Bilkent University
Department of Computer Science

Object-Oriented Software Engineering
Analysis Report

CS 319 Project: Monopoly Space Edition

Analysis Report

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Table of Contents

Table of Figures

1. Introduction

Monopoly is a well-known game that mainly focuses on trading between the players through real estate, properties. Main aim of this game is to be the richest one and by trying to make other players go bankrupt, winning the game. Therefore, the main topics of the game are strategy and economy management. In this project, the game will be modified with new innovations and re-designed for computers. This new addition will be called as space edition where each land is represented as planets and stars in space and the tokens will be represented as spacecrafts, astronauts etc with many additional features based on it.

The regular monopoly game is played by at least two people and up to at most four players. The tokens that are selected at the beginning of the game represents the players. Each rolls the virtual dice whenever it is their turn. Based on the number on the dice, the tokens move on and come to a represented land. The player either chooses to buy the land if it is unowned and has sufficient money to get it or pays the rent if it is owned by another player or just passes the turn intentionally. The game continues until there is one player left not bankrupt or decide on the richest among other players left in the game. The space addition will work as a regular one as described with additional features specific to it.

2. Current System

The Monopoly board game is the world's classic number one board game. Figures are placed at the starting point, dice rolled, moves made, and it's a kind of real estate game where players showcase their bargaining skills. The game can be played among 2 to 8 people.

The Monopoly board game includes:

- **Monopoly game pad**

It is placed on a table or on a flat area.

Figure 2.1: Current Monopoly Game Board [3]

- **8 pawns**

Each player has a pawn and moves forward with that pawn.

Figure 2.2: Current Monopoly Game Pawns [4]

- **60 Cards**

There are various cards in the game. Cards are shuffled before starting the game. Monopoly cards vary according to the game. Luck cards, action cards, millionaire cards, fortune cards etc.

Figure 2.3: Current Monopoly Game Cards [5]

- **1 Deck of Monopoly Money**

Each player receives some money at the beginning of the game.

Figure 2.4: Current Monopoly Game Money [6]

- **32 house figures**

When the house is erected on the owned land, a lesser amount of rent is received than the hotel.

Figure 2.5: Current Monopoly Game House Figure [7]

- **12 Hotel figures**

It is the property that gets the most rent from players.

Figure 2.6: Current Monopoly Game Hotel Figure [8]

- **2 dice**

When starting the game, 2 dice are rolled and who will start is determined. The number of units to move pawns in the rest of the game is determined using these dice.

Figure 2.7: Current Monopoly Game Dice [9]

- **Monopoly rule booklet**

The game has a booklet that describes the game.

Figure 2.8: Current Monopoly Game Booklet [10]

Rules of the Monopoly:

- Before starting the game, all players roll the dice once and the player with the highest value starts the game. The other players start the game in descending order according to the number rolled on the dice.
- The game is played in a clockwise direction.
- The game is played by rolling two dice.
- If the player rolls double dice, the player has the right to play one more time.
- If the player rolls double dice 3 times in a row in a single turn,the player will go to jail.
- The player moves forward the number of units that come when the dice are rolled.
- If a pawn comes on a owned property, the player should pay rent to the owner of the property.
- When starting the game, each player has a certain amount of money. (Money amount changes depending on the game edition.)

- For some Monopoly editions, since the game can take so long, Players can set an optional time limit for this. When the period is over, if the player wins it is not acceptable.
- For some Monopoly editions, the player can buy other players' city property. To do this, the player has to pay the amount written in the title deed.

How to Play Monopoly:

The game board is placed on a flat surface. Each player chooses a pawn for them. Each player is given a sum of money (The amount of the money changes depending on the game edition). Game coins are placed in the bank box. A player works as a bank clerk. This player manages the bank issues in the transactions of other players. For some editions, during the game, each player can make their own transactions with the bank (If the game plays among 2 people this way can be preferred.)

Before the Game:

Each player chooses a pawn and places it at the starting point. Each player receives a certain amount of money from the bank official before the game starts. This game is the starting fee. It is evenly distributed to each player. To choose which player will start first, dice are rolled. The first player to start the game is determined by dice. The player who gets the maximum number starts first. The player which starts first will have the right to buy the first property. If the player who rolls the first dice buys a property, the other 7 players can fall here and pay rent. Therefore, starting fist is an advantage.

Start the Game:

- The game starts by rolling the dice.
- If a player rolls the dice double, they have the right to roll the dice one more time.
- If the player rolls the dice 3 times in the same turn, he goes to jail.
- If the player comes to a property, the player can become the owner of that property by paying the purchase price of that property to the bank. The banker gives this person the title deed of that property. He receives rent from the player falling on that property. If the player does not want to buy the property, the game passes to the next player.
- If the player falls into a jail as a result of his roll of dice, the player stays in jail for 3 rounds. To get out of jail, he or she has to get the exit jail card beforehand or pay some money.
- If the player roll reaches the "Draw Card" section, the player draws a card.

Main points while playing the game:

1. Receive money from the bank every time the player passes from the start point:

The amount of money players will receive changes depending on the editions of the Monopoly.

2. Collecting Rent

The player receives money from other players when it comes to his/her property, thereby increasing the amount of money in the bank.

3. Buying Properties with the Same Color

Properties in the game are grouped by colors. If a player buys all properties of the same color, the rental rate on those properties increases. How much the rental rate will increase is written on the back of the deed. Trying to buy properties in the same color group provides the player with more money which gets from the rent.

4. Build a House and Hotel

House:
The player can build 4 level houses for each property. When a player comes to her own property, the player can build a house of any level. For each level the player has to pay some money to the bank. The advantage of building a house is that the rental price increases. (At the back of the deed, it is written how much the player will pay for each level of house. How much rent the player will get for each level is also written on the back of the deed.)

Hotel:
The hotel is the most valuable place in the Monopoly game. If the player rolls dice in the same place once again after building a fourth level house, you have the right to set up a hotel. The hotel is the most developed version of that property. To set up a hotel on that property, the player has to pay some money to the safe. The rent of the property will increase.

5. Draw Card:

If the dice which is rolled coincides with the "Draw Card" section, the player will get the next one from the cards which are in the middle of the board. (All cards are shuffled at the beginning of the game.) These cards are named as "Luck Cards". You draw a chance card and apply what is written on the card. Some possibilities that may come out of the card:
Transfer a property to another player for free.
Go to the prison.
Go to the starting point.

Pay tax to the safe for all your properties.
Free jailbreak card. (The player can use this card when you fall into jail.)

6. Mortgage

If a player cannot pay rent, pay tax debt from the card, or need money to buy another location, the player can mortgage a property she/he has already purchased to the bank. The amount of money the player will receive when she/he mortgage is written on the back of your deed. The player cannot get rent from your mortgaged properties. To remove the mortgage, the player has to pay some money back to the bank. This amount will be written on the back of the deed.

7. Go to Jail:

The player goes to jail if the drawn card says the player to go to jail or if the player rolls dice the same 3 times. When the player goes to jail, the player cannot play 3 rounds. In some cases, waiting in jail may give you an advantage. For example, if the opponent has many properties in front of you and you are likely to fall into one of them, you can expect the opponent to pay you 3 rounds of rent instead of leaving the jail. (It is a strategy to get more money.)

8. Get Out of Jail:

When the player waits three rounds, she/he has the right to play the next round and you exit the jail. If the player draws a "Get Out of Jail" card, the player can use it to exit. The player can also get out of the jail by paying a certain amount of money.

Win the Game:

The way to win the game is waiting for other players to go bankrupt.

Lose the Game:

The player who goes bankrupt loses the game. In order to go bankrupt, the player must not be able to pay large amounts of rents, mortgage his properties and pay rent on the property he last fell. If a player is unable to pay the rent or put money into the vault on the tax card, he/she is considered bankrupt and is removed from the game. This continues until there is only one player left.

3. Proposed System

3.1. Overview

3.1.1. Gameplay and Control

At the beginning, before starting the game the user immediately decides on the number of the players. For each player, the user enters a name, chooses a token to represent each and determines a theme background color. When the players are defined, the game is ready to start. The user firstly rolls the dice to randomly specify the order of the players and list them in terms of their turn to play the game each time. Then the game starts with the first player and the player rolls the dice to move to a land on the virtual board.

During the game, the controlling device is the mouse. Decisions such as purchasing a land or building structures, rolling dice, displaying the movements are made via clicking to the corresponding buttons. Each player makes the decisions when his/her turn is active.

