



Bilkent University
Faculty of Engineering

CS319 - Object Oriented Software Engineering

Project Analysis Report

RISK

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1. Introduction

The goal of our project is to design an online version of the Risk board game. We want to improve the game so that it becomes more user friendly and more fun. In order to do that we will add new features and extend some of the existing features.

Risk is a strategy game in which the goal is to conquer the world by capturing every territory on the map. To capture a territory, the player attacks another player's territory. At this point two players' troops engage in a battle. Depending on the number of troops players roll a dice and depending on the dice the player either defeats the other player or gets defeated [1]. The goal is simple but the game itself is very dynamic. The game depends on both luck and skill of the player but we want to give more credit to skill than luck. Moreover, we will be extending the dice, troop and territory systems of the game.

2. Overview

There should be at least 3 and at most 6 players to play the game. The game starts and each player is assigned to a specific color to represent them.

2.1 Game Setup

Depending on the number of players, each player gets armies.

- If there are 3 players , each player gets 35 assets.
- If there are 4 players , each player gets 30 assets.
- If there are 4 players , each player gets 25 assets.
- If there are 5 players , each player gets 20 assets.

After distributing the armies each player rolls a die. The player who rolls the highest number starts placing the assets first. Then other players start placing their assets on unoccupied territories in order according to their rolled numbers. Players continue until all territories have been occupied. After all territories are occupied each player adds additional assets to their occupied territories and there is no limit for adding assets to a single territory. When there are no armies left, risk cards are shuffled and the first player starts the game [2].

2. 2 Game Play

Each turn consists of 3 stages. Overall, the player adds the new soldiers to his/her territories, attacks and moves his/her soldiers at the end of the turn. Each turn starts with new soldiers obtained by the player. The number of the soldiers added are calculated with bonuses and territories that the player holds. During this stage the player can check his/her cards to see whether there is a bonus obtained. After this stage the player now proceeds to attack. Any territories holding 2 or more armies can attack a neighboring territory and dice are used to choose the winner. There are advantages that a player can have and these advantages affect the dice roll, for example if the attacked territory is the capital of another player the defense side rolls the dice twice and takes the greatest result. A player can attack

as much he/she wants as long as he/she has 2 or more army remaining in one of his/her territories that has at least one enemy neighbor. Once a player cannot attack anymore or chooses not to, the second stage ends and the last stage of a turn starts. During this last stage a player can move his/her existing armies that have at least 2 size to one of his/her other territories. This stage ends when one replacement is done or if it is skipped and does not let the replacement of more than one territory. When a player's turn is finished, the game engine checks to see if the game is ended and if not it passes to the next player's turn [2].

2.2.1 Getting and Placing New Armies

At the beginning of each turn players receive new armies based on the number of territories they occupied, value of the continents they hold , value of the matched set cards and other bonuses like the number of capitals they hold.

A. Territories

Players receive armies according to their occupied territories divided by three. Players can place their armies on their already occupied territories. Players will receive at least 3 armies even if their occupied territories are less than 9.

B. Continents

Players receive armies for each continent they hold. In order to hold a continent, players must occupy all the territories on the continent. Each continent has its own bonus points and it activates after the player holds a continent at the beginning of his/her turn.

C. Capitals

Each player chooses a capital at the beginning of the game after all the initial soldiers are placed that cannot be changed during the game session. This capital gives 2 bonus points while the player is still controlling the territory. If a player attacks and invades another player's capital, it gains the bonus points given by the capital. Therefore, the numbers of capital controls affects the number of soldiers obtained each turn.

2.2.2 Risk Cards

At the end of a turn in which the player captures at least one territory, the player gains one risk card. The main goal is to collect sets of 3 cards in one of the combinations:

- 3 cards of the same type(Infantry, Cavalry, or Artillery)
- 1 from each type(Infantry, Cavalry, and Artillery)
- Any 2 cards and a wild card

At the beginning of each turn players who have a set of cards that are one the above conditions can trade their set with armies. Each set has its own value in terms of troops.

Wild cards are like joker cards, if a player has 2 artillery cards, it behaves like the third artillery card and provides a set.

If a player has more than five cards at the beginning of the round, the system enforces that user to trade a set since there is always one set when 5 cards exist.

2.2.3 Attacking

When a player's turn comes he/she can attack other players' territories. The main goal of attacking is to capture an opponent's territory by defeating all the armies that are currently on the territory. The defeater of the battle is decided by roll of dice. The players may choose not to attack when their turn comes but can still fortify their armies.

In order to attack the player should satisfy the following conditions:

- The player can only attack a territory which is next to or connected to his/her territory.
- The player must have at least 2 armies in the territory which he/she attacks from.

The player can attack a territory till there are no opponent's armies left. Also, the player can attack territories as much as possible and can switch from one territory to another during his/her turn.

When the player chooses to attack it is pointed on the map where the player is attacking from and where the player is attacking [2].

A.Dice rolls

In our system of dice roll there will be a number generator that will generate a number between 1 and 100. This corresponds to two dice that are used by D&D players, both of them with 10 faces that gives the player a total number of 100 different possibilities. The player that rolls the highest number wins the round and if there is an advantage to one of the players, the player uses the best of two rolls to fight.

B.Capturing Territories

When there are no opponent's armies left where the territory that the player has attacked, he/she captures the territory. In this territory, remaining armies from the previous battle are placed. The logic should be keeping as many armies as possible on the front territories since the armies on the back can't help the player during a battle. Also, the player must leave at least one army on the territory that he/she has attacked from.

C. Ending Attacks

The player can end his/her attacks when desired. If the player has captured at least one territory he/she takes a one risk card.

D.Eliminating an Opponent

When the player eliminates all armies of another player, the second player is eliminated from the game and the first player gets all the cards that the second player has previously owned.

2.2.4 Fortifying Position

While always leaving one army behind, the player may choose to fortify their armies from only one territory into only one other territory that is his/hers. There are no requirements to fortify armies.

2.2.5 Winning

The player who captures all the territories wins the game.

3. Functional Requirements

All of the requirements will be provided to the user in the main menu.

3.1 Number of Players

The game will be available for 3 to 6 players. From this option, the host can determine the desired amount of players by sending them the game code.

3.2 Play Game

If the player chooses this option, the game setup will start by assigning a random color to the player to distinguish him/her from the other players. According to the number of players, each player will be randomly given an asset consisting of different types of soldiers. Then for each player a dice roll will be generated. After comparing the numbers the player who gets the biggest number will start the game and other players will be sorted according to their numbers. Each player will select territories by clicking on top of them on the map. After all territories are occupied and all armies are distributed the game play will start. When a player occupies all territories by eliminating other players will win and the game will come to an end.

3.3 Help

In this option the user will be given information about the game such as how to play, how to win, risk cards, capitals, territories, continents, types of soldiers and the rules of the game.

3.4 Quit Game

If the user chooses this option the game will be closed and the program will stop running.

3.5 Host and Join Options

After pressing the play game option, the system will ask the user whether they will host a game or join an existing game. In the host option user will be given a code to share with others. Whoever has the code can play the game with the host.

4. Nonfunctional Requirements

4.1 User Interface

The game will provide a user friendly interface so that the flow of the game won't be corrupted and players will be able to have a nice gaming experience.

4.2 Performance

The game will be responsive to the players. For example, when the players start playing, their actions and reactions will be fast.

4.3 Extendibility

Our game will be implemented in a way that it is easy to make new modifications, fix bugs and remove undesired features.

