Object-Oriented Software Engineering

CS319

Term Project

Analysis Report

Q-Bitz

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Introduction

For CS319 course we are assigned to implement the software version of the Q-Bitz board game. We decided to implement all features of the base game and also extend the game so that it has more features.

We started to plan by deciding the most feasible platform for the game and decided to implement a desktop application since the game is more convenient to play in bigger screens. It is more comfortable to play the game using mouse and keyboard than playing on touch screen.

The original game is made mainly for children, since the base features of the game are not complicated, and it is easy for an adult to solve the puzzles rapidly. We decided to expand the target audience by modifying game so that it is more sophisticated and charming. To make the game more attractive, we decided to develop more on adding new game modes. By adding more game modes, we think that we address not only children but also adults, as the game modes require the player to be strategical and to be good at time management. The additional game modes can be listed as follows:

- Switch Mode
- Survival Mode
- Daily Challenge

The game modes will be explained further in section 2.

What also make the game appealing are visual and audial effects and themes that we designed. We are also planning to produce game music and effect sounds ourselves. The player will be allowed to adjust the sound level of the music as well as effect sounds and master sound.

We will explain more about the features that we have designed in the upcoming sections but the whole list of added features can be seen below:

- Game Music
- Effect Sounds
- Themes
- Singleplayer Mode
    - Daily Challenge
    - Survival Mode
- Multiplayer Mode
    - Switch Mode
    - Classic Mode
- Tutorials
- Custom Made Environment (see interfaces)

Overview

Components

Board

The board (see Figure 1-1) is the canvas where the cubes will be placed. By default, the board will be loaded as 4x4 but will be adjustable by the player. The cubes can be placed, rotated and displaced in any order decided by the player.

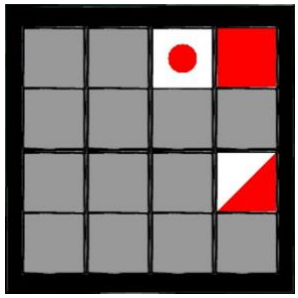


Figure 1-1

Cubes

The base component of the game is cubes (see Figure 1-2). There are 6 faces but 5 distinct faces in the cubes. All cubes are identical in the game. The cubes will be placed in the game board by the player. All the players have the same amount of cubes in a game and it's equal to the number of slots in the board.

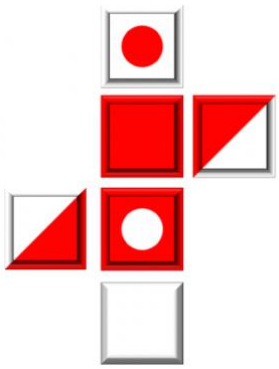


Figure 1-2

Game Cards

The game cards (see Figure 1-3) are the mission of the players. They will always be displayed in the game and maximized when "tab" key is pressed.

Figure 1-3

How to Play

There are various rules for each mode and they will be explained in the related sections, but the base rules and game-flow are as follows:

- At the beginning of the game, a game card is assigned to a player.
- The objective is to have the same shape as in the game card, on the board.
- The player will move, rotate and arrange the cubes as he/she wishes.
- When the objective is completed, the game will move on according to the game mode.

Game Modes

The game can be played both as a singleplayer and also multiplayer. Both have two more sub-modes.

Singleplayer Mode

There are two sub-modes of the singleplayer mode: Daily Challenge and Survival Mode.

Daily Challenge

In the Daily Challenge Mode, a player is assigned pre-determined game cards and those game cards will change daily. When the player solves a game card, the next one will appear. The player will be placed in the daily leaderboard according to the time elapsed to solve all the game cards. The size game board will be 8x8 for the Daily Challenge Mode and of course, will not be adjustable.

Survival Mode

In the Survival Mode, a player has a pre-determined time limit and will be randomly assigned game cards until the time is over. The time will be incremented by certain number of seconds – which is not determined yet – when each successful submission is made. The score will be the number of cards solved at the end of the time.

Multiplayer Mode

There are two sub-modes of the multiplayer mode: Switch Mode and Casual Mode.

Switch Mode

In the switch mode, there will be 2 players. At the beginning of the game both will be assigned a game card. In every 15 seconds, the boards will be switched, and the players will be progressing on the other board. The winner will be the one who finishes first, no matter which board he/she completed.

This mode is one of the most challenging ones since the strategy is crucially important. A player might choose either to complete the board or to disarrange the opponent's board.

Classic Mode

In the Classic Mode there may be up to 4 players. Each of them is assigned the same game card and the first one to finish wins the round. This mode was already in the base game.

Functional Requirements

Game Modes

Classic game mode

This is a multiplayer game mode. Players will join or create lobbies to play this mode. Up to 4 players can participate in a lobby to play. Players will compete against each other to complete more game cards until a fixed amount of game cards have been completed. After each puzzle is completed, the player who completes first will gain the card. The player with the highest amount of game cards wins the game.

Daily challenge

This is a single player game mode. Each day there will be a daily challenge assigned by developers, where each player is going to try to complete the challenge in the shortest time. Their completion times will be displayed in the leaderboard.

Switch mode

This is a multiplayer game mode. Players will join or create lobbies to play this mode. 2 players will compete against each other.2 boards will be switched between two players; each player will interact with the board for a fixed time interval. The player who completes the puzzle wins. Players can disarrange the cubes on the board so players will use various strategies when playing this mode.

Survival mode

Survival mode is a single player game mode in which player tries to solve as many puzzles as they can in a time interval. Player will start with a specified time, each time player solves a puzzle, he will be given bonus time. So in this mode players will challenge themselves against time.

Lobby System

A lobby system will be implemented for multiplayer game modes. A player can create or join a lobby. In the lobby creation screen, the creator of lobby will specify the name, game mode and player limit of the lobby. There will be an option to make the lobby private, so players can only join with an invite. In the lobby list screen players will be able to sort or filter the lobbies to find lobbies with desired features. There will be a chat box in the lobby so players in that lobby can communicate with each other. Lobby admin will be able to start the game. The lobby admin will be able to invite players to the lobby or kick players from the lobby.

The lobby admin needs to enter the nickname of the player to invite him/her to the lobby. The invited player will receive a pop-up screen with the nickname of host asking if they want to join the lobby or not. If the invited player accepts the invitation, he/she will be moved to the lobby, if the invitation is rejected, player will remain in the main menu.

How to play

Players will access tox this screen via the main menu. In this screen, game rules and tutorials are given for each game mode. Each game mode is explained under a tab. The tutorial is supported with pictures so that player can understand the basics of the game easier. The tutorial screen supports guides for classic, switch, daily challenge and survival game modes of the game. Game controls are also explained with pictures in this screen.

Settings

This screen is accessible from the main menu, here, player can change basic settings of the game. Player can submit a new nickname. Player can change

the resolution and make the game full-screen. Sound settings can also be changed here. Player can adjust master volume, effects volume and music volume.

Credits

This is the screen with the information of developers and the link to GitHub page of the project. Players can access to this screen from main menu.

Non-Functional Requirements

User-Friendly UI and Performance

Since the time plays a very significant role in this game because players will compete with each other and against time, the performance is very important and while they are struggling with these challenges it is really desired to have a smooth game play experience and this is all about UI.

- In the software version of the game, the navigation should be handled with menus which are simple and understandable.
- Board game is designed as a mind game for children, so even a child of a small age should be able to navigate through the menus.
- Joining a multiplayer game should not be overwhelming. Players should be able to play with their friends by finding the lobby they are in or just by accepting an invitation.
- In the lobbies screen, finding a lobby should be easy. Player should be able to sort the lobbies or filter them by particular properties.
- The software should be responsive. Selecting, rotating and placing a cube should feel smooth to the player.

Ease of Control

Q-Bitz is a time-based game, which means it requires players to play as fast as they can to win the game. Considering this feature of the game, its desktop version must be easy to play. Requirements for such a convenience can be listed as following:

- Cube selection should not be complicated. In the original board game selecting a cube from a pile of cubes is not difficult. However, in the software such a selection can be complicated. This complication can be fixed by showing the cubes to the player one by one. Next cube will be shown to player after placing the previous one.
- Cubes must be easy to rotate. A player should not spend all his/her time on rotating the cube. Player should be able to rotate the cube using arrow keys or with a click of a rotation button.
- In case of a misplacement, a player should not hassle with displacing the cube, instead, the player should be able to select the cube on the game board and just rotate it.

