CS 319 Term Project

Group 2C - Section 2

7 Wonders

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1. Introduction

As group 2C, we have chosen to make a digital version of Seven Wonders. Seven Wonders is a board game that came out in 2010, made by Antoine Bauza. We have based our project on the standard version of the game. The details and rules for it can be found at [1].

Our driving motivation to choose this game was our interest in mythology and history. We thought that the structure of the game would be suitable to implement with Object Oriented Design principles.

The target platform for the implementation of the game is JavaFX since it provides a variety of UI options such as 2D and 3D graphics. As a group, we decided to implement the game in 2D.

This report consists of an overview, the requirements, diagrams and mock-up designs for our version of the game.

2. Gameplay

Seven Wonders is a board game that can be played with up to seven players. Each player will start with a wonder and their goal will be to get the highest possible score. The game will consist of 3 ages, with 6 turns each. Each age will have it's own card sets, which will be discussed in more detail in the later parts of the report. Players will play in a turn-based fashion and will start each age with 7 cards in hand. Each turn, the player will choose a card to play and pass the remaining cards to one of the adjacent players. Cards have different types and functionalities, and there are different requirements to play different kinds of cards. When all the cards are played after 6 turns, an age will be over and battles will occur between the player and adjacent players, which will provide each user with a war token. This cycle will continue for each 3 ages.

After 3 ages, the final scores, which are called victory points, will be calculated based on various different factors. This calculation process will be thoroughly explained in a later subsection.

2.1. Wonders

At the start of the game, players will be allowed to choose one of the seven different wonders. If one or more players vote for the same wonder, it will randomly get assigned to one of the players that voted for it. Each wonder will have three stages. To unlock a stage, the player will have to meet the requirements, in terms of resources, that this specific upgrade demands. When a user meets the requirements, they can use any card they select to build a stage of their wonder. According to our new features, Gods and Heroes, when a player completes all stages of their wonder, they will be able to use the power of the god that is associated with their wonder.

2.2. Cards

The cards will be arguably the most crucial part of the game. There will be a total of 6 different types of cards a player can play. Apart from the purple cards, which are only playable in age 3, all other cards will be playable in all ages. These card types will be as follows:

- Brown & Gray cards (Raw Material & Manufactured Goods): These structures will produce resources.
- Blue cards (Civilian Structures): These structures will reward victory points.
- Green cards (Scientific Structures): These structures will score victory points depending on the scientific fields
- Yellow cards (Commercial Structures): These buildings will earn you coins, produce resources, change trading rules and sometimes will earn you victory points.
- Red cards (Military Structures): These buildings will increase your battle power.

- Purple cards (Guilds): Each purple card will have a different condition for earning victory points.

Players will start each age with seven cards in hand. They will play one card each turn, and pass the remaining cards to the other players. By the end of an age, each player will have played a total of six cards, and the last one will then be discarded into the discard pile.

2.3. Resources, Coins and Trading

Throughout the game, there will be 2 different types of resources a player can obtain. Players will either be able to obtain these resources through their resource-producing buildings or through trading, which will only grant them the use of these resources for a single turn. These resources will be:

- Brown resources (Raw Material): Wood, clay, stone, ore
- Gray resources (Manufactured Goods): Papyrus, silk, glass

Each player will start the game with 3 coins. They will be able to earn coins either by discarding cards, playing yellow cards that grant the player coins or via trading with their neighbours. The amount of coins a player has at the end of the game will also contribute to their score.

A player will be able to trade with their neighbours for resources. These trades will be done by the use of coins. Each resource traded will cost 2 coins, unless the buying player has a commercial structure (yellow cards) built, or has a stage unlocked in their wonder that enable them to reduce the cost of the trade to a single coin per resource.

2.4. War Tokens, Science and Victory Points

Victory points are in-game points that will be counted in order to decide who wins the game. There are several ways to gain victory points, which will be explained in detail in section 2.7. Green cards will provide the player with one token of science, out of three different tokens. The combinations of these tokens will grant players with different amounts of victory points. The same tokens will grant the user victory points equal to the square of the number of said tokens. For example, if the user has 3 of the same tokens, these will award him 9 victory points. If the user has one token from every token kind, that is considered a set, which will grant the user with 7 victory points. Detailed information on this subject will be provided in section 2.7.5.

War tokens are given to the player after the battles that will happen at the end of every age. The user will have to battle each neighbour and compare their shield number which will be acquired by playing red cards. According to the results of these battles, the user will receive a battle token:

In the first age, the user will receive 1 battle token if the battle is won.

In the second age, the user will receive 3 battle tokens if the battle is won.

In the third age, the user will receive 5 battle tokens if the battle is won.

At any age, the user will receive -1 battle tokens. How these battle tokens will be utilized are detailed in section 2.7.1.

2.5. Taking an Action

During each turn, a player has 4 options:

- Play a card: If you satisfy the card's condition, you can play a card to activate its effect. Some cards have free building conditions, which are achieved by having previously built the structure that provides this opportunity. The corresponding structures for these

opportunities can be seen at the bottom of the card. Additionally, your cards should have unique names excluding resource cards.

- Discard a card: You can choose to discard any card you want, which in turn earns you 3 coins and it is not revealed to other players. The chosen card is then moved to the discard pile.
- Upgrade your wonder: If you satisfy your wonder's "level up" condition, such as having enough resources, you can choose to upgrade your wonder. This is done by selecting any card from your hand and placing it face-down on the corresponding slot in your wonder board. However, you have to have previously built the preceding upgrades for your wonder to be able to upgrade your wonder to the next level.
- If the user managed to unlock every stage of their wonder, they can choose to activate the god power that is associated with their wonders. The gods and their corresponding powers will be explained in section 3.

2.6. Wars and End of an Age

After 6 turns are played, everyone will discard the last card they have in their hand instead of giving it to the nearby player. Nobody will receive coins for this discard action. Before ending the age, the battles will happen between neighbour players. Each player will compare their battle power to their two neighbours separately. If they have less power, they lose 1 war token. If they have more power, they gain 1 war token in Age 1, 3 war tokens in Age 2 and 5 war tokens in Age three.

2.7. Calculating the Final Score

After 3 ages, when battles are over and war tokens are given, each player will sum up their victory points to declare the winner. There are 7 rules for calculating victory points.

• Military conflicts

- Treasury contents
- Wonder Rewards
- Civilian structures
- Scientific structures
- Commercial structures
- Guilds

2.7.1. Military conflicts

Victory and defeat points will be added up to determine military score. These points were previously earned in the battles that take place after an age ends. This total military score will directly contribute to the victory point score of the player.

2.7.2. Treasury contents

If player has coins remaining at the end of the game, those coins will also contribute to victory points. Each three coins will be equivalent to one victory points. Fractional part does not count in this calculation. However, in the case of a tie, the player who has the most money player will be declared as the winner.

2.7.3. Wonder Rewards

Victory points granted for unlocking stages of wonder will be added to the total score. The amount is defined on relevant stages of wonder.

2.7.4. Civilian Structures

Civilian structures, which are blue structures will directly contribute to the victory points of the player, depending on the amount shown on the face of the card.

2.7.5. Science

There are 3 types of scientific artifacts in the game: mechanics, drawings, writings. Each green card has a scientific symbol on top of it. Also wonders or guilds might have some scientific artifact. Total victory points coming from the science cards are determined by the following formula:

M : number of mechanics , D : number of drawings, W : number of writings.

VP = M^2 + D^2 + W^2 + floor((M+D+W)/3) * 7

2.7.6. Commercial Structures

A commercial structure can grant victory points depending on the types of cards the player has. The amount that one can grant is written on top of the card.

2.7.7. Guilds

Each guild grants victory points depending on the player's wonder, buildings and neighbours. Each card is unique and the effect is written on the top of the card.

3. New Features

Current proposed new features of the game are based on the idea of including Gods and Heroes to the standard version of the game.

3.1. Gods

There will be 7 gods connected to the 7 wonders. When a player completes the construction of their wonder, they will be able to use the power that their god possesses. These wonder-god connections will be as follows:

- The Colossus of Rhodes - Ares
- The Lighthouse of Alexandria - Ra
- The Temple of Artemis in Ephesus - Artemis
- The Hanging Gardens of Babylon - Marduk
- The Statue of Zeus in Olympia - Zeus
- The Mausoleum of Halicarnassus - Athena
- The Pyramids of Giza - Seth

Each god will possess a special power. These single-use powers are as follows:

- Ares will grant the player with extra 5 war tokens for a single age.
- Ra will grant the player the ability to trade with any user for a single turn.
- Artemis will grant the player a victory each turn.
- Marduk will grant the ability to cause an earthquake to a selected player, destroying a stage of their wonder.
- Zeus will grant the ability to inhibit a player to use their selected card, destroying the card in the process.
- Athena will grant the ability of foresight, which is to be able to see the hand that the player will receive in the next turn.
- Seth will grant the ability to cause famine, which disables a selected player from using a specific resource for a single turn.

