GROUP ASSIGNMENT

Software Engineering Project II
COMP3006L

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BATCH 7

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Team Paradox

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Motivation to project

From this software engineering subject, we learn about many new approaches in development. They are such as Actor models, TDD, JUnit, Git etc. Learning about these theories gave us the biggest motivation to create the game. Also learning about the stock market was an interesting thing because it's a little bit of a new subject.

About the real stock market

A stock market/share market is the aggregation of buyers and sellers of stocks. Stocks, also known as equities, represent fractional ownership in a company, and the stock market is a place where investors can buy and sell ownership of such investable assets. An efficiently functioning stock market is considered critical to economic development, as it gives companies the ability to quickly access capital from the public. Stocks allow you to own a share of a public corporation. The stock price is based on the corporation's earnings. If the company does well, or even if everyone thinks the company is going to do well, the stock price goes up. Stocks also rise when the economy does well. Many companies also give a dividend payment each year to the stockholders, which provides extra value.

These companies and stock buyers has a coordinator. He or she is called as stockbroker. A stockbroker is a professional who executes buy and sell orders for stocks and other securities on behalf of clients. A stockbroker may also be known as a registered representative, investment adviser or simply, broker. Stockbrokers are usually associated with a brokerage firm and handle transactions for retail and institutional customers alike. Stockbrokers often receive commissions for their services, but individual compensation can vary greatly depending on where they are employed. Brokerage firms and broker-dealers are also sometimes referred to as stockbrokers themselves.

Game specification

Stock market simulated developed as a partial requirement of Software Engineering project.

Stock Market Game develop and manage a virtual investment portfolio of stocks. The Stock Market Game is conducted via the internet and allows Players to test their knowledge and skills against other players in an online competition. Each participating team manages all aspects of the portfolio including asset selection, buying and selling. The goal of the competition is to increase the value of the profit. During the course of the Stock Market Game, participants will develop investment strategies based on expectations of growth, diversification and stability

How we simulated the real stock market in our game

Our game that attempts to reproduce or duplicate some features of a livestock market on a computer so that a player may practise trading stocks without financial risk. Our Stock market game is a speculative game that allows players to trade stocks in a virtual or simulated market environment.

Game rounds exist in several forms but the basic underlying concept is that these games allow players to gain experience or just entertainment by trading stocks in a virtual world where there is no real risk. Players compete with each other to see who can predict the direction the stock markets will go next. We are used to random algorithms with probabilities to generate stock price but it looks like the real stock market.

How to win/lose in this game

- ### How to win

In each transaction, the profit of each player will be calculated using the following equation.

$$\text{Profit \%} = \frac{Sold\ stock\ price - Bought\ stock\ price}{sold\ stock\ price}\ 100\%$$

After completing all the rounds, the player who gets the highest profit of the game will be the winner. Players of the game will be ranked according to the profit.

- ### How to lose

The player who gets the lowest profit from the game will be the loser

Game

- Since this is a multiplayer game there must be 4 players per game.
- One player must create a game and share the game key among other players generated by the system.
- Each player must register to the game by inserting a one-timeThen click
- If the game is already started, no more players cannot join that game.
- There are five rounds per game. Each round is 100 seconds long. After the five rounds finished winner of the game will be announced.
- In the start of the game, an account with Rs 10 000 balance will be given to each player. Players must use this account balance for their transactions in the game.

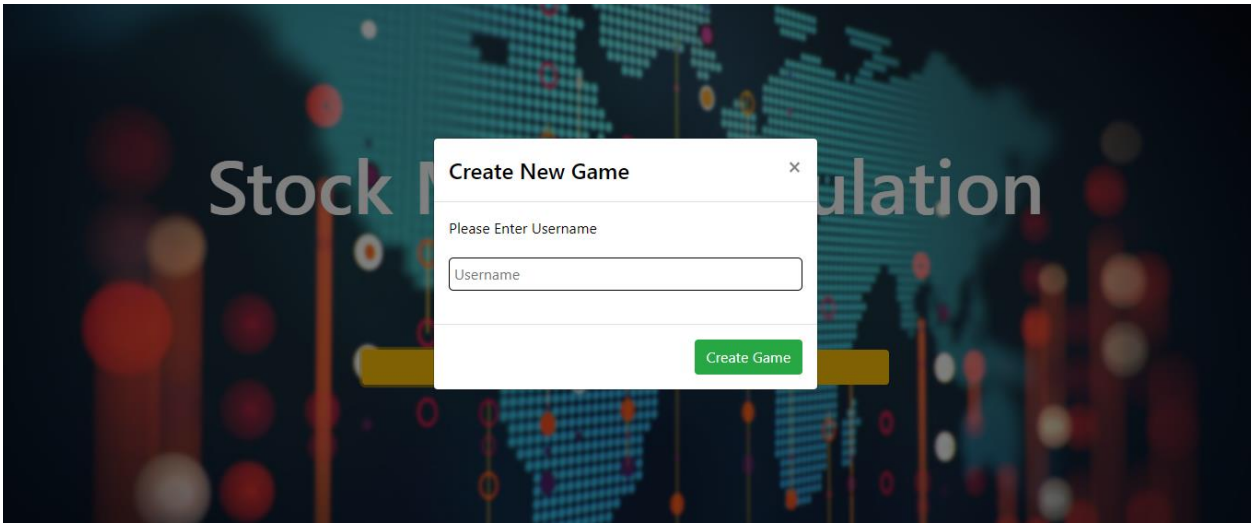
Rules in our game

- A game will consist of a fixed number of turns. (20 turns)
- Each turn will last for a constant amount of time. (10 seconds)
- The price of a stock will change once per turn.
- Players can buy or sell stocks at any time.
- Each game has 3 rounds.
- The total time to complete a game is 10 minutes.

Game flow

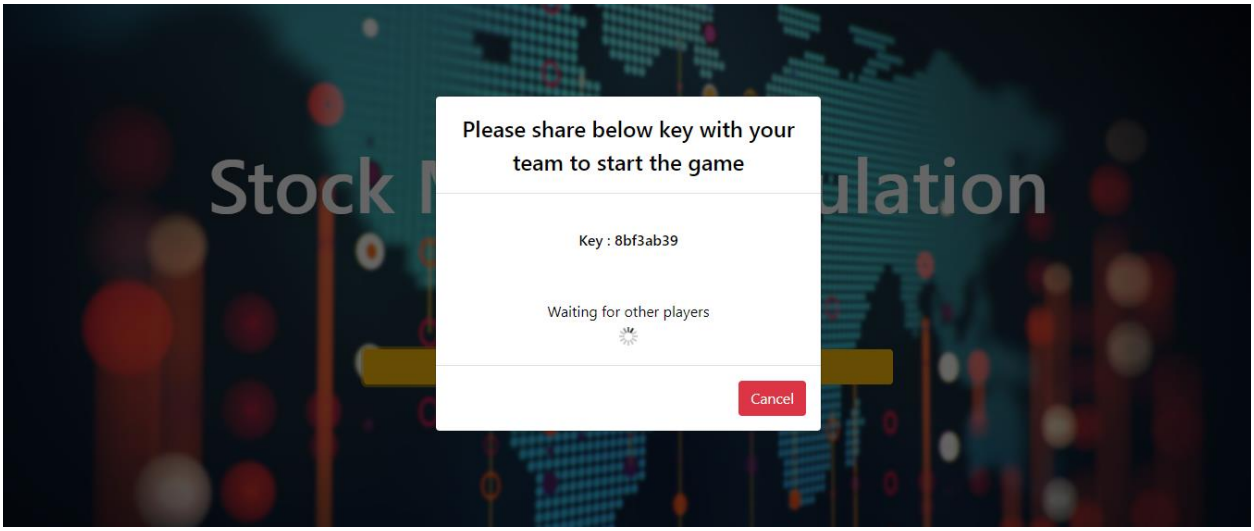
1. A player must click “Create Game” button on creating a new game.

start screen



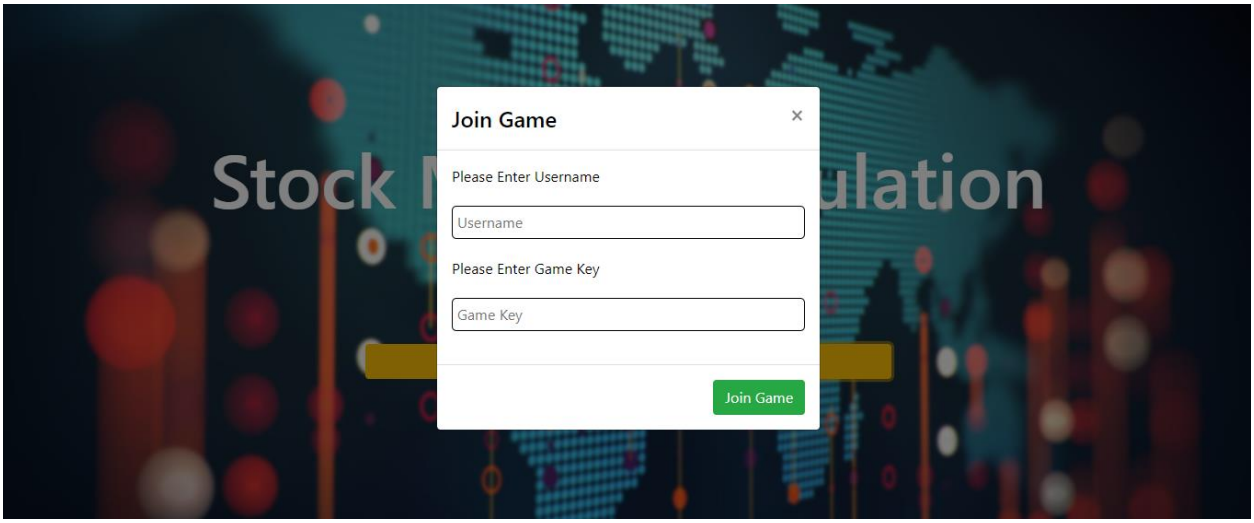
Create New Game Popup

2. The player must insert a valid username for him and click “Create Game” button.



Game key Popup

The player must share the game key generated with other players and wait till others connect to the game.

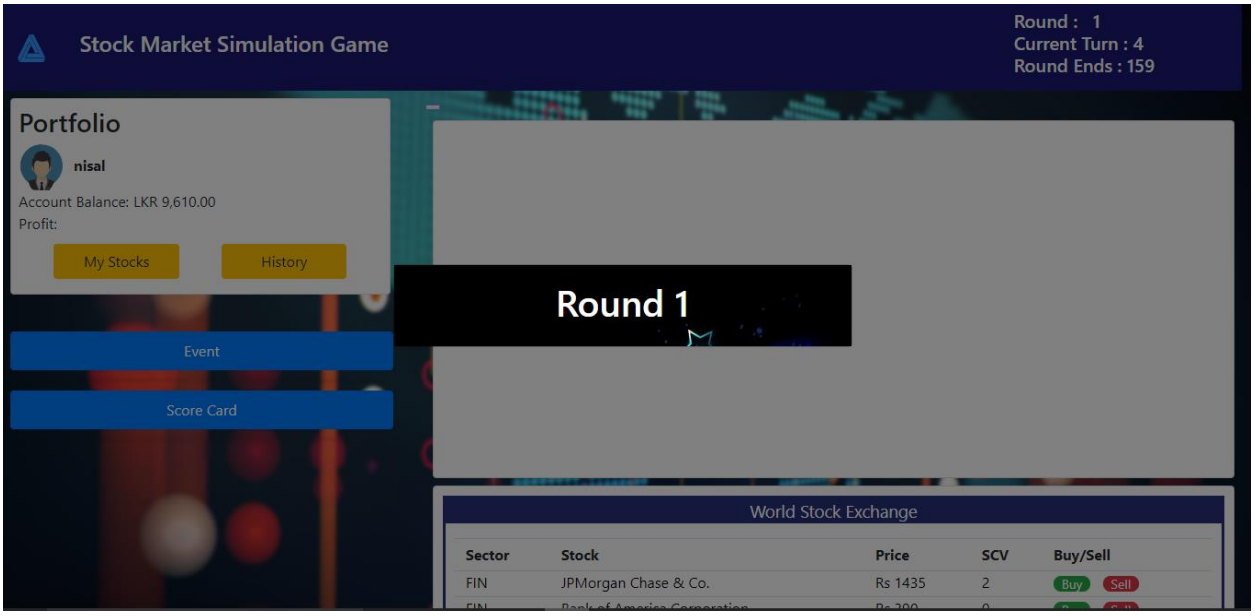


Join game popup

The player must insert a username and the game key shared by the first player. Then click “Join Game” button.