Additional Features and Attractiveness

The original board game only consists of one game mode with three steps which can make unappealing to adults. The base game is also simple and only requires players to memorize and not use any strategies. The game can be made more interesting and its target audience can be extended by adding some features that can be listed as following:

- There should be additional game modes in which players can use various strategies against their opponents and use the time more efficiently.
- There should be a leaderboard, so players can challenge with others and try to score highest which will make the game more competitive.

- Game music and sound effects should be implemented so that players will have a better experience when interacting with a cube or the board and they will enjoy the game more when listening to game music.
- In the software version of the game, a chat system in the lobby should be implemented so that players can communicate with each other.

System Models

Use-Case Diagram

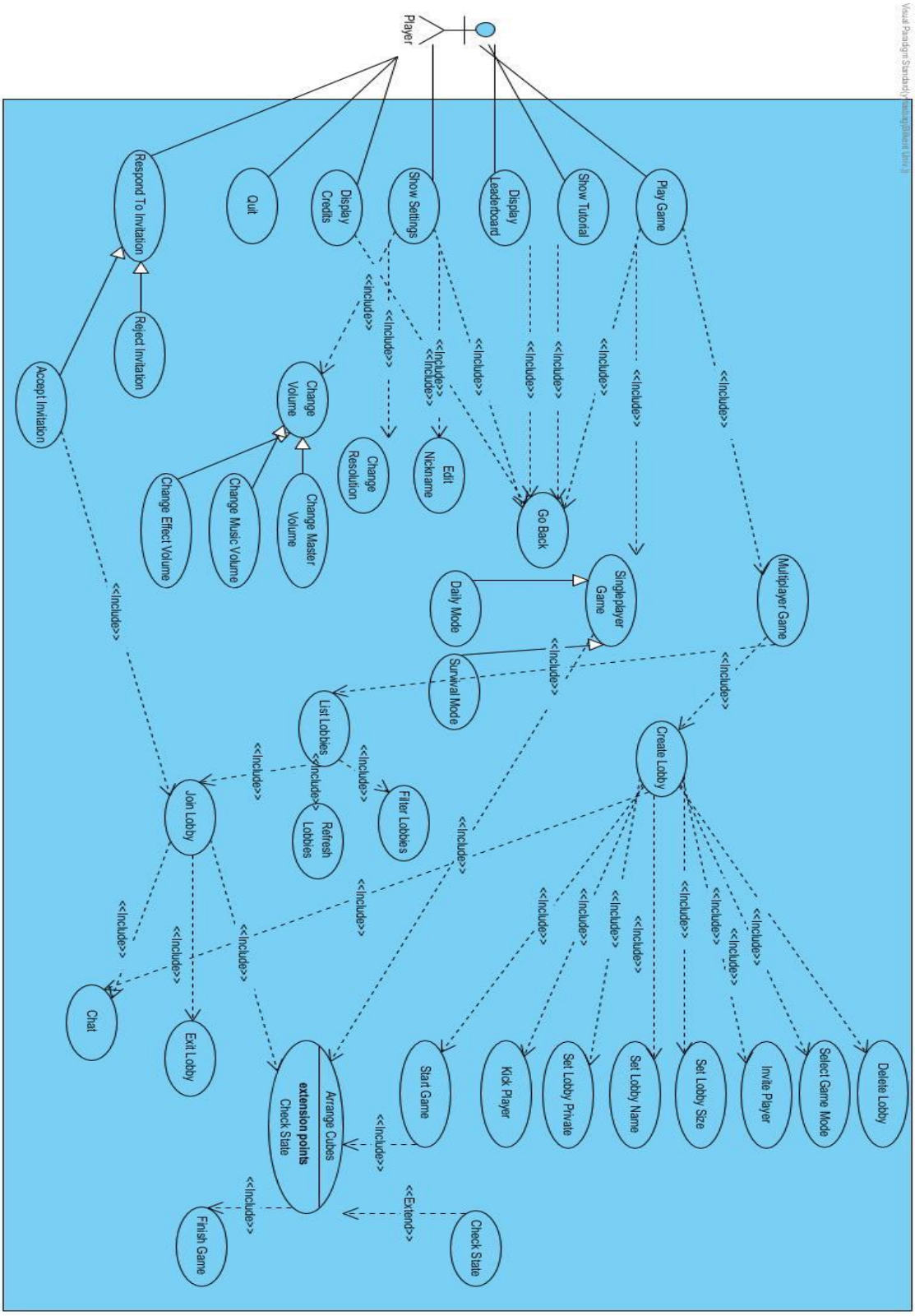


Figure 5-1-1

Use Case #1

1. Use Case: Play Game
1. Participating Actors: Player
2. Entry Condition: Player chooses play game
3. Exit Condition: Player chooses Go Back

Scenario #1

1. Player chooses multiplayer

Scenario #1.1

i. Player is in a classic game mode lobby
ii. Game starts by lobby master
iii. Player arranges the cubes according to a game card
iv. Game ends and displays scoreboard

Scenario #1.2

i. Player is in a switch game mode lobby
ii. Game starts by lobby master
iii. Players arrange the cubes according to game card
iv. Boards switch when time is up
v. Players arrange or disarrange the cubes
vi. The last two previous processes repeat until one player completes his/her board correctly.
vii. Game ends and displays winner

Scenario #2

1. Player chooses singleplayer

Scenario #2.1

i. Player chooses survival game mode

ii. Player arranges the cubes according to a game card

iii. Player gains bonus time if he/she completes a game card correctly

iv. Game ends when the time is up

v. Game displays score

Scenario #2.2

i. Player chooses daily challenge game mode

ii. Player arranges the cubes according to a game card

iii. Game ends when player completes all challenges

iv. Game displays leaderboard

Use Case #2

1. Use Case: Tutorial
2. Participating Actors: Player
3. Entry Condition: Player chooses tutorial
4. Exit Condition: Player chooses Go Back

Scenario #1

1. Player chooses the game mode for the tutorial of the desired mode
2. Player goes to next page

Use Case #3

1. Use Case: Leaderboard
2. Participating Actors: Player
3. Entry Condition: Player chooses Leaderboard
4. Exit Condition: Player chooses Go Back

Scenario #1

1. Player chooses Leaderboard for the desired game mode

Use Case #4

1. Use Case: Settings
2. Participating Actors: Player
3. Entry Condition: Player chooses Settings
4. Exit Condition: Player chooses Go Back

Scenario #1

1. Player chooses Edit Nickname
2. Player clicks submit

Scenario #2

1. Player chooses change resolution
2. Player clicks on OK

Scenario #3

1. Player chooses change volume

Scenario #3.1

i. Player changes master volume

Scenario #3.2

i. Player changes effect volume

Scenario #3.3

i. Player changes music volume

Use Case #5

1. Use Case: Credits

2. Participating Actors: Player
3. Entry Condition: Player chooses Credits
4. Exit Condition: Player chooses Go Back

Scenario #1

1. Player chooses Credits
2. Names of the developers are displayed

Use Case #6

1. Use Case: Accept invitation
2. Participating Actors: Player
3. Entry Condition: Player receives game invitation
4. Exit Condition: Player accepts or rejects invitation

