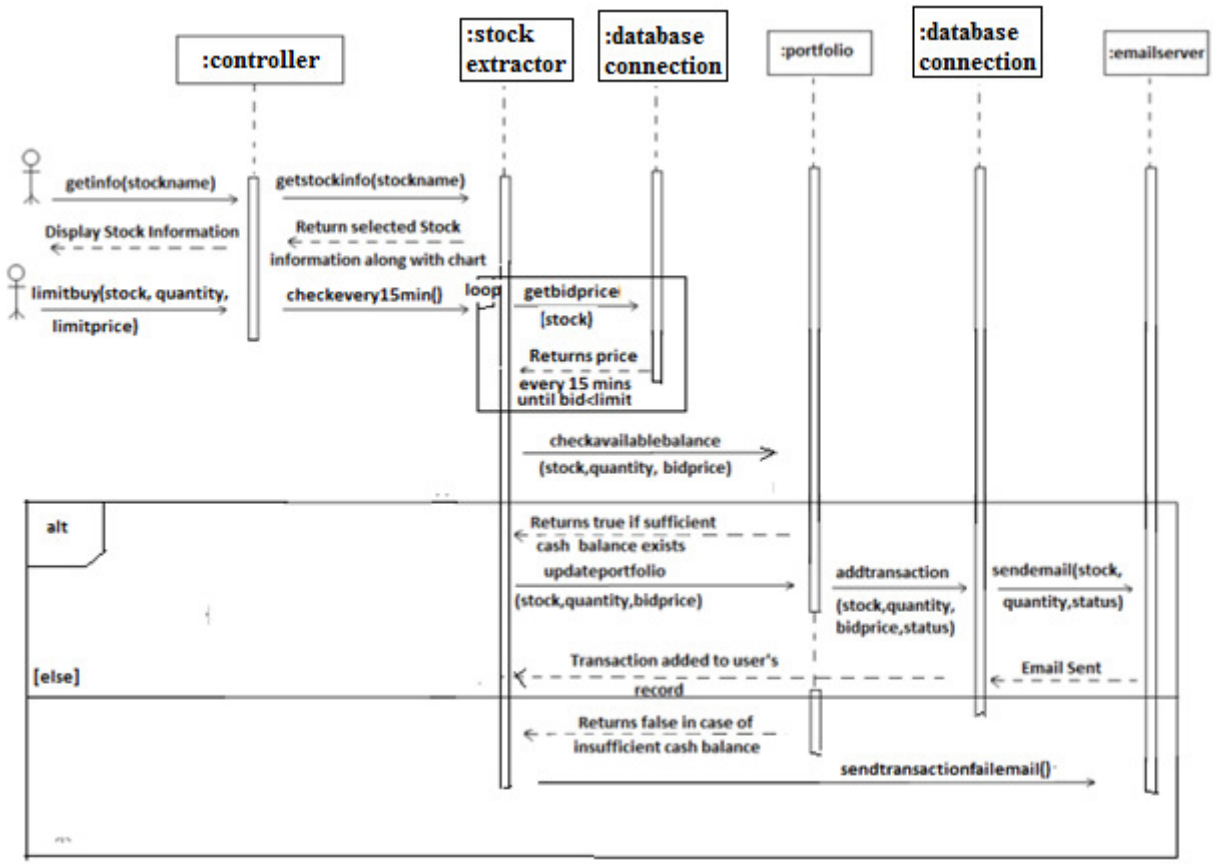


This interaction sequence diagram represents the **USE CASE 8: MARKET ORDER - SELL**. When the user wants to sell a stock (market order), he initiates this process using the 'getinfo(stockname)' function call to the controller where, 'stockname' is the stock he chooses to sell. The controller then gets the current information about the stock like it's ask price, bid price etc. along with a five day chart from the stock extractor. The stocks extractor fetches this information from Yahoo! Finance whenever a query is made. The user can then decide on the quantity of the stocks based on the information he sees.

'marketsell(stock,quantity)' then asks the database connection to check if the user has sufficient number of stocks to make this transaction. If yes, the portfolio table is updated, the transaction is added to the database connection and an email notification is sent. If not, the user is informed about the insufficient stocks scenario.

We have used the Publisher-Subscriber design pattern in this interaction diagram. The orders concept is the subscriber here which subscribes to the email server (the publisher) to send an email. It is unconcerned about the methods the server uses to accomplish this. This design reduces the complexity of the orders table functioning.

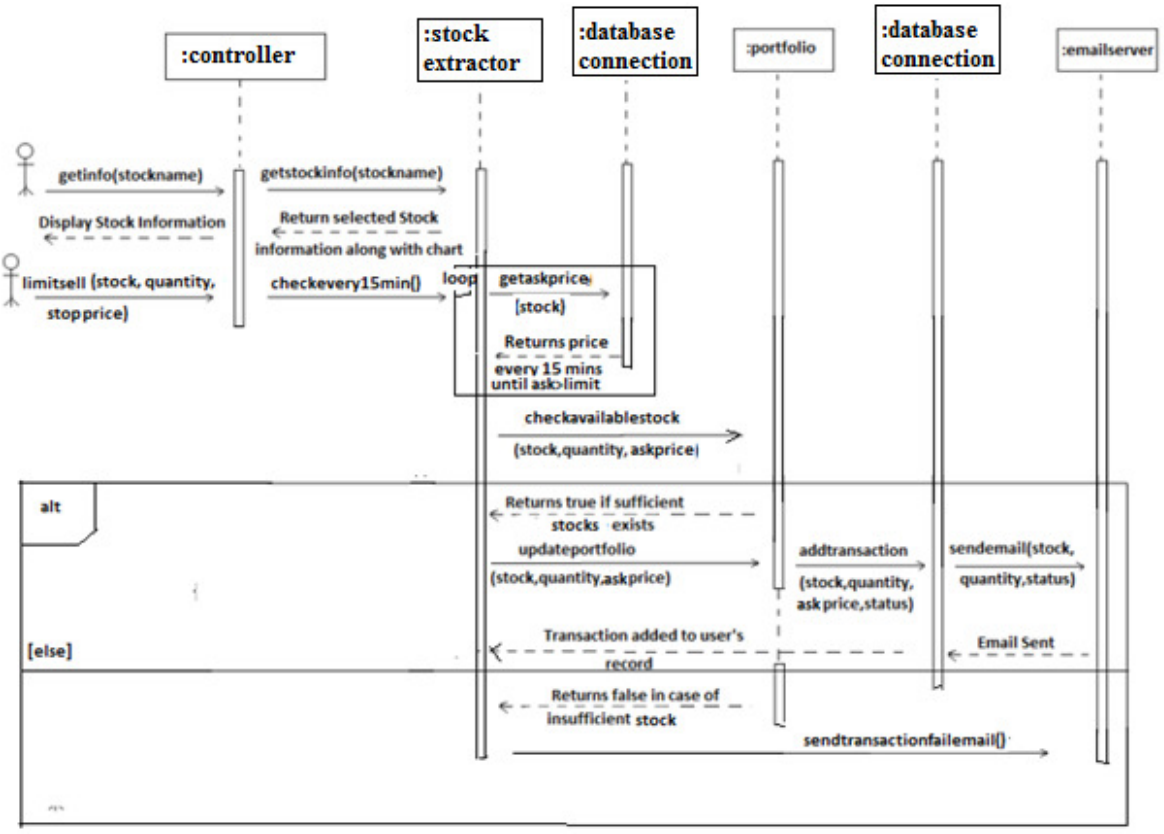
9. LIMIT ORDER: BUY



This interaction sequence diagram represents the **USE CASE 9: LIMIT ORDER - BUY**. When the user wants to buy a stock (limit order), he initiates this process using the 'getinfo(stockname)' function call to the controller where, 'stockname' is the stock he chooses to buy. The controller then gets the current information about the stock like it's ask price, bid price etc. along with a five day chart from the stock extractor. The stock extractor fetches this information from Yahoo! Finance whenever a query is made. The user can then decide on the quantity of the stocks based on the information he sees.
'limitbuy(stock,quantity,limit price)' then tells the connector the name of the stock as well as the quantity the user wishes to buy along with his limit price. The controller then instructs the database connection to check the stock price every 15 minutes (through checkevery15min() function call) and continue this until the bid price falls below the limit price. Once this happens, the loop is terminated and checkavailablebalance(stock,quantity.bidprice) asks the portfolio to check if the user has sufficient funds to make this transaction. If yes, the portfolio table is updated, the transaction is added to the database connection and an email notification is sent. If not, the user is informed about the insufficient funds scenario via an email.

We have used the Publisher-Subscriber design pattern in this interaction diagram. The orders concept is the subscriber here which subscribes to the email server (the publisher) to send an email. It is unconcerned about the methods the server uses to accomplish this. This design reduces the complexity of the orders table functioning.