When maximum four players are connected, all players will redirect to the game dashboard screen.

3.player has 3 rounds to play this game.

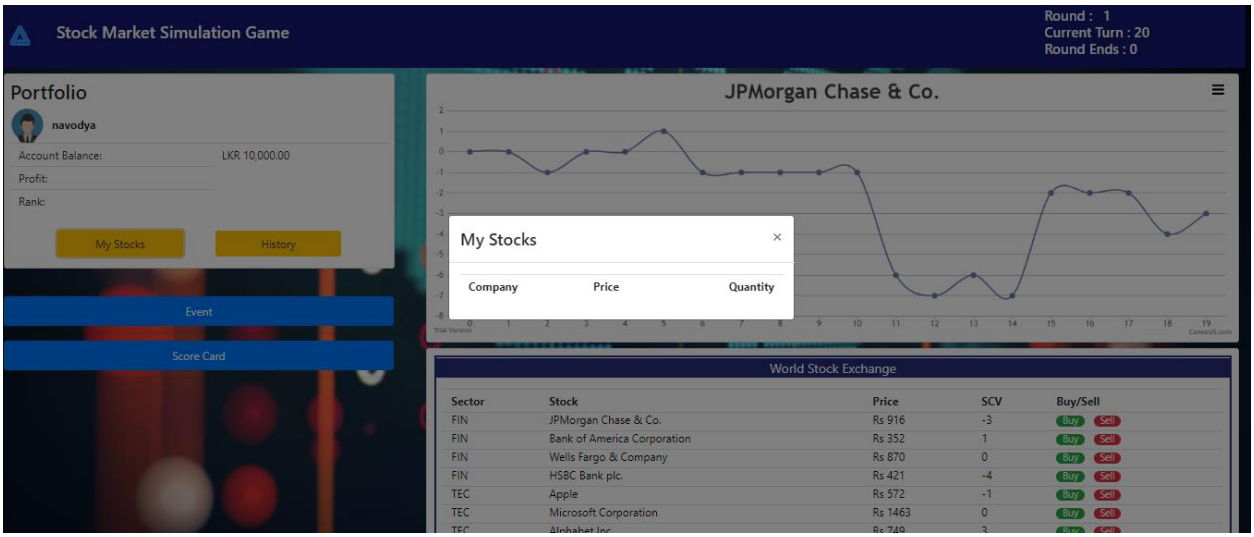


Round screen

4. This the game dashboard.

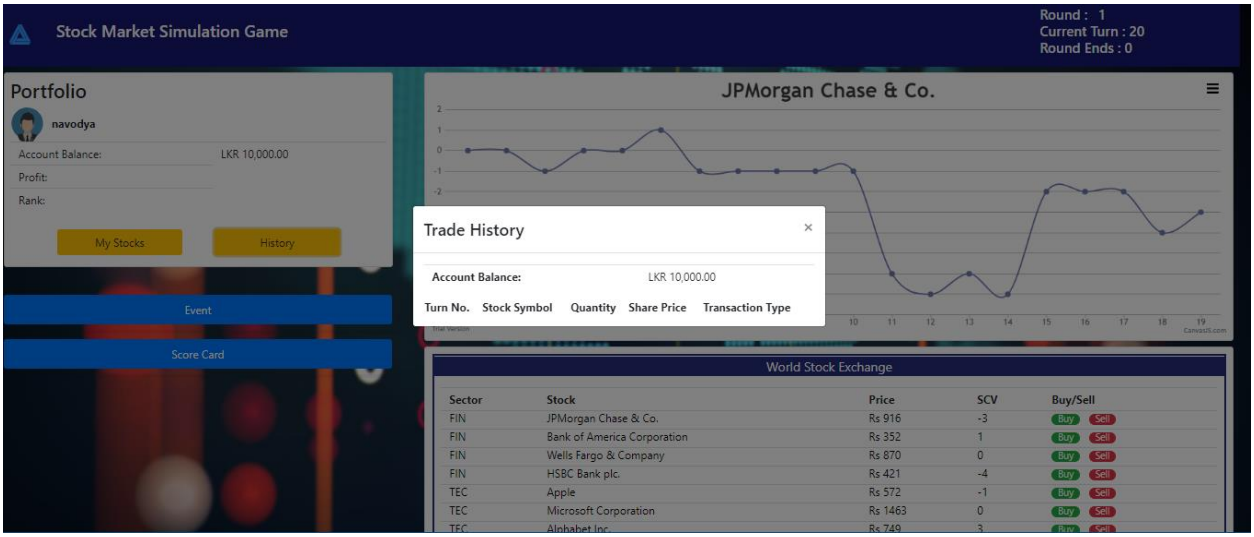
Dashboard screen

5.This includes all the bought stock of the player.



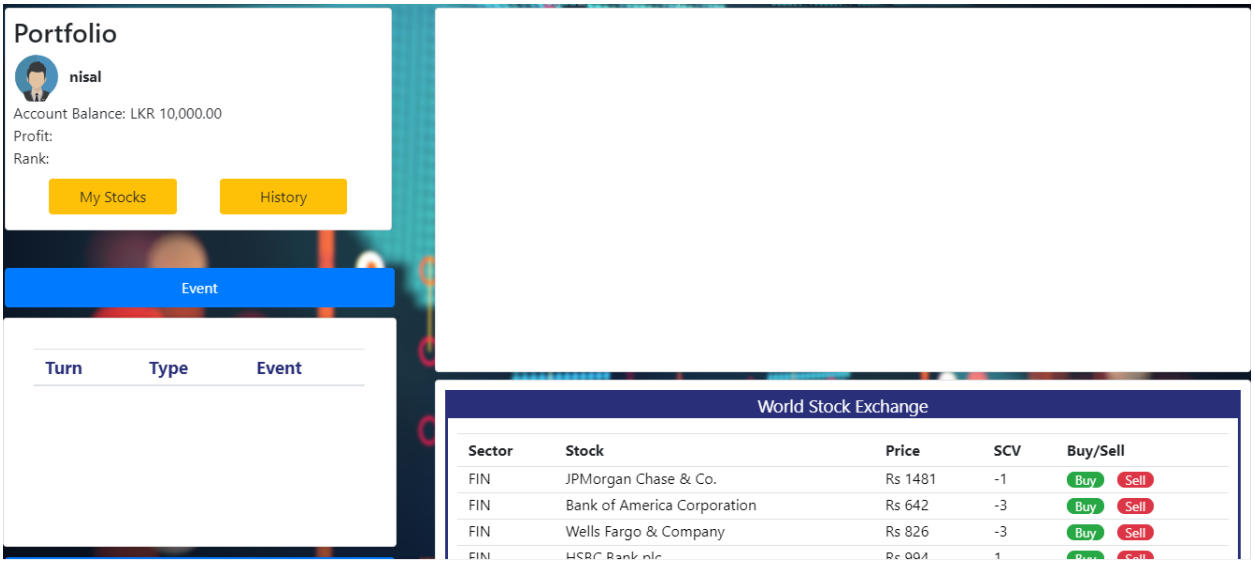
My Stocks screen

6. This includes transaction history of the player.



Trade History screen

7. This includes all the trading of the player

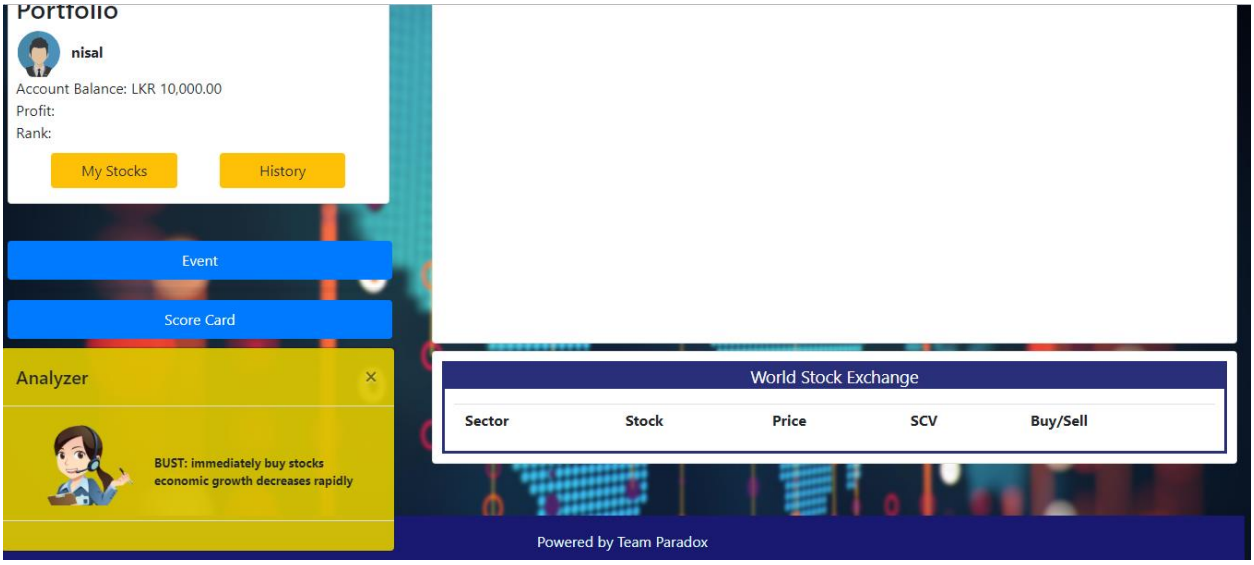


Event screen

8. This includes the balance of the players.

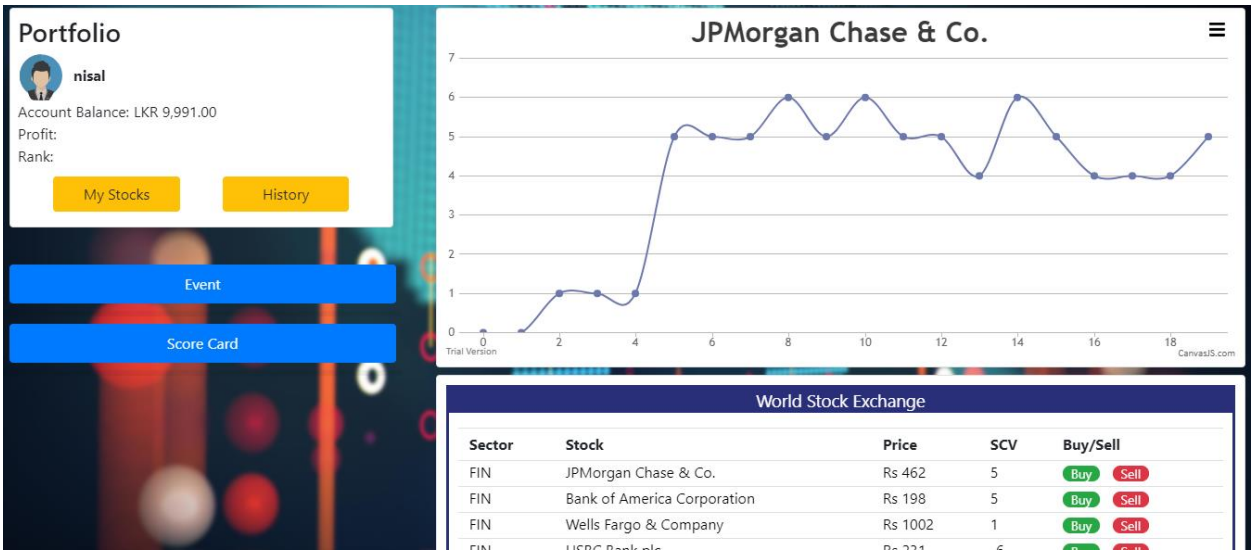
Score card

9.when you play the game Analyzer gives tips, to how to win the game.