Scenario #1

1. Player Accepts invitation
2. Player joins to Lobby

Scenario #2

1. Player Rejects invitation
2. Player remains in main menu

Dynamic Models

Activity Diagram

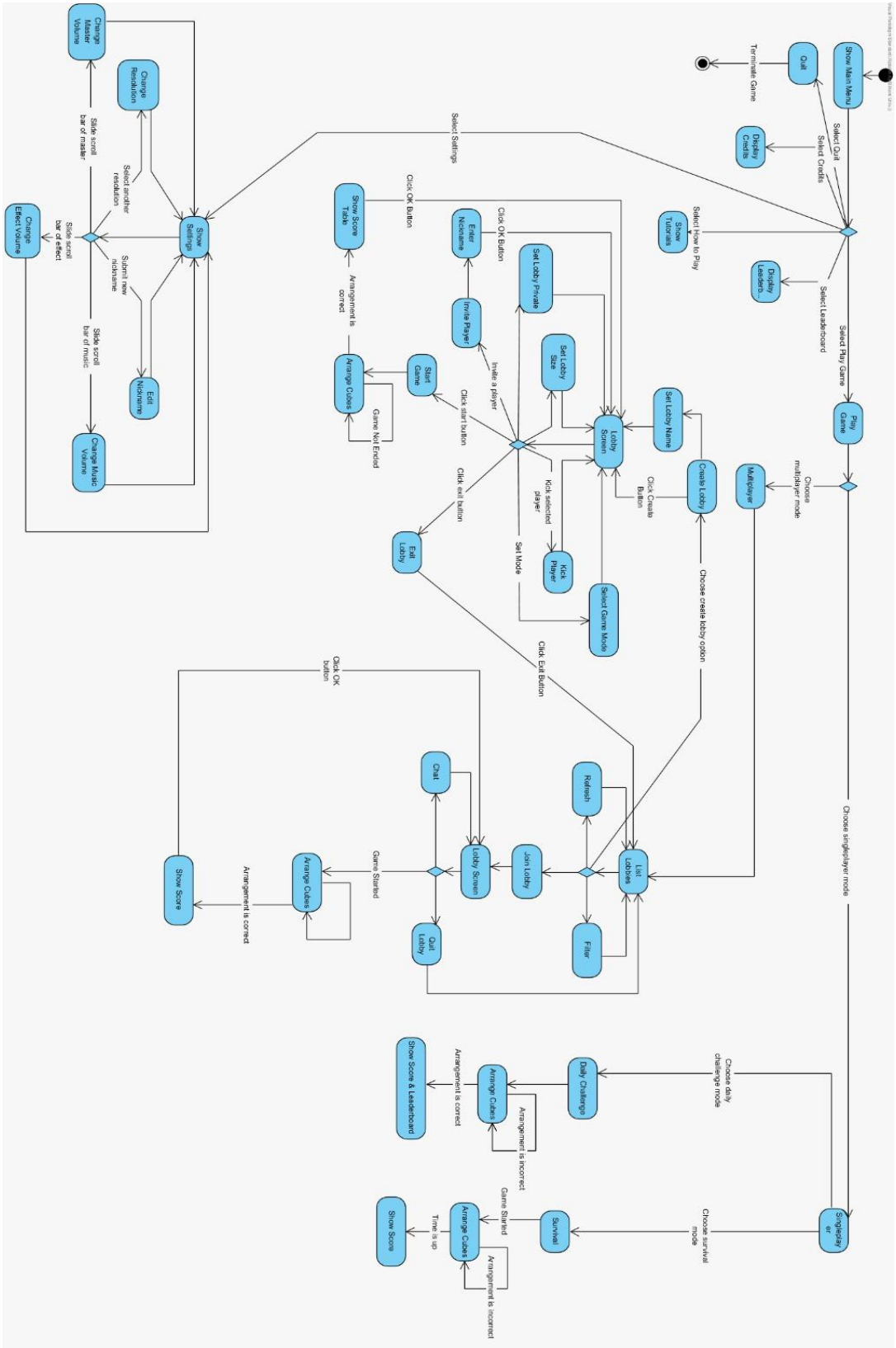
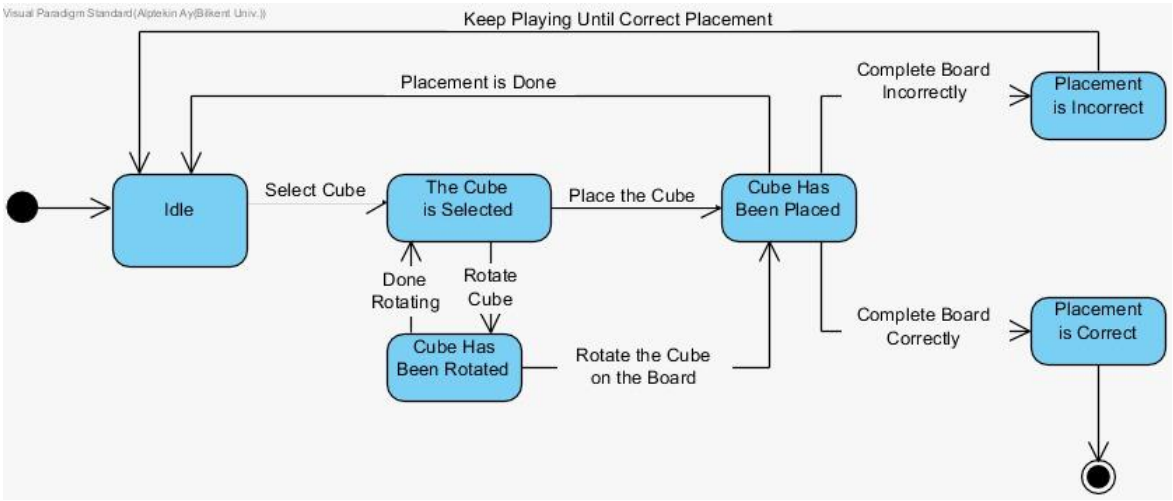


Figure 5-2-1

The activity diagram of the game is shown in Figure 5-2-1. The diagram starts from the very beginning of the game (main menu) and demonstrates all possible flows. There are 6 use cases of the game as explained in section 5.1: Play Game, Tutorials, Leaderboard, Settings, Credits, Quit. Those are all considered in activity diagram with their sub-flows.

State Diagrams

Classic Mode State Diagram



Idle State: This state is when no cubes are selected at the beginning of the game or after a cube has been placed.

The Cube is Selected: A cube has been selected by player and it is ready to be rotated or to be placed.

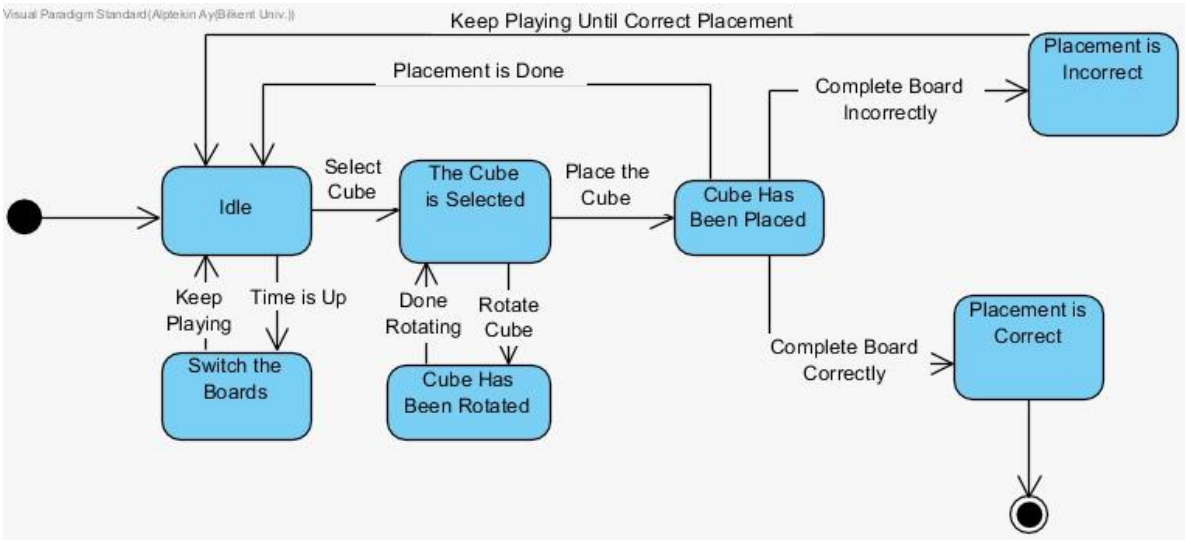
The Cube Has Been Rotated: The selected cube has been rotated by the player to find the correct face.

The Cube Has Been Placed: At this state a cube has been placed on the board or a cube which is already on the board has been rotated. If the board is not filled with cubes, player repeats the states above. Otherwise, correctness of the board will determine the next state.

Placement is Incorrect: If the board is filled with cubes and the current arrangement is not the same with the game card, player repeats the states above and keeps playing until he/she gets the correct placement.

Placement is Correct: If the board is filled with cubes and the current arrangement matches with the game card game ends.

Switch Mode State Diagram



Idle State: This state is when no cubes are selected at the beginning of the game or when the boards has been switched after time is up or after a cube has been just placed.

The Cube is Selected: A cube has been selected by player and it is ready to be rotated or to be placed.

The Cube Has Been Rotated: The selected cube has been rotated by the player to find the correct face.