10. LIMIT ORDER: SELL

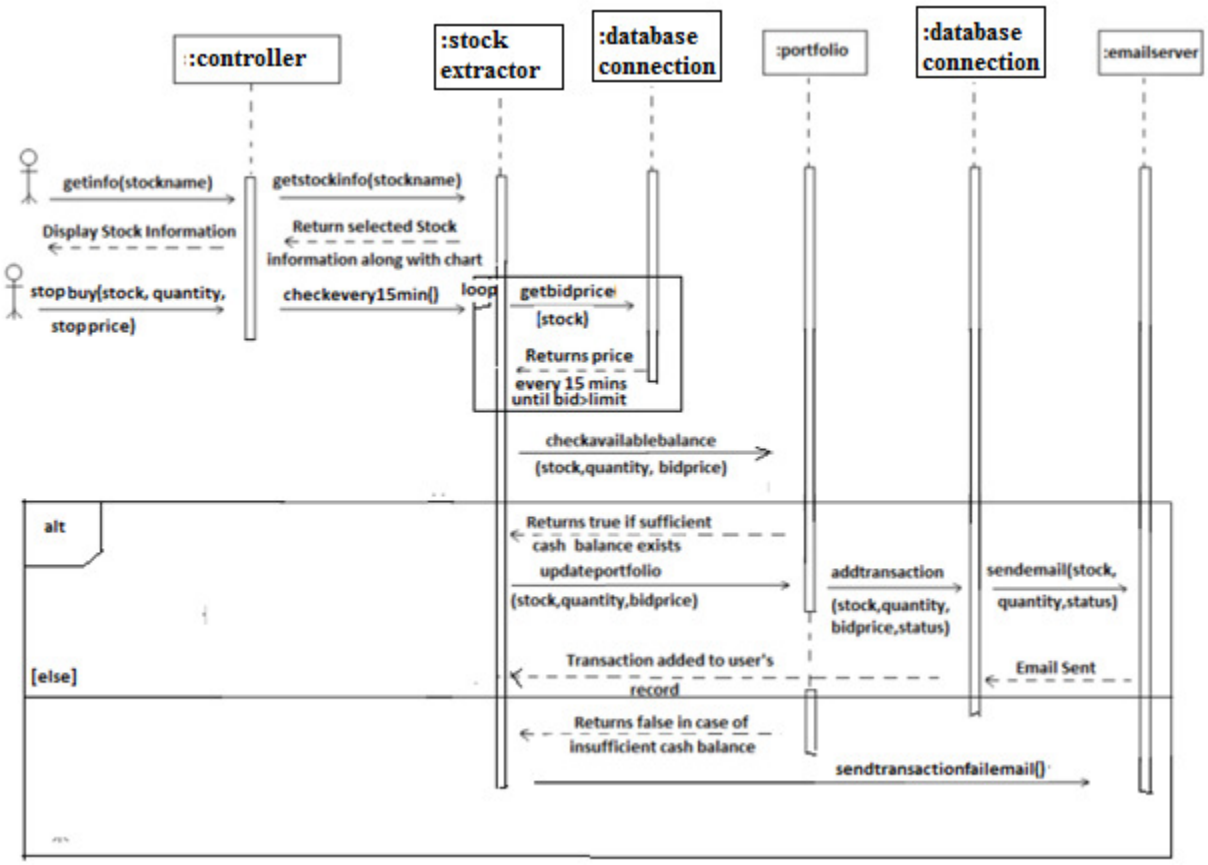


This interaction sequence diagram represents the **USE CASE 10: LIMIT ORDER - SELL**. When the user wants to sell a stock (limit order), he initiates this process using the 'getinfo(stockname)' function call to the controller where, 'stockname' is the stock he chooses to sell. The controller then gets the current information about the stock like it's ask price, bid price etc. along with a five day chart from the stock extractor. The stock extractor fetches this information from Yahoo! Finance whenever a query is made. The user can then decide on the quantity of the stocks based on the information he sees. 'limitsell(stock,quantity,limit price)' then tells the controller the name of the stock as well as the quantity the user wishes to sell along with his limit price. The controller then instructs the database connection to check the stock price every 15 minutes (through checkevery15min() function call) and continue this until the ask price rises above the limit price. Once this happens, the loop is terminated and checkavailablestock(stock,quantity.askprice) asks the portfolio to check if the user has sufficient number of stocks to make this transaction. If yes, the portfolio

table is updated, the transaction is added to the database connection and an email notification is sent. If not, the user is informed about the insufficient stocks scenario via an email.

We have used the Publisher-Subscriber design pattern in this interaction diagram. The orders concept is the subscriber here which subscribes to the email server (the publisher) to send an email. It is unconcerned about the methods the server uses to accomplish this. This design reduces the complexity of the orders table functioning.

11. STOP ORDER: BUY

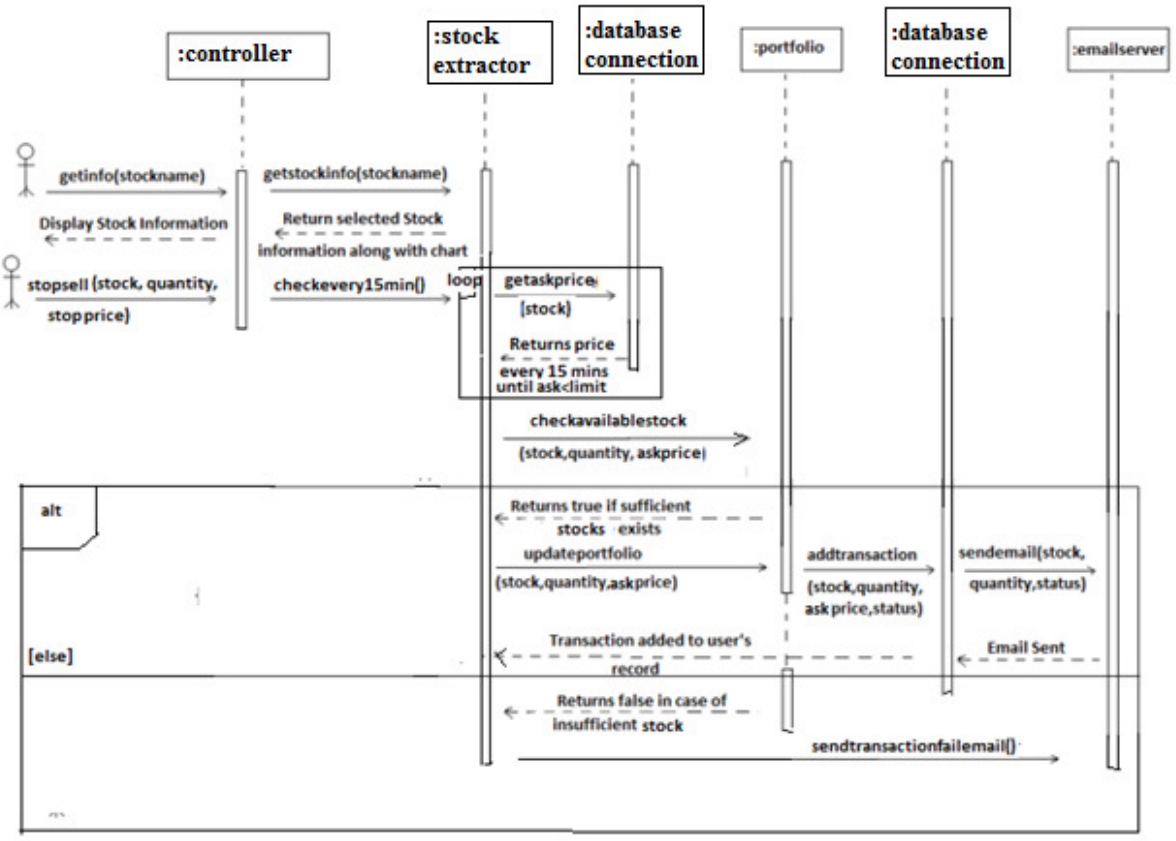


This interaction sequence diagram represents the **USE CASE 11: STOP ORDER - BUY**. When the user wants to buy a stock (stop order), he initiates this process using the

‘getinfo(stockname)’ function call to the controller where, ‘stockname’ is the stock he chooses to buy. The controller then gets the current information about the stock like it’s ask price, bid price etc. along with a five day chart from the stock extractor. The stock extractor fetches this information from Yahoo! Finance whenever a query is made. The user can then decide on the quantity of the stocks based on the information he sees.
‘stopbuy(stock,quantity,stop price)’ then tells the controller the name of the stock as well as the quantity the user wishes to buy along with his stop price. The controller then instructs the database connection to check the stock price every 15 minutes (through checkevery15min() function call) and continue this until the bid price rises above the stop price. Once this happens, the loop is terminated and checkavailablebalance(stock,quantity.bidprice) asks the portfolio to check if the user has sufficient funds to make this transaction. If yes, the portfolio table is updated, the transaction is added to the database connection and an email notification is sent. If not, the user is informed about the insufficient funds scenario via an email.

We have used the Publisher-Subscriber design pattern in this interaction diagram. The orders concept is the subscriber here which subscribes to the email server (the publisher) to send an email. It is unconcerned about the methods the server uses to accomplish this. This design reduces the complexity of the orders table functioning.