5. System Models

5.1 Use Case Model

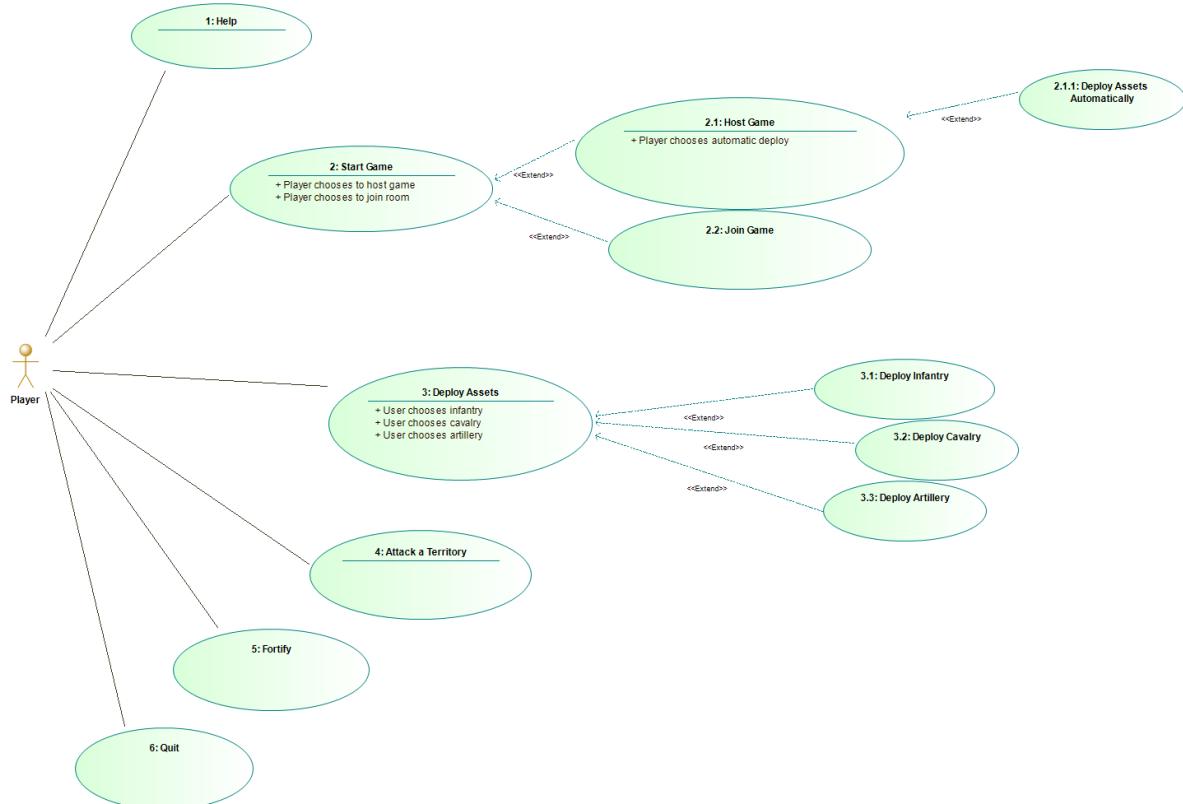


Figure 1: Main Use Case Diagram

Table 1 Main Menu Use Case Diagram

Use Case Name	Help
Use Case ID	1
Primary System Actor	Player
Definition	If the users choose to, they can learn more about the rules of the game.
Precondition	The user must be in the menu screen to access the help page.
Trigger	The user clicking on the “Help” button.
Basic Path	<ol style="list-style-type: none"> 1. User chooses the “Help” button in the main menu. 2. The rules of the game is given in a list in the Help page
Alternative Path	-

Exceptional Case	-
Postcondition	-
Rules	

Use Case Name	Start Game
Use Case ID	2
Primary System Actor	Player
Participating Actor	
Definition	The player starts a game and chooses either to join a game or host one.
Precondition	-
Trigger	The button named “Play Game” is clicked to start a game.
Basic Path	<ol style="list-style-type: none"> 1. Player chooses to start a new game from the main menu. 2. The player chooses if they are to host a game or join one.
Alternative Path	-
Exceptional Case	-
Postcondition	After the choices are made to start the game, the player advances to the Deploy Assets stage.
Rules	<ol style="list-style-type: none"> 1. The user must choose one of the two options given which are hosting or joining a game.
Explanation	-

Use Case Name	Host Game
Use Case ID	2.1
Primary System Actor	Player
Definition	The player chooses to host a game by creating a room.
Precondition	The player must choose to host the game from the Play Game page.

Trigger	The button named “Host” is clicked to create a room.
Basic Path	<ol style="list-style-type: none"> Player chooses to host the game. Player (host) chooses the number of players in the game
Alternative Path	<ol style="list-style-type: none"> The player may choose to automatically deploy assets.
Exceptional Case	-
Postcondition	After the game is hosted by the user, the game will start and begin with the deployment phase.
Rules	<ol style="list-style-type: none"> Only the host can choose the number of players in the game. Only the host can choose if the deployment of assets is automatically done. The host must begin the game. The host cannot begin the game if the stated number of players requirement is not fulfilled.
Explanation	The automatic deployment option lets the computer deploy the initially given assets to be deployed randomly, saving time for players who do not want to spend time on that. After the deployment phase is done automatically, the game continues the same way as the basic path and each player begins with the deploy assets phase.

Use Case Name	Deploy Assets Automatically
Use Case ID	2.1.1
Primary System Actor	Player
Definition	Before the game starts, the host chooses to deploy assets automatically in the beginning of the game.
Precondition	The player must choose the “Deploy Assets Automatically” feature in the room.
Trigger	The button named “Deploy Assets Automatically” is clicked to add the feature.
Basic Path	<ol style="list-style-type: none"> Player chooses to deploy assets automatically by clicking on the button. The game randomly deploys assets for the players before the deployment stage.
Alternative Path	-
Exceptional Case	-

Postcondition	After the game deploys the assets, it will begin with the deployment phase.
Rules	1. Only the host can choose this feature.
Explanation	-

Use Case Name	Join Game
Use Case ID	2.2
Primary System Actor	Player
Definition	The player chooses to join a game by joining a room created by a host.
Precondition	The player must choose to join a game from the Play Game page.
Trigger	The button named “Join” is clicked to join a room.
Basic Path	<ol style="list-style-type: none"> 1. Player chooses to join the game. 2. Player enters the code. 3. Player clicks on the “Ready” button.
Alternative Path	The player may choose to automatically deploy assets.
Exceptional Case	-
Postcondition	After the game is started by the host, it will begin with the deployment phase.
Rules	<ol style="list-style-type: none"> 1. The player can get out of the room 2. The player cannot begin the game 3. The player cannot choose the automatic deployment option or number of players in the game.
Explanation	The ready button referred to on the second bullet in the basic path is for the player to let the host know they are ready to play the game but it is not necessary for the game to start.

Use Case Name	Deploy Assets
Use Case ID	3
Primary System Actor	Player

Definition	Each player adds their remaining assets to a territory.
Precondition	The host must have started the game.
Trigger	The turn of the player begins.
Basic Path	<ol style="list-style-type: none"> 1. Player's turn begins. 2. Players add given assets to their owned territories. [A-1][A-2][A-3][A-4]
Alternative Path	<p>[A-1]: If the game mode does not automatically deploy assets, in the beginning of the game, each player will start deploying assets in empty territories.</p> <p>[A-2]: The player can choose to deploy infantry.</p> <p>[A-3]: The player can choose to deploy cavalry.</p> <p>[A-4]: The player can choose to deploy artillery.</p>
Exceptional Case	-
Postcondition	After the troops are deployed, the player advances to the Attack stage.
Rules	<p>In the alternative case of [A-1]:</p> <ul style="list-style-type: none"> • The territory the player deploys an asset on, will be owned by that player. • The first territory owned by the player becomes their capital. • If the empty territories are finished but the player has additional assets to deploy, the player will deploy these assets on their owned territory.
Explanation	In the alternative path, each player will add their assets to empty or their owned territories until the given assets are depleted. After all initially given assets are deployed, the game will carry on to the attack stage.

Use Case Name	Attack a Territory
Use Case ID	4
Primary System Actor	Player
Definition	The player attacks an opponent player's territory
Precondition	-
Trigger	After choosing one of their territories, the player attacks one of the suitable enemy territories.
Basic Path	<ol style="list-style-type: none"> 1. Players assemble an attack configuration by choosing the

	<p>asset types available in their territory.</p> <p>2. Players can attack other territories if they choose to.</p>
Alternative Path	-
Exceptional Case	-
Postcondition	After the attacks are finished, the player advances to the fortify stage.
Rules	<ol style="list-style-type: none"> 1. The attack configuration can include one or all of the asset types. 2. When attacking, at least one of any deployed asset types must remain in the attacker's territory. 3. The order of the engagement between assets in the attack configuration and the assets in the adversary side will be determined randomly. 4. The engagement result between the rival assets will be determined based on their relative odds of winning. 5. When determining the engagement result, the status of the territory will be taken into account (i.e if the defending player's territory is the capital, then odds of winning will be higher)
Explanation	-

Use Case Name	Fortify
Use Case ID	5
Primary System Actor	Player
Definition	The player relocates their assets to one of their owned territories.
Precondition	The attack stage must have ended.
Trigger	From one of their territories to another, the player chooses to relocate the assets.
Basic Path	<ol style="list-style-type: none"> 1. In their turn, the player chooses one of their territories in the fortify stage.[A-1] 2. The player chooses the types and numbers of assets to relocate. 3. The player chooses the second location the assets will relocate to.
Alternative Path	-
Exceptional Case	-

Postcondition	After the attacks are finished, the player advances to the fortify stage.
Rules	1. When fortifying, at least one of any deployed asset types must remain in the player's territories.
Explanation	-

Use Case Name	Quit
Use Case ID	6
Primary System Actor	Player
Definition	The player quits the game.
Precondition	-
Trigger	Player clicks the quit button.
Basic Path	1. On any page, the player clicks the quit button to exit the game.
Alternative Path	-
Exceptional Case	-
Postcondition	-
Rules	-
Explanation	After the player exits the game, they will forfeit from the game if there is an ongoing match.