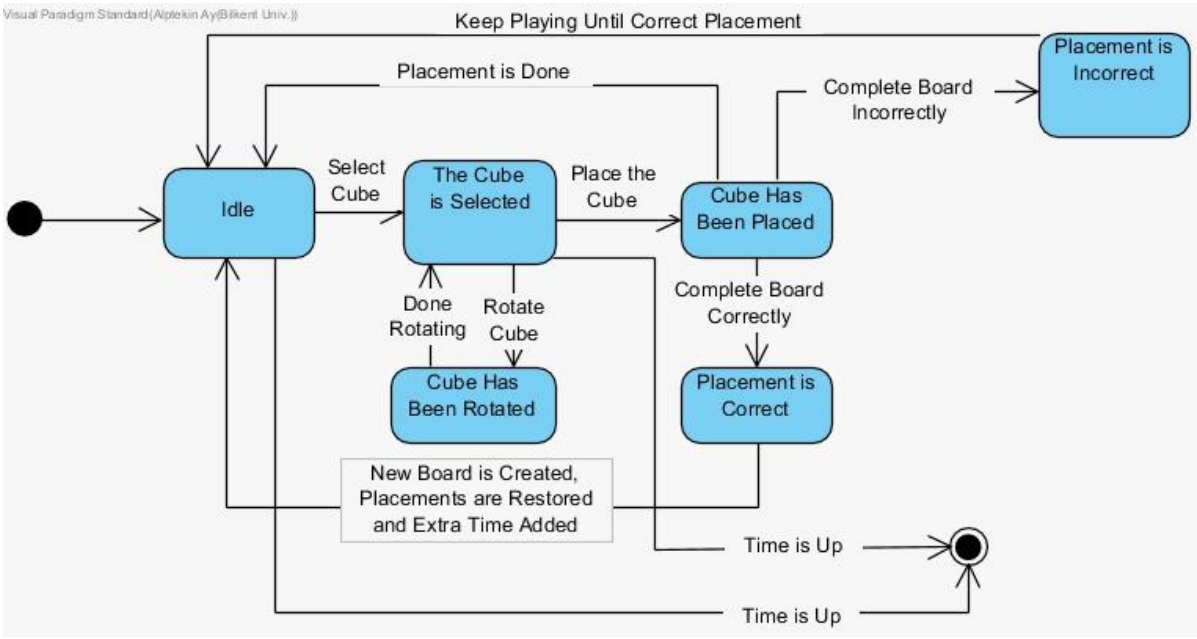
The Cube Has Been Placed: At this state a cube has been placed on the board or a cube which is already on the board has been rotated. If the board is not filled with cubes, player repeats the states above. Otherwise, correctness of the board will determine the next state.

Switch the Boards: When time reserved for players to arrange or disarrange a board is up, the boards that player work on will switch with each other.

Placement is Incorrect: If the board is filled with cubes and the current arrangement is not the same with the game card, player repeats the states above and keeps playing until he/she gets the correct placement.

Placement is Correct: If the board is filled with cubes and the current arrangement matches with the game card game ends.

Survival Mode State Diagram



Idle State: This state is when no cubes are selected at the beginning of the game or after the current board has been completed or after a cube has been just placed.

The Cube is Selected: A cube has been selected by player and it is ready to be rotated or to be placed.

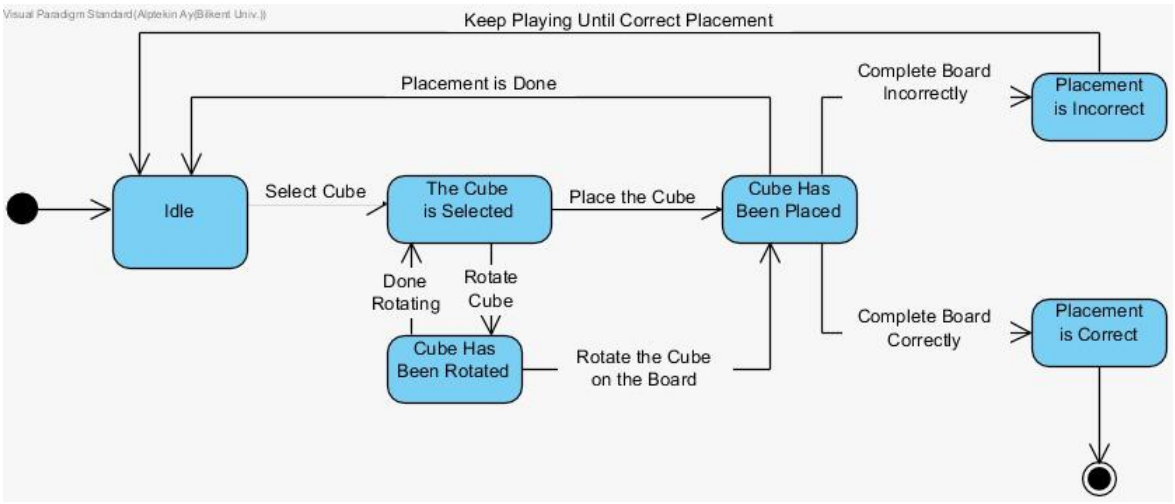
The Cube Has Been Rotated: The selected cube has been rotated by the player to find the correct face.

The Cube Has Been Placed: At this state a cube has been placed on the board or a cube which is already on the board has been rotated. If the board is not filled with cubes, player repeats the states above. Otherwise, correctness of the board will determine the next state.

Placement is Incorrect: If the board is filled with cubes and the current arrangement is not the same with the game card, player repeats the states above and keeps playing until he/she gets the correct placement.

Placement is Correct: If the board is filled with cubes and the current arrangement matches with the game card a new game card appears, placement are restored and Bonus time is given to the player.

Daily Challenge Mode State Diagram



Idle State: This state is when no cubes are selected at the beginning of the game or after a cube has been placed.

The Cube is Selected: A cube has been selected by player and it is ready to be rotated or to be placed.

The Cube Has Been Rotated: The selected cube has been rotated by the player to find the correct face.

The Cube Has Been Placed: At this state a cube has been placed on the board or a cube which is already on the board has been rotated. If the board is not filled with cubes, player repeats the states above. Otherwise, correctness of the board will determine the next state.

Placement is Incorrect: If the board is filled with cubes and the current arrangement is not the same with the game card, player repeats the states above and keeps playing until he/she gets the correct placement.

Placement is Correct: If the board is filled with cubes and the current arrangement matches with the game card game ends.

Sequence Diagrams

Main Menu Sequence Diagram

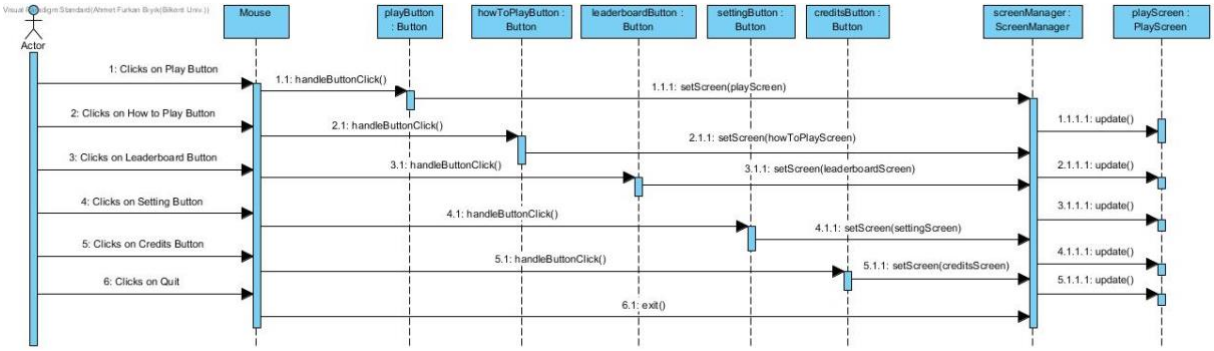


Figure 5-3-1

Here in the main menu sequence diagram, when a player clicks on play button, the game modes will be displayed. If the Tutorial choice is selected, the tutorial images will show up in the screen. If Leaderboard is selected, then the leaderboard screen will appear. The same applies for the settings and credits button. If player clicks on Quit button the game will be quitted. The screen management of the processes will be handled by a screenManager as demonstrated above.