12. STOP ORDER: SELL

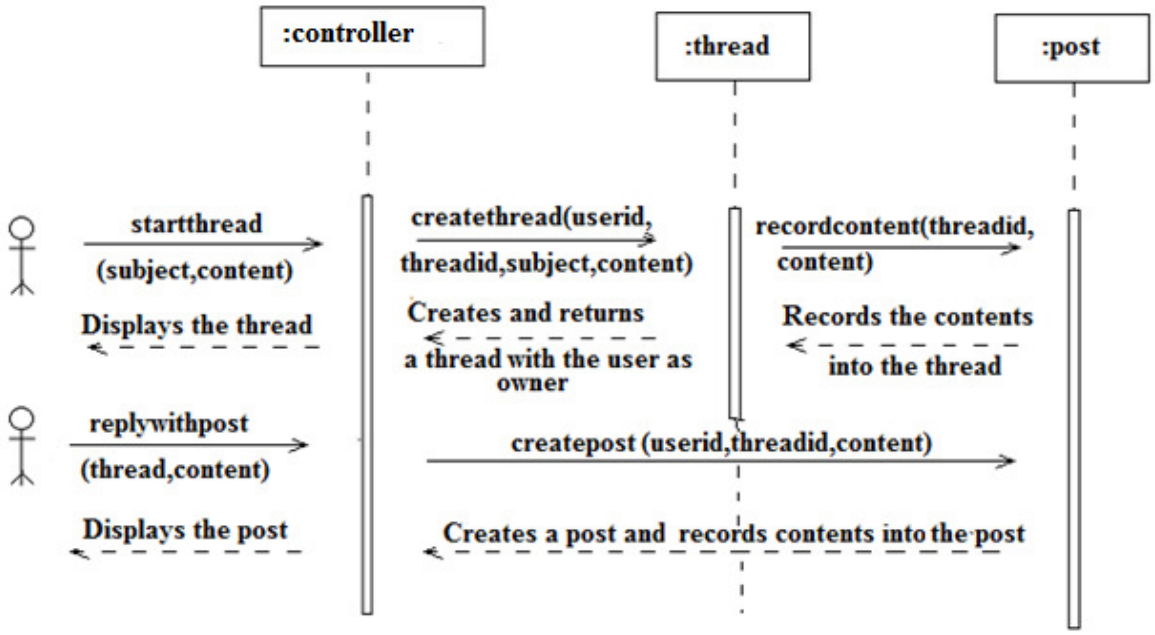


This interaction sequence diagram represents the **USE CASE 12: STOP ORDER - SELL**. When the user wants to sell a stock (stop order), he initiates this process using the 'getinfo(stockname)' function call to the controller where, 'stockname' is the stock he chooses to sell. The controller then gets the current information about the stock like it's ask price, bid price etc. along with a five day chart from the stock extractor. The stock extractor fetches this information from Yahoo! Finance whenever a query is made. The user can then decide on the quantity of the stocks based on the information he sees. 'stopsell(stock,quantity,stop price)' then tells the controller the name of the stock as well as the quantity the user wishes to sell along with his stop price. The controller then instructs the database connection to check the stock price every 15 minutes (through checkevery15min() function call) and continue this until the ask price falls below the stop price. Once this happens, the loop is terminated and checkavailablestock(stock,quantity.askprice) asks the portfolio to

check if the user has sufficient number of stocks to make this transaction. If yes, the portfolio table is updated, the transaction is added to the database connection and an email notification is sent. If not, the user is informed about the insufficient stocks scenario via an email.

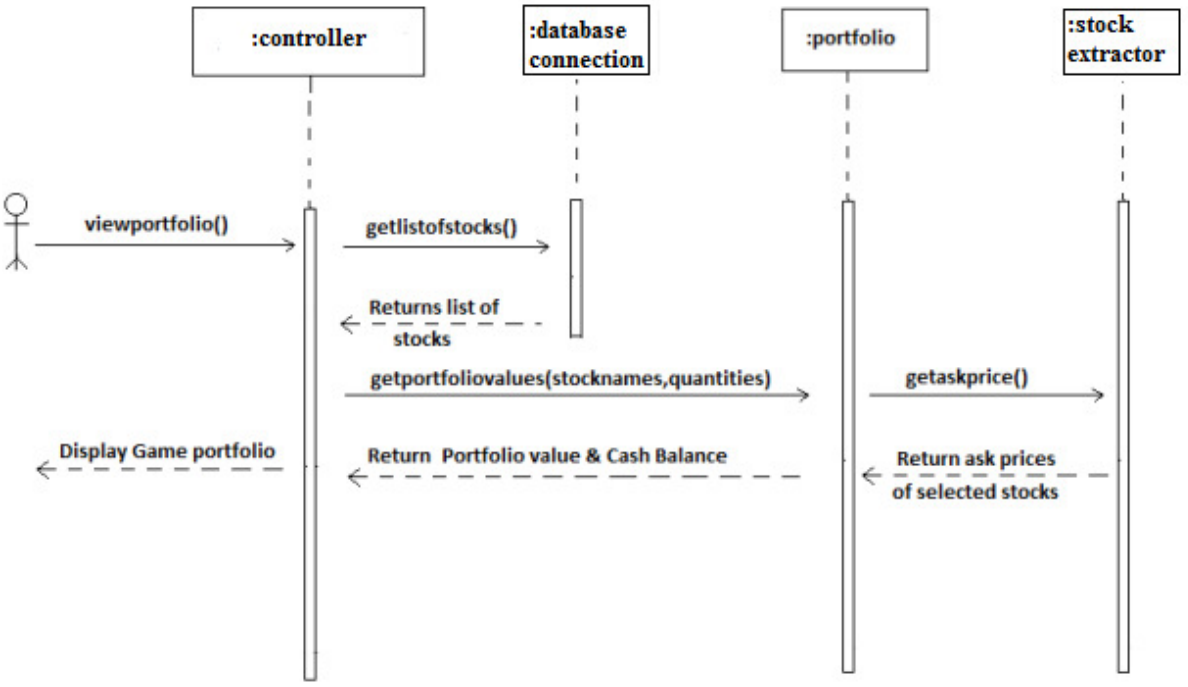
We have used the Publisher-Subscriber design pattern in this interaction diagram. The orders concept is the subscriber here which subscribes to the email server (the publisher) to send an email. It is unconcerned about the methods the server uses to accomplish this. This design reduces the complexity of the orders table functioning.

13. POST IN FORUM



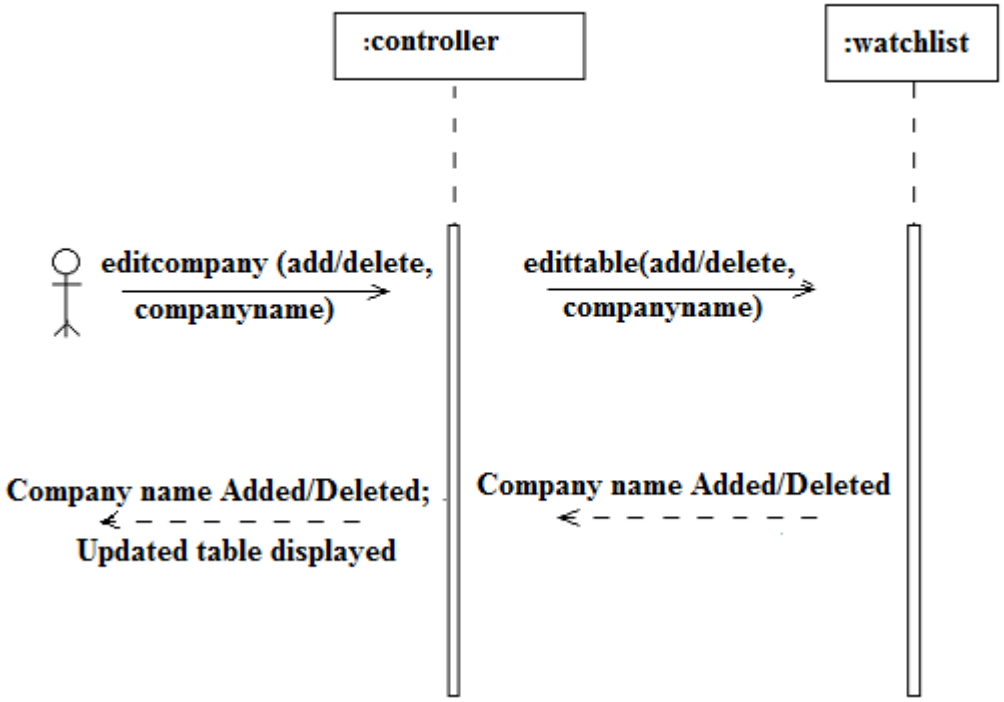
This interaction sequence diagram represents the **USE CASE 13: POST IN FORUM**. When the user wants to start a new thread, he initiates this process by sending the startthread(subject,content) function call to the controller. On receiving this, the controller instructs the thread table to create a new thread by giving it the user ID, Thread ID, subject and the content (via createthread(userid, threaded, subject, content)). The thread table then asks the post table to record the content of the thread. If a user wants to create a post to an existing thread, a call is made to the post table directly from the forum screen.

14. VIEW MY GAME PORTFOLIO



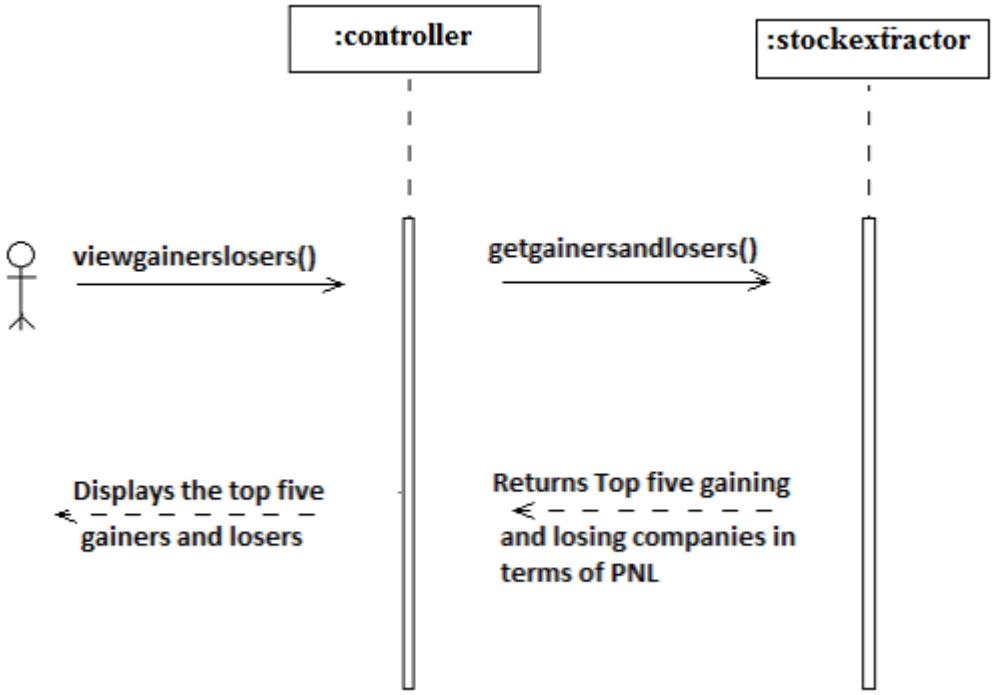
This interaction sequence diagram represents the **USE CASE 14: VIEW MY GAME PORTFOLIO**. The user initiates this process by sending the 'viewportfolio' function call to the controller. The controller then gets a list of all the stocks currently in the user's portfolio from the database connection and then provides this information to the portfolio table. The portfolio table in turn gets the current ask prices for all these stocks and calculates the portfolio value. It then returns this portfolio value along with the user's cash balance. These two values along with the list of current stocks in the portfolio are displayed for the user.