5.2 Dynamic Models

5.2.1 Activity Diagram

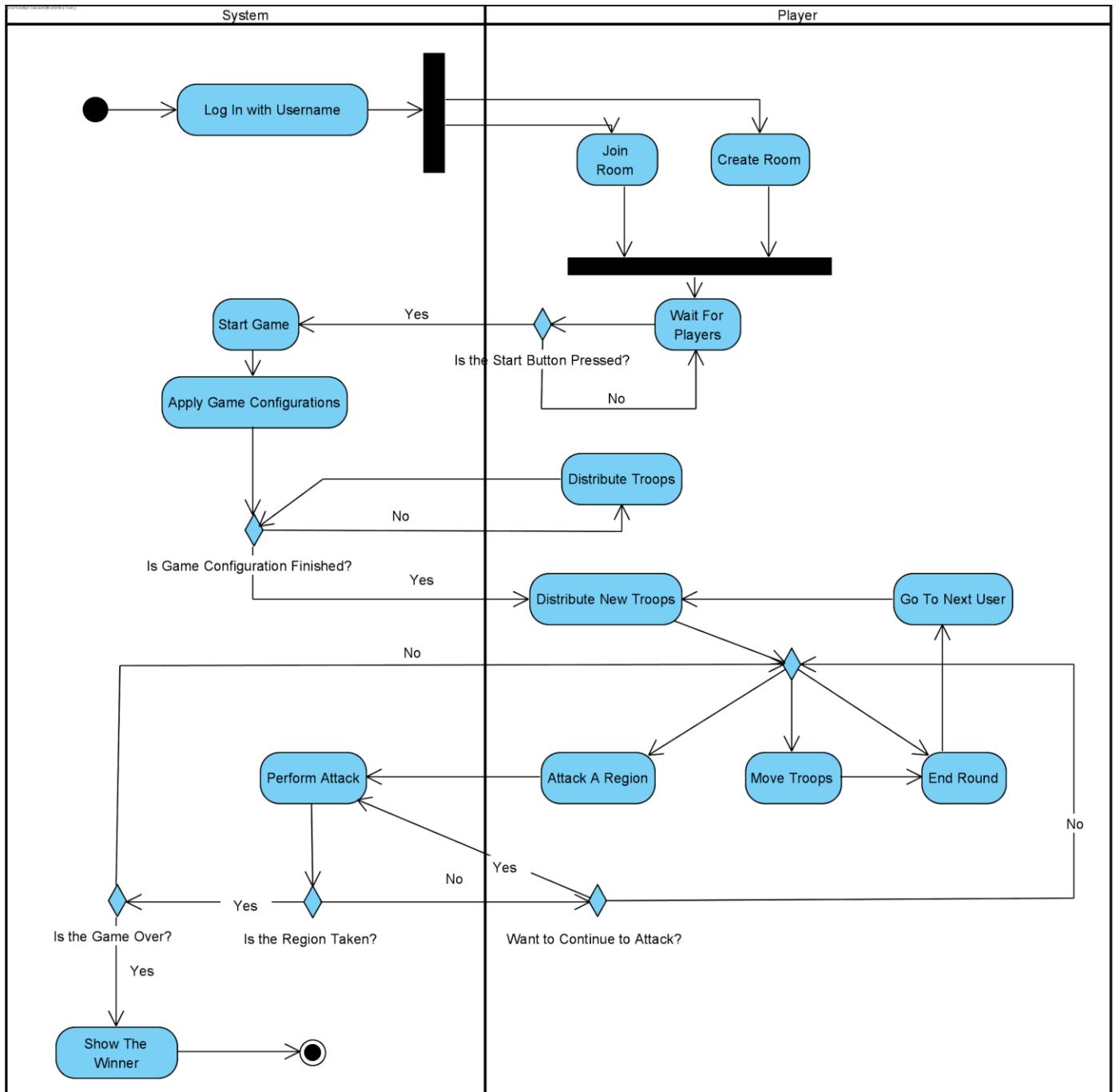


Figure 2: Activity Diagram

Since our Risk game will be an online game, the game starts with a dialog which asks the username to the player. After a user logs in the main page of the game is shown.

In the main page, users can either join a room or create a room. After game configurations are done, the game starts with the troop distribution phase which is the first phase of every game.

After all players distribute their all the troops, second and the main phase of the game begins. Every user gets a certain number of troops in the beginning of each round. After the distribution of new troops, the player has three options: attacking, moving troops or ending the round. The player can attack multiple times if possible. If a player gets a region, they receive a risk card and the system checks whether the game is over or not. A player can either end the turn directly or the round can be ended after the troops fortification.

5.2.2 State Diagrams

A. State Explanations for The Game Object

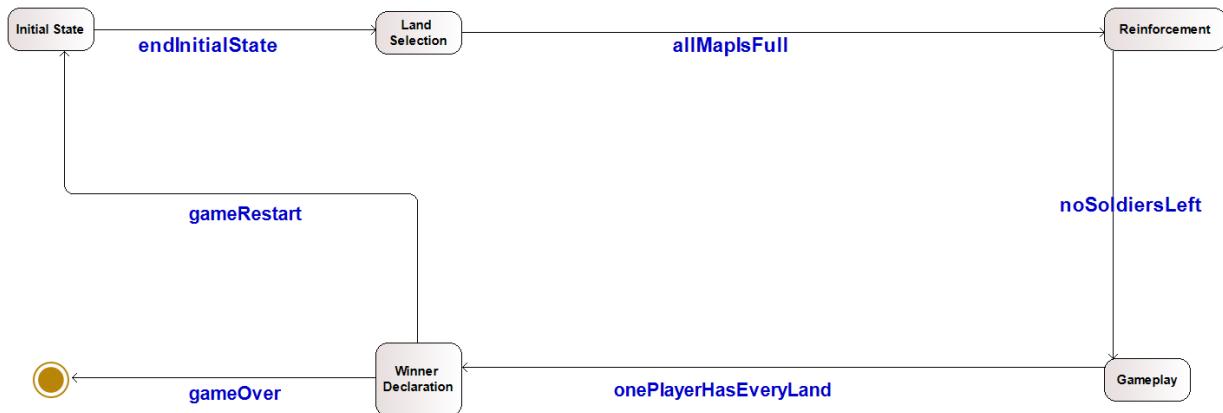


Figure 3: State Diagram for the Game Object

a. Initial State

Every game element is initialized to the default values.

b. Land Selection

This is the state where the players select their lands one by one. When no land is left, advance to the next state.

c. Remaining Soldiers Placement

In this state players will place their soldiers that are left after the land selection is over. This state and the previous state serves as a pre-game to the main game. When the soldiers that are given for his phase run out advance to gameplay.

d. Gameplay

This state is where the main game of RISK is played out. Some classic rules and some newly introduced rules apply. Advance to the next state when one player conquers the whole map.

e. Declare Winner

Declares the winner then returns to the initial state so that the game can be played again if desired. Advances to final state otherwise.

f. Final State

Game has ended and there is no desire for a restart.