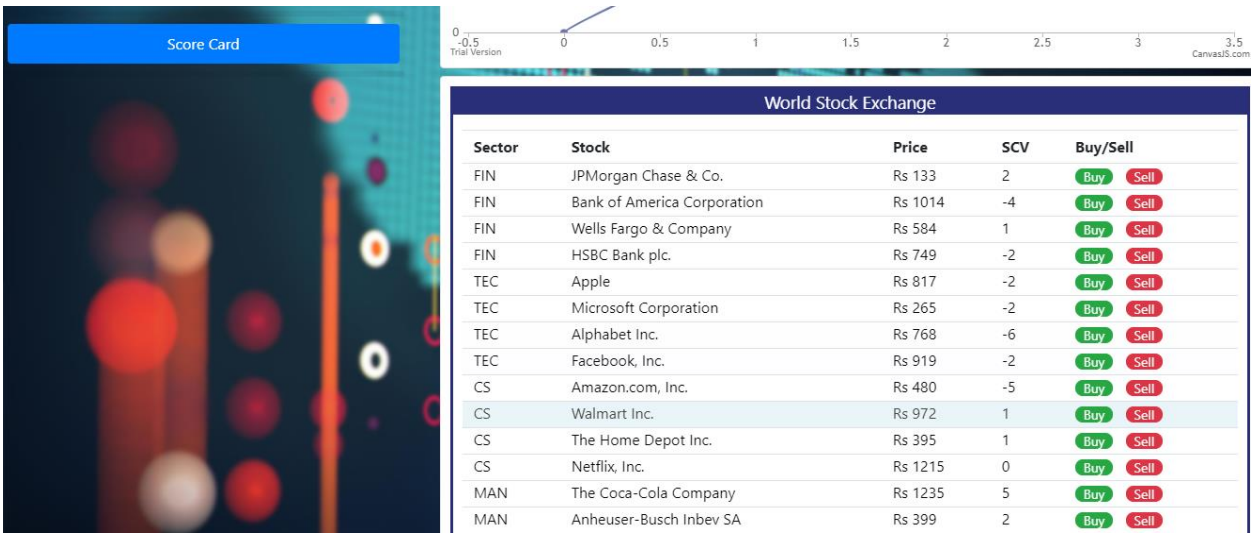
Analyzer screen

10.If you want to see the live chart of a stock, you have to click the companies in the stock table.



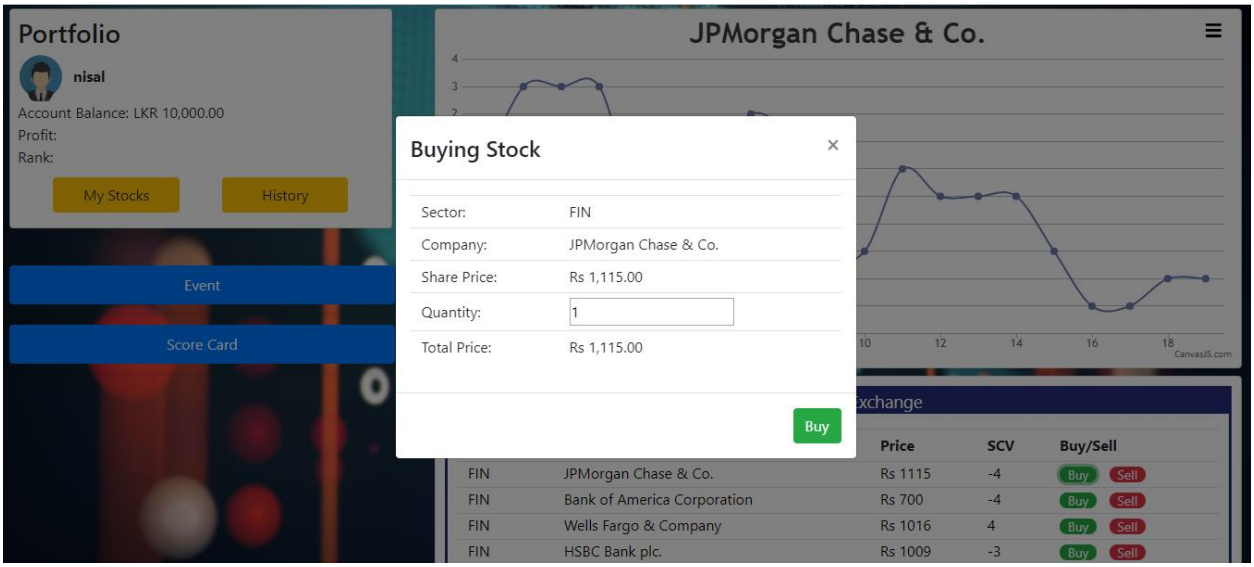
Live stock chart

11. According to the stock price you can buy stock clicking the buy button.



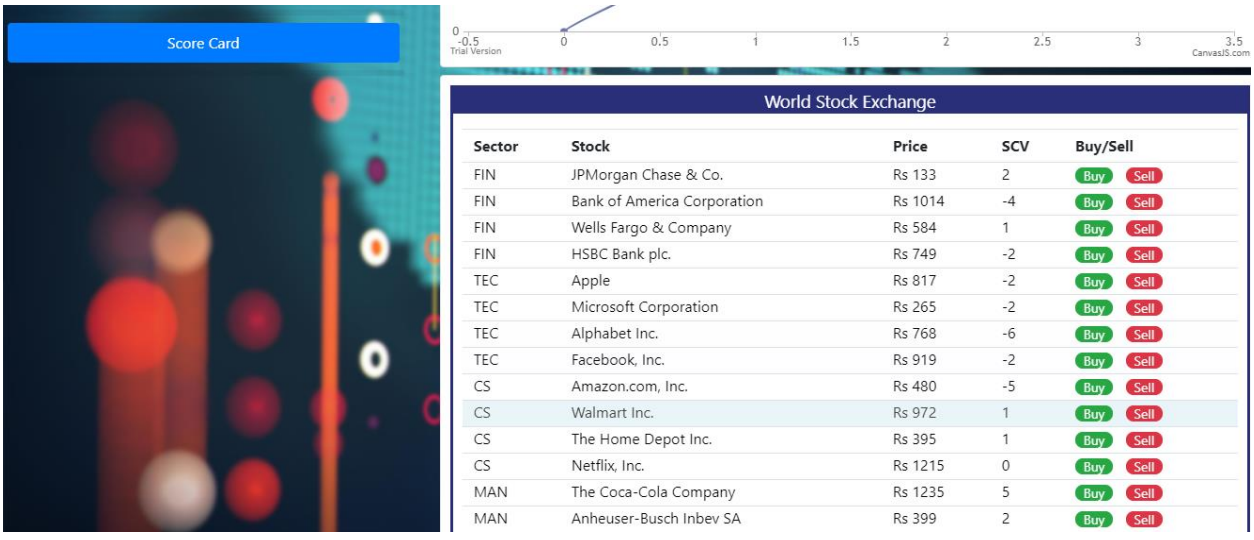
Sector	Stock	Price	SCV	Buy/Sell
FIN	JPMorgan Chase & Co.	Rs 133	2	Buy Sell
FIN	Bank of America Corporation	Rs 1014	-4	Buy Sell
FIN	Wells Fargo & Company	Rs 584	1	Buy Sell
FIN	HSBC Bank plc.	Rs 749	-2	Buy Sell
TEC	Apple	Rs 817	-2	Buy Sell
TEC	Microsoft Corporation	Rs 265	-2	Buy Sell
TEC	Alphabet Inc.	Rs 768	-6	Buy Sell
TEC	Facebook, Inc.	Rs 919	-2	Buy Sell
CS	Amazon.com, Inc.	Rs 480	-5	Buy Sell
CS	Walmart Inc.	Rs 972	1	Buy Sell
CS	The Home Depot Inc.	Rs 395	1	Buy Sell
CS	Netflix, Inc.	Rs 1215	0	Buy Sell
MAN	The Coca-Cola Company	Rs 1235	5	Buy Sell
MAN	Anheuser-Busch Inbev SA	Rs 399	2	Buy Sell

Then you get buying stock screen

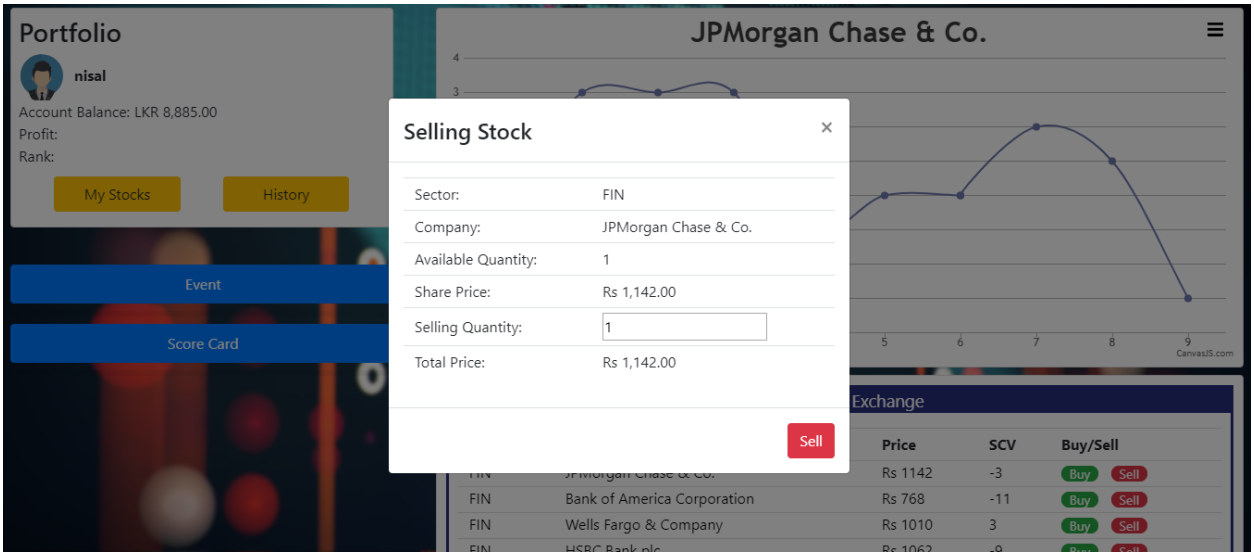


Buying stock screen

12.if you want to sell the stock click the sell button.