15. ADD TO WATCHLIST



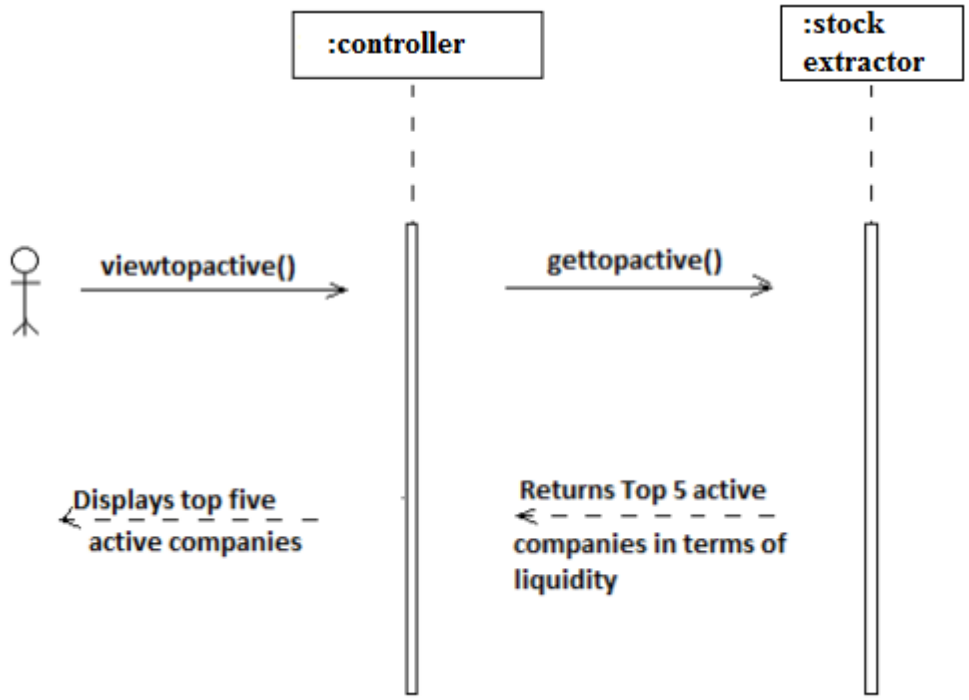
This interaction sequence diagram represents the **USE CASE 15: ADD TO WATCHLIST**. The user can add/delete a company to his Watch List. For this, he needs to make the editcompany(add/delete, companyname) function call to the controller. The controller then sends a 'edittable(add/delete, companyname)' function call to the watchlist table. This function call makes the required the changes to the table. The view watch list table then shows the user the updated table.

16. VIEW TOP FIVE GAINERS/LOSERS



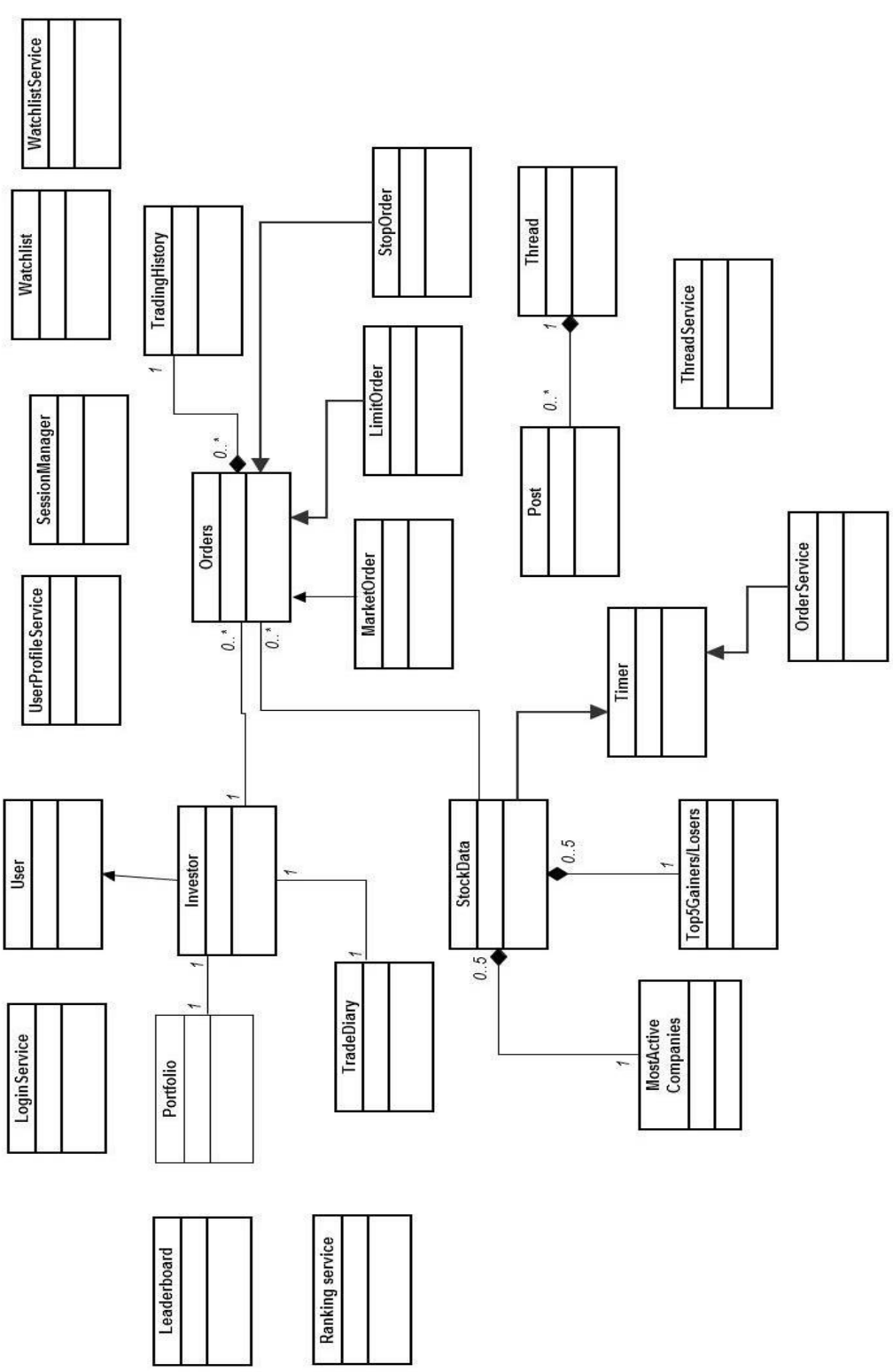
This interaction sequence diagram represents the **USE CASE 16: VIEW TOP FIVE GAINERS/LOSERS**. The user can see a list of top five price-gaining and losing companies from our current database of 20 companies. For this, he needs to make the 'viewgainerslosers()' function call to the controller. The controller then sends a 'getgainersandlosers()' query to the stock extractor. This function call returns the top five companies in the database that have the highest and lowest percentage change in the stock price. The percent change is calculated using the yesterday's closing price and the price at which the latest trade has been made.

17. VIEW MOST ACTIVE COMPANIES



This interaction sequence diagram represents the **USE CASE 17: VIEW MOST ACTIVE COMPANIES**. The user can see a list of top five active companies from our current database of 20 companies. For this, he needs to make the 'viewtopactive()' function call to the controller. The page then sends a 'gettopactive' query to the stock extractor. This function call returns the top five companies in the database that have the highest liquidity (volume of stocks) which are then displayed.