3.1.2. Game Board

Monopoly Space Edition has a virtual board consisting of a road to travel planets, jail, spaceship, blackhole, chance cards, chest cards, aliens. Each player travels the destinations on the board with respect to their dice result and struggles with different challenges and surprises such as paying rent, going jail, earning bonuses from chance cards during the game.

Figure 3.1.2.1: Monopoly Space Edition Game Board

3.1.3. Tokens

Tokens of Monopoly Space Edition consist of plenty of spacecraft. Each spacecraft has similar features and their main mission is to represent each player's movement on the map. Players can select their tokens according to their pleasure. Some of the spacecraft tokens are shown in the figure below:

Figure 3.1.3.1: Spacecraft Tokens for Monopoly Space Edition

3.1.4. Chance and Chest Cards

Chance and chest cards are taken by the players when they land on the representative places of these cards on the board. Each card tells a good or bad duty for the players such as winning prizes, going to jail, controlling their position on the board, losing money etc.

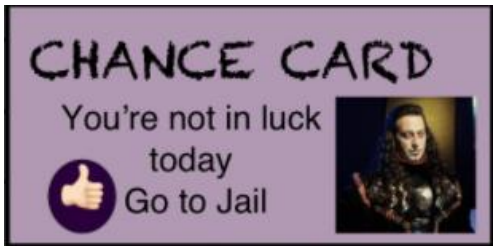

Figure 3.1.4.1: Chance Card for Monopoly Space Edition

3.1.5. Aliens

Aliens take place on the game board like chance and chest cards. There are 3 aliens on the game board that will be ready to make an invasion when the player lands on the representative compartments of these aliens during the game. Each has different duties assigned to them. One takes the player to the blackhole and the player is left there for its next 3 turns. The other steals some money from the player, and the last one seizes a

random title deed that the player possesses. One of these aliens is randomly assigned to the player to make an invasion.

Figure 3.1.5.1: Alien Invasion Compartment

Figure 3.1.5.2: Alien Invasion

3.1.6. Dice

Virtual dice is present on the game board to first determine the players' sequence for their turn before starting the game and then to determine and control each player's position on the board for the rest of the entire game.

Figure 3.1.6.1: Dice for Monopoly Space Edition

3.1.7. Sound Settings

The game has a background sound feature for the players. The players control its volume whenever they desire during the entire game.

Figure 3.1.7.1: Sound Setting

3.2. Functional Requirements

3.2.1. Enter Requirements

1. The player should be able to choose how many people the game is played with.
2. The player should be able to give himself a nickname.
3. The player should be able to choose their own token.

3.2.2. Play Game

1. The player should be able to roll the dice.
2. The player should be able to move on the board according to the number of the dice rolled.
3. After moving forward on the board, the player should be able to act according to the rules of the game in the location he came.
4. The player should be able to buy the planet.
5. The player should be able to plant a forest, home or hotel on the planet he bought.
6. The player should be able to purchase Spaceships.
7. The player should be able to enter and exit the jail.
8. The player should be able to draw cards.
9. The player should be able to undergo alien invasion.
10. The player should be able to see how much money is in their bank account.
11. The player should be able to trade.

12. The player should be able to mortgage.
13. The banker should be able to arrange the total balance of the players.
14. The banker should be able to sell Planet.
15. The banker should be able to declare Bankrupt.
16. The banker should be able to update the player's account.
17. The banker should be able to make mortgage

3.2.3. Quit Game

1. The player should be able to end the game both in the main menu and while playing the game.

3.2.4. Replay Game

1. The player should be able to restart the game and continue from the beginning during the game.

3.2.5. View Help

1. The player should be able to get information about the game through the help screen.

3.2.6. Arrange Volume

1. The player should be able to mute the game without changing the settings of his computer.
2. The player should be able to increase the sound of the game without changing the settings of his computer.

3.3. Nonfunctional Requirements

3.3.1. Usability

Monopoly space edition is designed as a game that users can learn and play very easily. Thanks to the help button on the main menu, players will be directed to a page where the game is explained. In this way, they will be able to get detailed information about the game. Thanks to the buttons on the game interface and the commands written on it, players will be able to easily make the actions they want to do and. As players can see the previous activities of other players, it will ensure continuity of the game and facilitate its traceability. The amount of money in the players' bank accounts will be displayed on the screen. In this way, players will be able to track who is about to beat and apply strategies accordingly. The fact that the colors of the planets in groups are the same has provided convenience to the user. Thanks to the tokens moving on the board, users can easily see who is in which position. The fact that the game is a desktop application and does not require internet increases usability.

3.3.2. Reliability

Since the money in the player's bank account is controlled by the bank every time, there is no problem in the system in detecting the bankruptcy incident that occurs when the money runs out. No cheating is possible in the game, as the money will be controlled by an actor named banker, not by an external agent, but by the code written. Users do not need to enter any personal information into the game, it can also be played with a nickname, which makes the game safe.

3.3.3. Performance

Since the game will be a desktop game, it does not require an internet connection, so the response time is very fast, there will be no hitch in the speed of the game in any internet problem. The system can do many activities at the same time in a short time. For example, it can build a hotel on a plane at the same time and update the planet's owner's bank account.

The game is available for anyone who has the game as a desktop application. They can access and play the game without any problems.

3.3.4. Supportability

The code of the game will be implemented in accordance with the concepts of adaptability, maintainability, internationalization and portability.

3.4. Pseudo Requirements

1. The game will be coded in Java and JavaFX library will be used for GUI part of the game.
2. Pencil and Sketch are used for designing Mockup images and game objects.
3. Visual Paradigm is used for designing and drawing the diagrams in the report.

3.5. System Models

3.5.1. Scenarios

Scenario 1 : Starting Game

Participating actor: Player
Flow of events:

1. Player clicks the “Play” button from the main menu.
2. Player selects how many people the game played with.
3. Players enter their name and select their tokens.
4. If the player wants to turn back the menu, click the “Back” button.
5. Player clicks the “Start the Game” button to start.
6. If the player clicks the “Start the Game” button, players roll dice to determine who will start first.
7. After determining who will start, the game starts.

Scenario 2 : Opening the Help Screen
Participating actor: Player
Flow of events:

1. Player clicks the “Help” button from the main menu.
2. Help screen opens and the player can be informed about the game.

Scenario 3 : Quit the Game
Participating actor: Player
Flow of events:

1. Player clicks the “Quit” button from the main menu.
2. The main menu screen is closed.

Scenario 4 : Change Sound
Participating actor: Player
Flow of events:

1. Player clicks to the “Change Sound” button
2. By clicking the “+” button, the player can arrange the volume up.
3. By clicking the “-” button, the player can arrange the volume down.

Scenario 5 : Playing the Game
Participating actor: Player
Flow of events:

1. When the game starts the game board is loaded to the screen.
2. In the beginning, players are at the start position on the game board.
3. Each player will move respectively by rolling the dice. Players will move based on the incoming dice total after rolling the dice.
4. Players can visit a planet, a spaceship, a location which they should take a chance or chest card, jail or free spaceship park.
5. Players act according to the rules for each location they visit.

Scenario 6 : Losing the Game
Participating actor: Player
Flow of events:

1. When a player has no money in the bank and no property he/she loses.
2. Loser players cannot continue the game.
3. The game continues with the other players, until just one player remains.