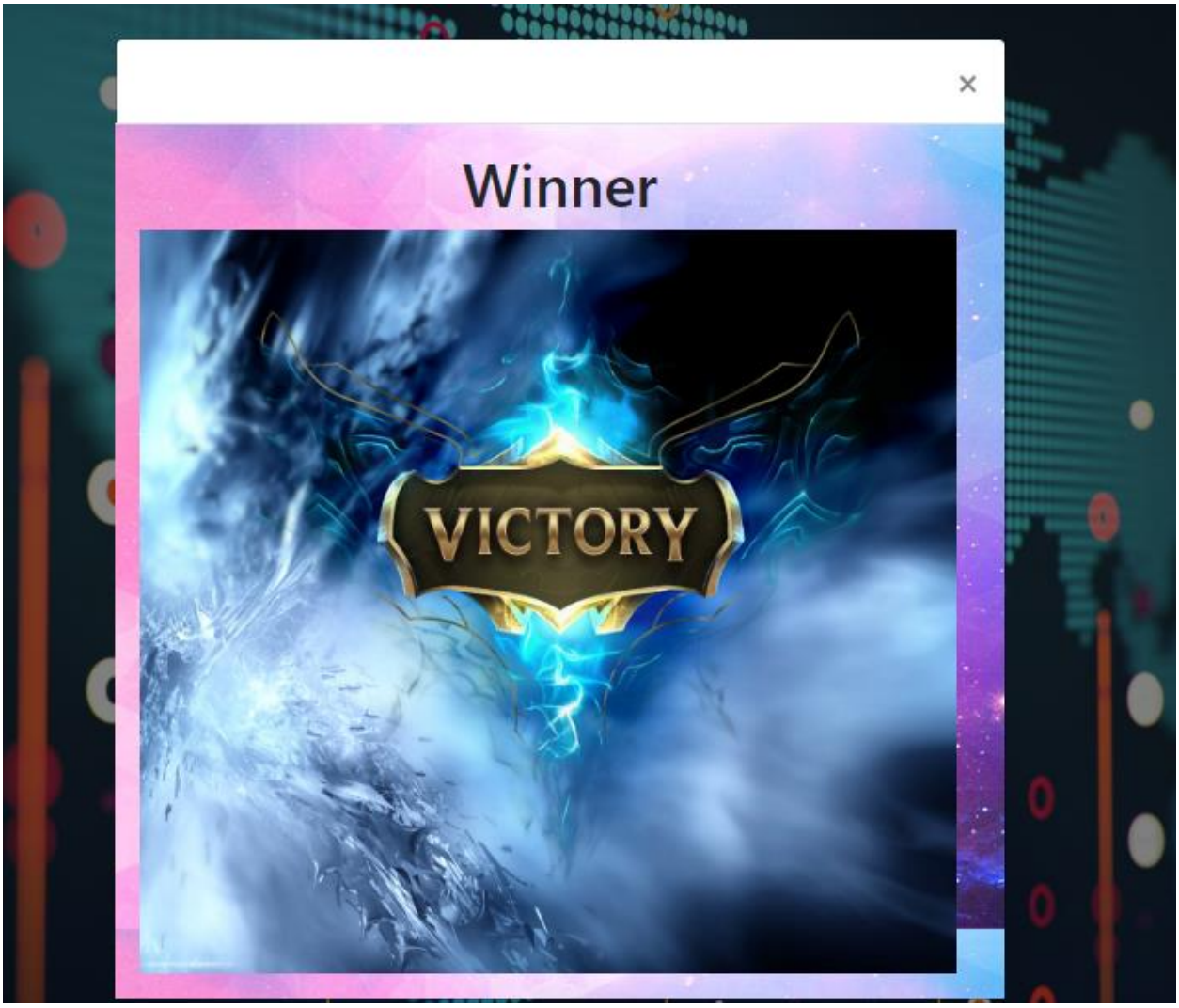


then you get selling “screen”



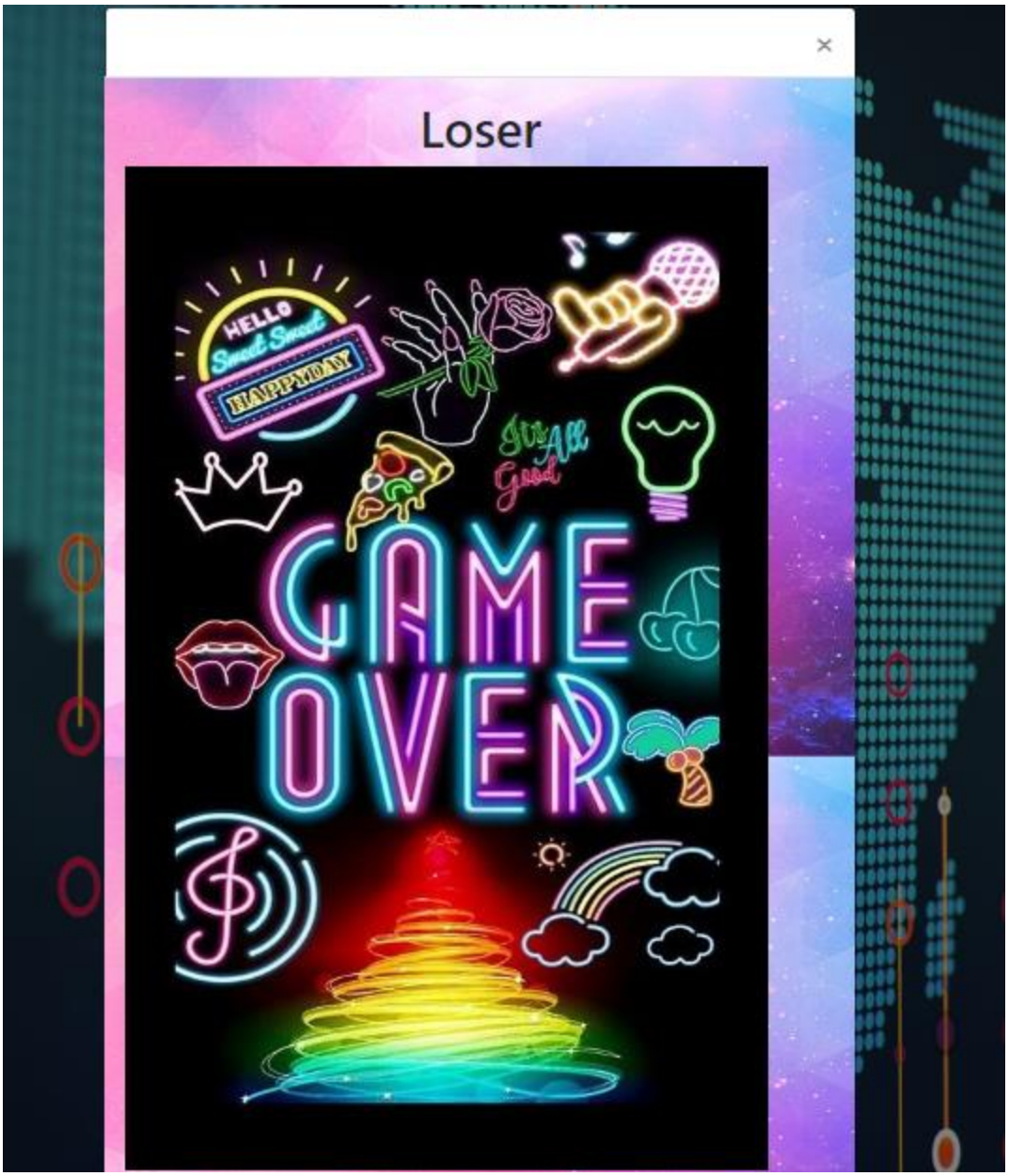
Selling Stock screen

13.At the end of the game winner get this screen



Winner screen

14.At the end of the game loser get this screen

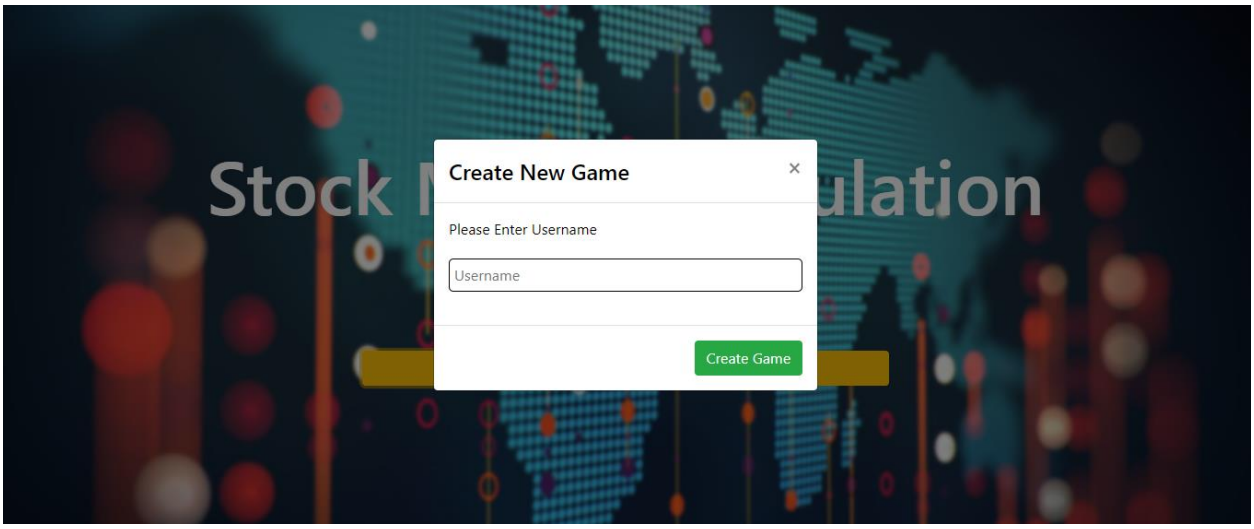


loser screen

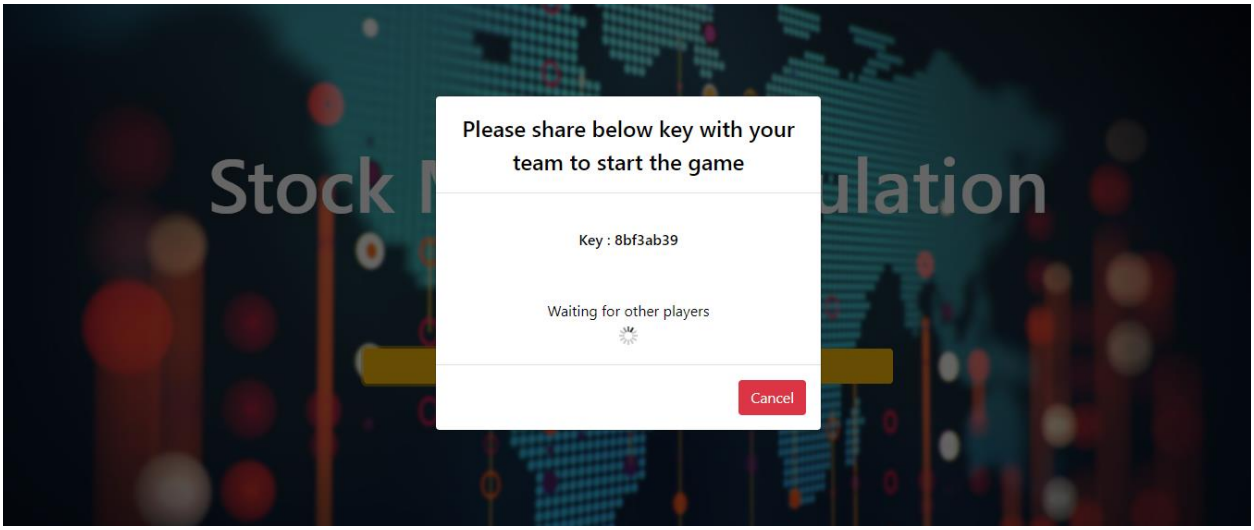
Game screen

This is a screen of “login”