11. (a) CLASS DIAGRAM



11. (b) Data Types and Operation Signatures:

1. User (Investor):

-userid: int

-firstname: String

-lastname: String

-aboutme: String

-email: String

-password: String

2. LoginService:

-home_display:boolean

-email: String

-password: String

+verify_login (in email: String, in password: String): bool{Post-condition: user is authenticated and homepage is displayed. Alternate-scenario: user enters wrong username and password and is requested to enter them again. }

3. SessionManager:

-userid: int

-email: String

+is_valid_session(): bool

+getuserid (in email: String): int

4. UserProfileService:

-display_userdata: boolean

+setfirstname(firstname: String):void

+setlastname(lastname: String):void

+setaboutme(aboutme: text):void

+setemail(email: String):void

+getfirstname(userid: int):String

+getlastname(userid: int):String

+getaboutme(userid: int):text

+getemail(userid: int):text

+getuser():int

+register (in user:User): void

+display_userdata(in userid: int):void{Post-condition: First name, Last name, Age, About-me is extracted from the database and displayed.}

+update_Profile(firstname: String, lastname: String, aboutme:text, email: String):void {Post-condition: Changed fields are updated in the userdata table in the database }

+delete_account(in userid: int):void {Post-condition: All information about the user is deleted in the database}

5. TradeDiary:

-Date: String

-Symbol: String

-Comment: String

-isdisplay: boolean

+insert_comment(in Date: Date, in Symbol: String, in comment: String,userid:int): void{ Post-condition: comment is inserted into the trade_diary table in the database}

+display_comment(userid: int):void{Post-condition: all the comments of the user are extracted from trade_diary table in the database and displayed.}

6. Orders

-orderid: int

-company: String

-tickersymbol: String

-action: String

-Order_type: String

-quantity: int

-transaction_date: datetime

-Price: double

-Commission: double

-userid: int

-status: String

7. MarketOrder:

8. LimitOrder:

-threshold1: float

9. StopOrder:

-threshold2: float

10. OrderService:

+insert_order(in order: Order):void

+get_orders(in userid: int): Array{Order}

+get_stockholdings(in userid:int): Array{Company, quantity}

+send_email(in email: String): void

+update_cashbalance (in quantity: int, in Price: double, in commission: double, userid: int ,action: String): void{Post-condition: cashbalance is increased or decreased depending on whether shares are bought or sold and is updated in the portfolio table in the database}

+process_limitorders():void

+process_stoporders():void

+delete_expired():void

11. Timer:

+timer_reset():void

12. TradingHistory:

+extract_history(in userid: int): Order

13. StockData:

-symbol: String

-company: String

-ask: double

-bid: double

-stockchange: double

-stockvolume: double

+update_stockdata(): void{Post-condition: stockdata is extracted from yahoo finance and updated in the stockdata table in the database.}

14. Top5Gainers/Losers:

-isvisible_gainers: Boolean

-isvisible_losers: boolean

+extract_gainers(in stockdata: StockData): Array{company, stockchange}{Post-condition: Top 5 companies based on the change% are extracted from stockdata table and displayed}

+extract_losers(in stockdata: StockData): Array{company, stockchange}{Post-condition: Last 5 companies based on the change% are extracted from stockdata table and displayed}

15. MostActiveCompanies:

-isvisible: boolean

+extract_active(in stockdata: StockData): Array{company, stockvolume}{Post-condition: Top 5 companies based on the volume are extracted from stockdata table and displayed}

16. Portfolio:

-portfolio_display:boolean

-portfolioid: int

-cashbalance: double

-portfoliovalue: double

-portfoliocurrent: double

-userid: int

+getcashbalance(userid:int): double

+ setcashbalance(userid:int,cashbalance: double): double

+getportfoliovalue(userid:int): double

+update_portfoliovalue(in userid: int) {Post-condition: Depending on the stock holdings of the user the portfolio value is updated in the portfolio table.}

+display_portfolio(in userid: int) {Post-condition: Displays the portfoliovalue, cashbalance and stockholdings of the user.}

+calculate_portfoliocurrent():void

17. Thread:

-threadid: int

-subject: text

-threadowner: String

-createdDate: date

18. Post:

-id: int

-post: text

-userid: int

-date_entered- date

19. ThreadService:

+CreateThread():void

+CreatePost(threadid:int):void

+getPost(threadid:int):Post

+deletePost(id:int):void

20. Leaderboard:

-position: int

-userid: int

-username: String

-datemodified: date

21. RankingService:

+rankUsers(datemodified:date): void

+displayRanks(): Leaderboard

22. Watchlist:

-id: int

-symbol: String

-company: String

-action: String

-exchange: String

-changev: float

-dayhigh: float

-daylow: float

-volume: double

-isdeleted: int

-userid: int

23. WatchlistService:

+add(symbol:String): void

+delete(symbol:String): void

+displayWatchlist(): void

11. (c) DESIGN PATTERNS:

A design pattern is a common software engineering practice for reusing solution to problems in software design. Often, it can be a generic template that can be modified to solve a subset of problems. In this project, we apply a popular design pattern: Indirect Communication: Publisher-Subscriber:

Indirect Communication: Publisher-Subscriber

Publisher-Subscriber pattern is a technique used to implement indirect communication where Objects are not programmed to send messages to specific receivers, rather send messages to any subscribers of a certain interest or topic. There are three main components: publishers, subscribers and events.

Publisher – Knows events sources, knows subscribers, registers/unregisters subscribers, notifies subscribers of events.

Subscribers – Knows events of interest, knows publisher, resisters/unregisters with publisher, processes received event notifications.

Events – The types of information that a subscriber want to be informed whenever it occurs.

Application of Publisher-Subscriber:

One of the functionalities implemented in this project is automatic email notifications based on user threshold stock values. The software solution to this problem can be realized using the publisher-subscriber model.

The limit orders/stop orders module is associated with every investor account.

This module subscribes the pending orders module for sending emails when the ask/bid prices reach the thresholds. The pending orders module implements the process of checking pending orders every 15 minutes and sending emails. Hence, limit orders/stop orders module is a

subscriber to pending orders module and pending orders module is a publisher to limit orders/stop orders module.

11. (d) OCL OPERATION CONTRACTS:

LoginService:

Context LoginService **::** verify_login (email: String, password: String): boolean post:

If (user->exists(c,v|c=email and v=password)) then

home_display=true

else

home_display=false

UserProfileService:

Context UserProfileService :: display_userdata(userid: int) : void post:

display_userdata=true

Context UserProfileService :: update_Profile(firstname: String, lastname: String, aboutme: text, email: String): void post:

if(firstname!=null) then

self.setfirstname(firstname: String)

if(lastname!=null) then

self.setlastname(lastname: String)

if(aboutme!=null) then

self.setaboutme(aboutme:text)

if(email!=null) then

self.setemail(email:String)

Context UserProfileService :: delete_account(userid: int): void post:

Let flag:bool=user->exists(c|c=userid)

Flag=false

TradeDiary:

Context TradeDiary :: insert_comment(in Date: Date, in Symbol: String, in comment: String,userid:int): void post:

Let flag:bool=comment->exists(c|c=comment)

Flag=true

Context TradeDiary :: display_comment(userid: int) :void post:

Isdisplay=true

OrderService:

Context OrderService :: update_cashbalance (in quantity: int, in Price: double, in commission: double,userid:int,action: String): void post:

If(action==”buy”) then

Let cashbalance_current: double=Portfolio.getcashbalance(userid:int)-((quantity*price)+commission)

If(action==”sell”) then

Let cashbalance_current: double=Portfolio.getcashbalance(userid:int)+((quantity*price)-commission)

Portfolio.setcashbalance(cashbalance_current)

Top5Gainers/Losers:

Context Top5Gainers/Losers :: extract_gainers(in stockdata: StockData): Array{company, stockchange} post:

isvisible_gainers=true

Context Top5Gainers/Losers :: extract_losers(in stockdata: StockData): Array{company, stockchange} post:

isvisible_losers=true

MostActiveCompanies:

Context MostActiveCompanies :: extract_active(in stockdata: StockData): Array{company, stockvolume} post:

Isvisible=true

Portfolio:

Context Portfolio :: update_portfoliovalue(userid: int):void post:

Self.calculate_portfoliocurrent()

Portfoliovalue=portfoliovalue@pre+portfoliocurrent

Context Portfolio :: display_portfolio(in userid: int): void post:

portfolio_display=true

11 e) COHESION METRICS:

CLASS	SCOM	CC	CAMC
UserProfileService	0.065	0.205	0.25
TradeDiary	1	0.25	0.67
OrderService	0.05	0.053	0.25
Top5Gainers/Losers	1	1	1
Portfolio	0.917	0.6	0.5
ThreadService	0.083	0.16	0.75
WatchlistService	0.33	0.33	0.67

We have considered only those classes on which all the three metrics can be applied and those which have methods.

12. System Architecture and System Design

a) Architectural styles

Architectural style corresponds to the composition of the system along with communications involved in it. The architecture of our software system is not limited to a single architectural style, but is a combination of architectural styles that make up the complete system. This is because the system under consideration (TradeFun! website) is an interactive and dynamic website. A few architectural styles that relate close to our system are explained in the following table

Architectural Style	Description(MSDN & Wikipedia)	Role in TradeFun! website
Client/Server	Segregates the system into two applications, where the client makes requests to the server. In many cases, the server is a database with application logic represented as stored procedures. A client does not share any of its resources, but requests a server's content or service function. Clients therefore initiate communication sessions with servers which await incoming requests.	Client/Server architectural style can be found in working of various applications of our website like during Login, Trading, Trading Diary, Portfolio display, Delete Account. This style acts as the back bone of our website as this a database driven website.
Component based Architectural style	Component-based architecture describes a software engineering approach to system design and development. It focuses on the decomposition of the design into individual functional or logical components that expose well-defined communication interfaces containing methods, events, and properties.	TradeFun! Website contains different modules which are interconnected and interact with each other. For example, Trading diary and Portfolio are two individual applications which interact with each other for data. This makes our website to have Component based Architectural style
	Event-driven architecture (EDA) is a software architecture pattern	A typical Web application design like TradeFun! works with the user

Event driven Architectural style	promoting the production, detection, consumption of, and reaction to events. An *event* can be defined as "a significant change in state"	logging in(an event), asking for information(event), executing the trade(another event) and logging out. Thus we can say that TradeFun! has an event driven architectural style

b) Identifying Subsystems

The following package diagram depicts our subsystems. It shows the domains <<boundary>>, <<control>>, <<entity>> that were discussed in the domain analysis and the classes that were discussed in the class diagram.