Scenario 7 : Winning the Game
Participating actor: Player
Flow of events:

1. When there is just one remaining player, the remaining one is the winner.
2. The game ends.

Scenario 8 : Pausing the Game
Participating actor: Player
Flow of events:

1. Player clicks the “Finish” button from the monopoly board screen.
2. The screen is closed and the game ends.

Scenario 9 : Replaying the Game
Participating actor: Player
Flow of events:

1. Player clicks the “Replay” button from the monopoly board screen.
2. The game starts again.

3.5.2. Use Case Models

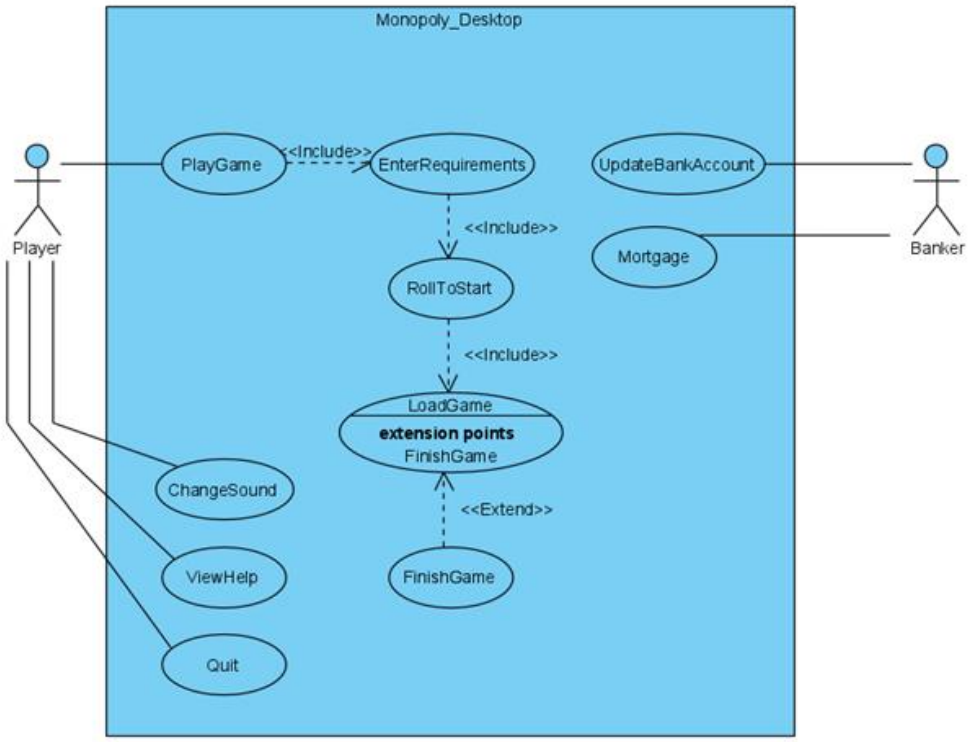

Figure 3.5.2.1: Use Case Diagram for Monopoly Space Edition

Use Case Name: PlayGame

Participating Actor: Initiated by Player

Flow of Events:

1. Player clicks the “Play” button.
2. Monopoly Desktop responds by presenting the screen that the player will enter the requirements on that page.

Entry Condition:

- “Play” button is clicked from the main menu.

Exit Condition:

- “Quit” button is clicked from the main menu.

Use Case Name: ChangeSound

Participating Actor: Initiated by Player

Flow of Events:

1. Player clicks the “ChangeSound” button.
2. Player arranges the volume level.

Entry Condition:

- “ChangeSound” button is clicked from the main menu.

Exit Condition:

- “Back” button is clicked from the sound change screen to turn back the main menu.

Use Case Name: ViewHelp

Participating Actor: Initiated by Player

Flow of Events:

1. Player clicks the “Help” button.
2. The screen with the information about the game opens.
3. By rolling the screen, the player can be informed.

Entry Condition:

- “Help” button is clicked from the main menu.

Exit Condition:

- “Back” button is clicked from the help screen to turn back to the main menu.

Use Case Name: Quit

Participating Actor: Initiated by Player

Flow of Events:

1. Player clicks the “Quit” button.
2. The game screen turns off.

Entry Condition:

- “Quit” button is clicked from the main menu.

Exit Condition: -

Use Case Name: EnterRequirements

Participating Actor: Communicates with Player

Flow of Events:

1. Player enters the player number to the requirements screen.
2. For each player, the player 's name is written by the player.
3. Each player chooses a token.

Entry Condition:

- “Play” button is clicked from the main menu.

Exit Condition:

- “Back” button is clicked from the requirements screen.

Use Case Name: RollToStart

Participating Actor: Communicates with Player

Flow of Events:

1. Each player rolls dice to determine who starts first.

Entry Condition:

- "Start the Game" button is clicked from the requirements screen.
- "Replay" button is clicked from the monopoly board screen.
- "Replay" button is clicked from the screen that shows the winner.

Exit Condition:

- "Finish" button is clicked from the monopoly board screen.

Use Case Name: LoadGame

Participating Actor: Communicates with Player

Flow of Events:

1. After determining who starts first, the game is loaded.
2. Players roll dice and move according to the total dice number.
3. For each location players come, they act by following the rules.

Entry Condition:

- Dice are rolled from the popup monopoly board screen.

Exit Condition:

- "Finish" button is clicked.
- There is only one remaining player. (Other players bankrupt.)
- "Quit" button is clicked from the screen that shows the winner.

Use Case Name: FinishGame

Participating Actor: Communicates with Player

Flow of Events:

1. After the game is loaded, players go bankrupt one by one.
2. When there is only one remaining player, who is the winner, the game ends.

Entry Condition:

- Only one player remains.
- "Finish" button is clicked from the board screen.
- "Quit" button is clicked from the screen that shows the winner.

Exit Condition: -

Use Case Name: UpdateBankAccount

Participating Actor: Initiated by Banker

Flow of Events:

1. The banker arranges the bank accounts of the players as the financial situation of the players change.

Entry Condition:

- A player passes through the starting point.
- A player purchases a planet.
- A player builds a hotel on a planet.
- A player builds forest on a planet.
- A player builds home a planet.
- A player gets rent.
- A player pays rent.
- A player gets out of jail.
- A player is bankrupt.

Exit Condition:

- Updating the bank account according to the rules is completed.

Use Case Name: Mortgage

Participating Actor: Initiated by Banker

Flow of Events:

1. Player should rent although there is not enough money.
2. Player chose to mortgage his planet.
3. Banker completes the mortgage operation.

Entry Condition:

- Mortgage is chosen by a player.

Exit Condition:

- Mortgage operation is completed.

3.5.3. Object and Class Model

Class Diagram

The class diagram of the “Monopoly” game is illustrated below. The system currently has 12 classes.