3.2. Heroes

Once a player has three cards in their construction zone with red, green or blue structures, a specific hero that is specific to the color will be summoned. These possible heroes to be summoned and their respective colors are as follows (the hero's name that the player receives will be selected randomly):

- Red Cards - Achilles, Leonidas, Spartacus, Hector…

    - These heroes will grant 1 war token.
- Green Cards - Aristotales, Ibn-i Sina, Pisagor, Thales..
    - These heroes will grant 1 random science.
- Blue Cards - Leonardo Da Vinci, Michelangelo, Donatello…
    - These heroes will grant 3 victory points.

4. Requirements

4.1. Functional Requirements

- The game must be played with 7 players, either bots or humans.
- Each player must be able to select a unique wonder.
- The game must have 3 sets of decks, each consisting of 49 cards.
- The player must be able to see their hand and select a card to play but the game should not allow the user to make illegal moves:
    - In each turn, the player must be able to choose from 4 different actions: play a card, discard a card, upgrade the wonder or summon god power.
    - The player must be able to trade the resources with neighbours if they have enough money to trade.
    - If a user lacks the resources, money or any other requirement to play a card, playing that card is considered an illegal move.
- The player must be able to see their wonder and his/her resources and other players's wonders and their resources.
- The player must be able to see the moves other players made.
- The player must be able to see their resources, money, battle points, science scores and victory points.
- In the end players must see the score sheet and who won the game.

4.2. Non Functional Requirements

4.2.1. Graphics

- The graphics should be implemented as a 2D card game.

4.2.2. Input

- The game must be played with a mouse, a keyboard is optional for hotkeys.

4.2.3. Multiplayer Connectivity

- There must be two options in the game: Single and multiplayer. In addition to single player, user must be able to create or join lobbies of other players in multiplayer game.

4.2.4. AI

- There must be an AI that can fill the empty slots in both single and multi player games.

5. System Models

5.1. Use Case Modal

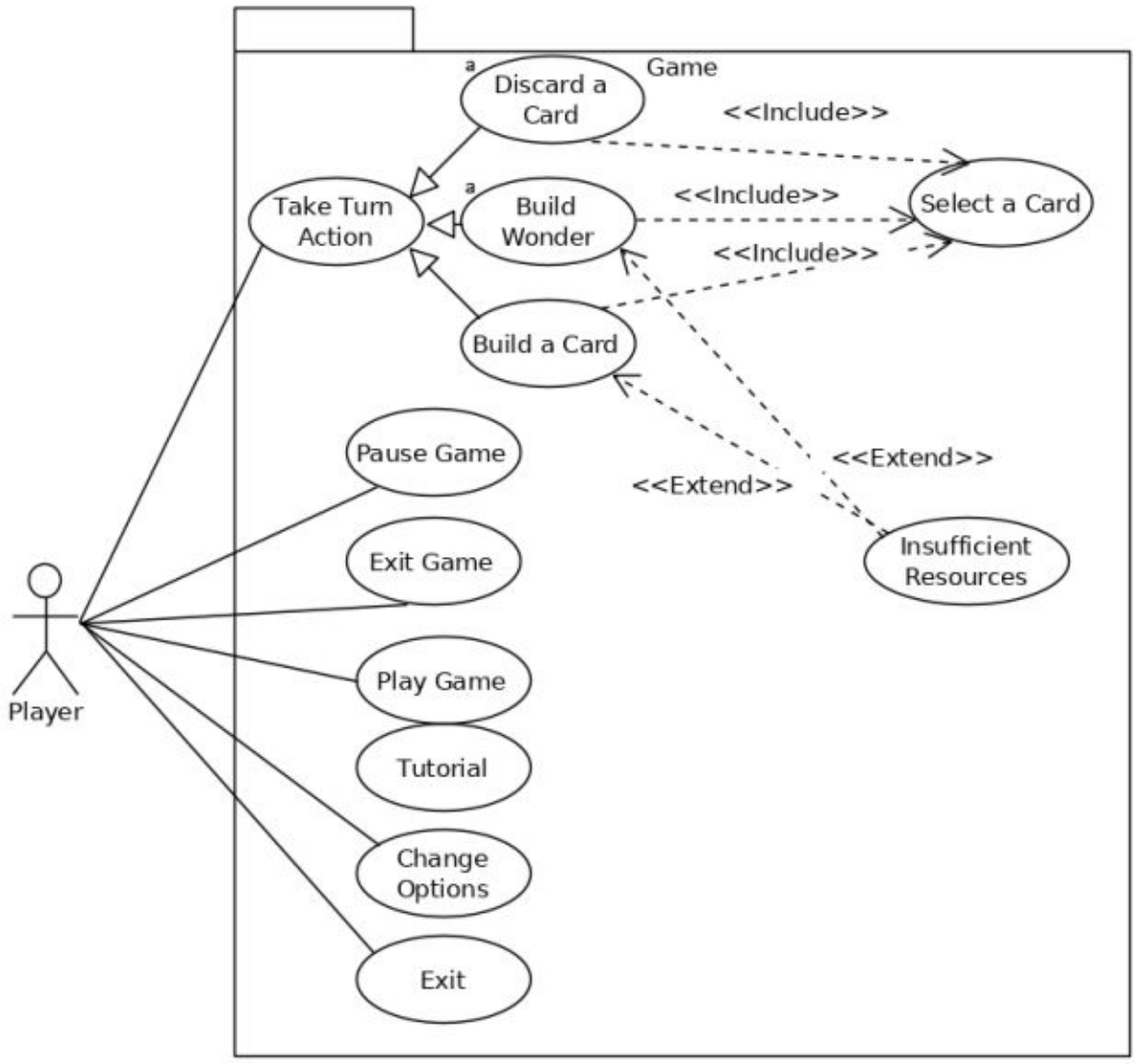

Figure 1: Use Case Modal

Use Case #1

Use Case: Play Game

Actor: Player

Entry Condition:

- The player is not in an on-going game.

Exit Condition:

- Game is finished.
- User pauses and exists the game.
- Connection lost if multiplayer.

Flow of Events:

1. Player creates a game room, or joins a pre-existing game room.
2. Game starts after the game leader sets game options and starts the game.
3. Each player chooses a wonder, and the remaining wonders are dealt randomly.
4. Game deals each player 7 cards.
5. Each player chooses which action they will take.
6. After every player chooses an action, the actions are played simultaneously.
7. Each player passes the cards in their hand to their neighbour.
8. After all the cards are played, a new age starts and new cards are dealt to the players.
9. After 3 ages are played, scores are calculated, the player with the highest score wins the game.

Special Requirements:

- User needs an active internet connection if they want to play multiplayer.

Use Case #2

Use Case: Take Action

Actor: Player

Entry Condition:

- Player is on the start of a turn.

Exit Condition:

- User pauses and exists the game.
- All users select which action to take.
- Connection lost if multiplayer.

Flow of Events:

1. A turn starts.
2. Player receives their new hand.
3. Player selects a card to play:

a. Build a building if resources are enough.

b. Discard a card to get 2 coins.

c. Build a stage of the wonder if conditions are met.

4. When every player selects a card, the turn is played.
5. Next turn starts if the game is not finished.

Special Requirements:

- A game is on-going.
- The game is not finished yet.
- Internet connection is necessary if playing multiplayer.

Use Case #3

Use Case: Tutorial

Actor: Player

Entry Condition:

- None

Exit Condition:

- User exits tutorial.
- Tutorial is finished.

Flow of Events:

1. User opens tutorial.
2. Tutorial starts with game terminology.
3. Tutorial shows the general game rules (age and turns).
4. Tutorial shows the victory points calculations.
5. Tutorial shows video of an example game.
6. User can go back or close the tutorial.

Special Requirements:

- None.