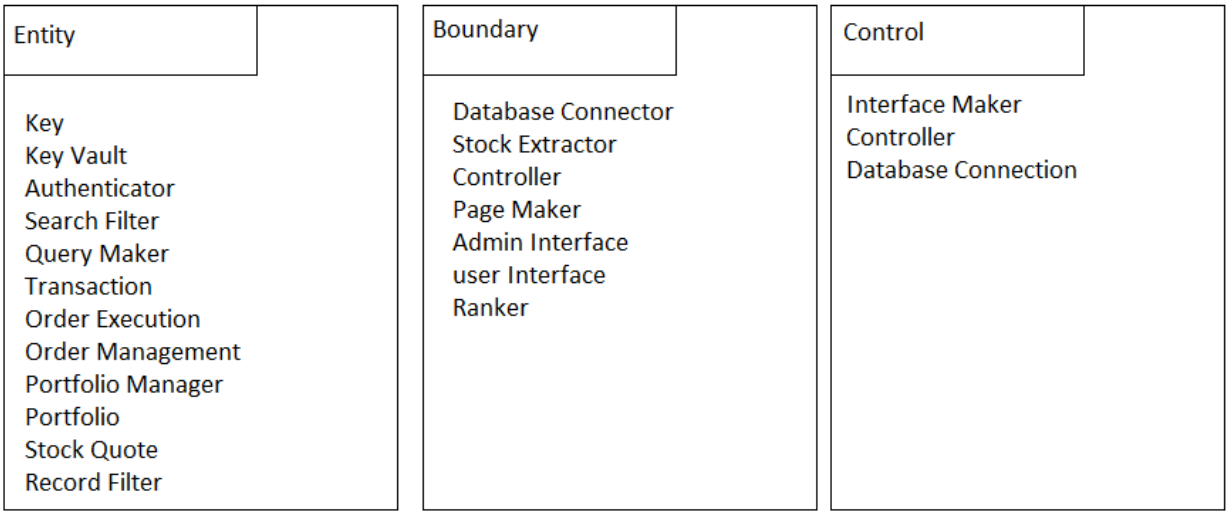


Fig 5.1 Package diagram of subsystems

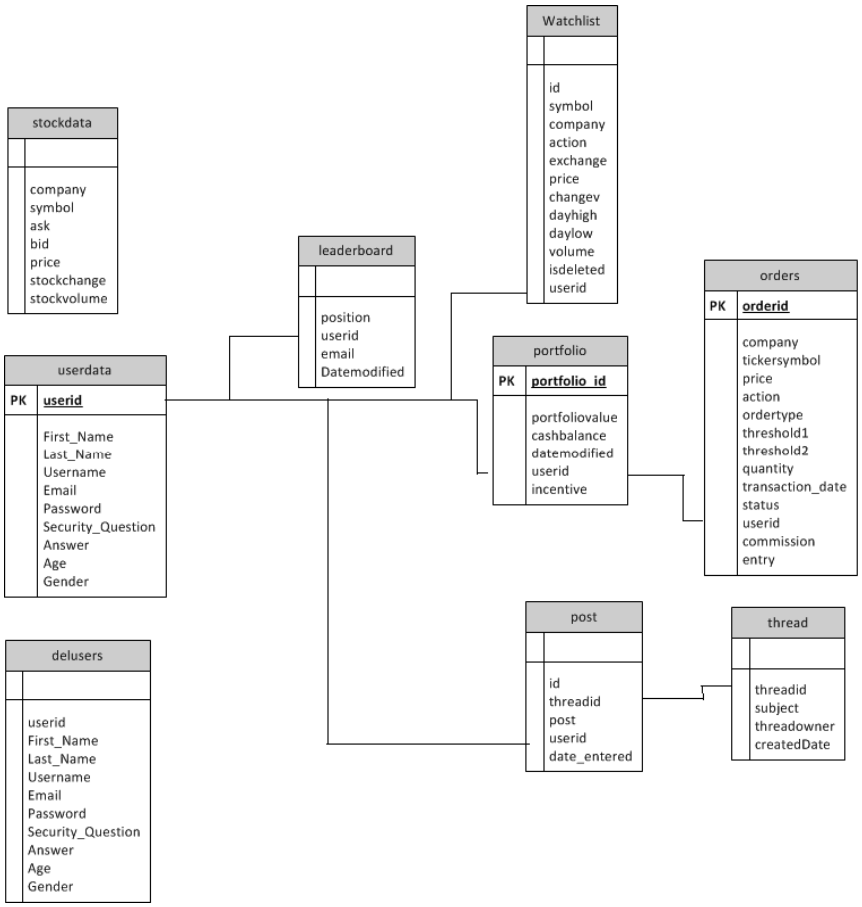
c) Mapping subsystems to hardware

At the time of writing this report, our system runs on a single machine. Both the server and client reside on the same machine, which means, to play the game user should have database and web server setup on his/her machine. By the time of final release, we want to make sure that this is not required.

d) Persistent Data Storage

As our system is a register and play model, we are required to store the personal information of our registered users along with their individual portfolios and trading diaries. This was achieved by setting up a relation database called MySQL. In MySQL, at present we have a database called "test". This has all the tables that are required for the smooth flow of the game. All the personal information of the users is stored in a table called "userdata" in which email will be a unique column. This was implemented so that no two users can have the same email (just like a username). "yahoo data table" is the table which stores the stock information and gets updated frequently by running a query.

These tables are interconnected either through the primary key (userid) or through email. Email was used to connect the tables because it is easy to store and update tables with this as email will be the session variable and all the data pertaining to that session can be sent to database tagged with the email.



5.2 Database Schema

e) Network Protocol

Since our system is a web based application using PHP and MySQL, we will be running on an Apache server. PHP has built in a library for communicating with MySQL databases. It is much more efficient and faster than opening an ODBC connection. We will use this library for communications between the application and its backend MySQL database. The PHP-MySQL extension makes full use of the MySQL Client/Server Protocol. This is a powerful protocol and will facilitate all the server-to-database server connections. We choose MySQL not only because it is highly robust, but also it is completely free and enables us to invest resources in other facets of the system.

Also, our system connects to Yahoo! Finance using HTTP. We are using an HTTP protocol because it is the most commonly used protocol on the internet and it is a standard protocol in any server as well as browser. This option was especially attractive as it allows for great flexibility in design and high reliability. Any user who can run a web browser will be compatible with our system. By the way, HTTP is driven simply by the fact that HTTP URLs for stock quotes and charts on Yahoo! Finance are readily available.

f. Global Control Flow:

- Execution Orderness:

Most of our system is event-driven. Which means actions can be generated by any user at any point in time. Once an action is generated the system will respond accordingly, managed by the control structure. When no actions are being taken, the system will remain idle until user-interaction occurs. The advantage of event-driven is that it provides a simpler structure and waits in a loop for events, and every user can generate the actions in a different order. The difficulties arise when a sequence requires multiple steps to complete.

Some of screens in our system have two threads that run concurrently. For example, my portfolio and my trading history are both have two threads. One is event-driven, which we have mentioned above, the system responds when the user clicks a button or when an event occurs.

The other is procedure-driven which periodically updates the display of the portfolio contents and transaction history with taking no inputs from the users.

- Time Dependency:

Until now we have not used any timers in our system. That is to say, when a user clicks trade stocks, my portfolio, top five gainers/losers and most active companies, the stock data table in the database is automatically updated with the data extracted from Yahoo! Finance and accordingly the actions are carried out with the updated data. Maybe we will add timers in the future demo.

- Concurrency:

Since our system is implemented via a server-side scripting language and we use Apache as our web server, it is, by nature, multithreaded. This is completely seamless to us and saves a lot of development time while making use of proven technologies. Apache, PHP, MySQL are all proven to be solid, enterprise caliber software. These are multithreaded and allow for many concurrent users and concurrent database queries.

g) Hardware Requirements

 Disk Storage**:** 100MB Available Hard Drive Space would satisfy our needs to hold user data in database.

 Operating System: the user can access to our website using Windows XP/Vista/7.

 Internet-LAN Connection with minimum bandwidth of 56Kbps are needed to connect to Yahoo! Finance and CNBC so that users can get the latest information.
 Screen Display-our website will be well presented if users use a computer with a display resolution of 1024x768 or greater.

 System should be able to run PHP, MYSQL, java script and Apache HTTP server smoothly.

These requirements are not minimal, but are recommended for the best server experience.

13. ALGORITHMS AND DATA STRUCTURES:

(a) Algorithms:

Top 5 Gainers/Losers:

The top 5 gainers/losers list gives a list of top 5 companies based on change (%) whose share values have increased and decreased.

Change in %:

Change is the difference between the last closing price and the current price (Last trade).Change percent signifies the profit per share made by the company.

Previous day's closing price=p1

Last trade (current price) = p2

Change (%) = ((p1-p2)/p1)*100

(b) Data Structures:

Our system uses two types of data structures. Arrays are used in many parts of our system. The other data structures used are data tables loaded in the MYSQL database.