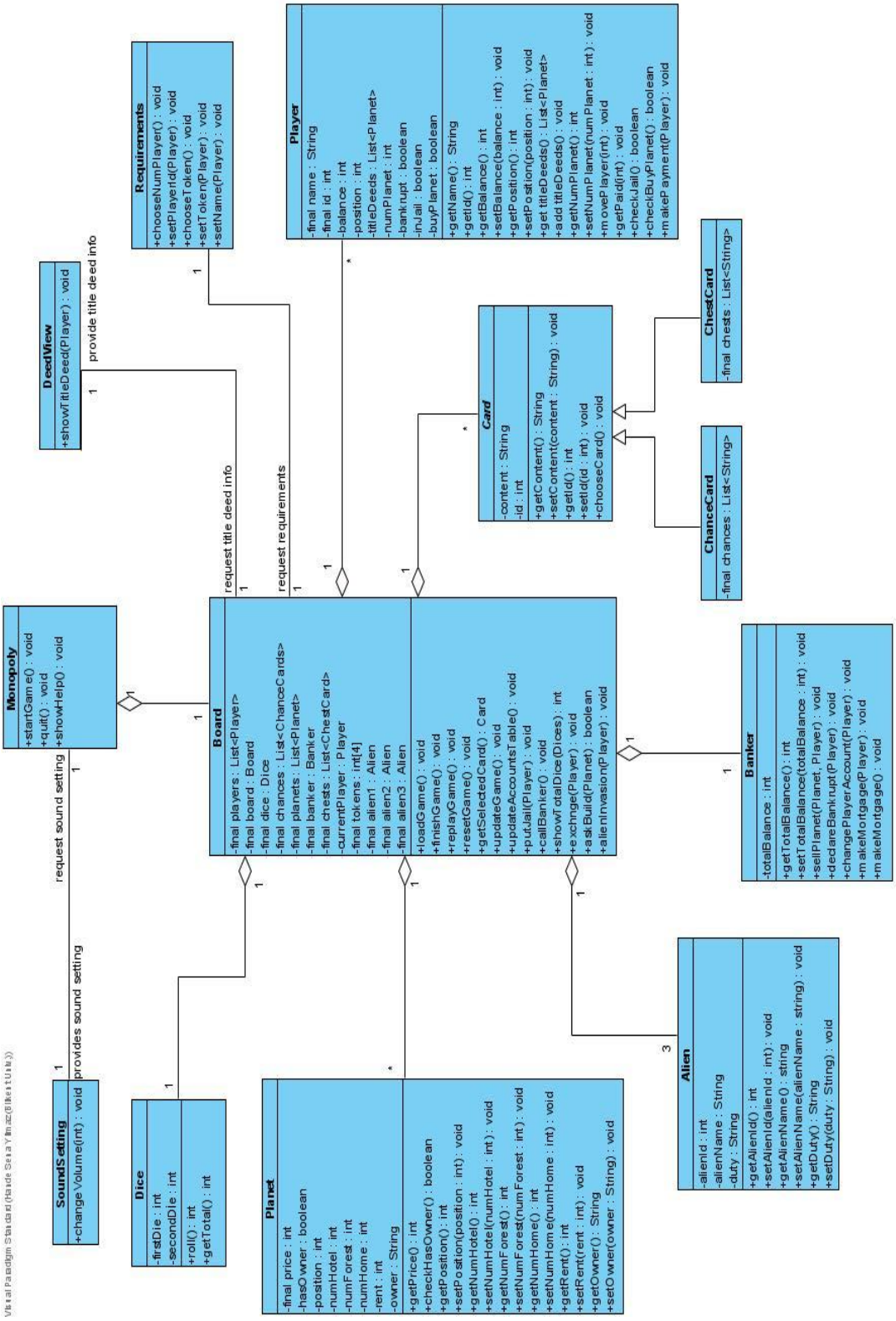

Figure 3.5.3.1: Class Diagram for Monopoly Space Edition

Monopoly Class:

On the top of everything there is Monopoly class to provide the user interface for the starter of the game. When the user opens the game this class illustrates the first page of the game. The startGame() operation provides the next page to start the game. The quit() operation quits the game and closes the page. The showHelp() operation illustrates a new page to help the user about the details of the game. It also has an association with SoundsSetting class to request the settings of the sound that will be active throughout the game and to illustrate it from the first page of the game.

SoundsSetting Class:

This class provides the sound settings for the entire game, so it has an association with Monopoly class. The changeVolume(int) operation gives a control for the volume of the sound. This tool will be available for the entire game on each page.

Requirements Class:

This class represents the interface of the page where the user provides the players' information before starting the game. It has an association relationship with Board class where the game is played. The user determines the number of players playing the game with chooseNumPlayer() operation and gives each player's name with setName(Player) operation. After this each player's id will be automatically assigned with the help of setPlayerId(Player) operation. The chooseToken() operation illustrates the tokens and provides the user to choose a token for each player. Each token will be assigned to its player with the setToken(Player) operation.

Dice Class:

This class represents the dice rolled at each players' turn during the game and it has an aggregation association with Board class. Two properties for each die are present in the class as firstDie and secondDie. The roll() operation rolls the dice and getTotal() operation returns the total value of the dice.

DeedView Class:

This class represents the view page for each player. When the player requires this page to see the current deeds, it will provide the title deed information for that player with the showTitleDeed(Player) operation. It has an association relation to Board class as well since the game play is represented here.

Planet Class:

Planet class represents the planets (title deeds) on the game board. Each planet has a name, price for purchase, owner if any, a position on the game board, and rent amount for the visitors. It may also have a certain number of hotels, houses and forests based on the desire of the current owner of the planet. Each attribute of the class has getter/setter operations to have the control of these during the game and for their updation at each turn. This class also has an aggregation association to Board class to represent the final list of the planets on the game board.

Banker Class:

This class represents a virtual banker for the game to control the balances the purchase and sale of the planets to players, to declare a possible bankruptcy for a player, and to make the mortgage process between players or a certain player to the bank. It has operations to control each action and an attribute called totalBalance to represent the total assets of the virtual bank. Banker class also has an aggregation association to Board class to provide the banker action to the game board.

Player Class:

This class represents each player with their attribution to play the game. Each player has a name, id, funds (balance), token position on the game board, and owned title deeds. Whether a player is in jail or wants to buy a planet or goes bankrupt are also kept as an attribute of this class. When another player comes to a planet, they need to pay for the rent. The player receives the payment for the rent with getPaid(int) operation. In the game when it is the player's turn, the token of the player will move on the game board and come

to a planet based on the rolled dice and this is controlled with the movePlayer(int) operation. If the player comes to a planet owned by another player, the rent of the planet will be paid to the owner player with the makePayment(Player) operation. This class also has an aggregation association to Board class to represent the final list of the players and the current player on the game board.

Alien Class:

Alien is the extra object which is present on the game board to give a new feature to the game. This class is used to create 3 aliens on the game board and each alien has a different duty to contribute to the game. One takes the player to black hole and the player waits there for the next three turns, another makes the invasion with seizing one of the title deeds of the player forever, and the other steals a certain amount of money from the player. When a player lands on alien invasion property on the game board, one of three aliens will automatically be assigned to the player to make these invasions. Since the aliens are one of the objects present on the game board, it also has an aggregation association to Board class.

Card Class:

Card class is an abstract class. It is the superclass of ChanceCard and ChestCard classes and represents the id and contents of each card. When the player comes to a land represented by either type of card, it will call chooseCard operation to include the content of the chosen card to the game. Card class has an aggregation association to Board class to represent the list of each type of cards on the game board.

ChanceCard:

ChanceCard is a subclass of Card Class and it represents the list of chance cards and their final content.

ChestCard:

ChestCard is a subclass of Card Class and it represents the list of chest cards and their final content.

Board Class:

This class represents the game board where the game actually takes place and which includes all the features of the game. It defines all aggregated objects as attributes and starts the game with loadGame() operation. This class also controls the entire game with finishGame(), replayGame(), resetGame() and updateGame() operations. Other features like selecting cards, showing the accounts' table of players, putting a player to jail, making exchanges with title deeds, showing the total value of the dice in each roll, building properties to a specific planet, calling the banker when needed and alien invasion are also controlled here with specified operations. It is basically the central part of the entire game.

3.5.4. Dynamic models

State Diagrams

State Diagram for Main Menu User

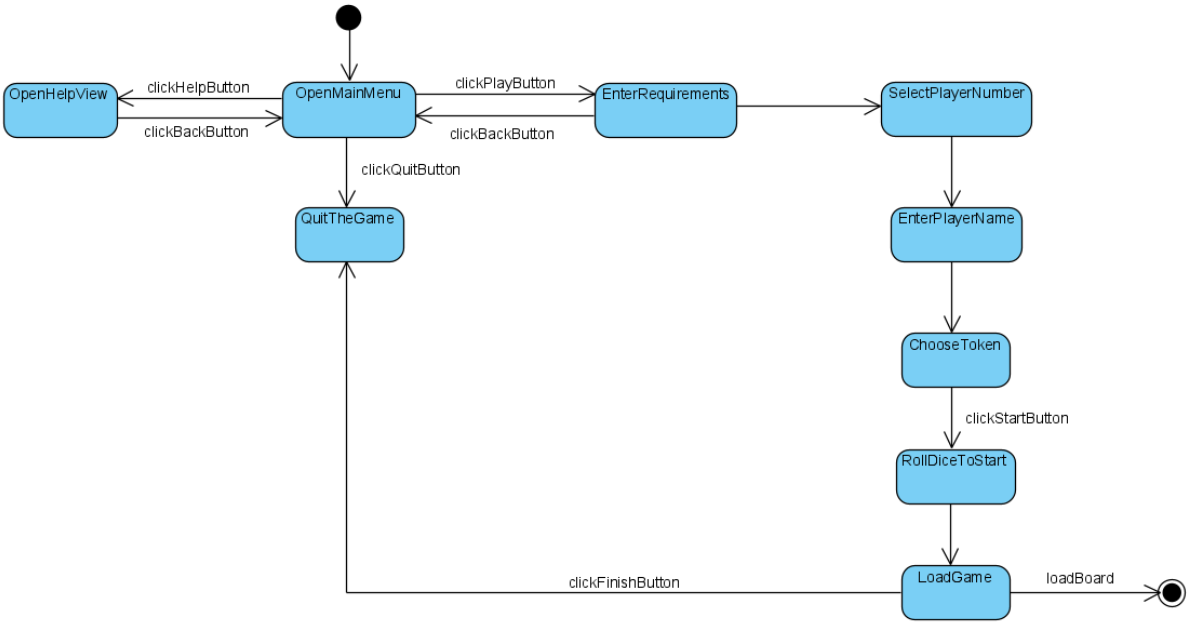

Figure 3.5.4.1: State chart diagram for user in main menu

This state diagram describes behavior of the user on the home screen of the game. If the user clicks to the play button then requirements such as player number, player names and tokens have to be entered. Then, if the start button clicked, the dice is rolled to indicate the

first player and game is loaded. At any point of the game, if the finish button clicked game comes to an end immediately. There is also a help option in the main menu which pops up by clicking the help button and the window can be closed by clicking the back button.