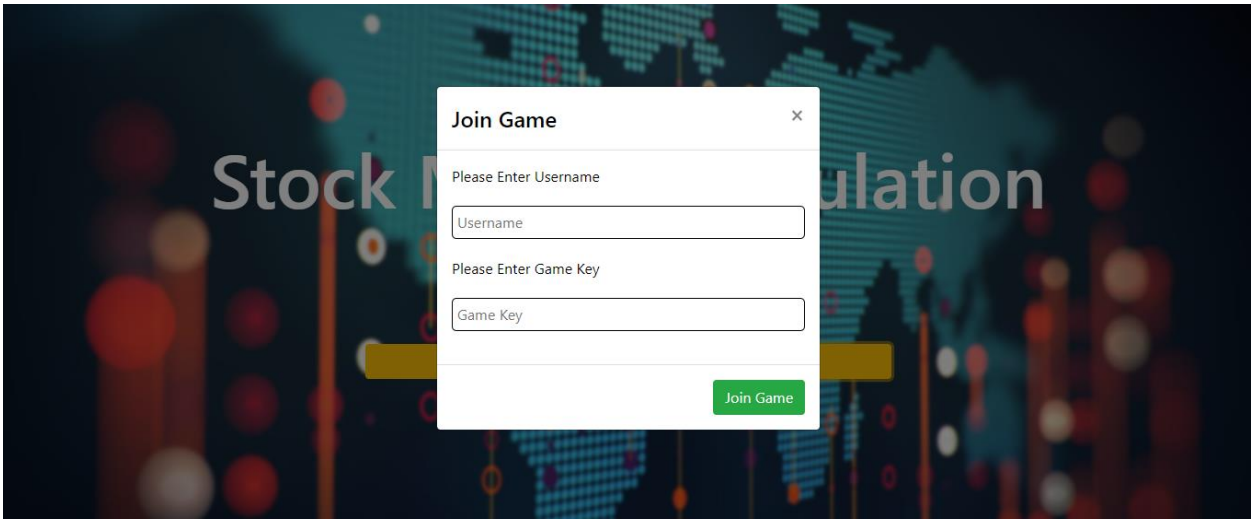
This is a screen of “create new game”



This screen will show the “game key”

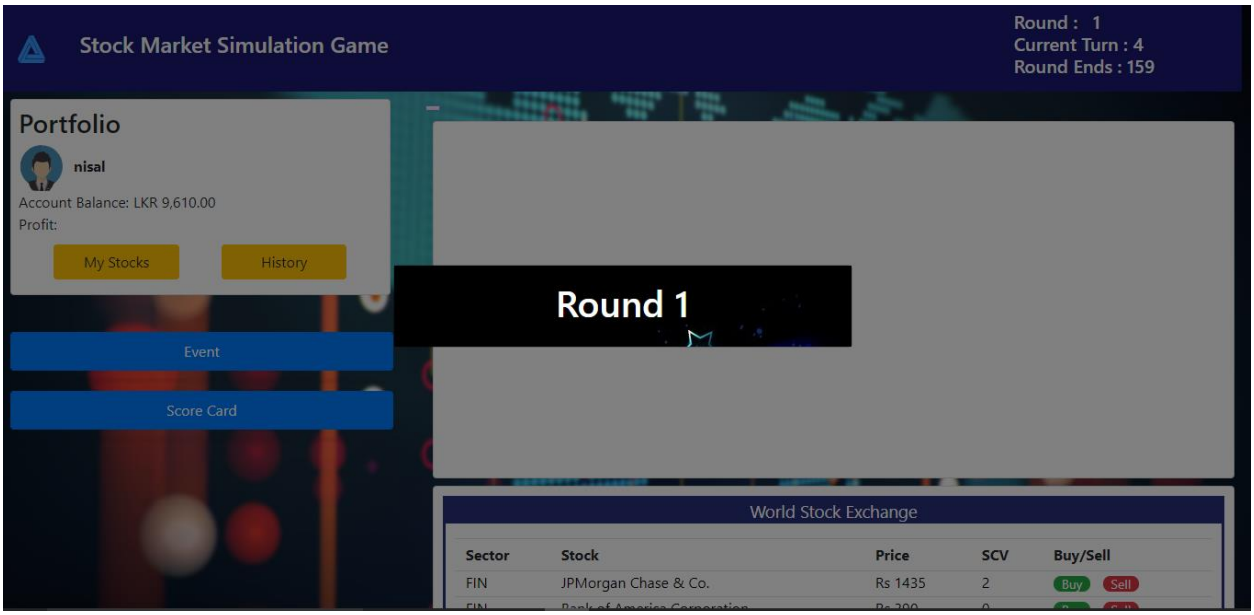


This is the “join game” screen

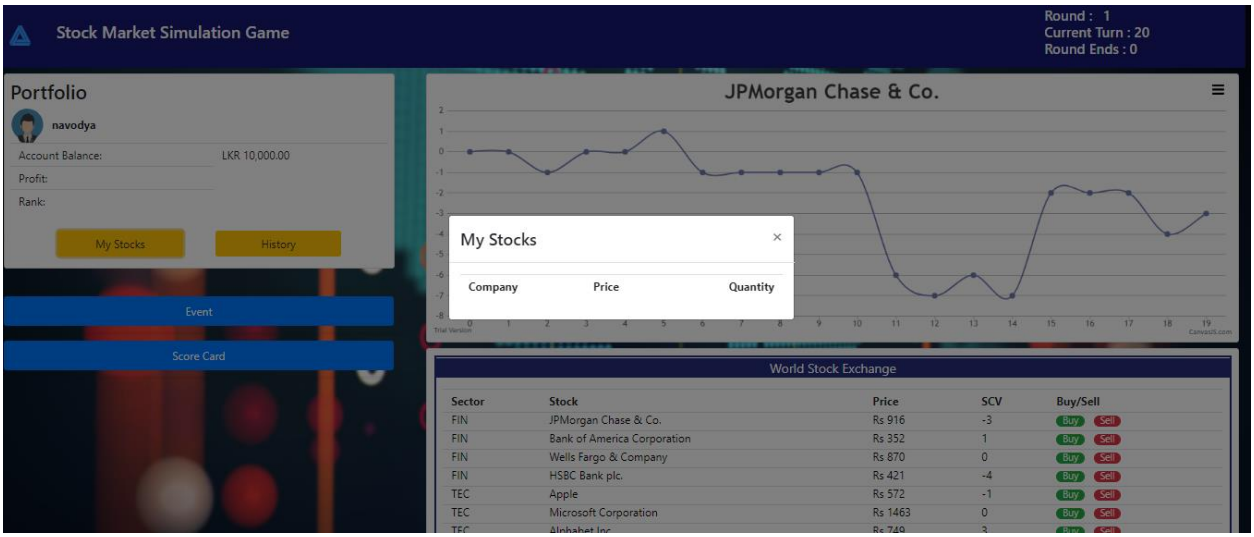


This is a screen of “DashBoard”

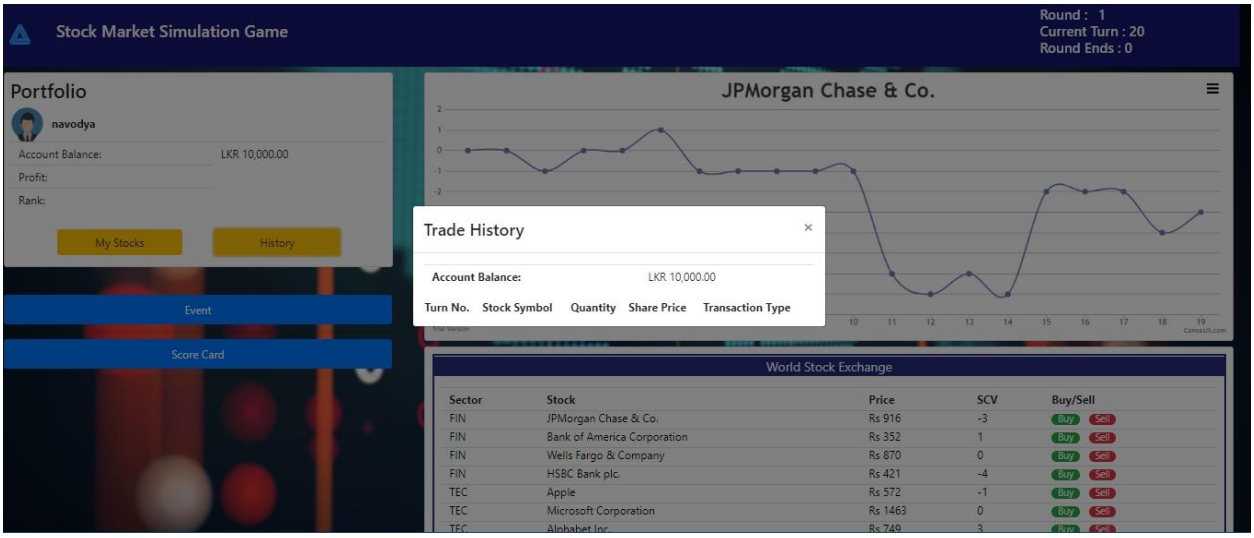
This is the screen of “round “



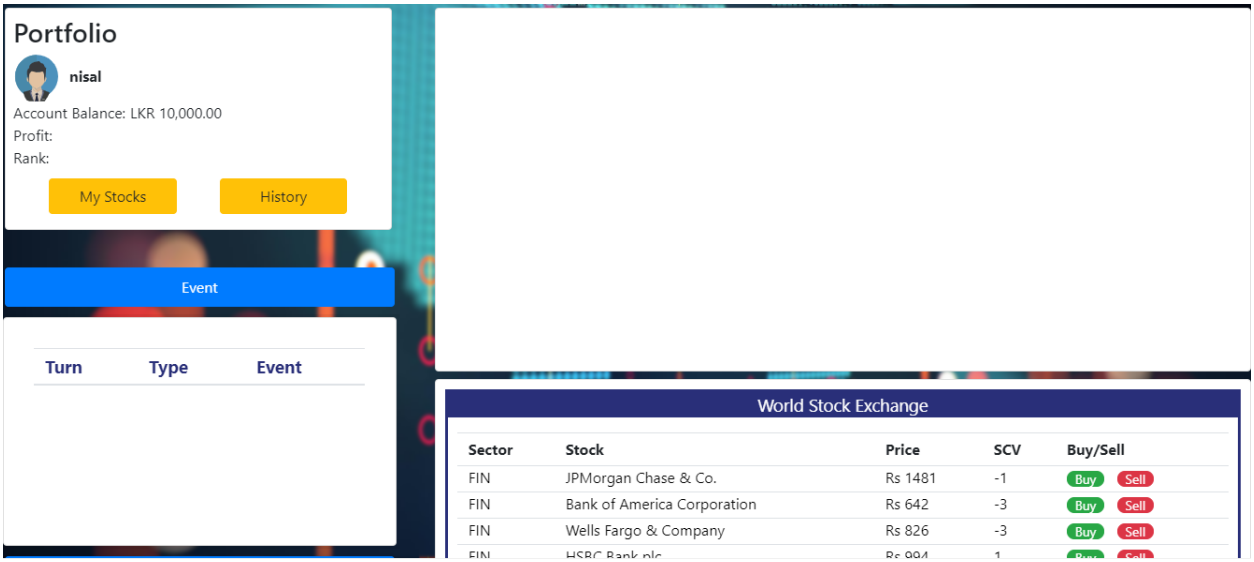
This is a screen of “My Stocks”