Play Sequence Diagram

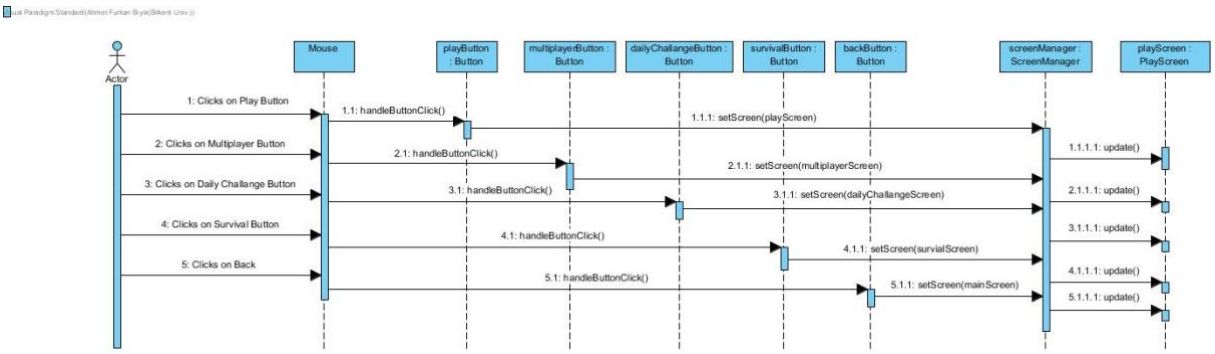


Figure 5-3-2

In this screen, if the player clicks on play button the game screen will be displayed. If the player chooses multiplayer, the screen of the multiplayer mode will appear. Likewise, if player chooses daily challenge or survival button, the related screen will be shown. If the player clicks on back button, main menu screen will be displayed.

Survival Mode Sequence Diagram

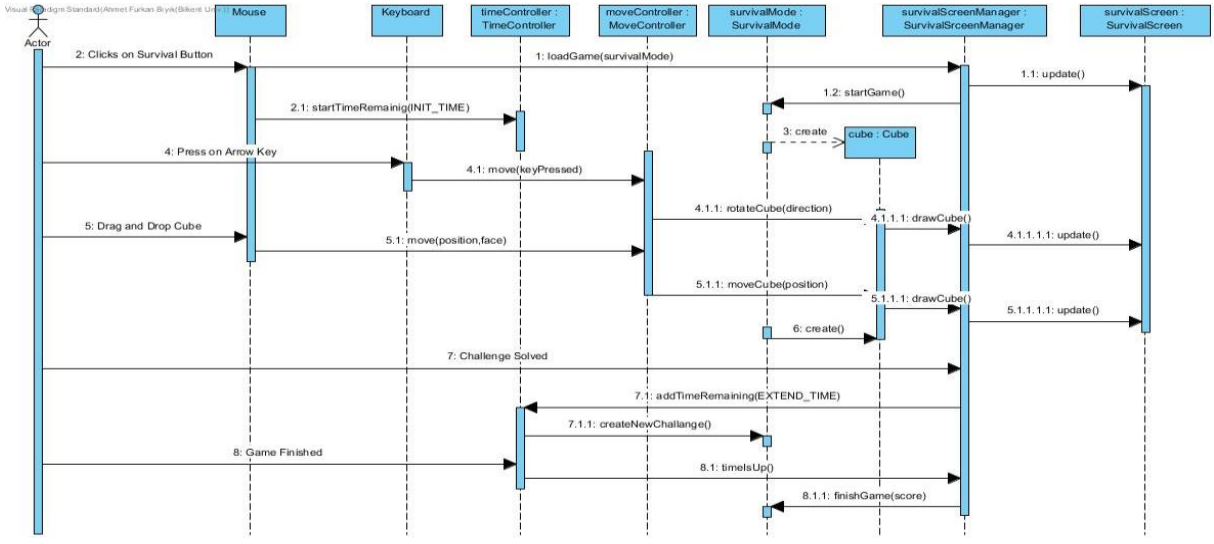


Figure 5-3-3

In the survival mode, if player presses on an arrow key or drags and drops the cube, the cube will be moved to the desired place if he/she still has time. If the game is over, the score will be displayed.

Daily Challenge Mode Sequence Diagram

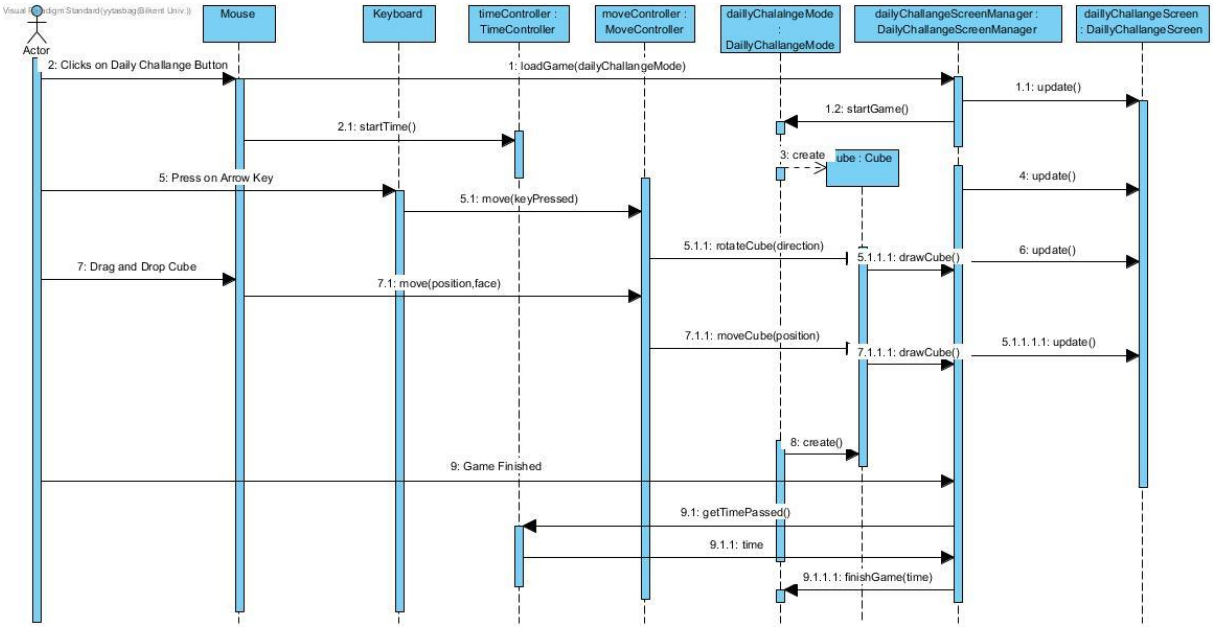


Figure 5-3-4

In the daily challenge mode, if player presses on an arrow key or drags and drops the cube, the cube will be moved to the desired place. If the overall placement of the board is correct, the next card will be assigned. When the game is over, the score – time elapsed – will be displayed.

Create Lobby Sequence Diagram

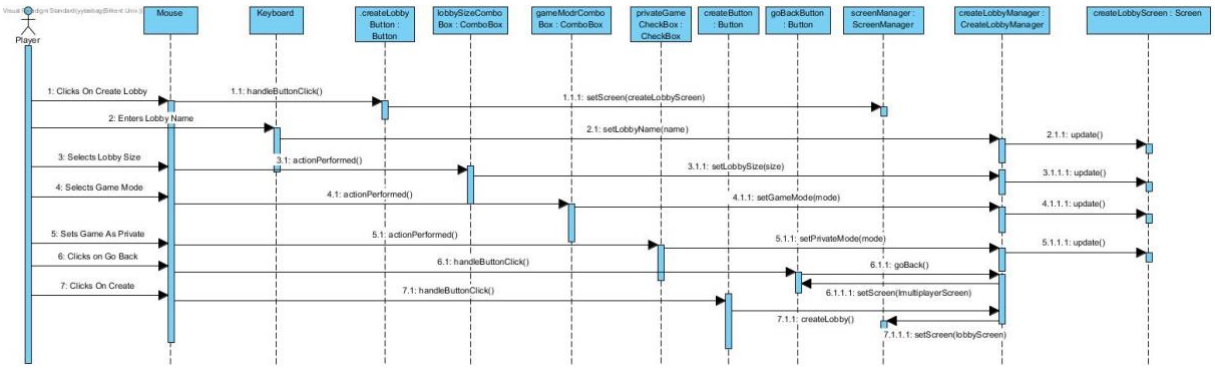


Figure 5-3-5

In the create lobby screen, the player can enter the lobby name by clicking on the textbox, he/she can choose the game mode by clicking on the select game mode button. The player can also decide about the capacity of the lobby (in terms of number of players). The lobby can be set as private or public by checking the checkbox of the privacy status.