State Diagram for Player

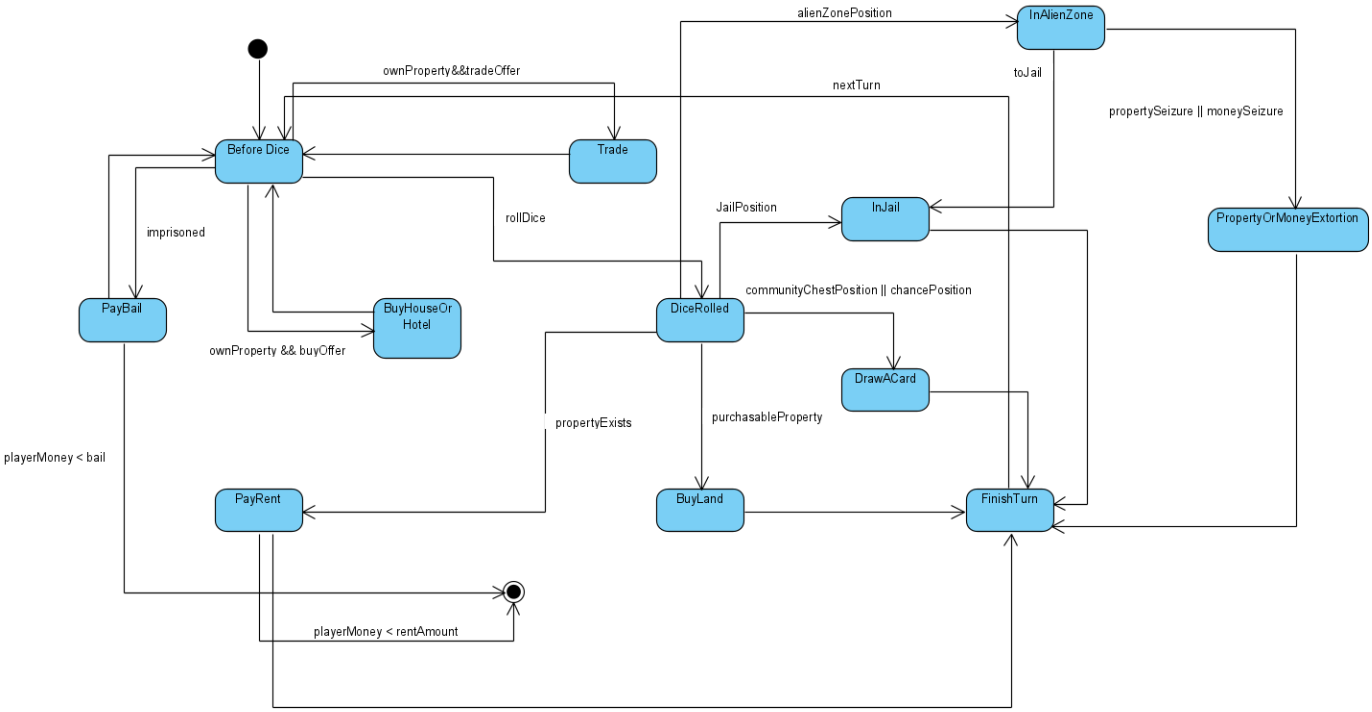

Figure: 3.5.4.2: State chart for a player in Monopoly game

This state diagram describes behavior of the player and is valid for each turn in the game. Before rolling dice if a player is in prison then s/he has to pay a certain amount of money. If player balance is less than this amount of money, s/he is eliminated. The player can buy properties in case requirements have met or made a trade offer to another player as well. After the dice is rolled, the player may arrive on the jail position, alien zone, chance card or community chest position. In the alien zone, the player's properties or money can be stolen by an alien or s/he may go to jail. If the player is in a card position after the move, then s/he picks up the card on top of the deck from the respective card type. If any property exists in the current position of the player after the move, then s/he has to pay rent to the owner of the property. If the land that player is on is not owned by anybody, then s/he can buy it as well.

State Diagram for Banker

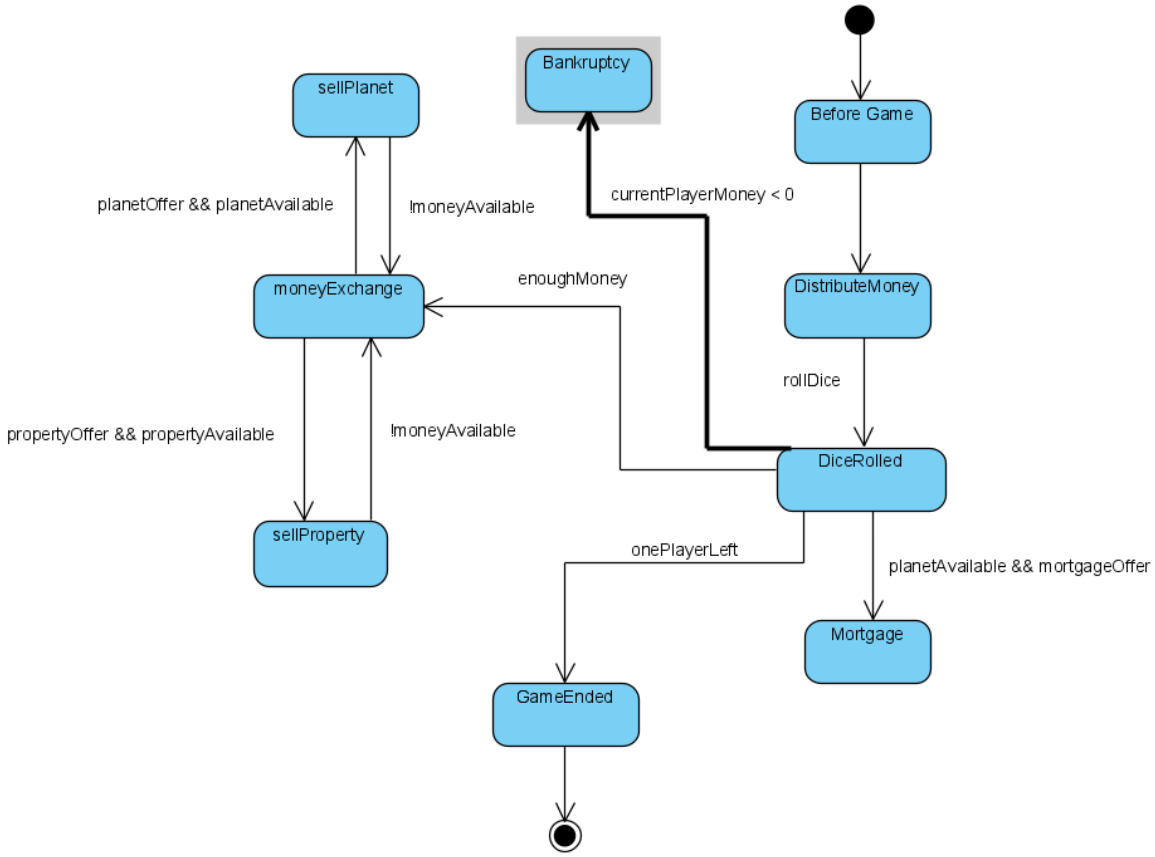

Figure 3.4.5.3: State chart diagram for the banker in Monopoly Game

This state diagram describes behavior of the banker. Banker distributes money before the game starts and sells any available land or property to the player according to his/her balance. Additionally, if any mortgage offer is made, the banker is responsible for the financial stage of this offer. If the player has a balance less than zero, it means s/he goes bankrupt which is also in the banker's scope.