5.2. Object and Class Modal

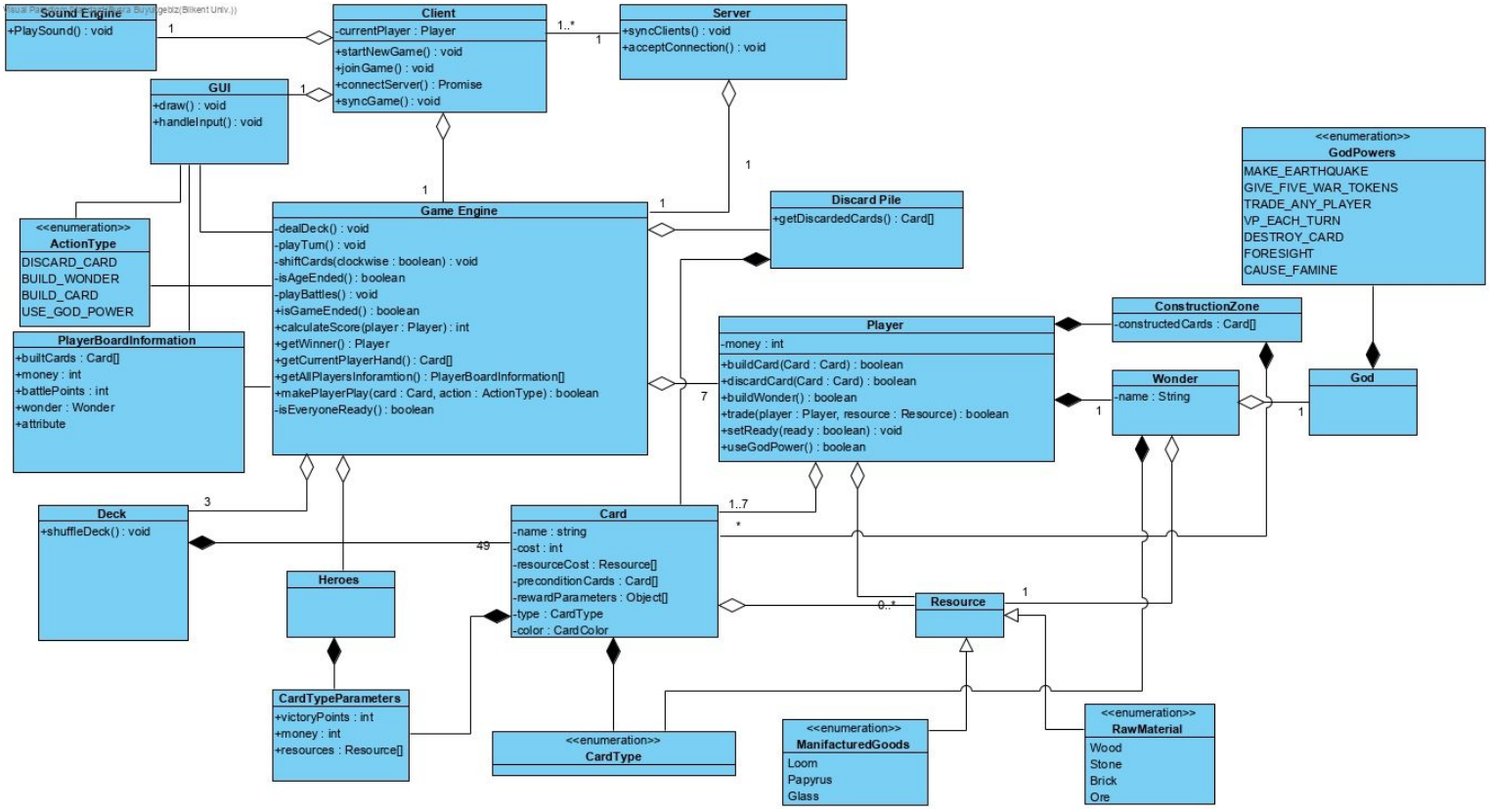

Figure 2: Object and Class Modal

Required Classes:

- **Card:** Card class will be used to store information of a card has, such as color, card type, cost, precondition (which cards make this card's cost zero), effect when played, resources it provides and name. This structure is explained in more detail in the next class modal.
- **Player:** Player class is necessary for holding information such as their hand, wonder, money, cards that they built (constructionZone), its type (current player, AI, remote player). This class also should have methods such as build, discard or upgrade wonder.

- **ConstructionZone:** This simple class basically holds the cards that a player built. It will be used to draw to the screen. calculate resources a player have, calculate victory points of a player, get card effects that are played.
- **Heroes:** Each hero is based on a card parameter type. This type is used for granting bonuses for players.
- **God:** Each wonder has its own god which has unique powers defined in **GodPowers.**
- **GUI:** There will be a class that is responsible for drawing menus, screens or the game itself. GUI should retrieve objects that it will draw from the game engine. This flow of information will be done using **PlayerBoardInformation**, a replacement of playerDTO with some filtering, such as other players' hands. When the user clicks on buttons/cards on the GUI, the action will be sent to the **GameEngine**.
- **GameEngine:** Game engine is basically a rule coordinator for the game. GameEngine will contain all the players, cards, wonders and money. GUI will request some information from the GameEngine for drawing the screen. When the player interacts with the game, GUI will send actions that user does on the screen to GameEngine. There are 3 different types in **ActionType**: Build card, discard, upgrade wonder. GameEngine will give a feedback to the GUI if possible or not. If it is possible, GameEngine will queue the action for the turn. Moreover, it will have all the logic such as age, turns, battles and victory point calculations. Also it will contain AI players and remote players. It will allow GUI to make actions for only the current player. Other actions are automated or retrieved by the server.
- **Client-Server:** If we are playing a multiplayer game, our local GameEngine instance won't be used. Instead of requesting PlayerBoardInformation from GameEngine, GUI will request it from server. Server will respond GUI, depending on which user they are (to prevent showing other players' hands). While playing, we will also send the actionType to the server instead of GameEngine.

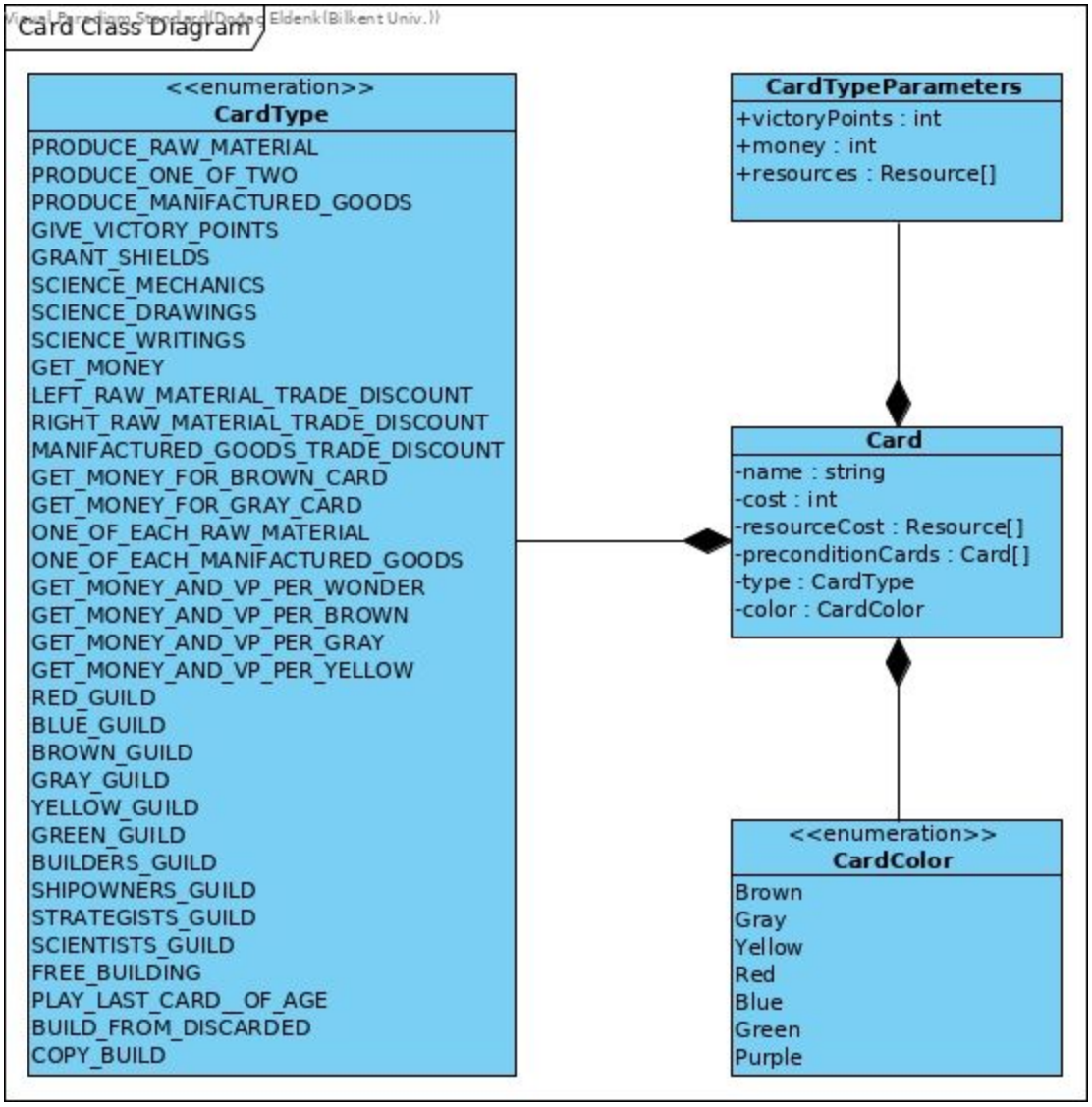

Figure 3: Card Class Diagram

Card Class in-detail review

In seven wonders, there are lots of effects a card can do. Because of the complexity of the cards, we will use a **CardType** on each card. Those types are derived from the official rulebook of seven wonders and it contains all the possible action a card can do. Most of the card types are self explanatory for the people who are similar to the game. But some card types require additional parameters, like how much victory points they give, how much money they grant, which material they produce etc. They will be stored in **rewardParameters** property of the card.