Lobby Sequence Diagram

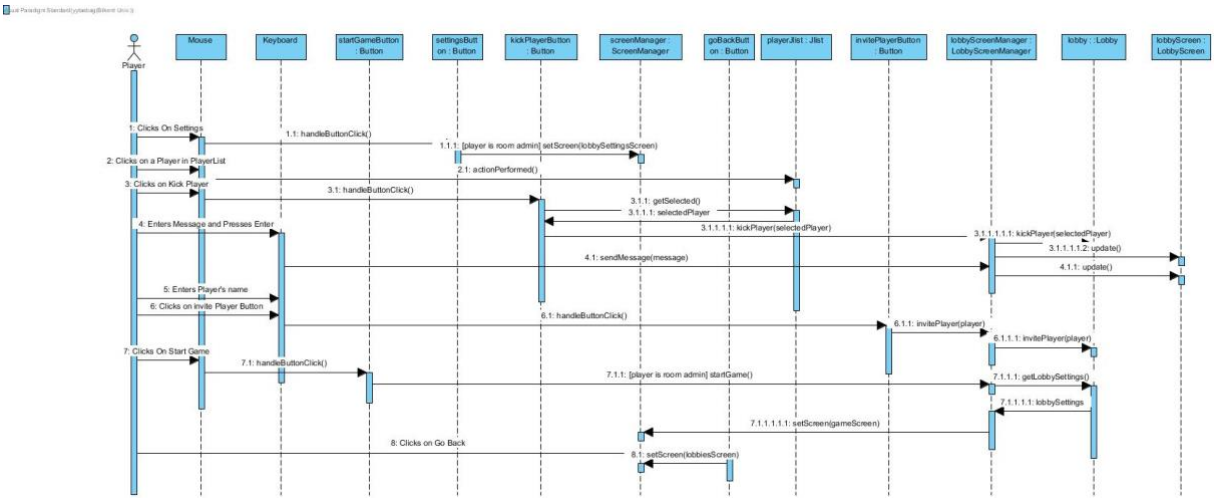


Figure 5-3-6

Player plays a game through lobby screen. After lobby admin clicks the Start button, the game starts. Lobby admin can change lobby settings by clicking the Settings button. This redirects lobby admin to lobby settings screen. Lobby admin can kick a player from lobby by clicking the Kick Player button. Players can invite players by entering a player's name, and

clicking the Invite button. Players also can chat in lobby screen. If a player wants to leave lobby, player clicks the go back button.

Lobby List Sequence Diagram

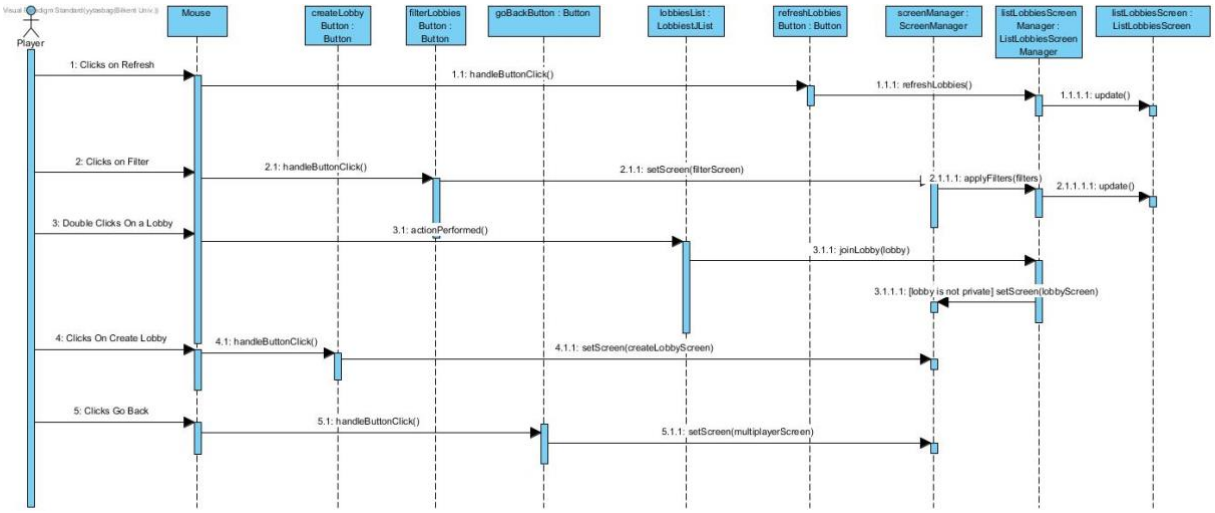


Figure 5-3-7

Player can see lobbies and their properties in the lobby list screen. Player can refresh to get the newest lobby list or filter the list to find the game player wants. Player can join a game with double clicking on the game. Player is redirected the lobby screen after double clicking. Player can create a game by clicking Create Lobby button. This redirects player to create lobby screen. Player can return the play menu by clicking the go back button.

Lobby Filters Sequence Diagram

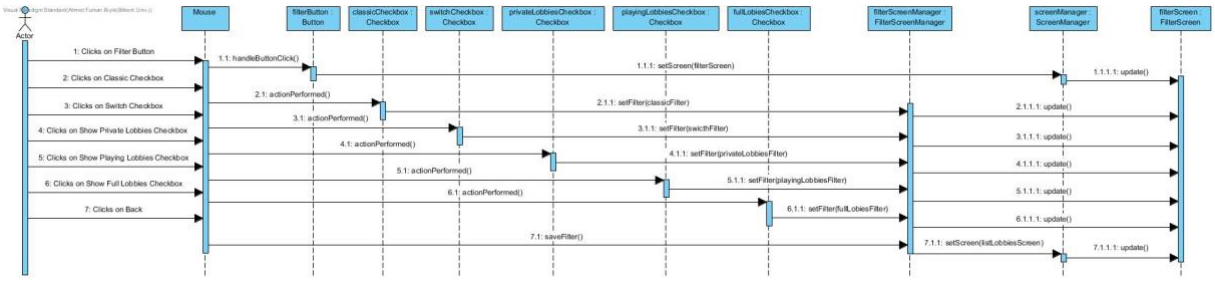


Figure 5-3-8

In the filter screen, the mode of the game can be selected by selecting the checkbox of the modes. Private, full and playing lobbies can be visible by selecting the checkbox of them. When the player wants to go back, the filter is saved and the lobby list menu is displayed on the screen.

Lobby Settings Sequence Diagram

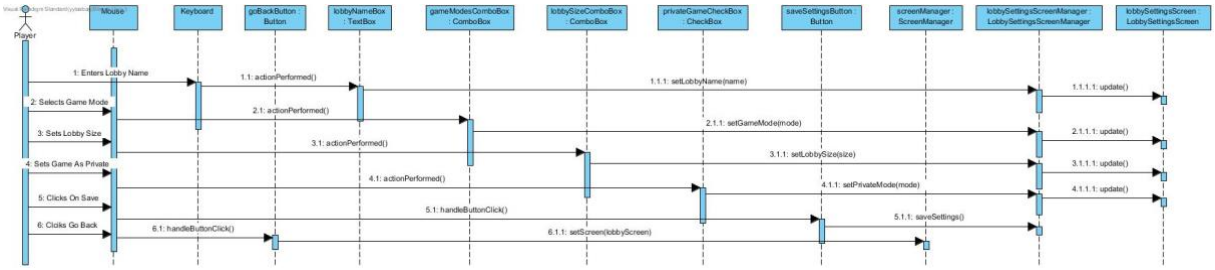


Figure 5-3-9

In the lobby settings, the player can enter the lobby name by clicking on the textbox, he/she can choose the game mode by clicking on the select game mode button. The player can also decide about the capacity of the lobby (in terms of number of players). The lobby can be set as private or public by checking the checkbox of the privacy status.