Activity Diagram

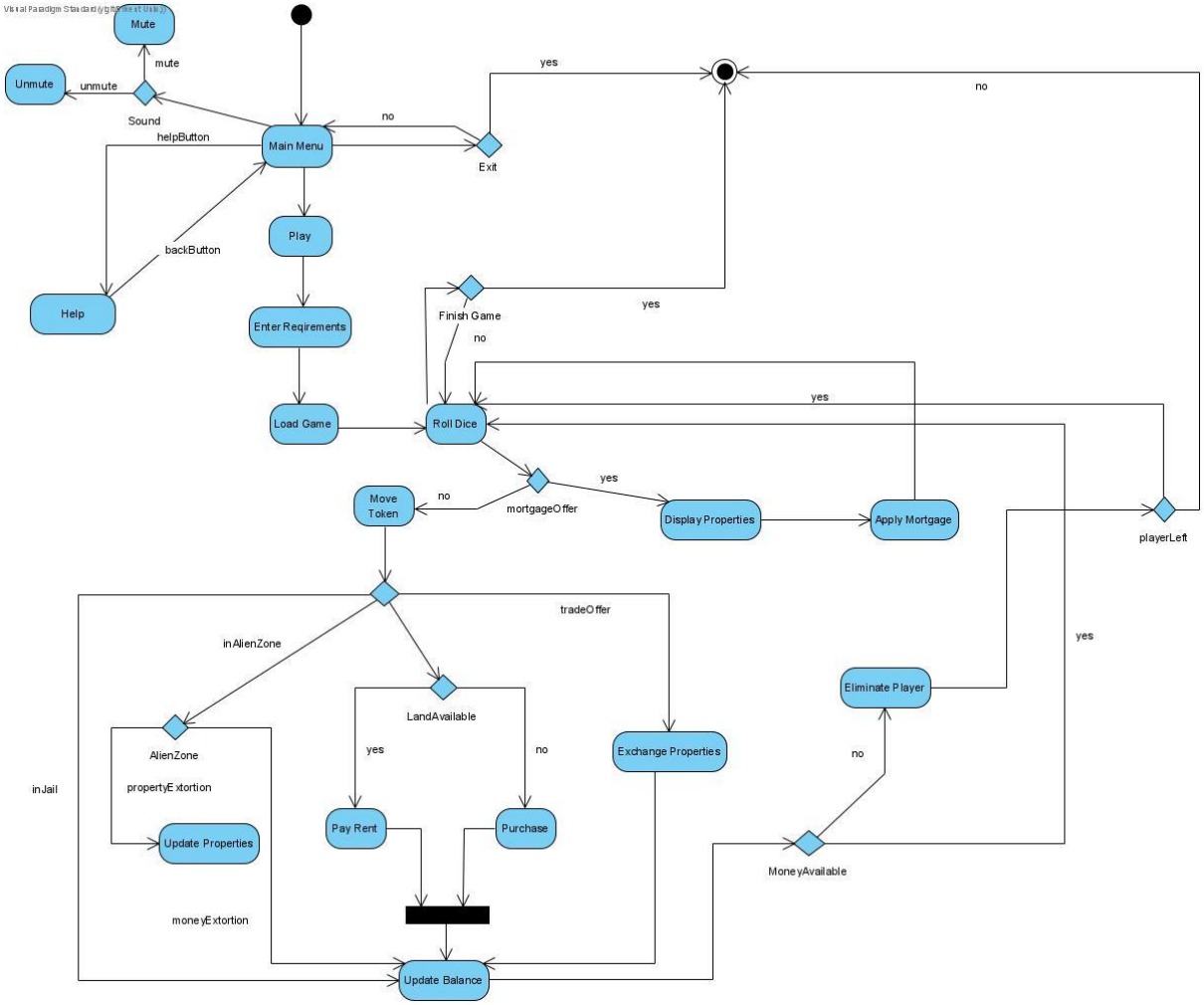

Figure 3.4.5.4: Activity diagram for Monopoly Space Edition

The activity diagram above depicts the behavior of the system.

First screen user view is the main menu with three options: Play, Help and Exit. If a user exits, the system goes to the final node. If the user denies to exit, the main menu can be viewed again. If the help button is pressed, then the help window will be displayed, the back button directs the user to the main menu. Mute button is also clickable and the system stays on the main menu.

When the play button is clicked, the system waits for input from the user which is named as requirements. After this node system loads the game and rolls the dice to begin.

In every turn in the game, the system waits for the player to make a mortgage offer and if any offer is made, properties of the player are displayed. Dice can be rolled after this stage.

When dice are rolled, the system takes action according to the player's current position. Hence, it can be mentioned from four different types of actions which are Alien Zone, Jail, Land and Trade. If a player is in jail, then the system updates users and bankers balances. If the player is in an alien zone, the system updates users' properties or balances. If a player is on a land owned by another player, the balance is updated according to rent amount. If land is not owned, in case the player buys it, the balance is updated by the system. If any trade offer is made, the system exchanges properties of both sides. System eliminates players whose balance is less than zero. If the game is ended, then the system goes to the final node. Similarly, if one player left, the system goes to the final node.

Sequence Diagram

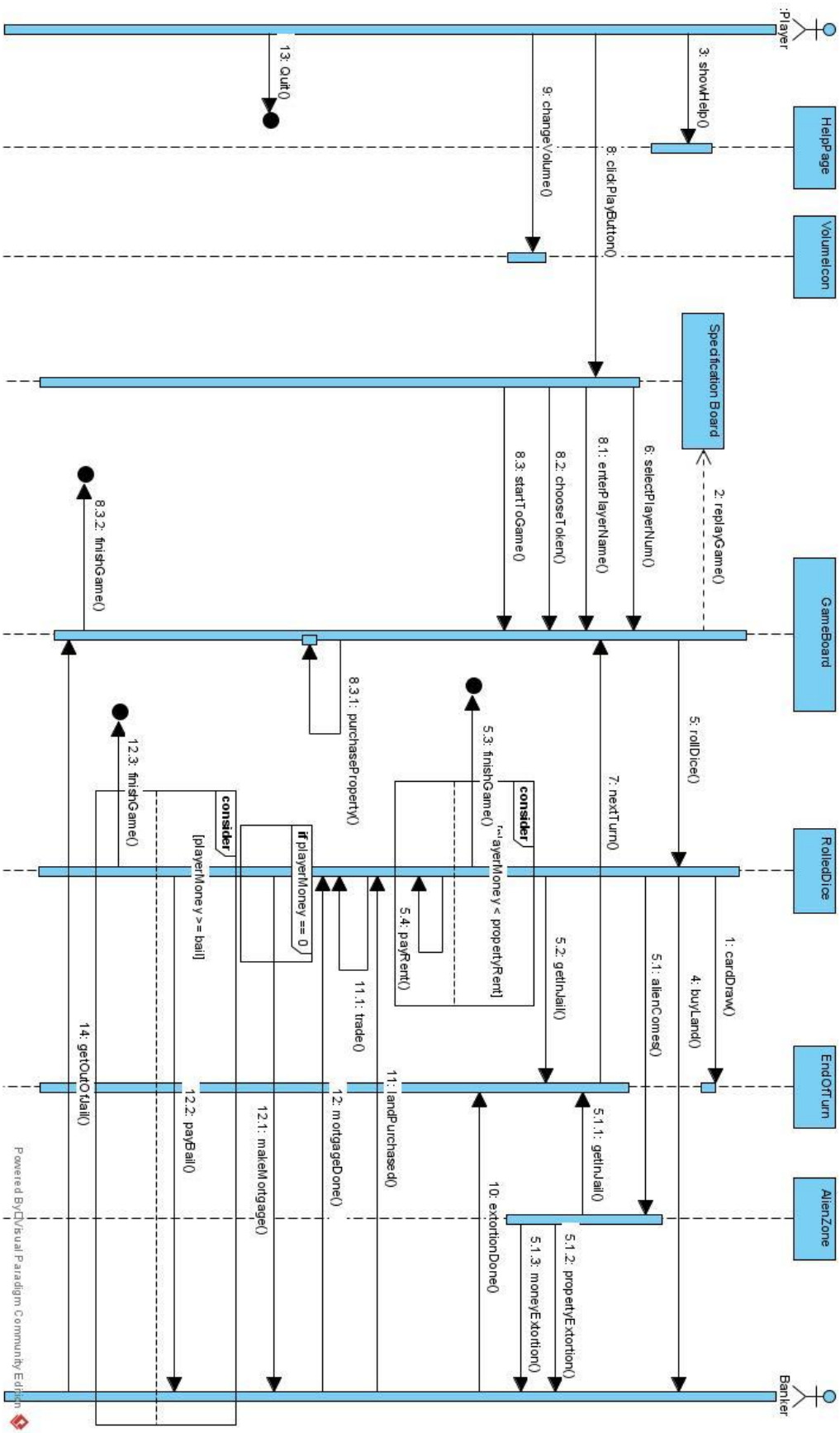

Figure 3.4.5.5: Sequence diagram for Monopoly Space Edition

This sequence diagram correlates the interaction with the game objects sequentially and shows the game functionality. In this diagram, there are two actors who are the player and the banker. Interactions between these two actors are shown in a sequential order with functions. The player has four options initially which are showHelp() directing to the help page, clickPlayButton() directing to the specification board, Quit() exiting the game and changeVolume() that mutes or the volume or not on VolumeIcon. In the specification board lifecycle, the player has three methods for specification which are selectPlayerNum(), enterPlayerName(), chooseToken() and startToGame() leading the player to the game board. In the game board, the player can roll dice when his/her turn comes, trade with other players, purchase properties, finish or replay the game. In the game board, the player can purchase properties like lands or buildings and roll dice.