Stock Market Simulation Game
Round : 1
Current Turn : 20
Round Ends : 0
Portfolio
navodya
Account Balance:
LKR 10,000.00
Profit:
Rank:
My Stocks
History
Event
Score Card
JPMorgan Chase & Co.
My Stocks
Company
Price
Quantity
World Stock Exchange
Sector
Stock
Price
SCV
Buy/Sell
FIN
JPMorgan Chase & Co.
Rs 916
-3
FIN
Bank of America Corporation
Rs 352
1
FIN
Wells Fargo & Company
Rs 870
0
FIN
HSBC Bank plc.
Rs 421
-4
TEC
Apple
Rs 572
-1
TEC
Microsoft Corporation
Rs 1463
0
Buy
Sell

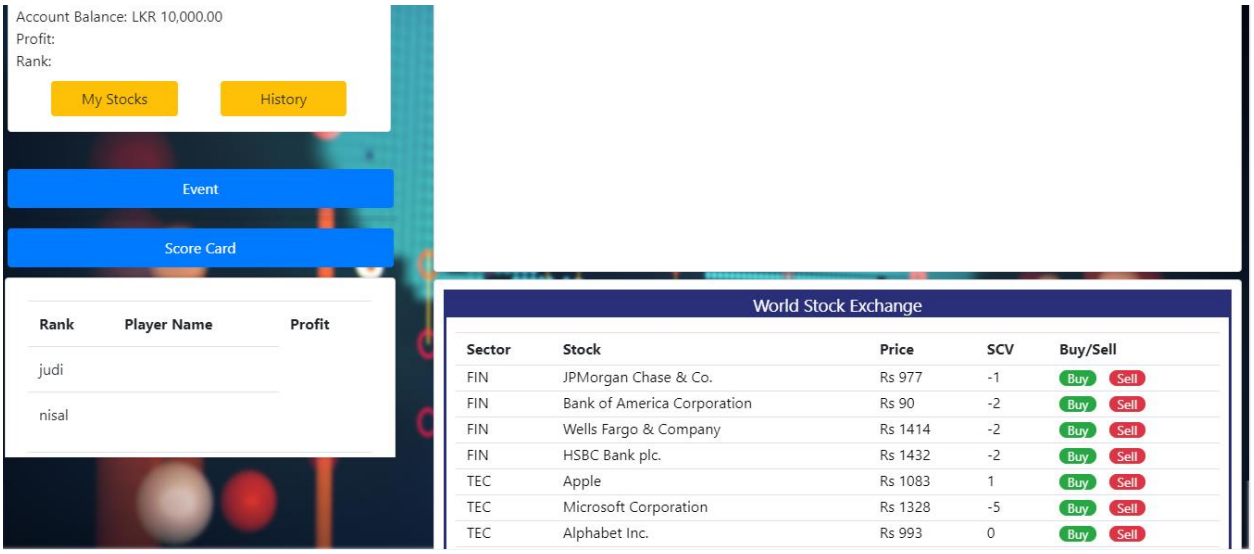
This is a screen of “Trade History”



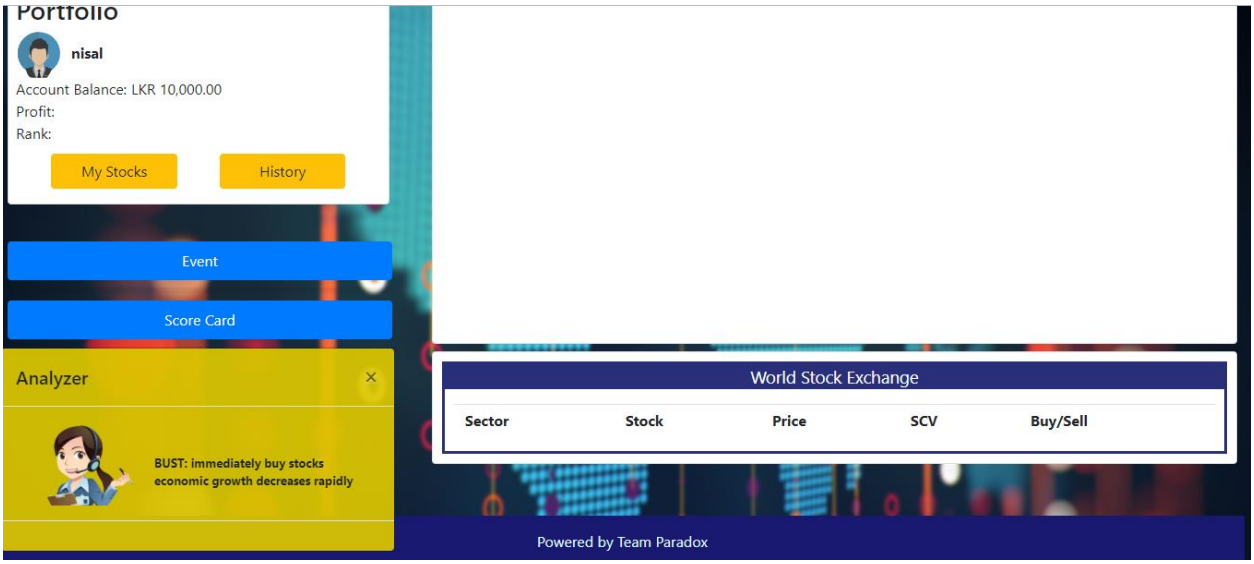
This is a screen of “Event”



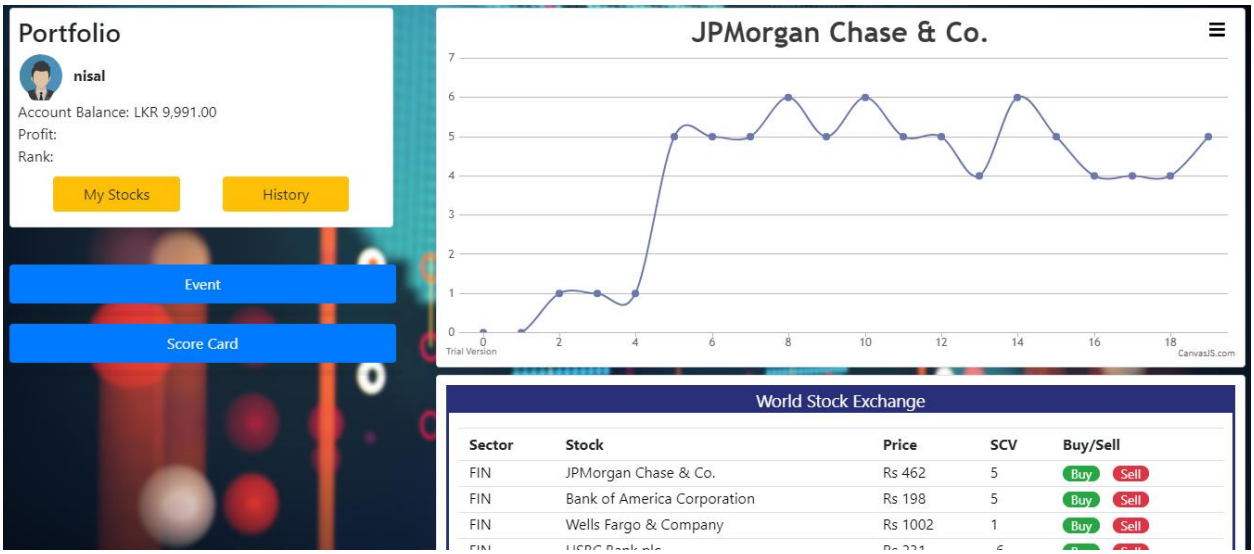
This is the screen of “Score card”



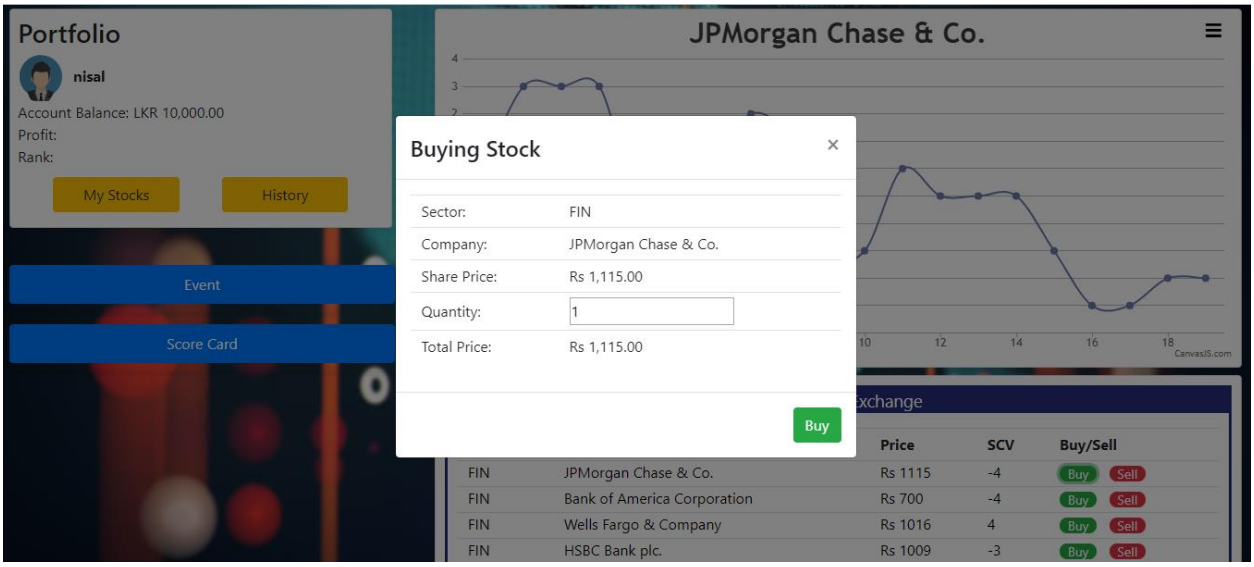
This is the screen of “Analyzer”