B. State Explanations for the Player Object

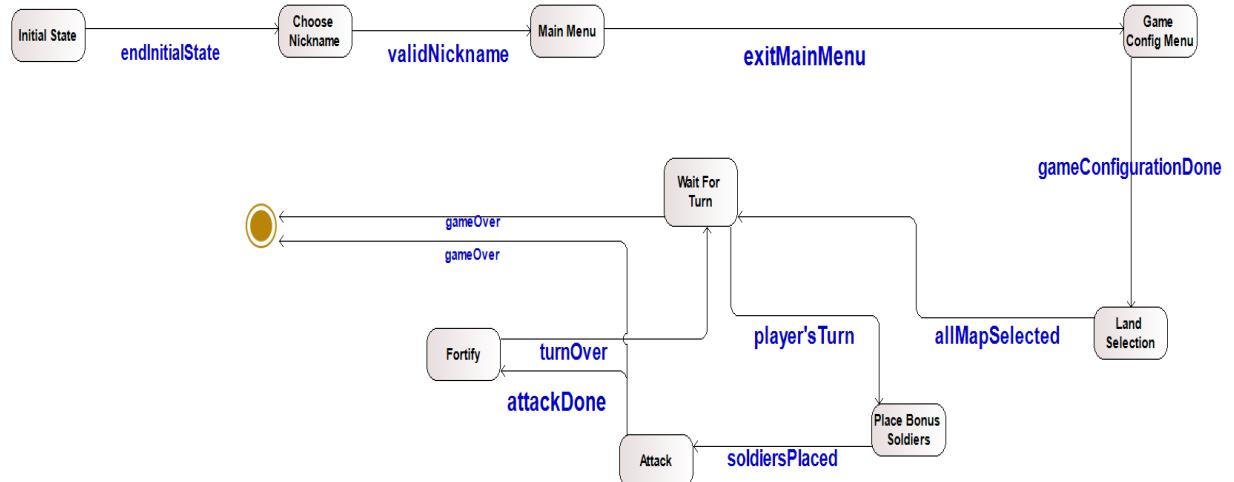


Figure 4: State Diagram for the Player Object

a. Initial State

Player is at the opening screen of the game.

b. Choose Nickname

Players choose their nickname. If the nickname is valid, advance to the next state.

c. Main Menu

This is the main menu that players can use to launch a game config screen.

d. Game Config Menu

This is the menu where the player will launch a game by either hosting or joining. Advance to the next state when the game is launched.

e. Land Selection

As the game is launched, the player selects the land when the selection turn is theirs.

f. Wait For Turn

After the land selection state the main game starts. In the main game this is the state where the player will mostly spend their time. State ends when it's the player's turn or if a different player has all the land.

g. Place Bonus Soldiers

When it's the players turn to play, firstly they place the bonus soldiers that they get at the start of every round. This is the state when that happens. State is over when all the soldiers are placed.

h. Attack

This is the state when the player attacks if they choose to. Complete the attack or skip the attack to advance to the fortify state. If the player acquired the whole map after the attacks advance to the main menü.

i. Fortify

This is the state where the player reinforces their troops, shuffles them for tactical purposes if they choose to. Advance to the next state when the player is pleased with their troops' locations. After this state, the player again advances to "Wait For Turn" State.

j. Final State

Game has ended.

5.3 Object and Class Model

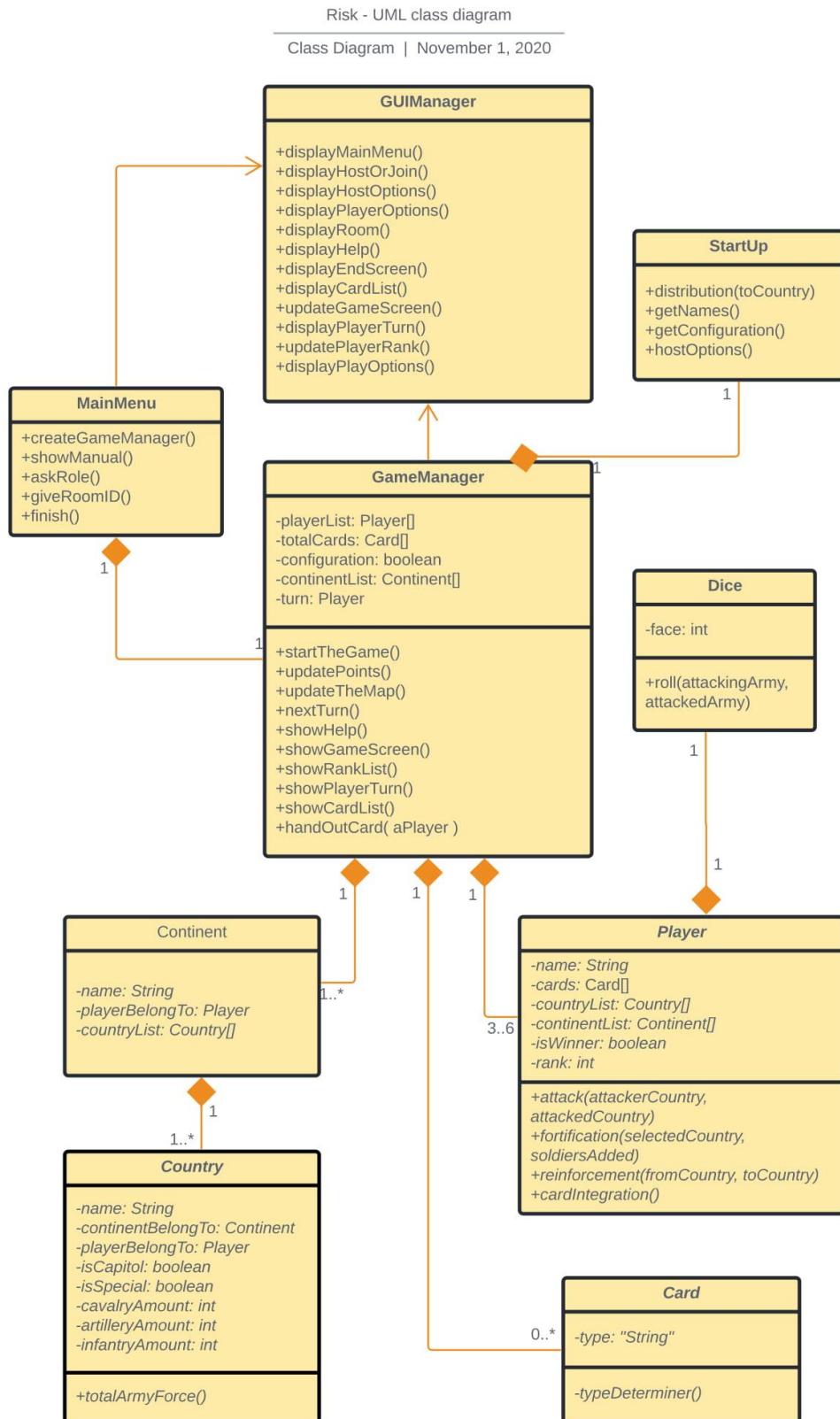


Figure 5: Class Diagram

5.3.1 GUIManager Class

GUIManager class has been established due to the necessity that emerged for the interaction between the players. GUIManager provides the user interface by calling the relevant method. It is called by MainMenu and GameManager.

5.3.2 MainMenu Class

MainMenu class handles the beginning of the game. It takes the input from the user for the options: Manuel, Play, and Exit. In order to offer the user this selection in a proper interface, it calls GUIManager. If the user selects to play, it calls GameManager.

5.3.3 StartUp Class

StartUp class was designed for the beginning functions of the game. If the player selects the “Play” option, GameManager will call StartUp to determine player names, configuration status and the initialization of the game.

5.3.4 GameManager Class

GameManager class is the main controller of the game. It is created when the MainMenu calls it after the player selects the “Play” option. Other attributes of the game such as Player, Continent, Card, and StartUp are attached to it and created if GameManager calls them. Furthermore, GameManager calls GUIManager so that the changes upon the game can be reflected to the player through the user interface that GUIManager provides.

5.3.5 Card Class

Card class represents a Card that will be drawn within the game. Cards can provide cavalry, infantry.. etc. Thus, a card should have a property that indicated the type. The type of the card should be random so that the player cannot count the cards to determine what will come. typeDeterminer() provides a random card to be created. Because this method is only used when the card is created which is in the constructor, the method will stay private.

5.3.6 Player Class

Player class will be created when the Game Manager calls it. Thus, the existence of the Player is dependent on GameManager. If there is no game to play, there will be no player. The player has multiple properties as well as methods. Player will have the attributes of a name, a CardController that will handle the a list of cards, a country list to track down the conquered countries, the continent list so that at the next round, the player can receive a bonus for conquering an entire continent, a boolean to determine that whether the exact player is the winner one or not and lastly, the rank of the player.