14. User Interface Design Implementation

One of the main goals of TradeFun! Website is to attract students and traders with little or no technical knowledge. In order to achieve this goal, from the beginning we made sure to keep the User Interface as simple and as easy to use as possible. The initial design for a general page that we planned was as follows:

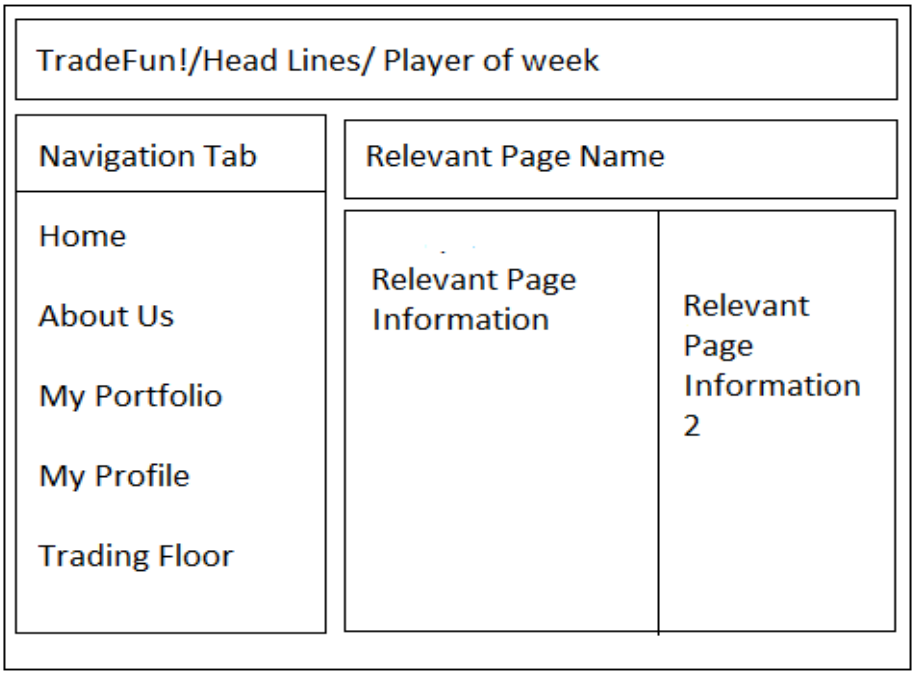


Fig 7.1 General page format

Keeping our initial promise, we decided to use the above design for all our pages. This decision was made after we found that the users feel comfortable if all the pages are of the same design/ pattern (as opposed to boredom attached to it). In order to achieve this goal, we are using iframes where all the new pages open in the frame at the center of the page as opposed to an entirely new page. This has two distinct advantages: it is easy to navigate through the pages- using the navigation bar on the left side of the page and it is easy to keep the session alive through all the pages (in addition to keeping the number of mouse clicks at minimum).

Our User Interface promises least number of mouse clicks to get the work done. The front page of TradeFun! Has login along with links that redirects the user to “new user registration” and

“forgot password”. There will be running scroll on the left side of the page with latest updates/news from TradeFun! Team.

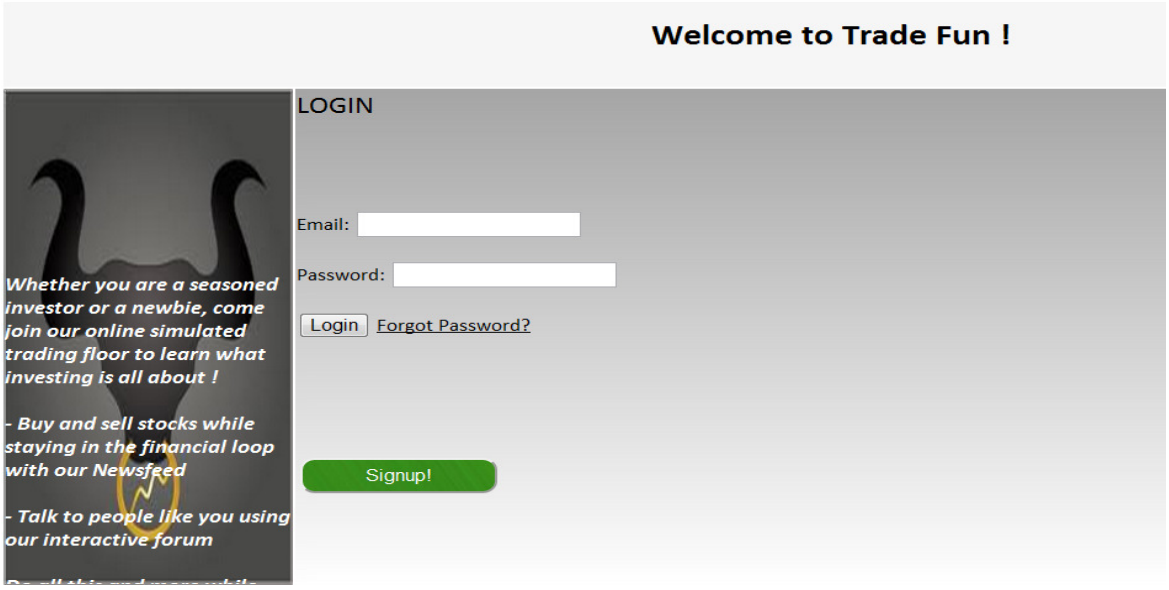


Fig 7.2 Login Page

Once the User enters his/her credentials and system authenticates it, user will be redirected to the homepage which is shown below. Going along with the lines of general page description, home page has navigation on the left side of the page and an iframe at the center of the screen with latest financial/ world headlines from CNBC. Care has been taken not to include the entire CNBC website into our homepage as this may result in giving up the valuable space.

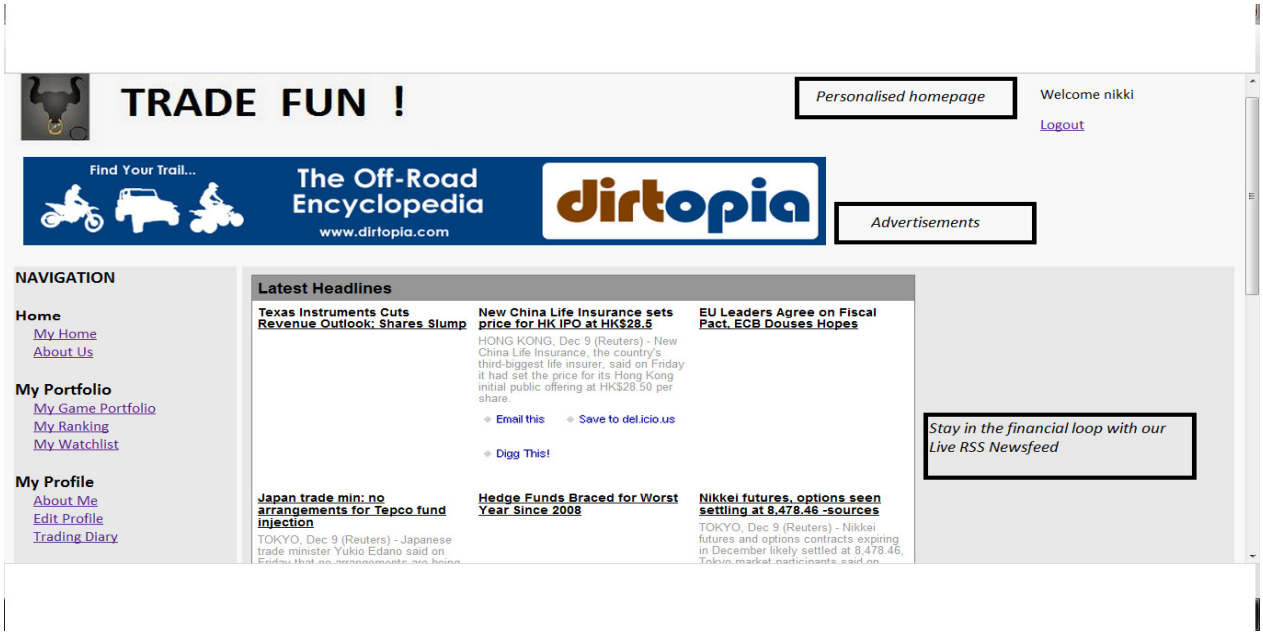
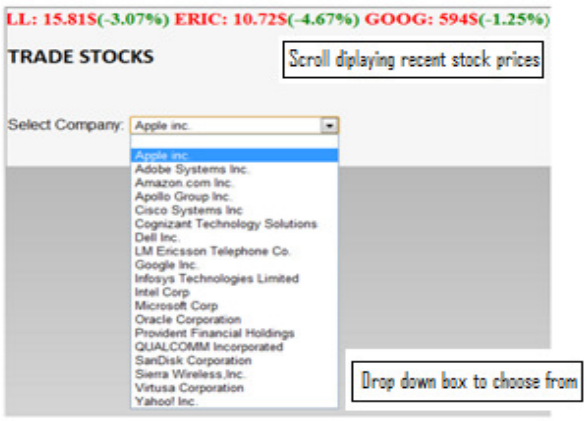
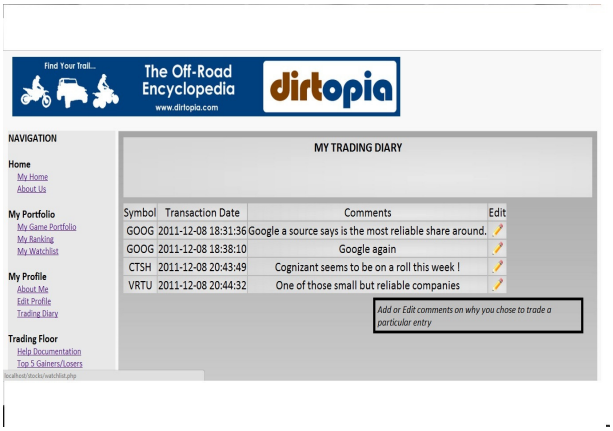