Classic Mode Sequence Diagram

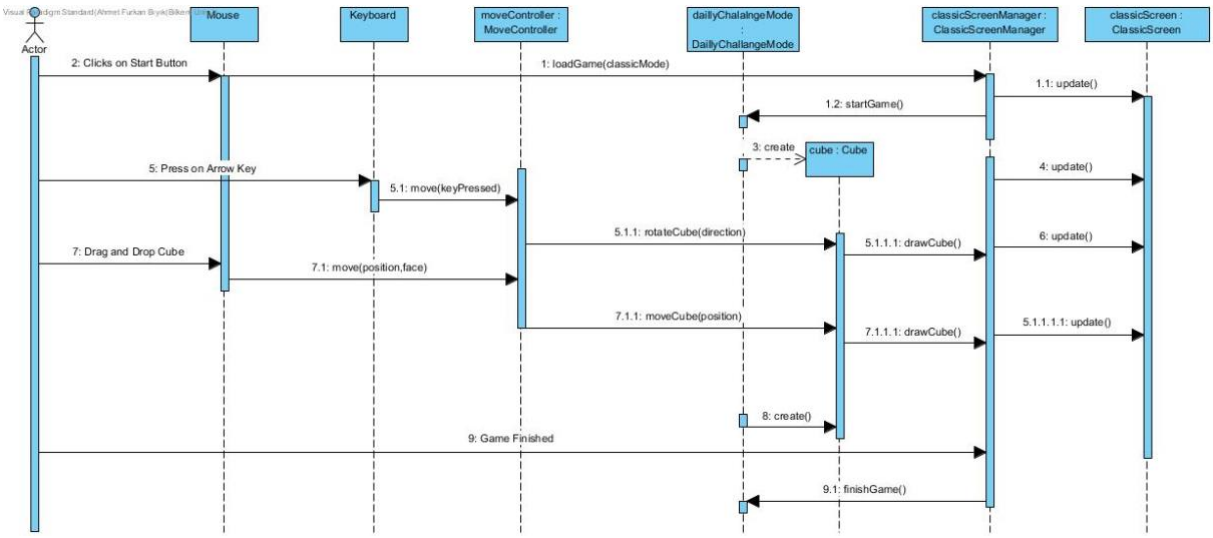


Figure 5-3-10

In the classic mode, if player presses on an arrow key or drags and drops the cube, the cube will be moved to the desired place if the opponent has not completed his/her board. If the overall placement of the board is correct and the opponent is not finished yet, the player will be the winner of the round. When the game is over, winner of the game will be displayed.

Switch Mode Sequence Diagram

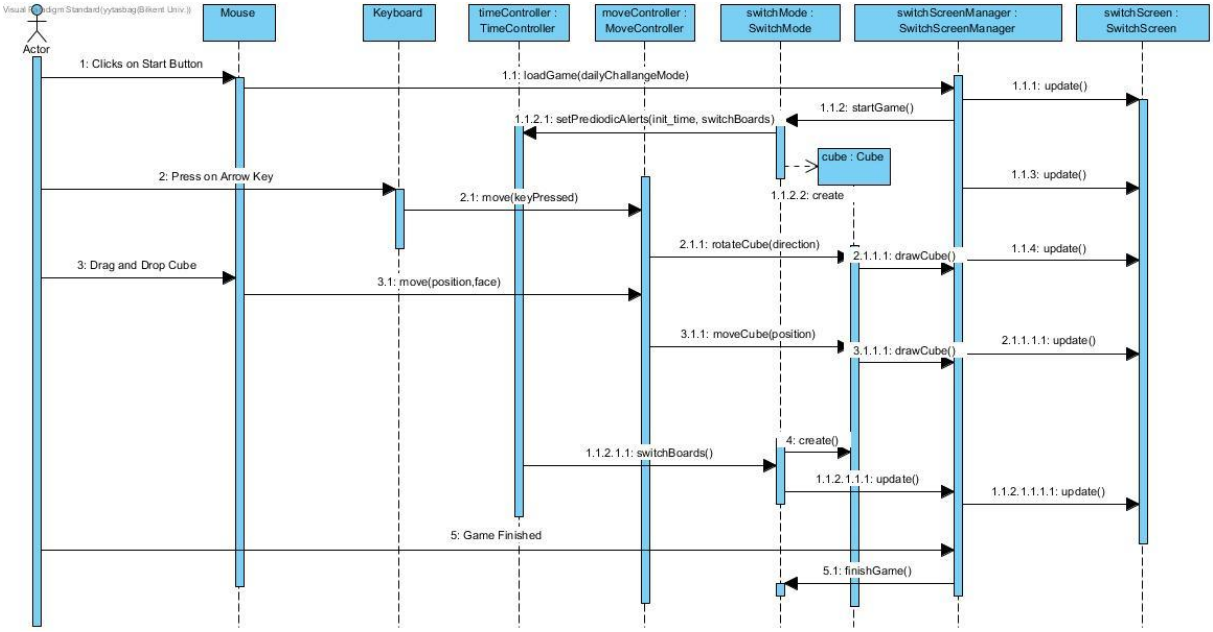


Figure 5-3-11

In the switch mode, if player presses on an arrow key or drags and drops the cube, the cube will be moved to the desired place. In every 15 seconds, they players will switch the boards – time will be controlled by a timeController –. If the overall placement of the board is correct, the game is over, and the winner will be displayed.

Leaderboard Sequence Diagram

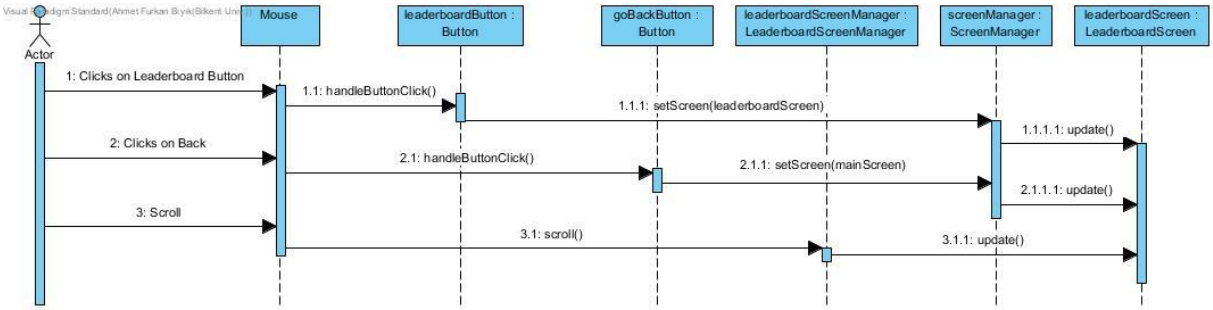


Figure 5-3-12

In the leaderboard screen, the user can only scroll and go back to main menu, if he/she scrolls, the screen will be handled by the screen manager. If the player chooses to go back, the main menu of the game will be shown.

Credits Sequence Diagram

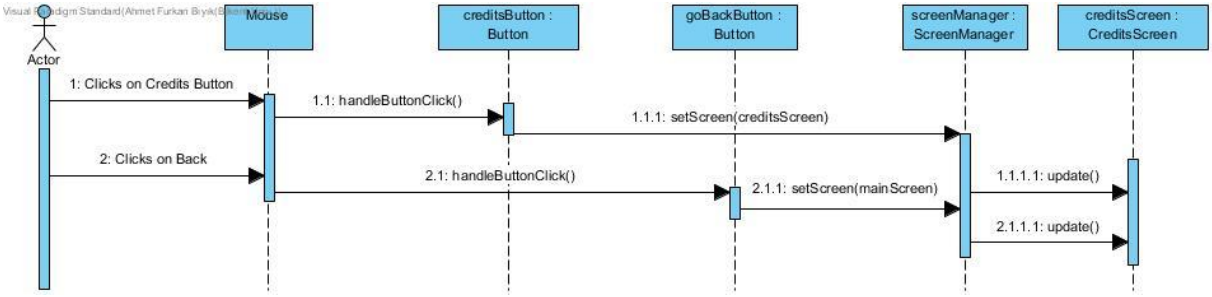


Figure 5-3-13

When the Credits button is pressed, credits screen is displayed. Player can see the developers of the project. The player can return the main menu by pressing the go back button.