5.3.7 Country Class

The creation of the Country class is dependent on the existence of the Continent class. If only if the Continent class is ever created, a list of Country objects will be created.

Country class has 8 attributes: the name of the country, the owner of the country, the continent that the country is within, is it a capital or is it a special city like Rome, and lastly, the numbers of three different kinds of soldiers deployed in the country. There is only one method that this class contains which calculates the total army force according to the amount of the different types of soldiers.

5.3.8 Continent Class

The creation of the Continent class is dependent on the existence of the GameManager class. If only if GameManager class is ever created, a list of Continent objects will be created. Continent class has 3 attributes: the name of the continent, the owner of the continent, and the list of countries that the continent includes within. This class works as the board of the game which is the map.

5.3.8 Dice Class

The existence of the Dice class is dependent on the Player class, since if there is no player to roll the dice, no need for the dice.

5.4 Sequence Diagram

5.4.1 Sequence Diagram for the Start of the Game

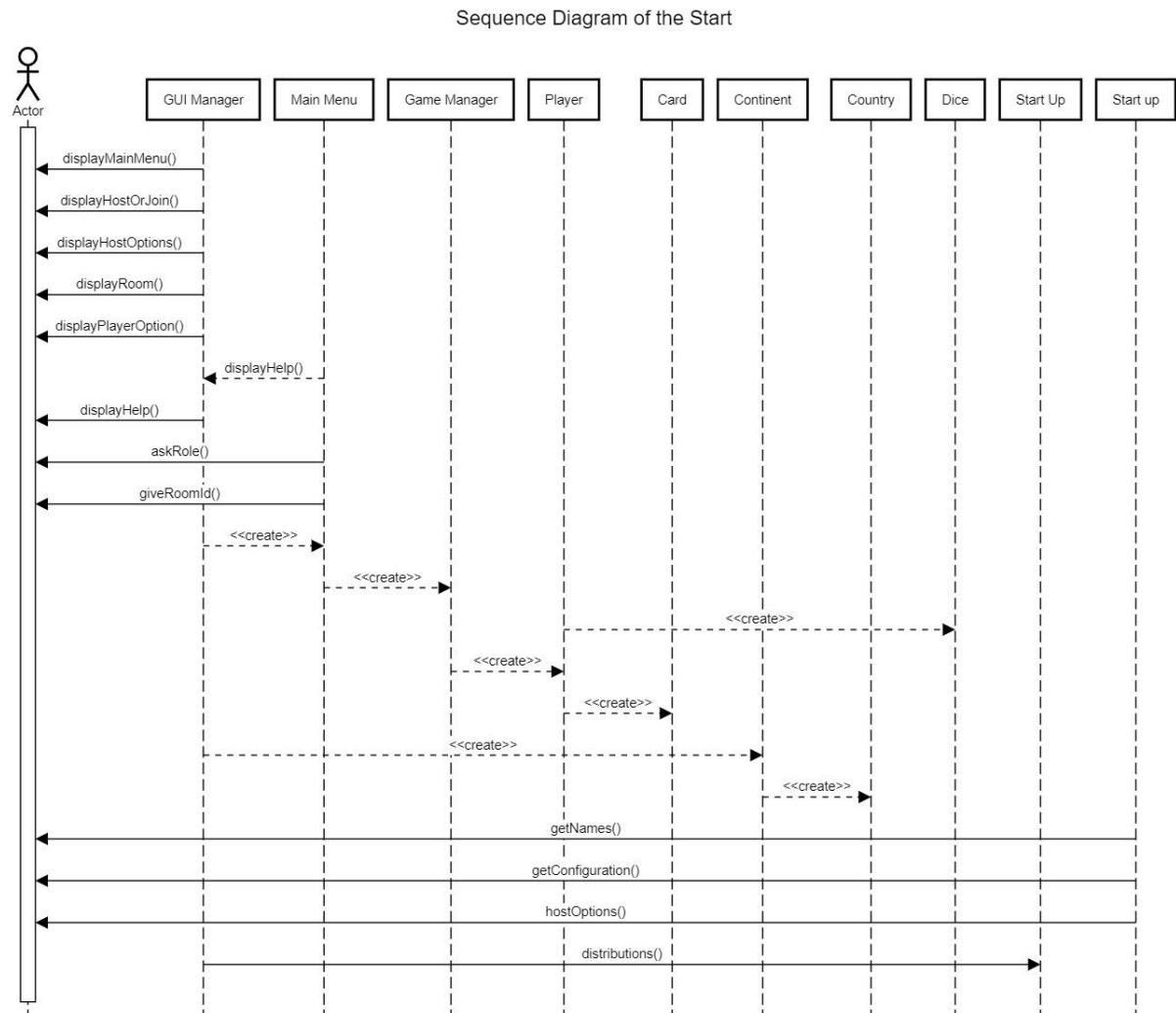


Figure 6: Sequence Diagram of the Start

In this sequence diagram we see the start of the game. The actor who is the player, chooses if he/she wants to be the host or join an already existing game. After that if the actor is the host he decides the number of players and starts the game. When the game is started a series of object creations occur. After all the object creations the game is ready to start and a special game part that lets the actors to distribute their army and choose their initial lands occur that is controlled by the class Start Up. This part is not involved in the main game play as it is not in the main loop of the game and the mechanics are different. Therefore, it is a special state and is considered separately. It can be seen by the sequence diagram that there is no main Class that calls all the others to create a more simple game control. This simplifies the control of the operations and will enable simpler coding.