The game engine will decide how to use those parameters because each card type has a unique distribution of parameters. Also it is not idiomatic to generate classes for each card because it will be too messy.

For example, if a user plays tavern, it should grant 5 coins to the user. Game engine will check the cardType after the card is played, it will see *GET_MONEY* and game engine knows there will be an amount it should get. Engine will look for the first parameter of the rewardParameters and will find out 5 coin should be given to the player.

One of the hardest parts will be determining resources for the buildings. Because some cards have optional resource selection, such as *Forest Cave*, we should check every possible combination on our construction zone + wonder generated resource. This can be done using a greedy algorithm, prioritizing non-optional resources to optional resources should be enough. If they still don't have enough resources, they should trade with their neighbours. If they don't, the game won't allow player to do that action. Other properties in the card are the following:

- Building conditions of the cards are stored in a resource array. The gameEngine is responsible for determining if that card can be built or not. Additionally, gameEngine can look at precondition of the card to determine if it is a free card or not.
- GUI will use card color to display them in stacks.
- **Name** is for displaying the user card name and to ensure that user is not building two cards with the same name.
- Cost for the build cost in terms of money.

5.3. Dynamic Modal

5.3.1. Activity Diagram

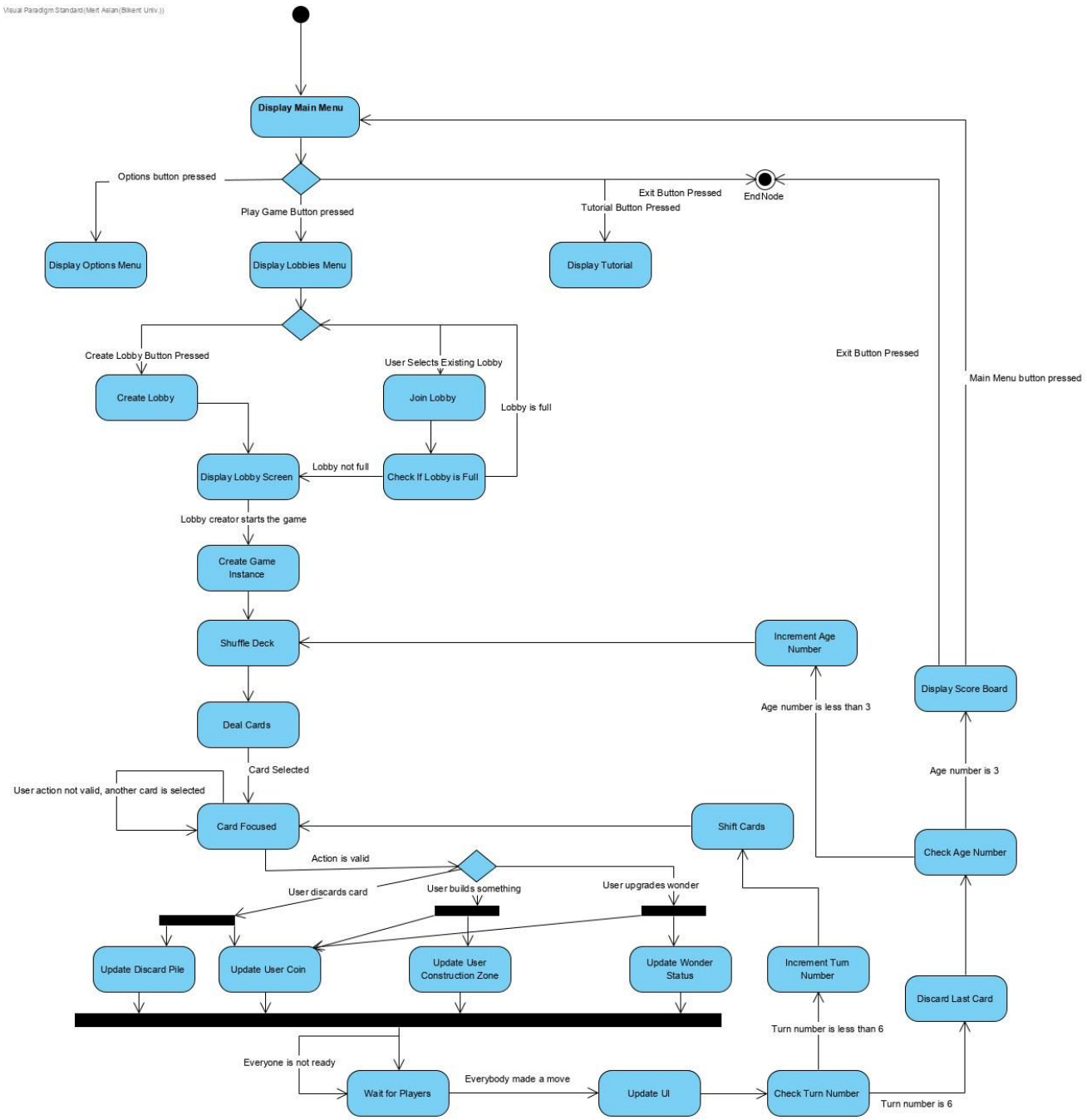

Figure 4: Activity diagram

Activity Diagram in-depth review

The system will first display a menu screen that has the options of play game, view game options and view tutorial. If the user clicks options, an option menu is displayed with a button to take the user back to the main menu. If the user chooses to view tutorial, the tutorial screen will be displayed, again with a menu to return to main menu. If the user clicks on the play game button, a lobby menu, consisting of Join Game or Create Lobby options will be displayed. If the user enters an IP address and tries to join an existing lobby, the system will check whether the lobby is full or not. If full, user will be returned to the lobby menu. If the user presses the create a lobby button, a game room screen will be displayed. When the lobby creator starts the game, the server will create a game instance. Then the system will deal cards to the players. When the user selects a card, GUI will store the card as the focused card. When the user selects an action to perform with that card, the system will check whether the action is valid. If it is not valid, card will not be played. If it is, depending on the user's choice, one of the following actions will happen: If the user discards the card, the system will update the discard pile and the user coins. If the user upgrades their wonder, the system will update the user coins and the wonder of the user. If the user builds a card, the user coins, and the user construction zone will be updated. Then the system will wait for all players to be in the ready state. When everyone is ready, the system will update the UI and increment the turn number. Then the system will check whether the turn number is less than 6 or not. If it is, the system will shift the cards, starting a new turn. If it is equal to 6, last cards will be discarded and the system will increment the age number, then check if it is less than 3 or not. If it is, new deck will be shuffled and players will start playing a new age. If the third age is over, the game will finish and show the scoreboard.