When the player rolls dice, s/he can draw a card leading to the end of his/her turn, can confront aliens leading him/her to the alien zone, can get in jail, can pay the bail for getting out of jail to the banker if s/he has enough money; otherwise the game ends for him/her, can pay rent if s/he has enough money, if not, the game ends; can make mortgage if s/he has no money, and s/he can buy the current land or build properties. The difference between buyLand() and purchaseProperty() is that the money is paid to the banker for the land and properties, but in purchaseProperty(), the money is paid to the player who owns the property.

In the alien zone lifecycle, aliens have three options to punish the player which are selected randomly. These options are property extortion, money extortion and getting the player into jail. Extortions are paid to the banker.

The banker actor approves the purchasing operations, extortion operations and mortgage operations. Also, it lets the player get out of jail and directs to the game board.

3.5.5. User interface

Figure 3.5.5.1: Open Page for Monopoly Space Edition

There are 3 buttons on the Monopoly home page, top to bottom. When the play button is clicked, the page where the parameters will be entered by the player to start the monopoly game opens. Clicking the Help button opens the page where players can get information about the game. When the Quit button is pressed, the game is quit. Sound adjustment can be made from the mute button in the lower left corner.

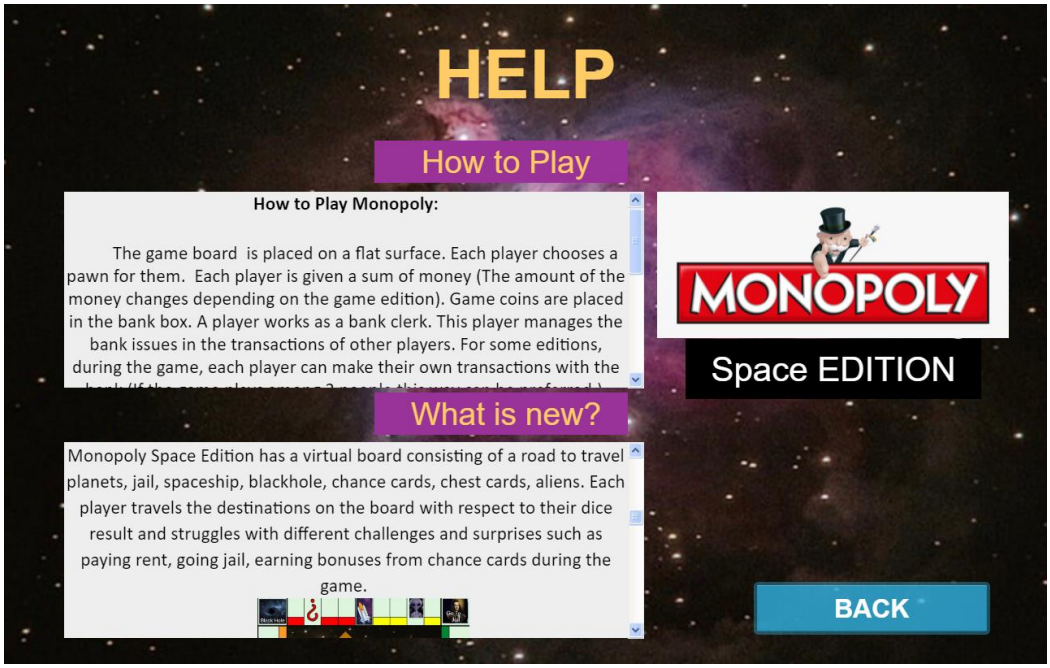

Figure 3.5.5.2: Help Page for Monopoly Space Edition

Help page mainly consists of two text pads composing “How to Play” and “What is new?” sequentially. In how to play text, general game rules and orders of Monopoly is explained in detail. Symbols, tools and several terms are expressed to the player and aimed to teach how to play Monopoly with its features. In the second pad, innovations coming with the Monopoly Space Edition and implementation of these innovations are explained. New tokens, terms and tools are introduced to the player with corresponding images.

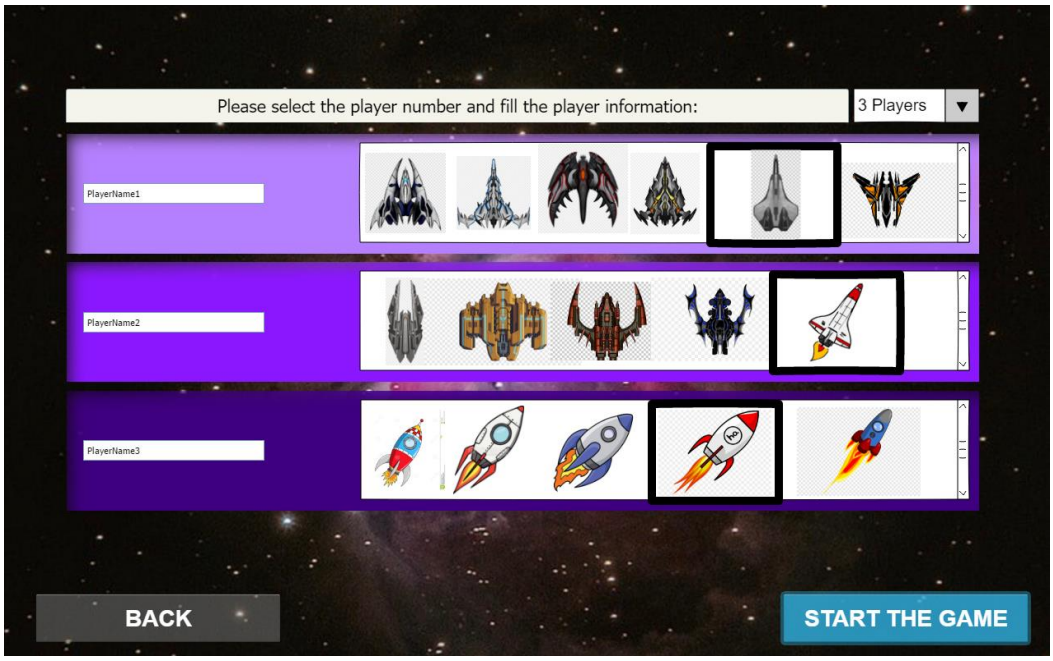

Figure 3.5.5.3: Requirements Page for Monopoly Space Edition

At the open page, after clicking the start button, the requirements page is provided to the player in order to fulfill the player name and select the player number and players' tokens used throughout the game. Tokens are spacecraft in different styles. At first, the number of players needs to be selected in order to display the corresponding number of specification rows. Players should write different names and select different tokens on the specification rows in order to distinguish the competitors during the game. After the specifications have been done, two buttons offer two options which are to start the game button leading the player to the game board and back button moving the player on the open page.

Figure 3.5.5.4: Monopoly Board for Monopoly Space Edition

There will be a section in the upper left corner of the page where the Monopoly Board is located, showing the actions of the players throughout the game. This will make it easier to follow the game. There will be two dice under this compartment. Each player will move on the board according to the number on the dice by stepping on these dice in their turn. Just below the dice is a pane showing the Players' nicknames and money in their bank accounts. There is a button named Deeds next to each player's bank account. When this

button is pressed, the properties belonging to that player will be displayed. Below this pane there will be two buttons named Replay and Finish. The Replay button is used to restart the game. Finish button serves to end the game. To the right of the screen is the Monopoly board. On this board, there are the starting point, planets, chest card, chance card, go to jail compartment, jail, spaceship and alien invasion compartment. In the middle of the board, there is the section where chest cards and chance cards are located. In the lower left corner of the board, the nickname of whoever is currently playing is displayed.