5.4.2 Sequence Diagram for the Game Play

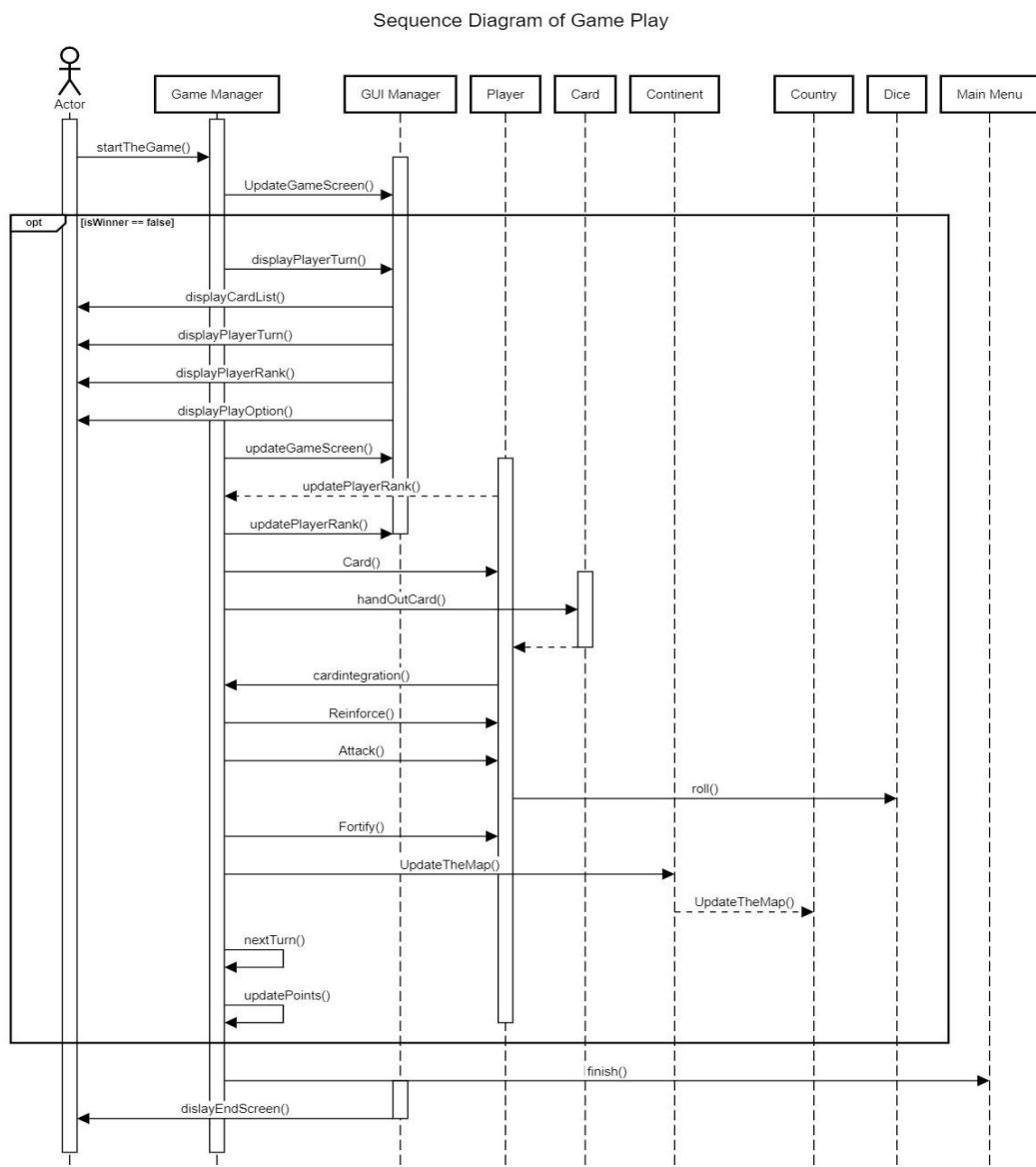


Figure 7: Sequence Diagram for Game Play

In this sequence diagram we see the actual game play. It starts after the game is started by the actor and the screen is updated. There is a main loop for the gameplay that controls the turns. The turn starts when the GUI Manager shows the actor which is the player of the game (but not to be confused with the player class and therefore the players are addressed as actors) who's turn it is. After that the play options are shown to the actor and depending on the actor, the game manager can check the cards, reinforce, attack or fortify during the actors turn. After each turn it is checked if the player has won and the variable isWinner updated. As long as a player is not the winner it remains false and therefore the game continues. Once all the actions of the actor are done, the map is updated and the turn is passed to the next player. As long as there is no winner the loop continues and the game carries on. When there is a winner the game exists the loop and the main menu is called with the finish method.