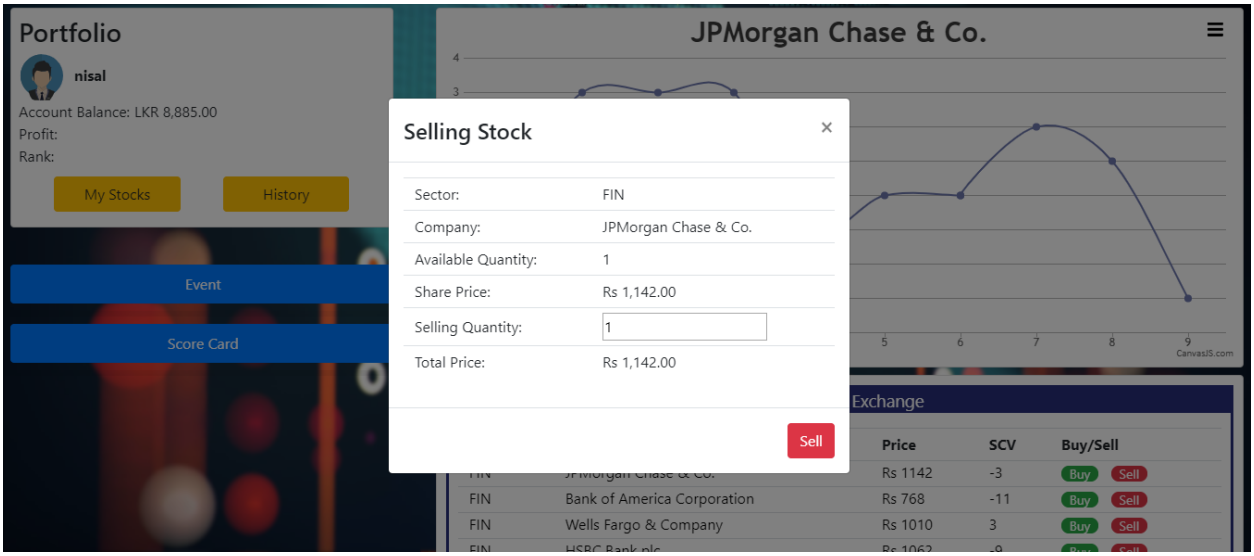
This is the screen of live stock chart



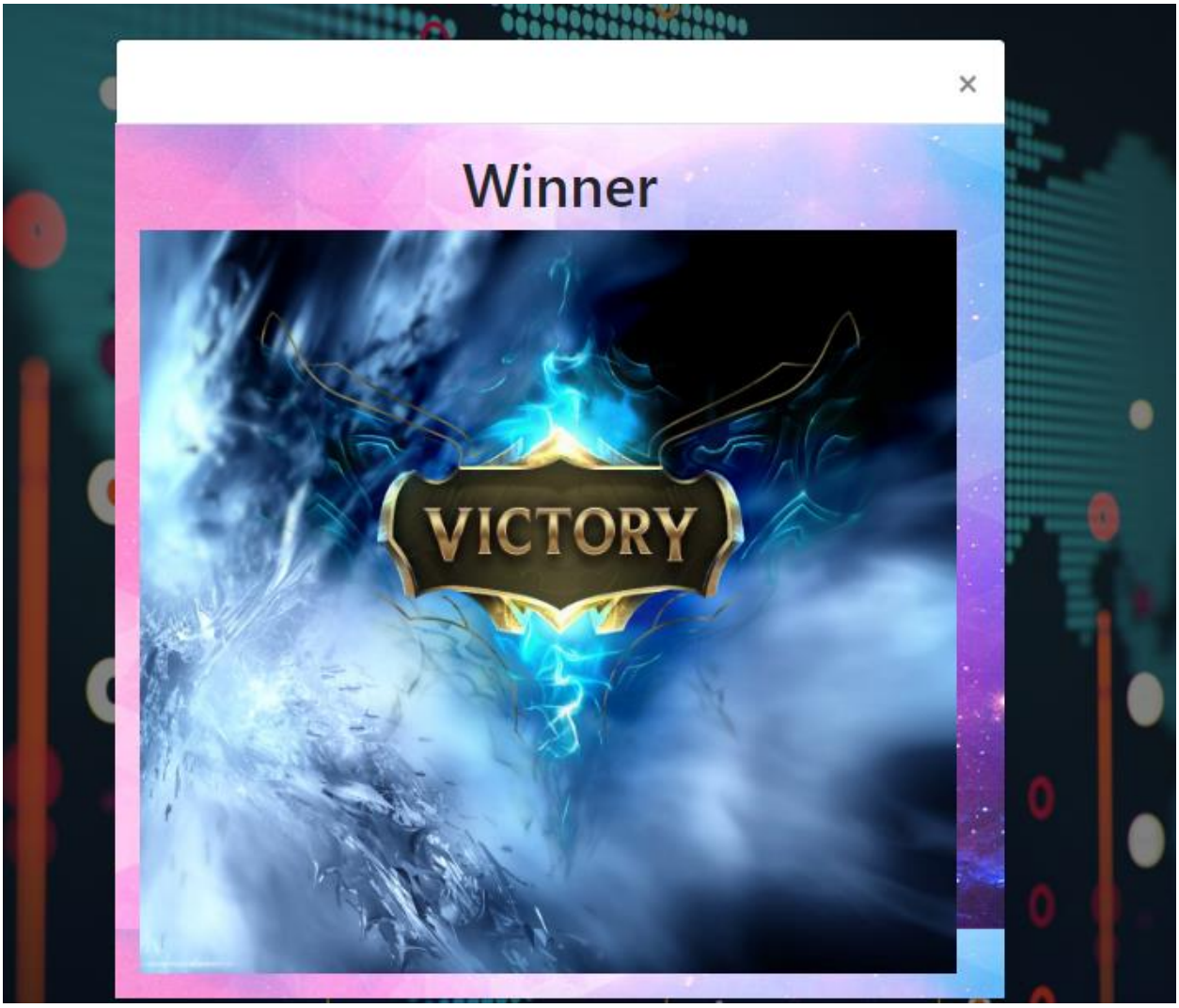
This is the screen of " buying stock"



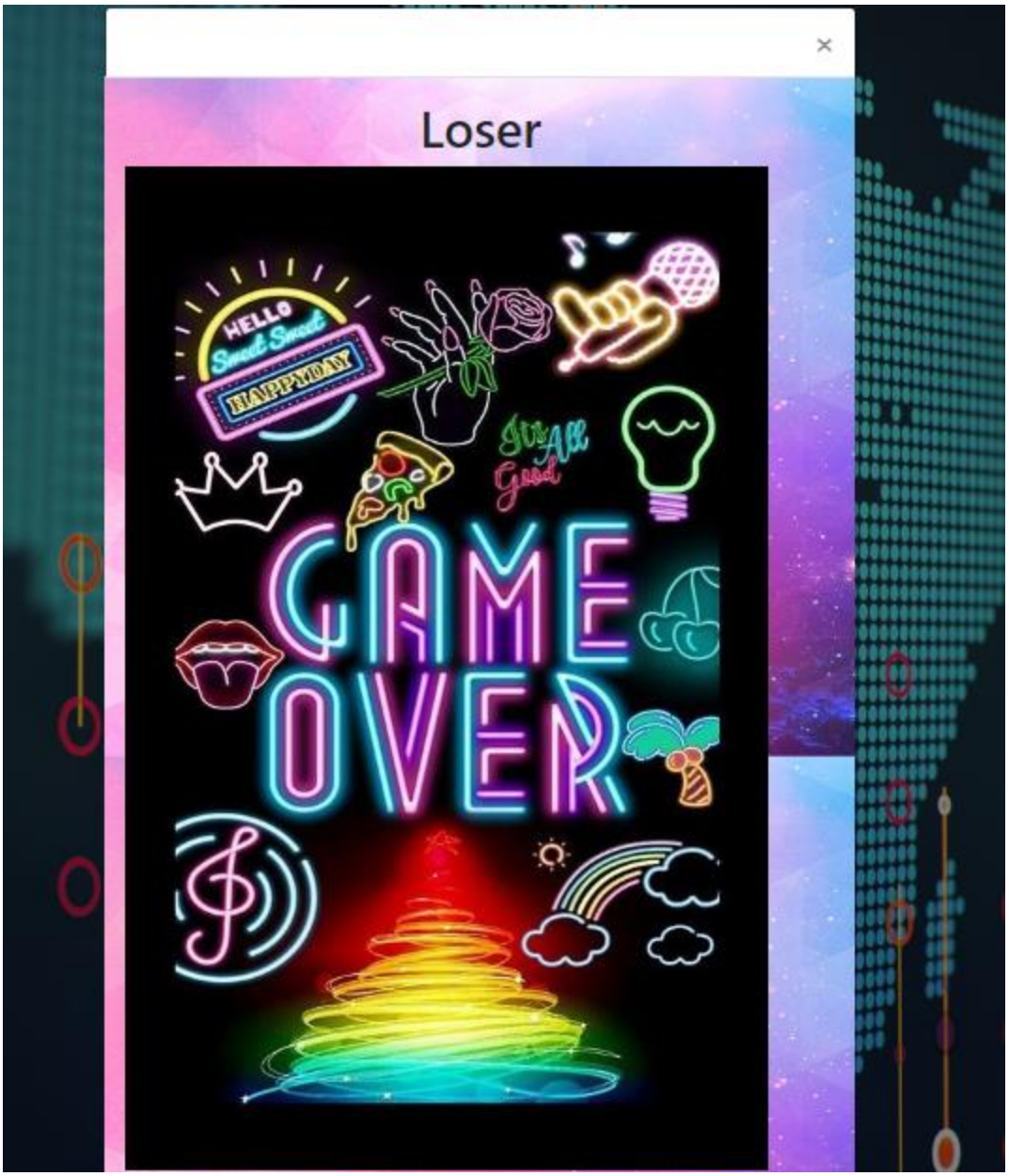
then you get "Selling Stock screen"



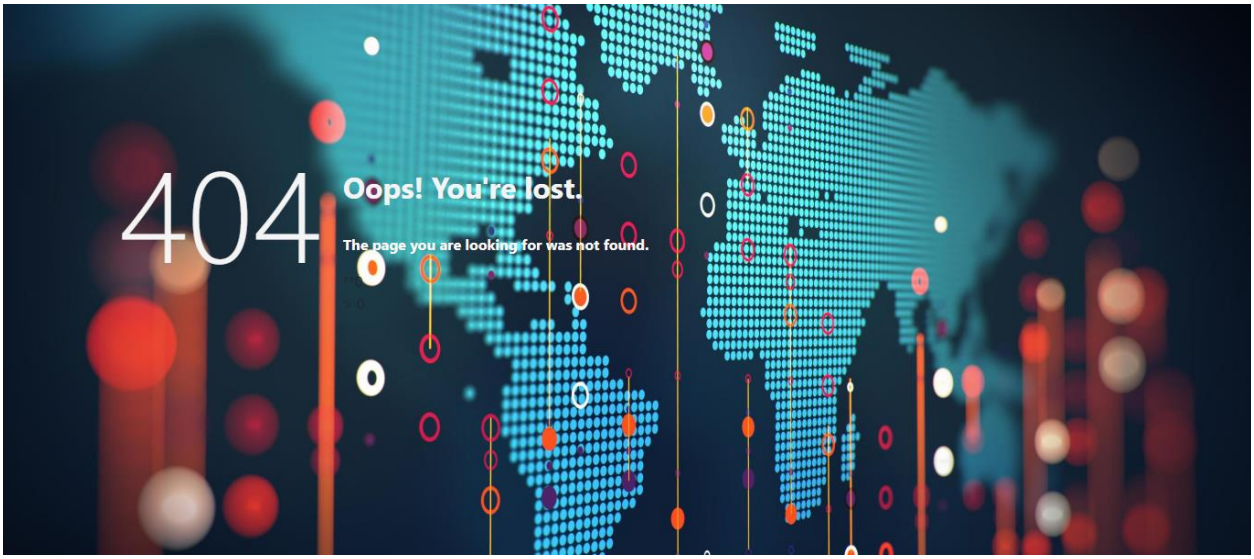
This is the screen of " winner"