5.3.2. Sequence Diagram

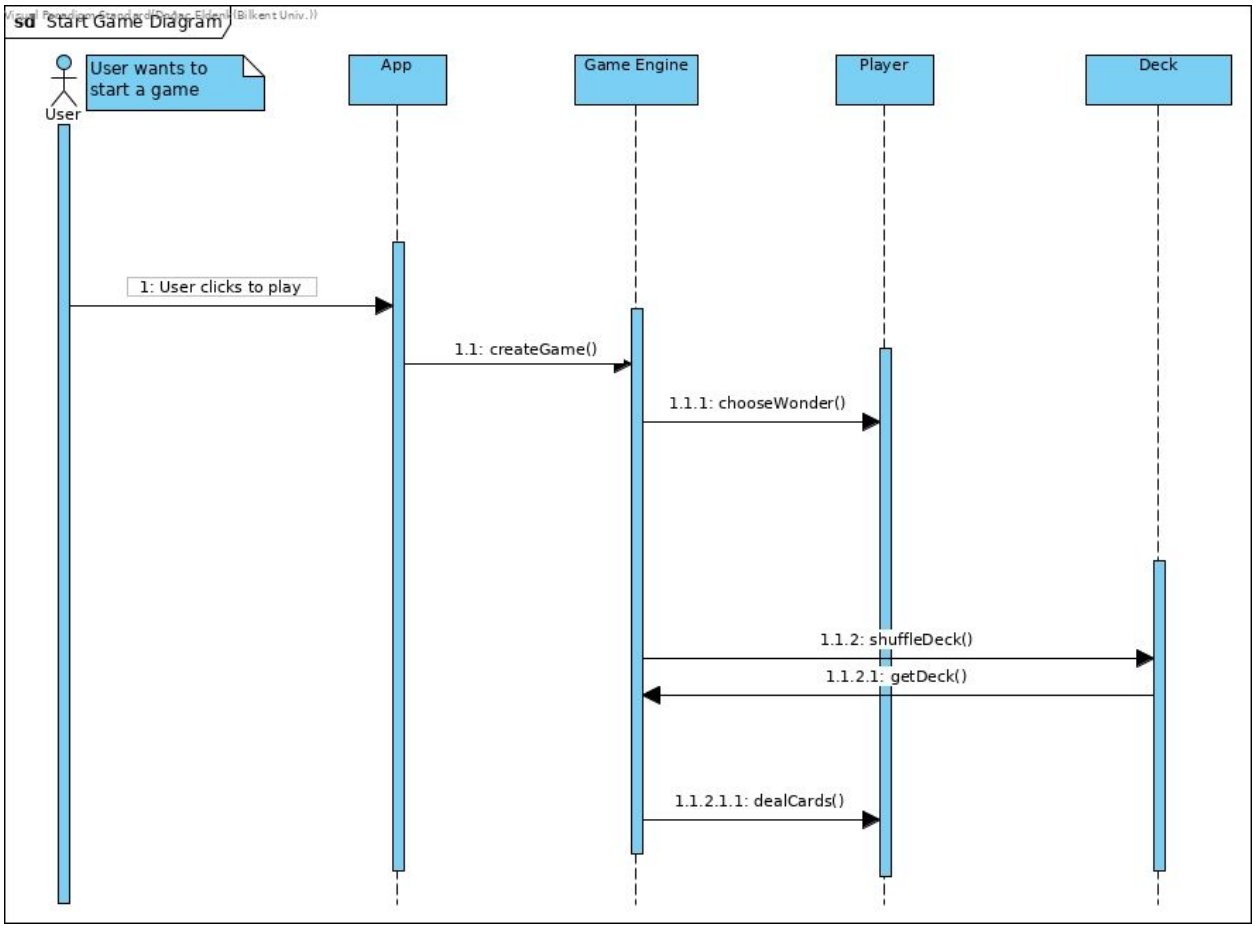

Figure 5: Sequence Diagram of Start Game

The user wants to start a new game. First, the user should click on the main menu. After the user selects play, the lobby screen pops out. User can either join or create a game. After user selects create a game, app spawns a new game instance. The user chooses a wonder from the list, then the game starts. The deck is shuffled by the game and dealt to players. This is the start sequence of a single-player game. In multiplayer game, additional checks for connectivity are required.

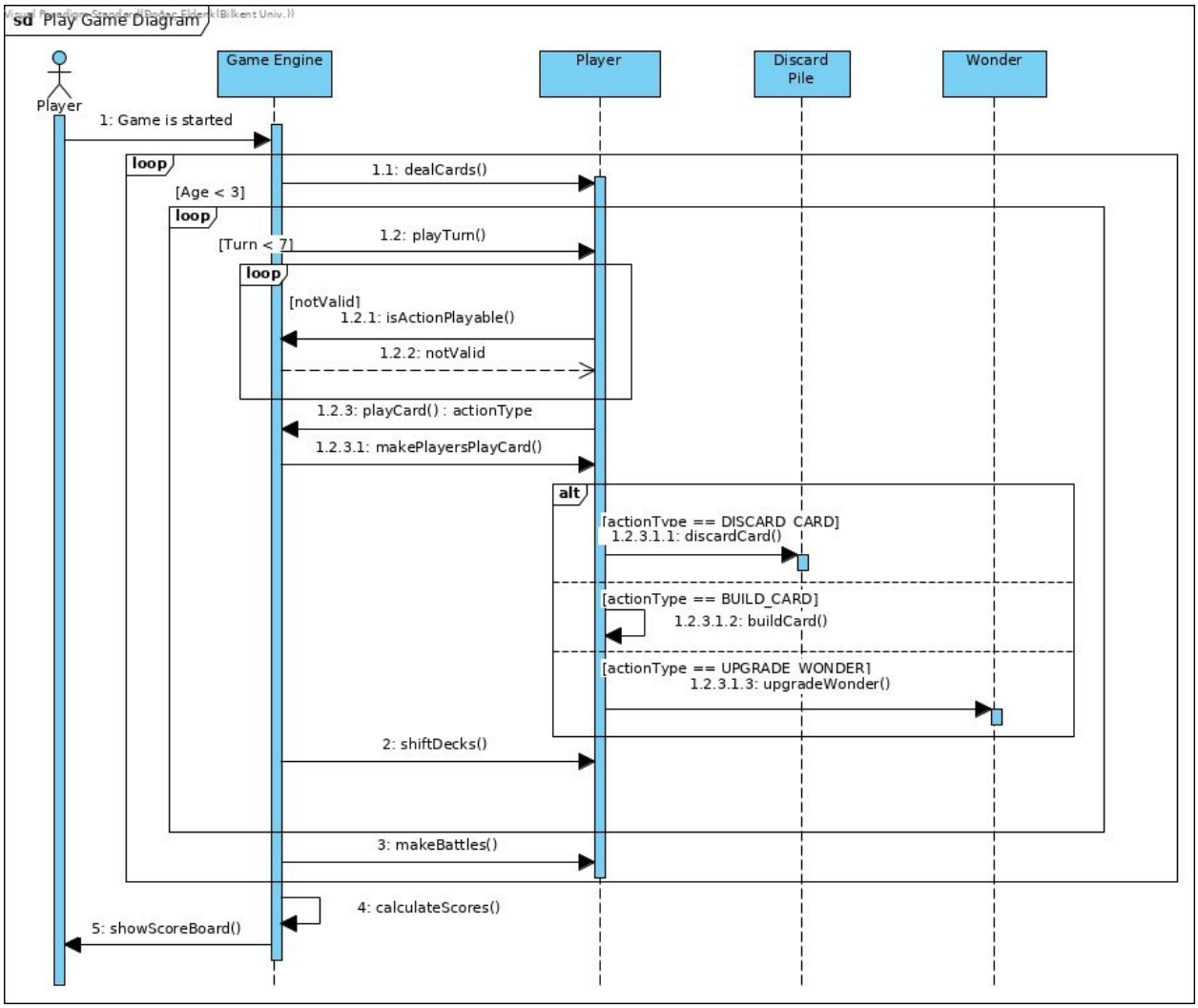

Figure 6: Sequence Diagram of Play Game

The user has to start the game and must possess a wonder in order to play it. At the start of each age,each user is dealt 7 cards. After the cards are dealt, each player can select a card to play during a turn. The game engine checks if the card is playable, and until user selects a valid card, he/she cannot make a move. After the user selects a valid card, there are three possibilities that the user can choose. They can discard the selected card, build various constructions or use the card to upgrade their wonder. After every player plays a card, decks

are shifted in the required direction. For six turns, user will repeat these actions, starting from card selection. After six turns, the current age ends and a battle sequence commences between the player and the two neighbouring players. After three ages and 21 turns, the game ends and the scores are calculated. After all the scores are calculated, all the players are shown the scoreboard.