5.5 User Interface

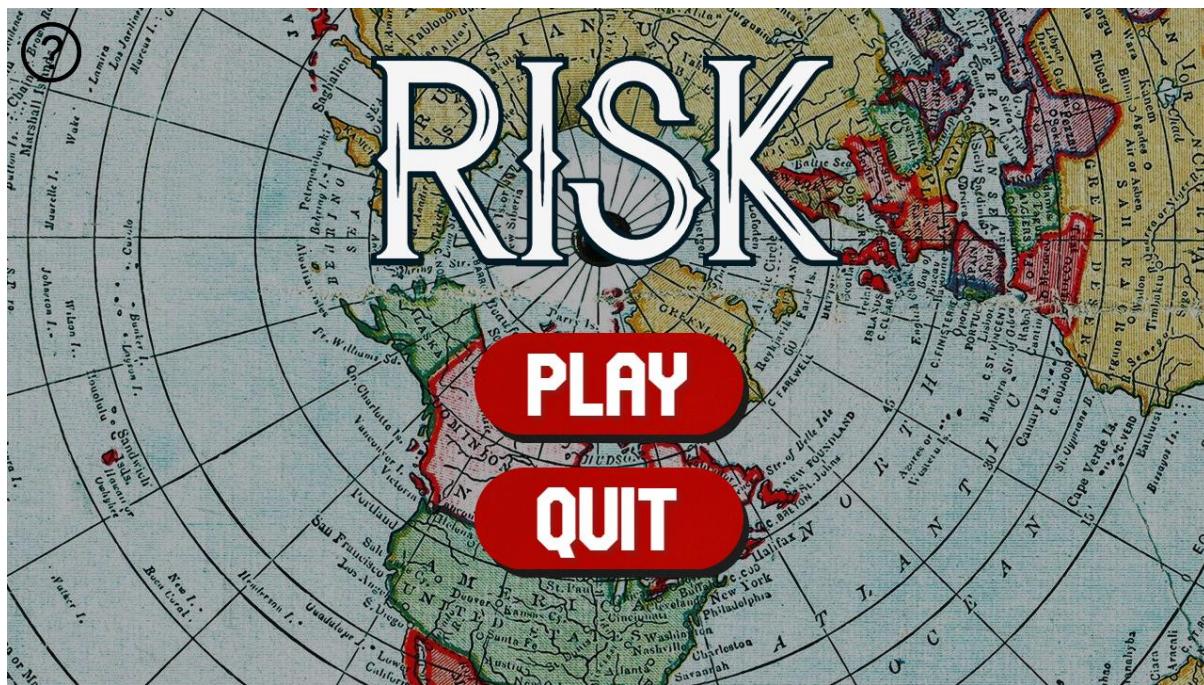


Figure 8: UI of the Main Menu Screen

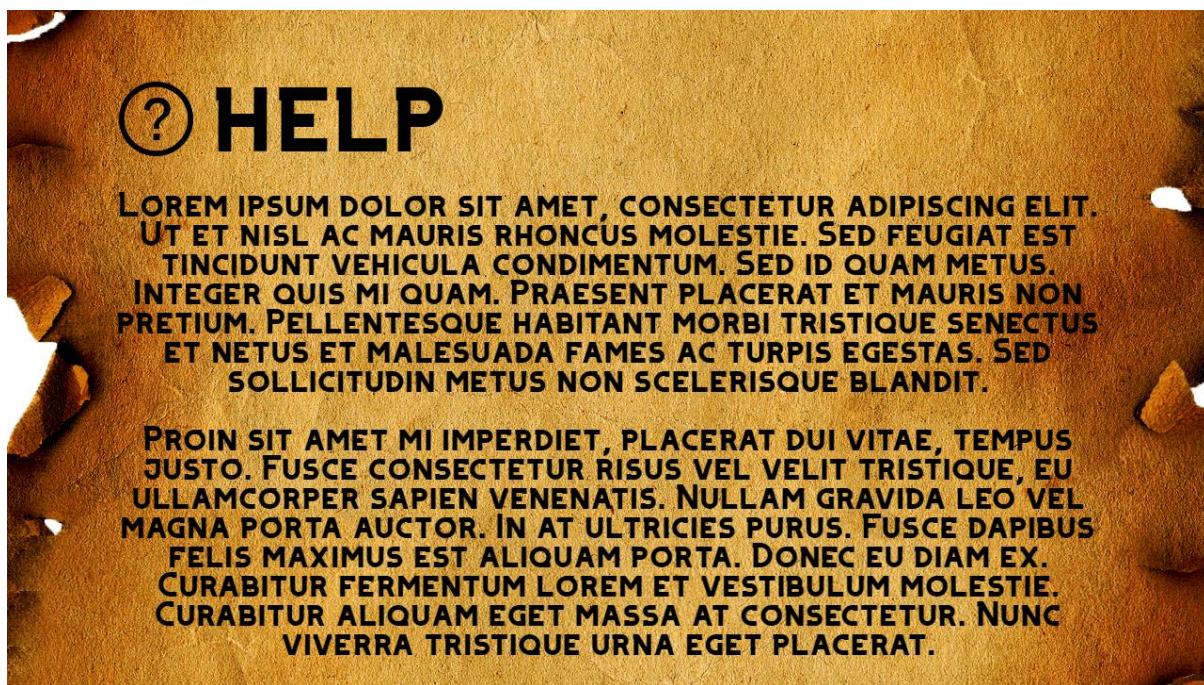


Figure 9: UI of the Help Screen

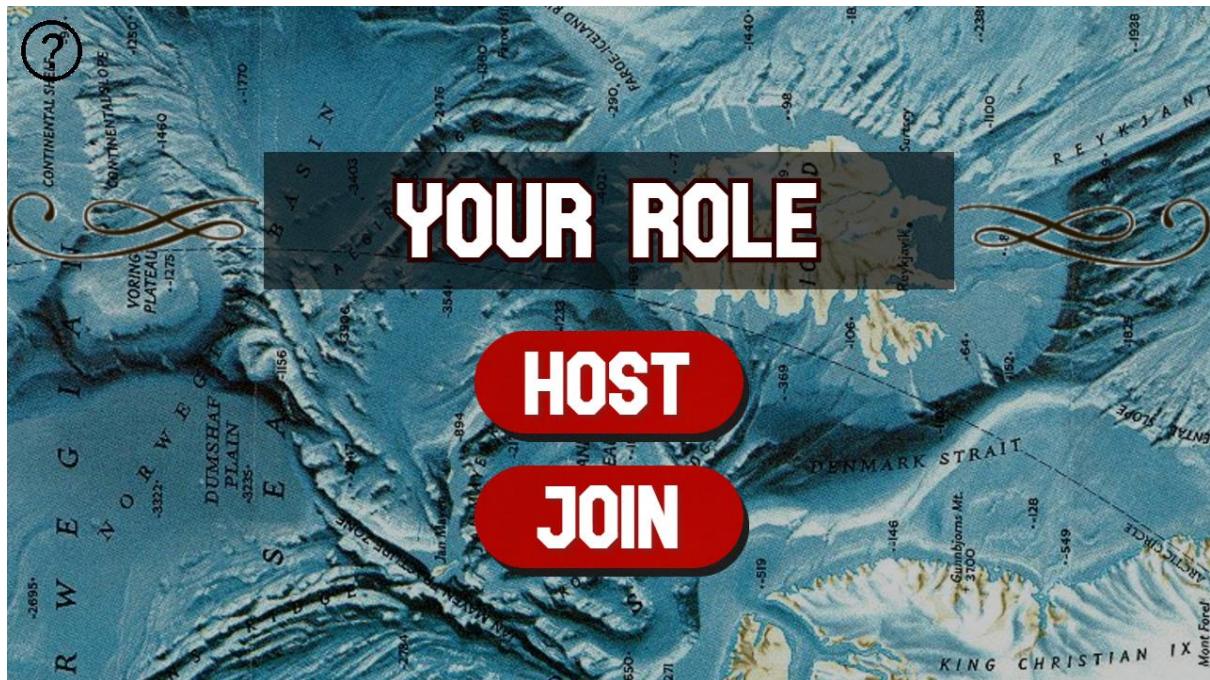


Figure 10: UI of the Host and Join Options Screen

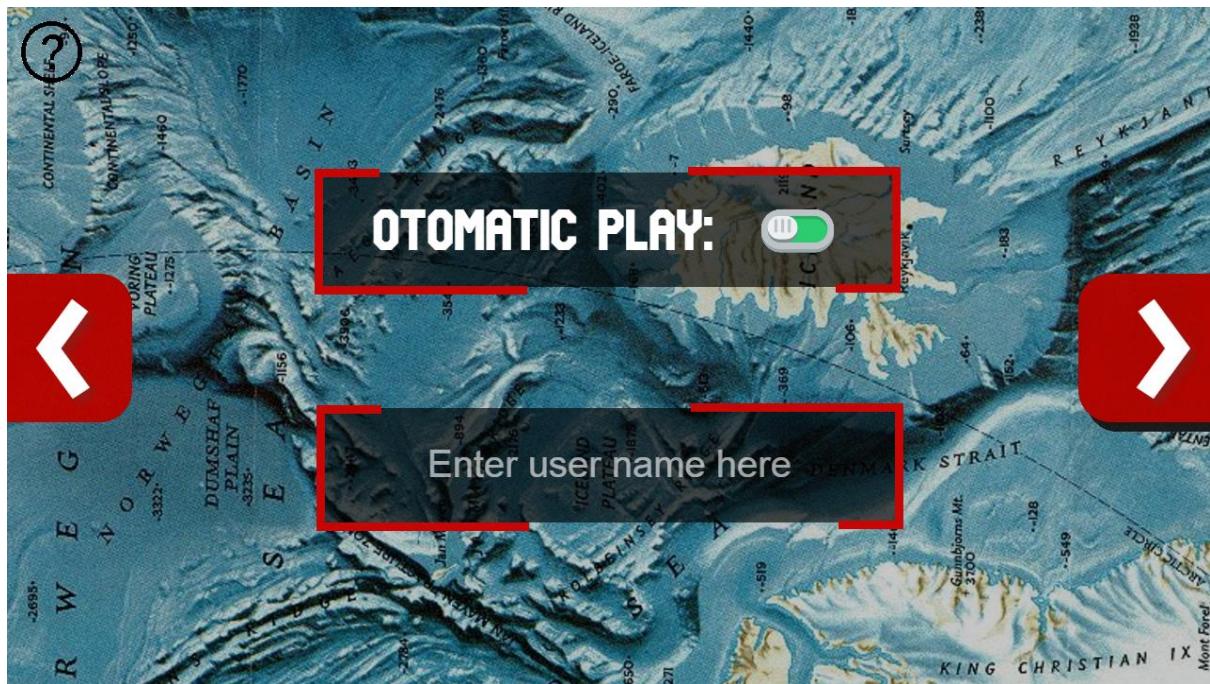


Figure 11: UI of the User Configurations Screen for Host

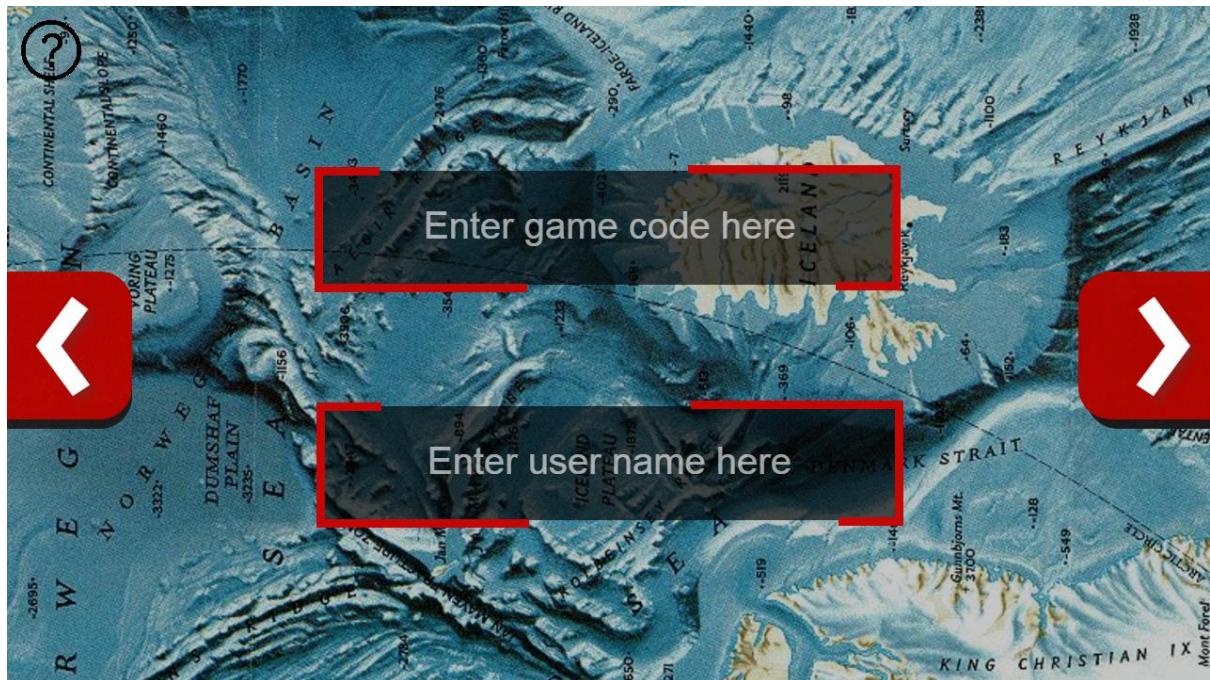


Figure 12: UI of the User Configurations Screen for Guests

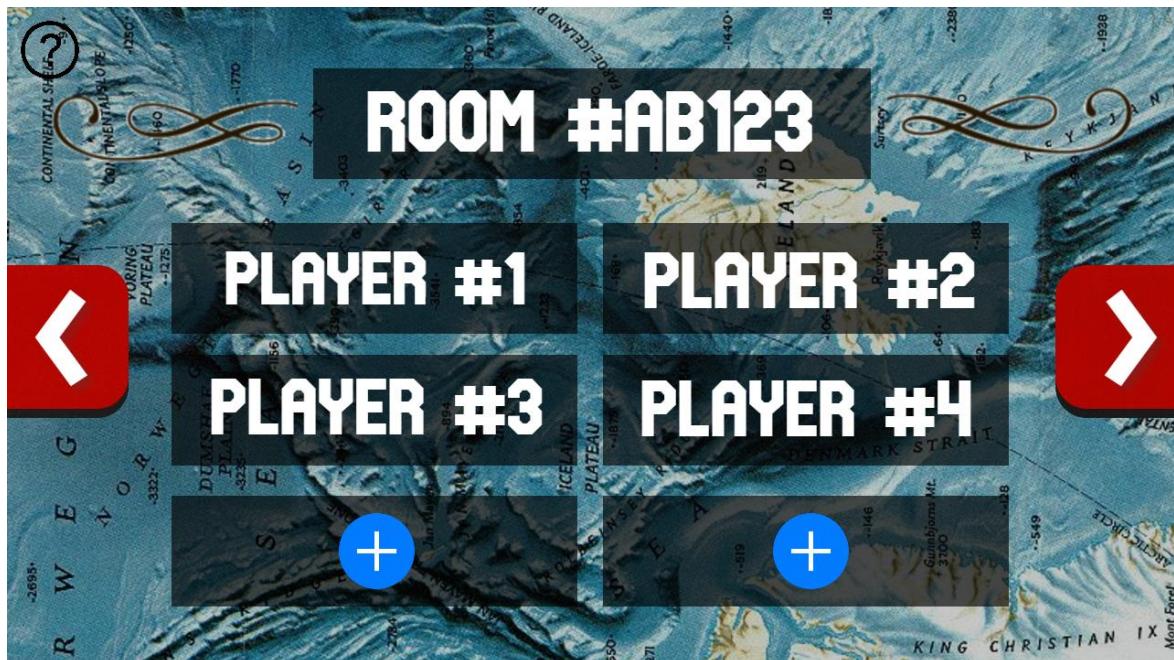


Figure 13: UI of the Game Room Screen



Figure 14: UI of the Player’s Reinforcement and Game Setup Screen

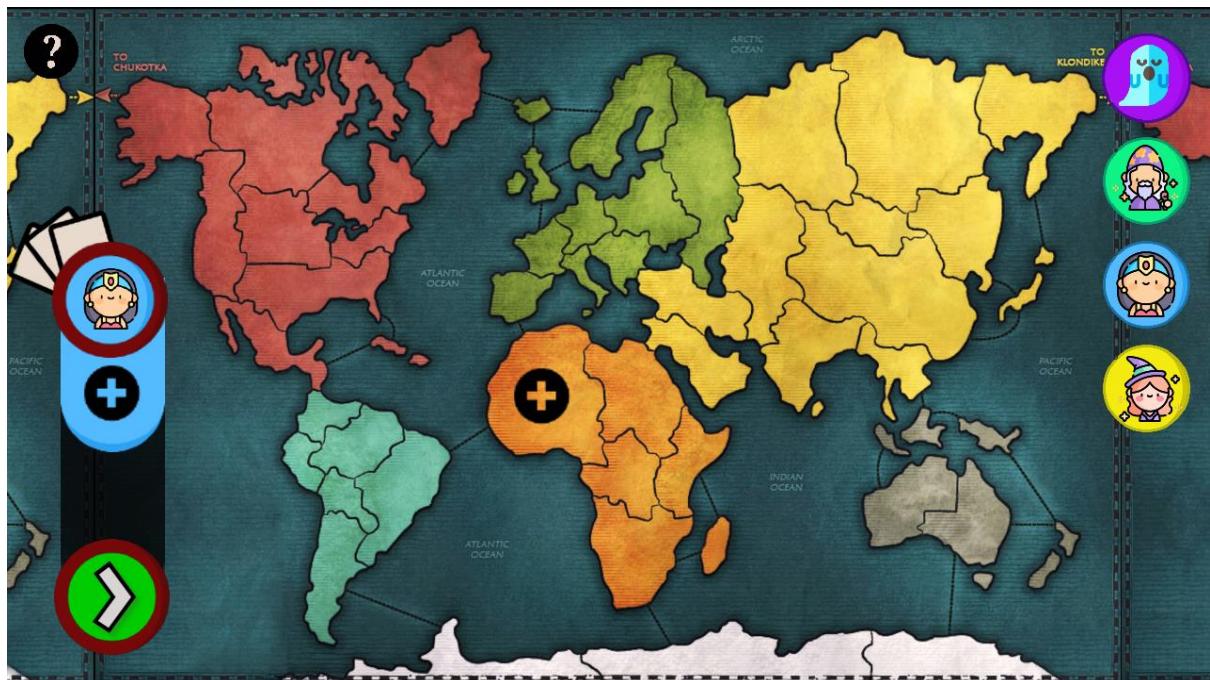


Figure 15: UI of the Player’s Reinforcement and Game Setup Screen



Figure 16: UI of the Player's Reinforcement and Game Setup Screen



Figure 17: UI of the Player's Attack Screen | Selecting the attacker country