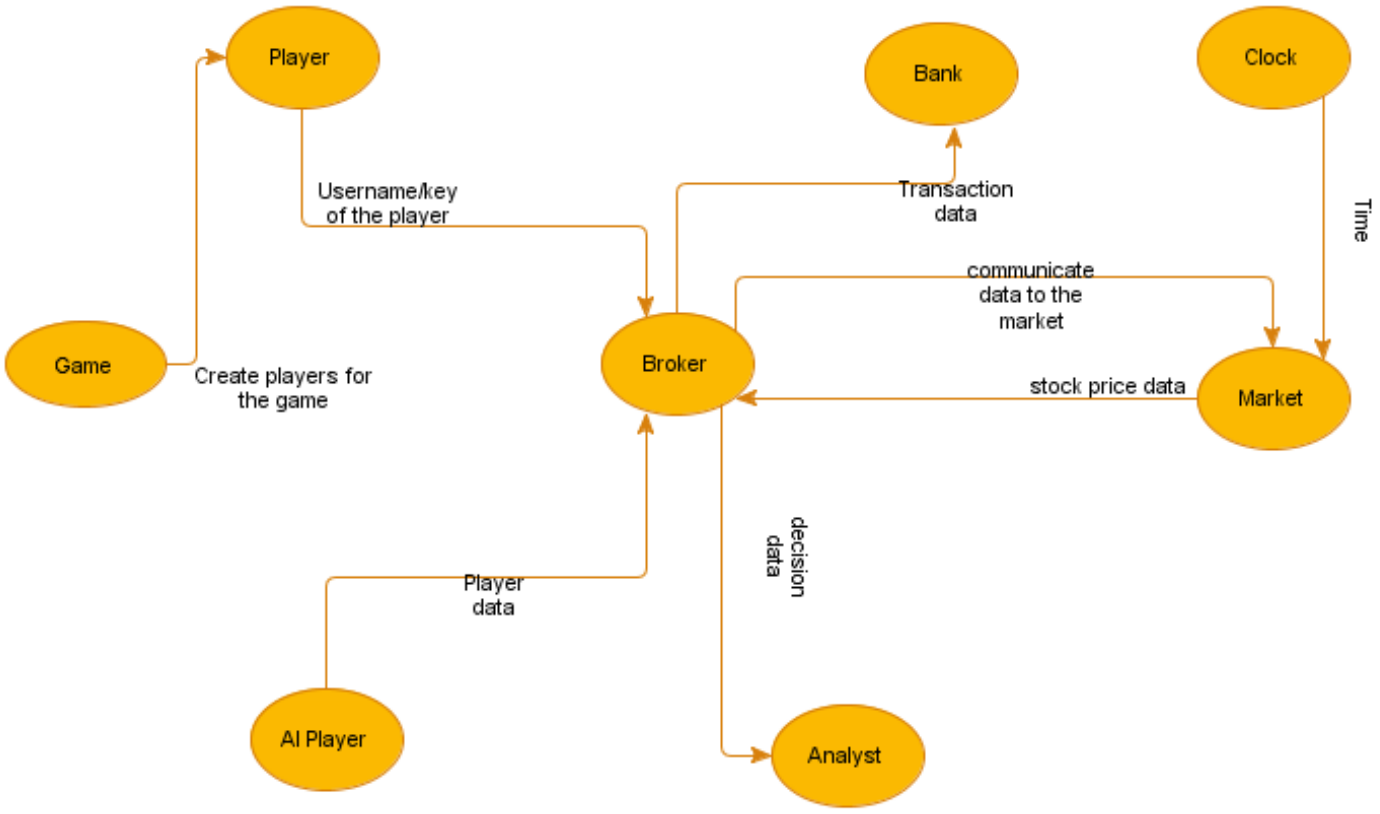


This is the screen of “ looser”



This is the screen of “Page not found ”


404
Oops! You're lost.
The page you are looking for was not found.


Player
Bank
Clock
Username/key
of the player
Transaction
data
Time
communicate
data to the
market
Game
Create players for
the game
Broker
stock price data
Market
decision
data
Player
data
AI Player
Analyst

Player Actor

- This is a human player of the game who interacts with the game.
- This actor sends messages to the broker when buying/selling happens.
- When the game initiates and this actor is created and stock, bank accounts will be created. The bank account will be initiated with LKR 10000.
- The player actor also keeps track of his purchase history and

Al Player Actor

- The Player AI is a computer player of the game.
- This player will be created with a bank and stock account.
- According to the analyst decisions and the events, the AI player will decide to buy or sell stocks.
- The broker will receive a message to initiate the bank and stock accounts.

- Operations:

  Play() - should be called once per turn

Broker Actor

- The Broker is compatible with managing stocks.
- Also organised into a set of (stock) accounts that consist of a portfolio (the current stocks owned by the player) and a transaction history (record of all stocks bought/sold by the player).

Operations:

- Create a stock account
- An account must be opened with the Bank BEFORE the stock account can be created. The lack of a bank account causes an exception to the thrown.
- **buy(name, stock, quantity, price)** – broker purchases the specified quantity of the given stock at the given price. Returns true as an indicator of success. Returns false if the transaction fails
- A balance check is carried out on the player and the transaction fails if the player has insufficient funds.

- The transaction fails if the price given does not match the current market price.
- The broker withdraws the specified quantity of funds from the players bank account.

- **sell(name, stock, quantity, price)** – broker sells the specified quantity of the given stock at the given price. Returns true as an indicator of success. Returns false if the transaction fails
- The transaction fails if the price given does not match the current market price.
- The transaction fails if the player does not have the specified quantity of stock
- The broker deposits the specified quantity of funds to the players account.
- **portfolio(name)** – returns the current portfolio of the player (list of stocks owned by the player, quantities, and purchase prices).
- **price(stocks) –** returns the current price for each of the stocks specified in the input stocks list.

Clock Actor

- Holds the current turn of the game
- This actor will send messages to the game so the turns shown correctly.

Bank Actor

- The bank component is responsible for managing a players money
- This bank account consists of the account balance, transaction type (buy/sell), amount. etc.
- Player Id name is used as a unique identifier for each account.

- Operations:
  - **Create an account**
  - **Deposit**
  - **Withdraw**
  - **get data**

Analyst Actor

- The analyst is an expert who will predict for you what will happen in the next in the stock market.
- This actor displays the predictions once in 5 turns.
    - Based on the upcoming events and the event occurrence probability, the decisions will be made.
        - If there is a BOOM, PROFIT_WARNING, the analyst issues a SELL recommendation for that share.
        - If there is BUST, TAKE_OVER, SCANDAL the analyst issues a BUY recommendation for that share.
    - If a BUY or SELL recommendation is made after 5 turns the next one will appear.

Market Actor

- This actor will be responsible for creating random trend values when requested.
- The calculated trends are
    - Market trend
    - Random Trend
    - Event component
    - Sector trend
- The values of those above trends will be generated and passed to the broker and then to each player.

Market Component

The Final stock price value is calculated using a couple of algorithms.

- Market trend
- Random Trend
- Event component
- Sector trend

Market trend

Market and Sector trends must be pre-computed at the start of the game.

This market trend is the same to all the stocks.
The range will be between -3 and +3.
Each turn at most 1 will be changed.

Random Trend

This market trend is the same to all the stocks.
The range will be between -3 and +3.
Each turn at most 1 will be changed.

Event component

There are 2 types of event types

Sector
Stock

Each of those event types have different types of events.

Sector (Prob 0.33) – duration 2 – 5 turns

- ► BOOM (Prob 0.5): range +1 to +5

- BUST (Prob 0.5): range -1 to -5

Stock (Prob 0.67) – duration 1 – 7 turns
- PROFIT_WARNING (Prob 0.5): range +2 to +3
- TAKE_OVER (Prob 0.25): range -1 to -5
- SCANDAL (Prob 0.25): range -3 to -6

Only one event can be applied in a turn

Sector trend

Market and Sector trends must be pre-computed at the start of the game.

This market trend is the same to all the stocks.
The range will be between -3 and +3.
Each turn at most 1 will be changed.

PROBLEMS ENCOUNTERED

- Difficult to understand Akka model.
- Implementing actors.
- To connect the Multiplayer game model.
- To discrete-time and run for a fixed number of rounds.
- Understanding the stock market.
- Hosting the game

LESSON LEARNED

- Learning about the stock market.
- Learned how to work with Gitlab.
- Learned about test-driven development.
- Learn how to work with IntelliJ IDEA.

- JAVA
- Akka modelling
- Test Driven Development
- JQuery
- java script

We hosted this game in the **amazon web server. We got this web service for one year. Apache Tomcat** server is used here.

You can go to the game through the following link.

http://ec2-18-191-255-153.us-east-2.compute.amazonaws.com:8080/paradox/

You can also view a Demo of our game from the below link.
HTTPS://DRIVE.GOOGLE.COM/OPEN?ID=1XBBXI4DUUCOI3DINZBZMXDLNLTPPIGC1

clearer, simple and bug-free. Test-Driven Development starts with designing and developing tests for every small functionality of an application. In TDD approach, first, the test is developed which specifies and validates what the code will do.
When using TDD the code becomes clearer and less complicated.

5. OUR IDEA ABOUT AKKA (IDEAS FROM EACH PLAYER)

K.A.N.S. Wickramasinghe ' libraries are highly scalable, resilient and responsive for using applications in Actor Model'

W.G.D. Judith Imasha ' difficult to understand actor model. I have to refer a lot of tutorials. By design, it is distributed, and it's very easy to use distributed applications'

G.N.D.N. Silva ' It is open source. It is easy to develop highly performant, highly scalable, highly maintainable, and highly available applications using Akka'

G.J.H. Aponso ' Akka is both a design principle and a concurrency platform. it is scalability'

Suhasini Kodituwakku 'Akka is based on an Actors that are constructed in a hierarchy from parent to child. For a simulation game like this, Akka is more suitable than OOP'

Harini Mallawaarachchi 'Akka is a free and open-source toolkit and runtime simplifying the construction of concurrent and distributed applications on the JVM'

R.A.D.D.C.Randeniya ' Akka is open-source middleware for building highly concurrent distributed and fault-tolerant systems on the JVM. It is scalable and We should not think of Akka as OOP. The way to think of using Akka is the, Everything is an actor approach'

5. TEAM CONTRIBUTION

Group member	UCD ID	Contribution
Harini Mallawaarachchi	17209248	
Suhasini Kodituwakku	17209246	• Dashboard GUI design • Company stock table backend and frontend development • Stock graph value change functions development • Stock buy and stock sell transaction development • Player's profit calculation development • Game rounds development and game over functions development • AI player frontend development
G.J. Hashane Aponso	17209258	• Login page Backend development • Multiplayer connecting • Player portfolio history list (Backend) • Player portfolio account list (Backend) • Stock Company Price list sync to players (Backend) • Game Scorecard (Backend) • Rest Api Controller • Stock buy Transaction (Backend)
R.A.D.D. Chathura Randeniya	17209448	• Modified dashboard • Event Component • Game ScoreBoard • Graph Component • PageNotFound Component • Server Error page • Front-End Tables • Bug fixing

		• Login service • AI player • Add Global variables • Game testing • Documentions
K.A.N.S. Wickramasinghe	17210318	• created player component • players component created • stock component created • created win screen • created loser screen • event,history,timer conflicts fixed • bugs fixing • testing game flow • Creating document
G.N.D. Nisal D. Silva	17209259	• create player model • Modify dashboard component • design login page • design modals • create analyzer • Frontend event handler function • stock graph value change function
W.G.D. Judith Imasha	17209438	• **dashboard component created** • **modified dashboard** • **stock transaction created** • **timer function** • **fine tune turn function** • **fine tune player in dashboard component** • **fine tune login component** • **Testing** • **create document**