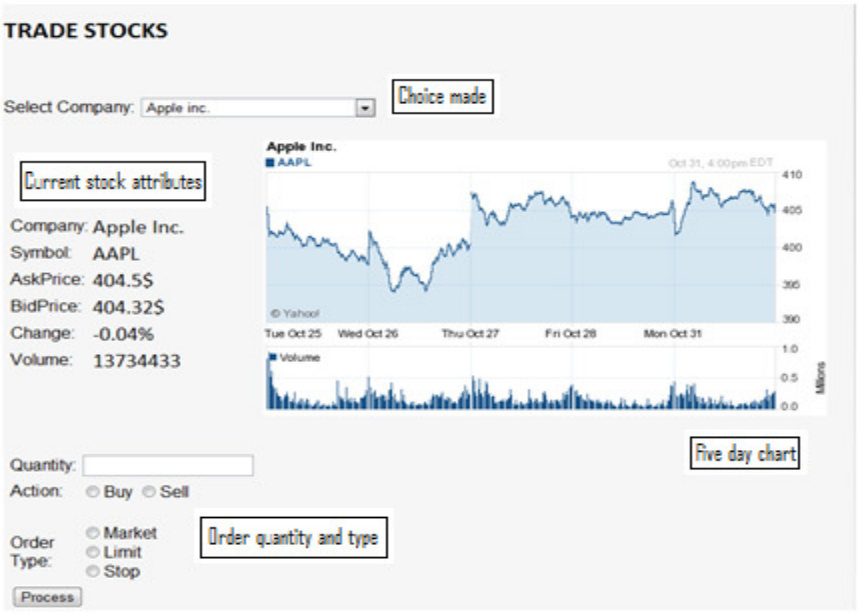
Fig 7.3 Homepage

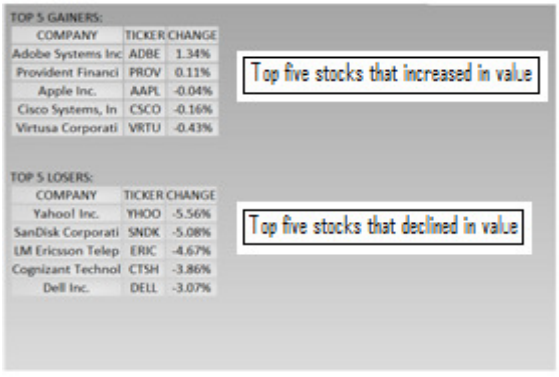
From the homepage, user can navigate to the page of his/her choice using the navigation bar.

For reference, trading page and portfolio are shown below.









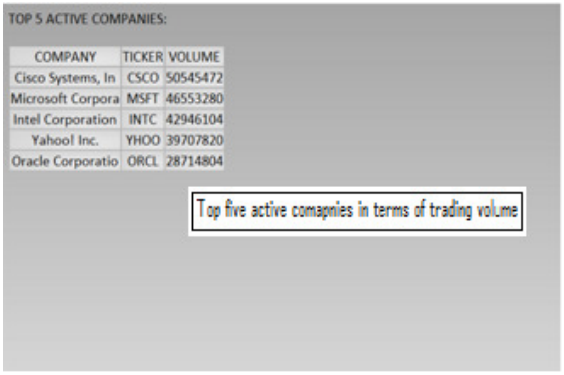
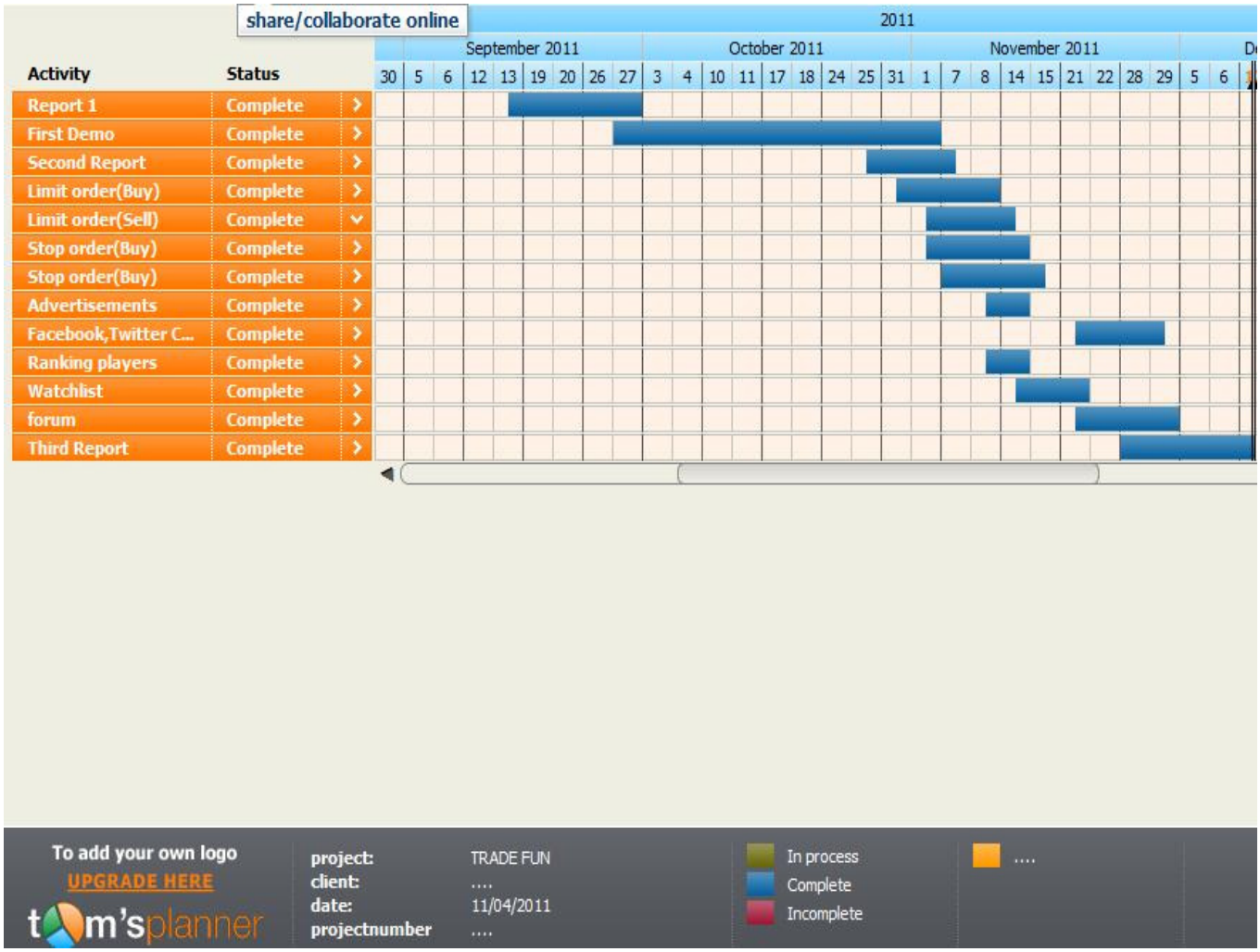


Fig 7.4 Trading Floor pages

15. HISTORY OF WORK & CURRENT STATUS OF IMPLEMENTATION:



All the deadlines were met according to the schedule we planned in report 1 and report 2.

OUR KEY ACCOMPLISHMENTS:

1. Our biggest achievement is that we were able to learn different software techniques and we succeeded in providing the user a user-friendly interface.
2. We provided him as much financial information as possible with RSS feed from CNBC and Reuters as well, Top 5 gainers/losers, Most Active companies.
3. We were able to personalize the website with the trading diary and forum.
4. We provided the users a leaderboard to keep them motivated.

16. Conclusions and Future work

Learning and working PHP, SQL, JavaScript and HTML was the biggest challenge that we faced during the first iteration. Getting familiar with web design and implementation was tedious and also exciting. The biggest challenge that we faced during the first iteration was division of work and assigning responsibilities. Apart from this, one other challenge that we faced was imagining a thing in our heads and putting it on the table in the form of pen and paper. In the context, various Software Engineering techniques that we learned during the course of the semester helped us a lot in regards to breaking the problem into various small pieces and working them iteratively.

One biggest technical challenge that we faced during the second iteration was automation of stock price updates, limit and stop orders (which requires the system to check the price iteratively every 15 minutes and execute the trade when the bid/ask reaches the threshold set by the user). Software engineering technique of associating the problem at hand to something that we already know and is solved helped us in automating our system. We automated the process by using the windows task manager whose function we already know beforehand.

The second biggest challenge that we faced was integrating work from different members from the group and maintains backups at every stage of the project. This was achieved again by using the various software engineering techniques that we learned in the class. Agile software development was implemented at every stage of the project. For example, use cases very changed iteratively during various stages of the project. Correcting the requirements and updating Domain model towards the end of the project was also done as was required.

It would have helped to know a little more beforehand about the trading environment we were modeling, as well as having a class that teaches the basics of PHP, MySQL, Apache. This would have given us the basics that we need to start our project and concentrate more on the software engineering techniques that would help us to achieve our objectives more smoothly.

Due to time constraint and lack of required knowledge in Java Programming, we did not implement TradeFun! on an android platform. But this would be a good recommendation if the

reins were to be picked up at the point where we are leaving them. Also an iPhone app would make TradeFun! a mobile application.

Recommendations: At the time of writing this report, to run Tradefun! On a system it should have all the required software like Apache, MySQL database with the required tables in it. Hosting the application on web can enable the users to access the website like another website without having to install all the required softwares. This is one recommendation that the development team has that should be taken as an immediate priority.

Prediction System: Adding to all the information that we provide to the user, predicting techniques can be one addition to TradeFun!. Simple technical analysis algorithms which will give the users a sense of direction- buy, sell or hold on to a particular stock can be added to the existing system. This will attract new customers who want to know what is going to happen to the stocks that they are holding and aid them in decision making.

Options and Derivatives trading: Due to time constrains, only stock trading had been implemented. One future recommendation would be to add option and derivative trading to the existing trading. Also, trading in international markets can be added to increase global user pool. For users who are not familiar with international business, tutorials can be added to improve the knowledge base.

Real time stock data: Once the website has enough revenue generating subscribing to real time data can be implemented. This will enable the users to trade more precisely using their virtual money. However at this point of time, this recommendation is a very ambitious one because there is no revenue from the website.

17. REFERENCES

- Wikipedia: Stock market, http://en.wikipedia.org/wiki/Stock_market
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