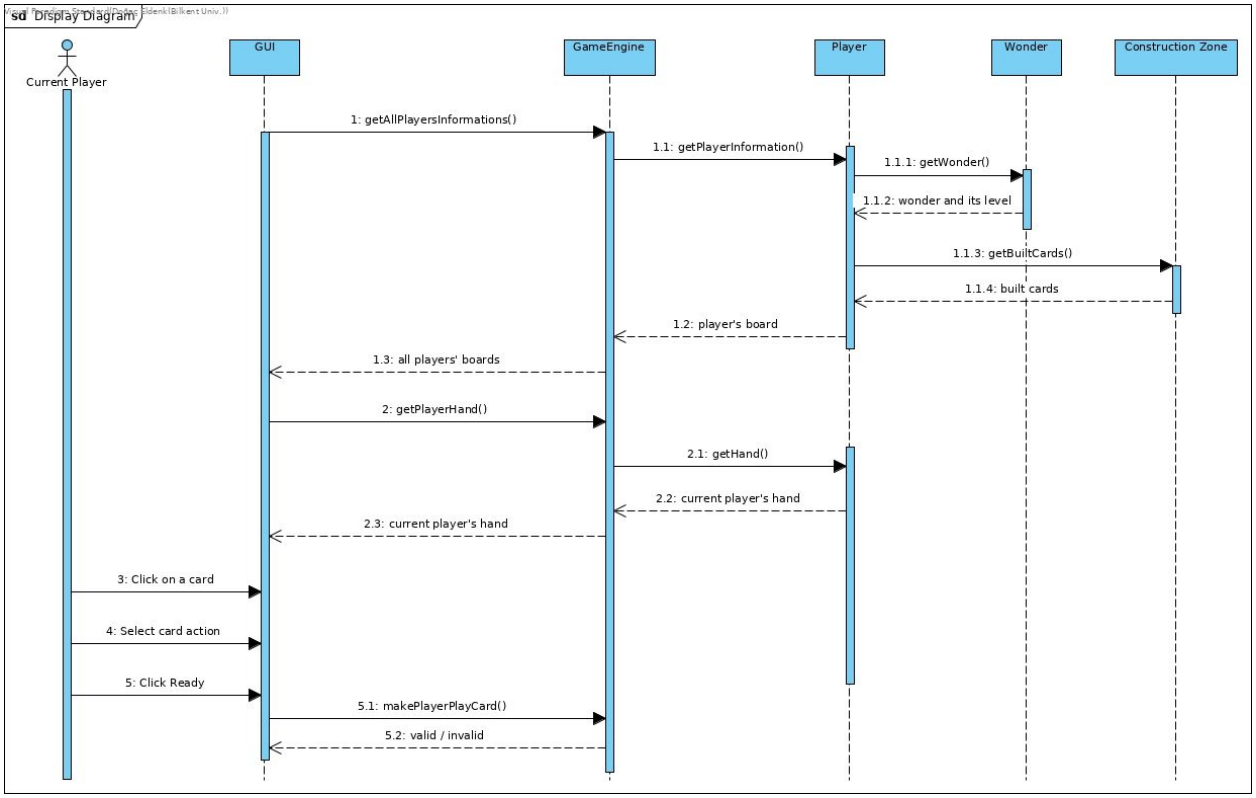

Figure 7: Sequence diagram of interaction between display and game

This diagram shows how interface and game interacts. The game screen will show the following:

- All cards in the current player's hand.
- Wonder of every player and it's upgrade level
- Each player's construction zone (Built cards)
- Each player's coins

The GUI requests that information from the game engine. Game engine collects information from each player then returns the playerBoardInformation objects. Each player collects their

played cards and their wonder and sends the information to the game engine. After that, game engine specifically requests hand of the current user. After clicking and playing a card, the information is sent to the game engine. The game engine checks if that move is valid or not. If it is not valid, GUI gives a visual feedback to the user. Additionally, game engine can be remote if the game is multiplayer. The client will communicate with server instead of local gameEngine while playing a multiplayer game.

5.3.3. State Machine Diagram

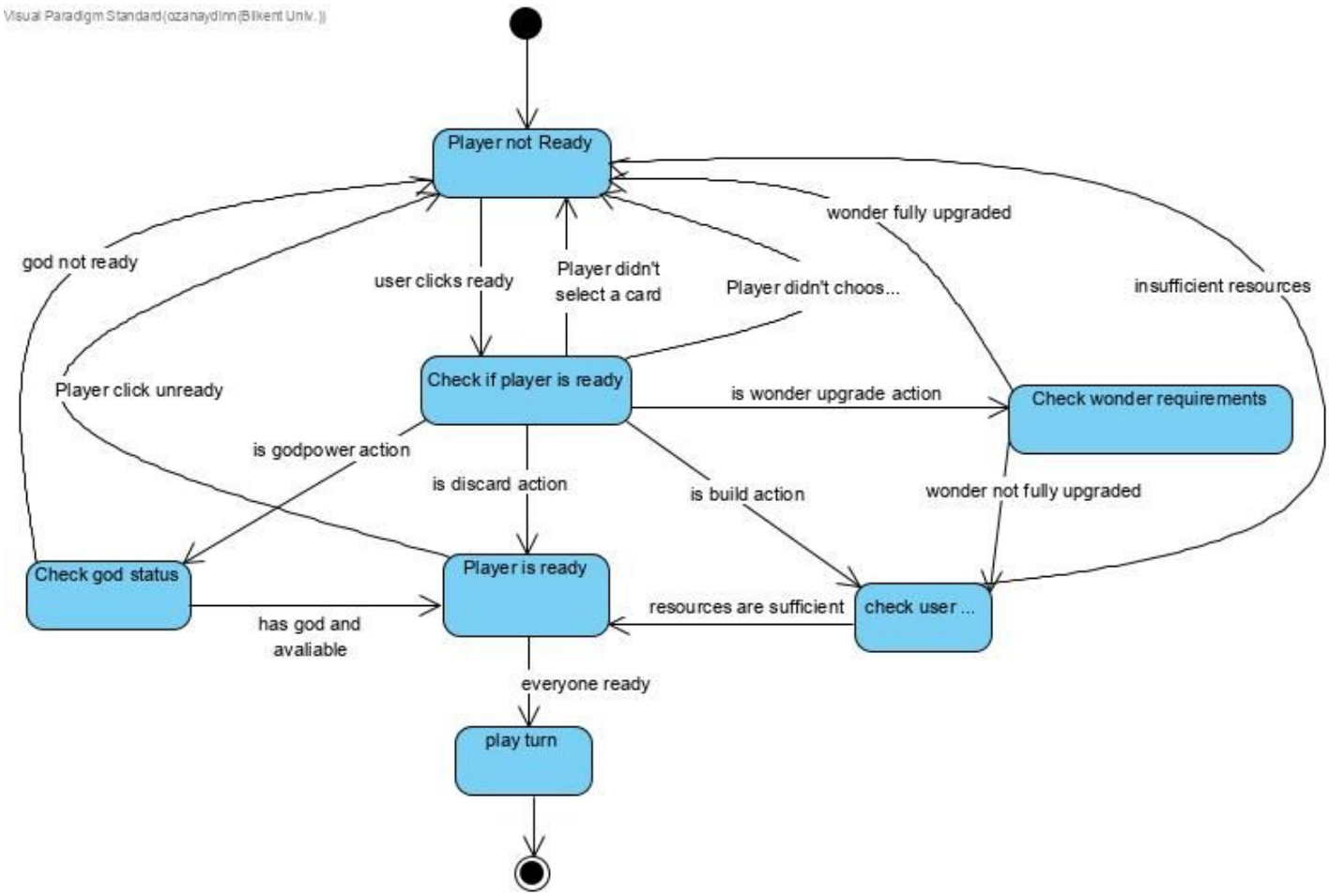

Figure 8: State Machine Diagram of a Turn of a Player

Detailed Explanation of a Turn of a Player

When the turn starts, each player is expected to take an action and press the “Ready” button. There are three types of actions: discard a card, build a construction and upgrade their wonder. Each of these actions are being performed by choosing a card. A player should choose a card and an action before pressing the ready button. If ready button is pressed without a selected card or an action, program does not advance to the ready state. After player is ready, one of the three possible actions will be executed. User can discard a card without any requirement. However, for upgrading the wonder and building construction, user must have sufficient resources. If the player does not satisfy the requirements, program goes back to the “Player not ready” state and waits for a valid move. After pressing the ready button, the player can press ready button again to change their move if not all of the other players are ready. When everyone is ready, the moves are made and the turn is over.