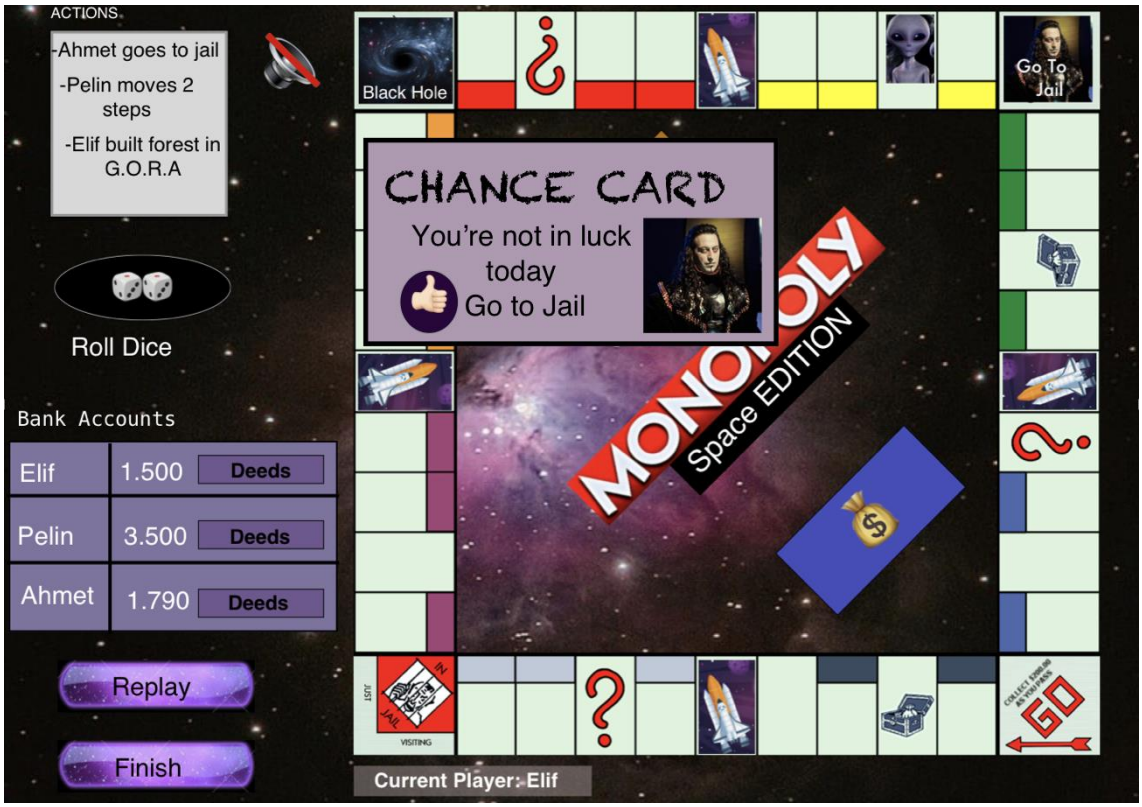

Figure 3.5.5.5: Chance Card Comes

When the player comes to the slot that requires the chance card drawing, the content of the chance card is shown on the screen in this way. Clicking on the mark at the bottom left of the card closes this card and the player does the task given by the card.

Figure 3.5.5.6: Buy Planet Option

When a player comes to a planet, if that planet does not have an owner yet, the game asks the player a question like this. If the player presses the yes button, he pays the money for that plan to the bank and gets the deed of that plan. If he presses the no button, the turn passes to the other player.

Figure 3.5.5.7: Build Option

If the player has come to his planet, the game asks him such a question. With the yes and no buttons, the player indicates the property to be planted on the planet.

Figure3.5.5.8: Pay For Rent

How much rent he has to pay when the player arrives on another player's planet is shown like above. By clicking the Make Payment button the player pays rent to the property owner.

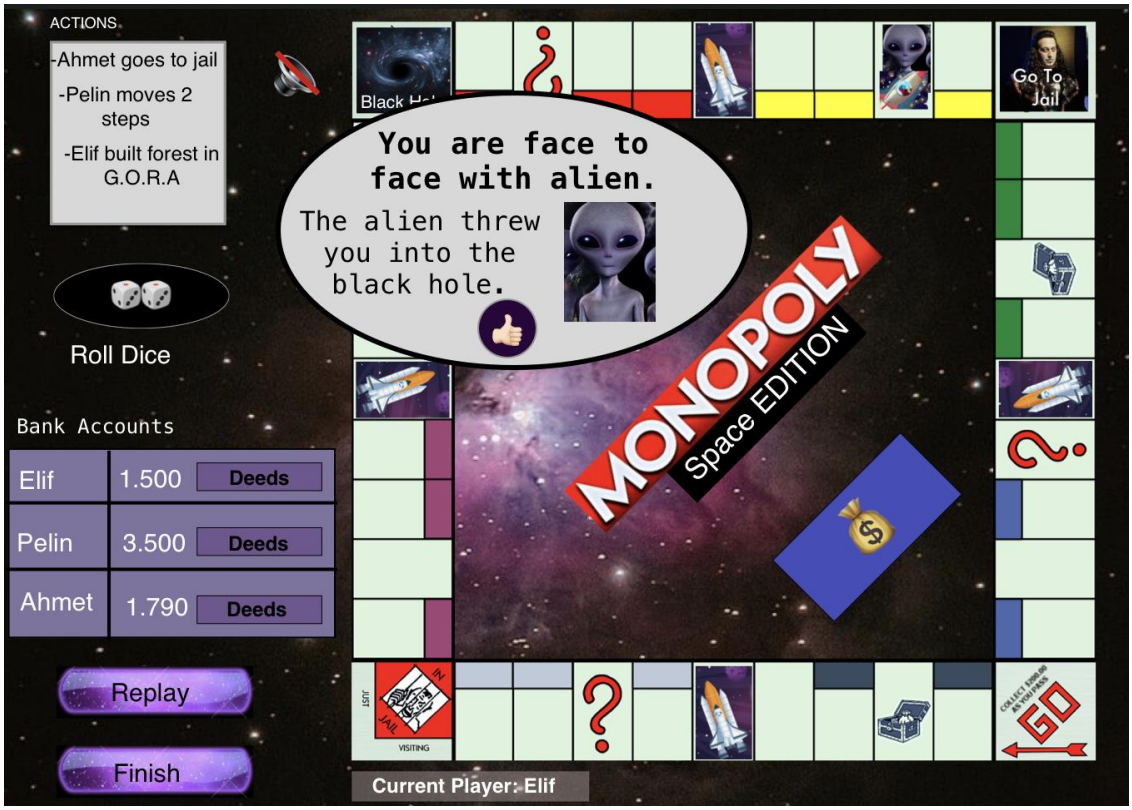

Figure 3.5.5.9: Alien Invasion

If the player has arrived in the alien invasion compartment, what will happen to the player according to the alien she encounters is shown in this way. If the player has arrived in the alien invasion compartment, what will happen to the player according to the alien he encounters is shown in this way. Clicking on the sign will exit the compartment and perform the required action.

Figure 3.5.5.10: Winner

When players go bankrupt one by one and only one player is left, the last player wins. The winning player is shown in this way. The game can be restarted by pressing the Replay button on the left or quit by pressing the quit button on the right.

4. Conclusion

In this analysis report, a well-known “Monopoly” game with an updated space edition is analysed in order to design and implement it. The report consists of 5 main parts where the detailed analysis of the proposed system is given in part 3 and its subparts.

In the “Overview” (3.1), the newly proposed system was briefly explained. In the “Functional Requirements” (3.2) part, all the new features added with space addition and the functionalities of the game were stated. All the functionalities were determined considering the possible future implementation. In the “Nonfunctional Requirements” (3.3) part, the advantages we offer to users with our design of the game was explained. We

further explained the extended and added features for the user of the game in terms of usability, reliability, performance and supportability. In the “Pseudo Requirements” (3.4) part, the implementation language and the environment which the system will operate were stated. In the “System Models” (3.5) part, we explained each scenario of the game, user interface, and the models representing the actions and relations of the system. As parts of the models, we showed the use case models, object and class model and dynamic models and explained their overall representation of the system which will later be implemented. How the user interface will be also illustrated and clarified in the “User interface” sub part of the system models.

To sum up, this report was written to make the implementation stage of our design of the space edition monopoly game compatible and easy to work on for the upcoming design processes of the game.

5. References & Glossary

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