Figure 18: UI of the Player's Attack Screen | Attacker country is selected



Figure 19: UI of the Player's Attack Screen | Attacked country selected



Figure 20: UI of the Player's Attack Screen | Attack



Figure 21: UI of the Player's Fortify Screen | Fortified country selecting



Figure 22: UI of the Player's Fortify Screen | Fortified soldier amount selecting

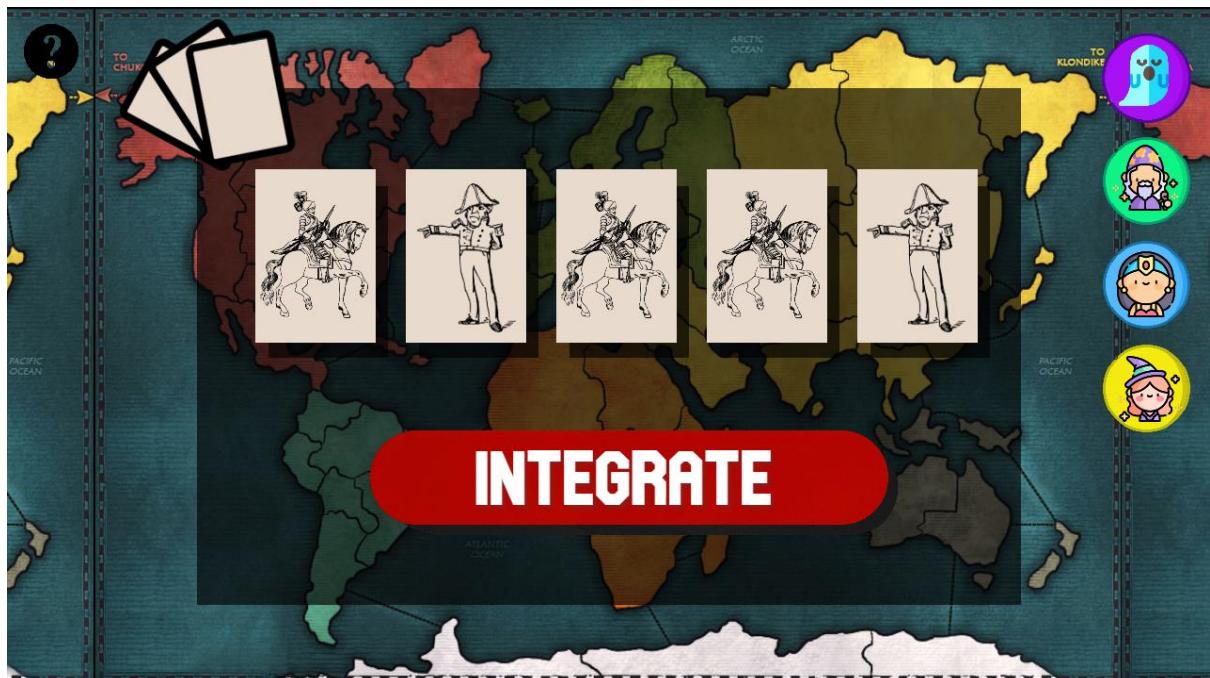


Figure 23: UI of the Player's Risk Cards Screen



Figure 24: UI of the Victory Screen Where the Winner is Shown

Glossary and References

- [1] Robinson, G., n.d. *The Strategy Of Risk*. [online] Web.mit.edu. Available at: <<https://web.mit.edu/sp.268/www/risk.pdf>> [Accessed 26 October 2020].
- [2] Hasbro.com. 1993. *Risk: The World Conquest Game*. [online] Available at: <<https://www.hasbro.com/common/instruct/risk.pdf>> [Accessed 26 October 2020].