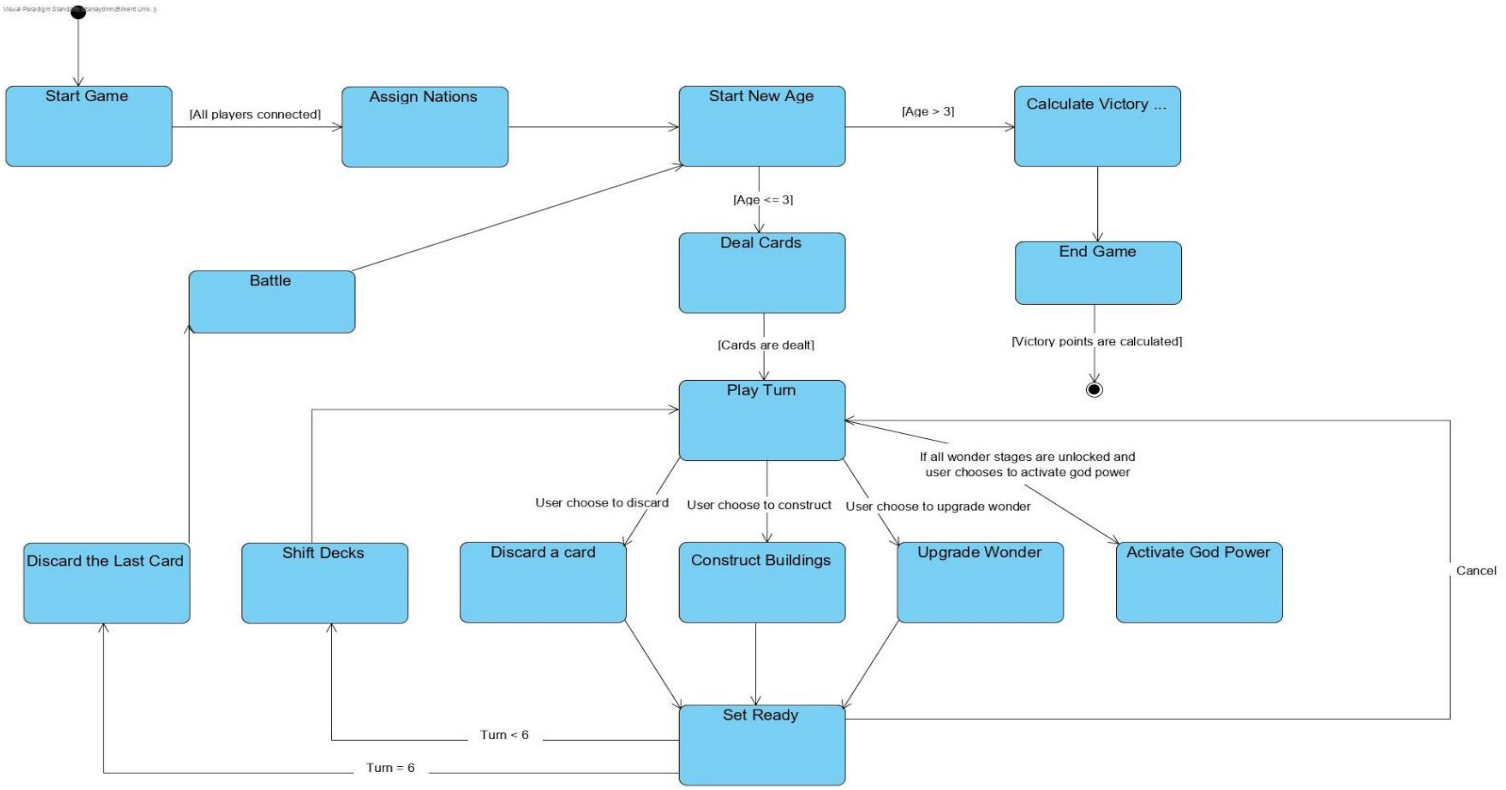

Figure 9: State Diagram of the Game

5.4. User Interface

Figure 10: Main menu screen

This is the main menu screen of the game. This will be the first screen that the user will see when they open the game. There are four buttons, labeled “Play”, “Tutorial”, “Settings” and “Exit”.The users can only interact with these buttons.

Figure 10: Settings menu

This is the Settings page, which is accessible via “Settings” button in the main menu. This page will contain various game settings. The user can close this screen via clicking the outside of the parchment.

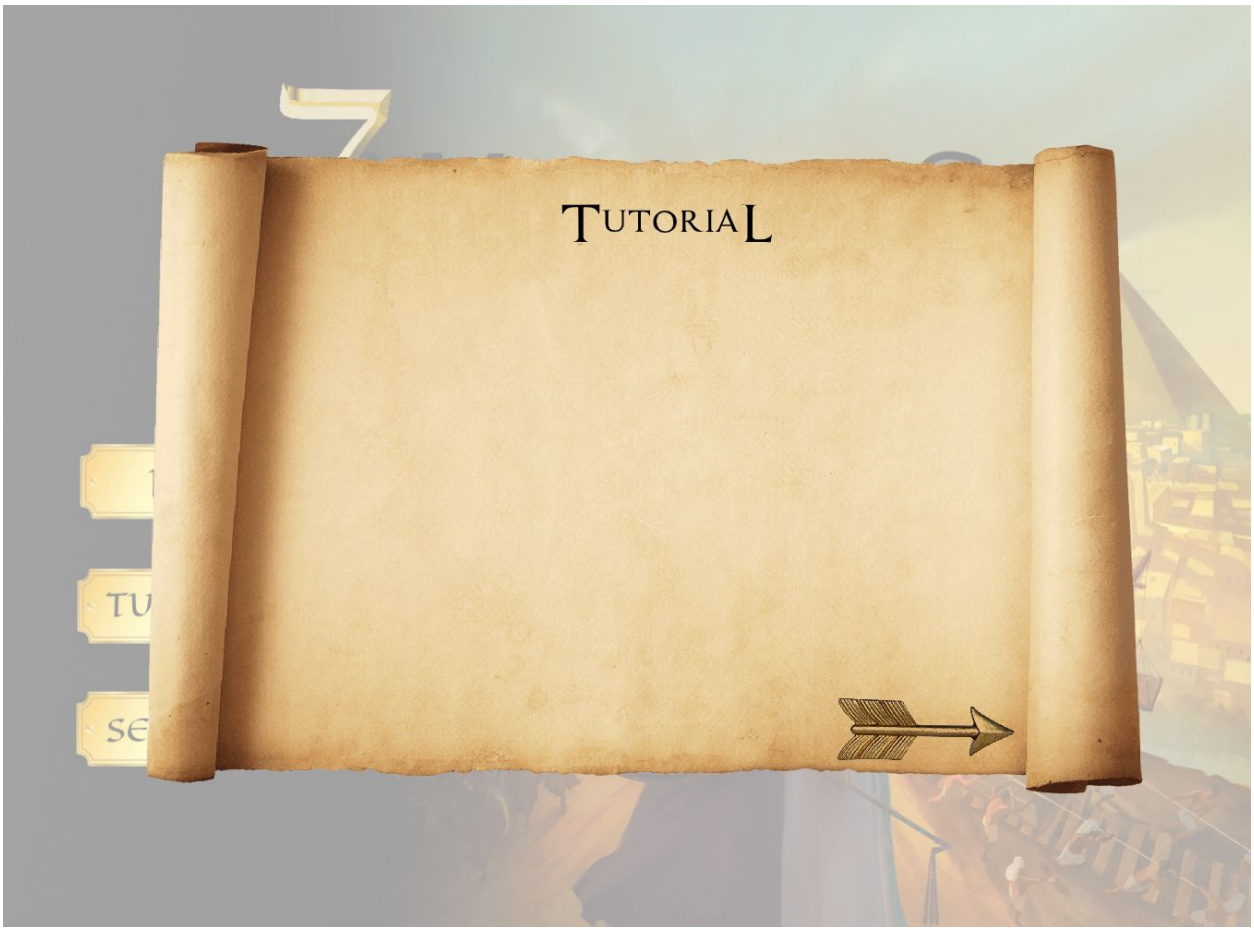

Figure 11: Tutorial screen

This is the tutorial screen of the game, which is accessible via ‘Tutorial’ button in the main menu. User can learn the terms of the game and how to play it from this tutorial. Tutorial will contain more than one page.

Figure 12: Prompting the user to enter a player name

After the user clicks “Play” button, this screen will appear to take user’s name to be displayed in the online game.

Figure 13: Lobby selection screen

After the user decides to play and creates a name, there will be two options in the lobby screen.

The user can either create a game or join an existing game.

Figure 14 : Mockup for gameplay

Information about rivals can be expanded using the "..." button. Adjacent players are displayed with their details for trade purposes. User can select any resource from their neighbours to trade. Traded cards are circled in yellow and can be used to play a card. In the middle of the screen, user can view cards in their hand and select a card to play. Once the player selects a card, the cards displayed here will disappear. Below the hand, user can view stages of their wonder. On the bottom left corner, there are "settings" and "god power" buttons. On the bottom right corner, user can select actions. In between, constructed buildings are displayed. When a

card is selected, possible actions are have green background and impossible actions are grayed out.

Appendix

Appendix A: Seven Wonders

Name	Produceses	Stage 1 (R: Required, G: Grants)	Stage 2 (R: Required, G: Grants)	Stage 3 (R: Required, G: Grants)
The Colossus of Rhodes	**Ore**	**R: 2 Wood G: 3 VP**	**R: 3 Brick G: 2 Shields**	**R: 4 Ore G: 7 VP**
The Lighthouse of Alexandria	**Glass**	**R: 2 Stone G: 3 VP**	**R: 2 Ore G: Choose one material**	**R: 2 Glass G: 7 VP**
The Temple of Artemis in Ephesus	**Papyrus**	**R: 2 Stone G: 3 VP**	**R: 2 Wood G: 9 Gold**	**R: 2 Papyrus G: 7 VP**
The Hanging Gardens of Babylon	**Brick**	**R: 2 Brick G: 3 VP**	**R: 3 Wood G: Choose one science artifact**	**R: 4 brick G: 7 VP**
The Statue of Zeus in Olympia	**Wood**	**R: 2 Wood G: 3 VP**	**R: 2 Stone G: Free build next card**	**R: 2 Ore G: 7 VP**
The Mausoleum of Halicarnassus	**Loom**	**R: 2 Brick G: 3 VP**	**R: 3 Ore G: Build from discard pile.**	**R: 2 Loom G: 7 VP**
The Pyramids of Giza	**Stone**	**R: 2 Stone G: 3 VP**	**R: 3 Wood G: 5 VP**	**R: 4 Stone G: 7 VP**

Appendix B: Cards

Age 1 - Brown

#	Name	Requirement	Building Chain (pre)	Grants
2	Lumber Yard	-	-	1 Wood
2	Stone Pit	-	-	1 Stone
2	Clay Pool	-	-	1 Brick
2	Ore Vein	-	-	1 Ore
1	Tree Farm	1 Gold	-	1 Wood / 1 Brick
1	Clay Pit	1 Gold	-	1 Brick / 1 Ore
1	Forest Cave	1 Gold	-	1 Wood / 1 Ore
1	Mine	1 Gold	-	1 Ore / 1 Stone

Age 1 - Gray

#	Name	Requirement	Building Chain (pre)	Grants
2	Loom	-	-	1 Loom
2	Glassworks	-	-	1 Glass
2	Press	-	-	1 Papyrus

Age 1 - Blue

#	Name	Requirement	Building Chain (pre)	Grants
2	Pawnshop	-	-	3 VP
2	Baths	1 Stone	-	3 VP
2	Altar	-	-	2 VP
2	Theater	-	-	2 VP

Age 1 - Yellow

#	Name	Requirement	Building Chain (pre)	Grants
3	Tavern	-	-	5 Gold
2	East Trading Post	-	-	Raw material discount on right
2	West Trading Post	-	-	Raw material discount on left
2	Marketplace	-	-	Manufactured good discount on neighbours

Age 1 - Red

#	Name	Requirement	Building Chain (pre)	Grants
2	Stockade	1 Wood	-	1 Shield
2	Barracks	1 Ore	-	1 Shield
2	Guard Tower	1 Brick	-	1 Shield

Age 1 - Green

#	Name	Requirement	Building Chain (pre)	Grants
2	Apothecary	1 Loom	-	1 Drawings
2	Workshop	1 Glass	-	1 Mechanics
2	Scriptorium	1 Papyrus	-	1 Writings

Age 2 - Brown

#	Name	Requirement	Building Chain (pre)	Grants
2	Sawmill	1 Gold	-	2 Wood
2	Quarry	1 Gold	-	2 Stone
2	Brickyard	1 Gold	-	2 Brick

2	Foundry	1 Gold	-	2 Ore

Age 2 - Gray

#	Name	Requirement	Building Chain (pre)	Grants
2	Loom	-	-	1 Loom
2	Glassworks	-	-	1 Glass
2	Press	-	-	1 Papyrus

Age 2 - Blue

#	Name	Requirement	Building Chain (pre)	Grants
2	Aqueduct	3 Stone	Baths	5 VP
2	Temple	1 Wood 1 Brick 1 Glass	Altar	3 VP
2	Statue	1 Wood 2 Ore	Theater	4 VP
2	Courthouse	2 Brick 1 Loom	Scriptorium	4 VP

Age 2 - Yellow

#	Name	Requirement	Building Chain (pre)	Grants
3	Forum	2 Brick	East/West Trading Post	1 of manufactured good
3	Caravansery	2 Wood	Marketplace	1 of raw material
2	Vineyard	-	-	1 gold for each brown neighbour and player
2	Bazar	-	-	2 gold for each gray neighbour and player

Age 2 - Red

#	Name	Requirement	Building Chain (pre)	Grants
2	Walls	3 Stone	-	2 Shield
3	Training Ground	1 Wood 2 Ore	-	2 Shield
2	Stables	1 Ore 1 Brick 1 Wood	-	2 Shield
2	Archery Range	2 Wood 1 Ore	Workshop	2 Shield

Age 2 - Green

#	Name	Requirement	Building Chain (pre)	Grants
2	Dispensary	2 Ore 1 Glass	Apothecary	1 Drawings
2	Laboratory	2 Brick 1 Papyrus	Workshop	1 Mechanics
2	Library	2 Stone 1 Loom	Scriptorium	1 Writings
2	School	1 Wood 1 Papyrus	-	1 Writings

Age 3 - Blue

#	Name	Requirement	Building Chain (pre)	Grants
2	Pantheon	2 Brick 1 Ore 1 Papyrus 1 Loom 1 Glass	Temple	7 VP
2	Gardens	1 Wood 2 Brick	Statue	5 VP

3	Town Hall	1 Glass 1 Ore 2 Stone	-	6 VP
2	Palace	1 Glass 1 Papyrus 1 Loom 1 brick 1 Wood 1 Ore 1 Stone	-	8 VP
2	Senate	1 Ore 1 Stone 2 Wood	Library	6 VP

Age 3 - Yellow

#	Name	Requirement	Building Chain (pre)	Grants
2	Haven	1 Loom 1 Ore 1 Wood	Forum	1 Gold and 1 VP for each brown you have
2	Lighthouse	1 Glass 1 Stone	Caravansery	1 Gold and 1 VP for each yellow you have
2	Chamber Of Commerce	2 Brick 1 Papyrus	-	2 Gold and 2 VP for each gray you have
3	Arena	1 Ore 2 Stone	Dispensary	3 Gold and 1 VP for each wonder level

Age 3 - Red

#	Name	Requirement	Building Chain (pre)	Grants
2	Fortifications	1 Stone 3 Ore	Walls	3 Shield
3	Circus	3 Stone 1 Ore	Training Ground	3 Shield

3	Arsenal	1 Ore 2 Wood 1 Loom	-	3 Shield
2	Siege Workshop	1 Wood 3 Brick	Laboratory	3 Shield

Age 3 - Green

#	Name	Requirement	Building Chain (pre)	Grants
2	Lodge	2 Brick 1 Loom 1 Papyrus	Dispensary	1 Drawings
2	Observatory	2 Ore 1 Glass 1 Loom	Laboratory	1 Mechanics
2	University	2 Wood 1 Papyrus 1 Gold	Library	1 Writings
2	Academy	3 Stone 1 Glass	School	1 Drawings
2	Study	1 Wood 1 Papyrus 1 Loom	School	1 Mechanics

Age 3 - Purple

Name	Requirement	Grants
Workers Guild	2 Ore 1 Brick 1 Stone 1 Wood	1 VP for each neighbour brown
Craftsmens Guild	2 Ore 2 Stone	2 VP for each neighbour gray
Traders Guild	1 Loom 1 Papyrus 1 Glass	1 VP for each neighbour yellow
Philosophers Guild	3 Brick 1 Loom 1 Papyrus	1 VP for each neighbour green

Speis Guild	**3 Brick 1 Glass**	**1 VP for each neighbour red**
Strategists Guild	**2 Ore 1 Stone 1 Loom**	**1 VP for each neighbour battle lost**
Shipowners Guild	**3 Wood 1 Papyrus 1 Glass**	**1 VP for each brown or gray or purple you have**
Scientists Guild	**2 Wood 2 Ore 1 Papyrus**	**Choose one of the science artifacts**
Magistrates Guild	**3 Wood 1 Stone 1 Loom**	**1 VP for each neighbour blue**
Builders Guild	**2 Stone 2 Brick 1 Glass**	**1 VP for each wonder level neighbour or you have**

Resources

[1] “7 Wonders rulebook”

http://rprod.com/uploads/file/7WONDERS_RULES_US_COLOR.pdf. [Accessed: 25th October 2019]