Settings Sequence Diagram

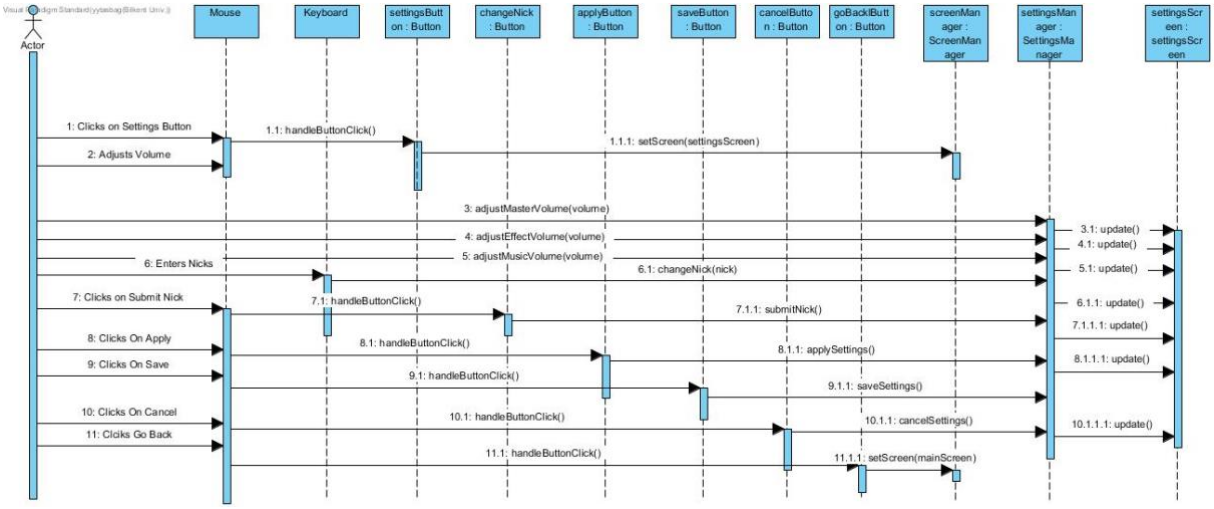


Figure 5-3-14

Player clicks on the Settings button. Settings about the game will be shown. During this interaction the player can adjust volume, resolution and can change nick name. After this interaction player can apply, save or cancel the changes. After this player will be redirected to the main menu.

Tutorials Sequence Diagram

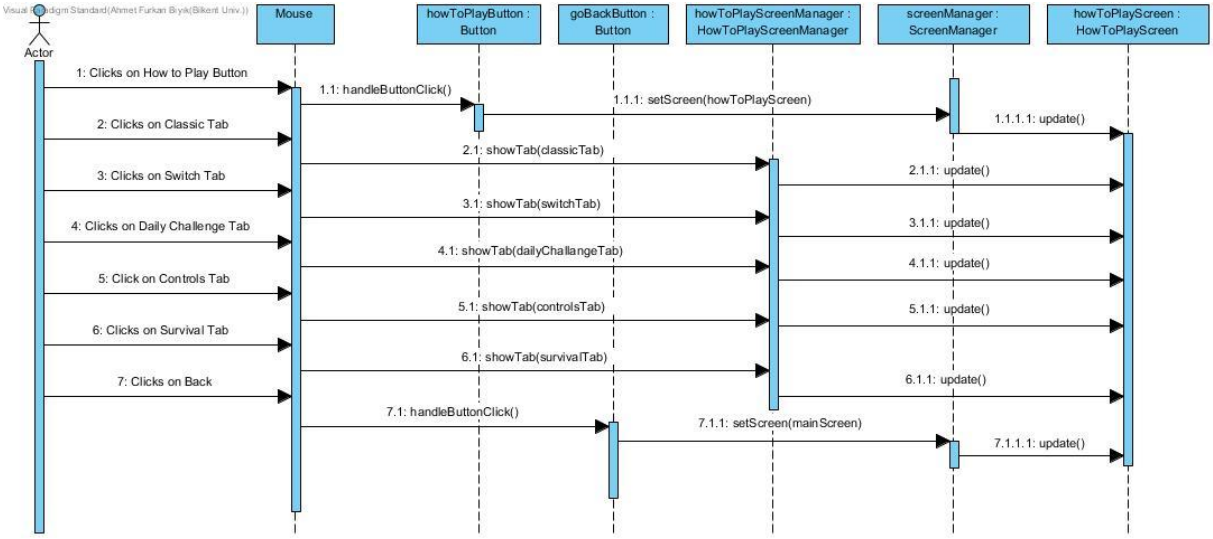


Figure 5-3-15

If player wants to learn how to play game, player clicks How to Play button. Player sees information about the game with different aspects such as game modes and controls represented on different tabs which player chooses.

Object and Class Model

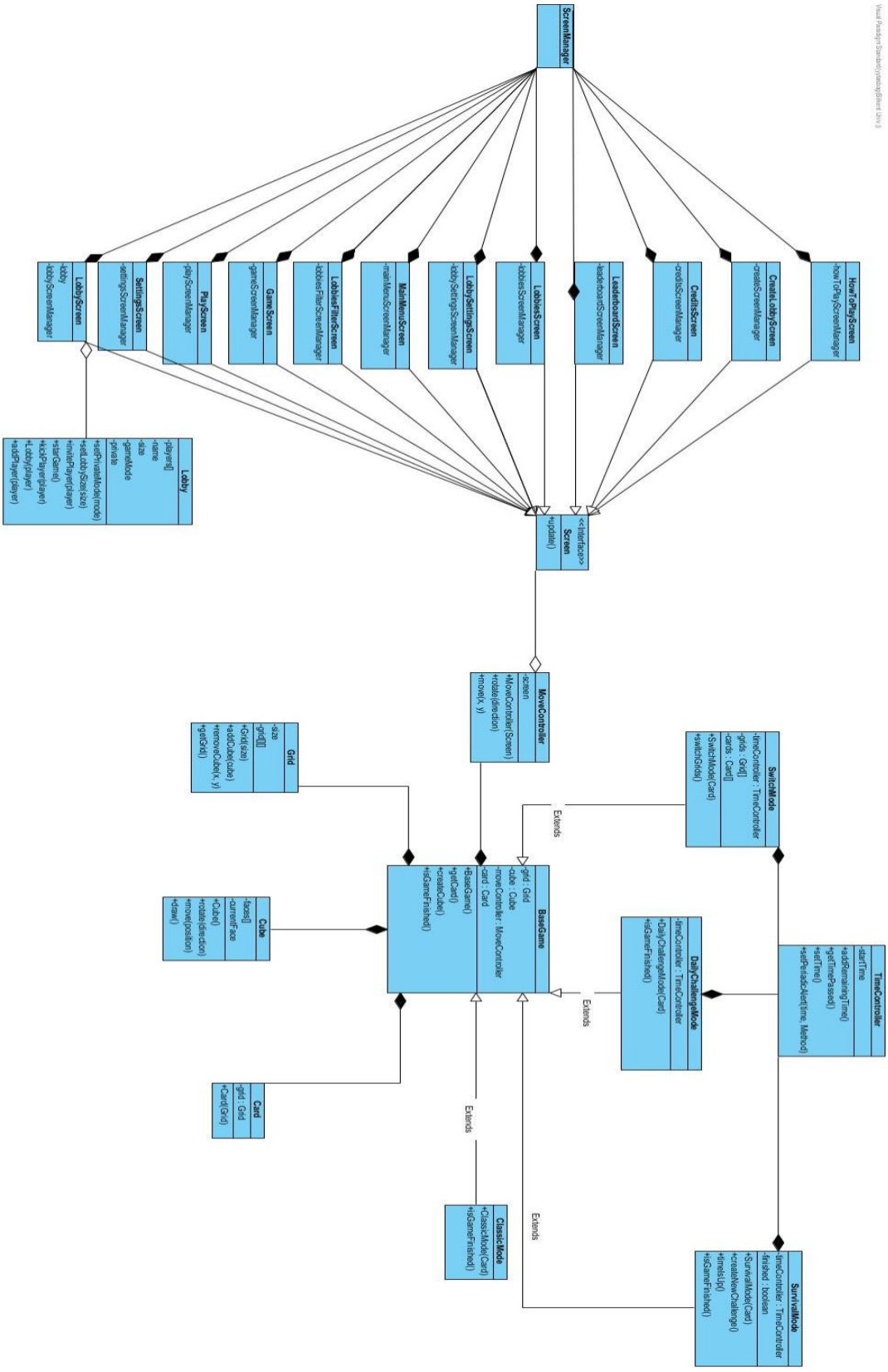
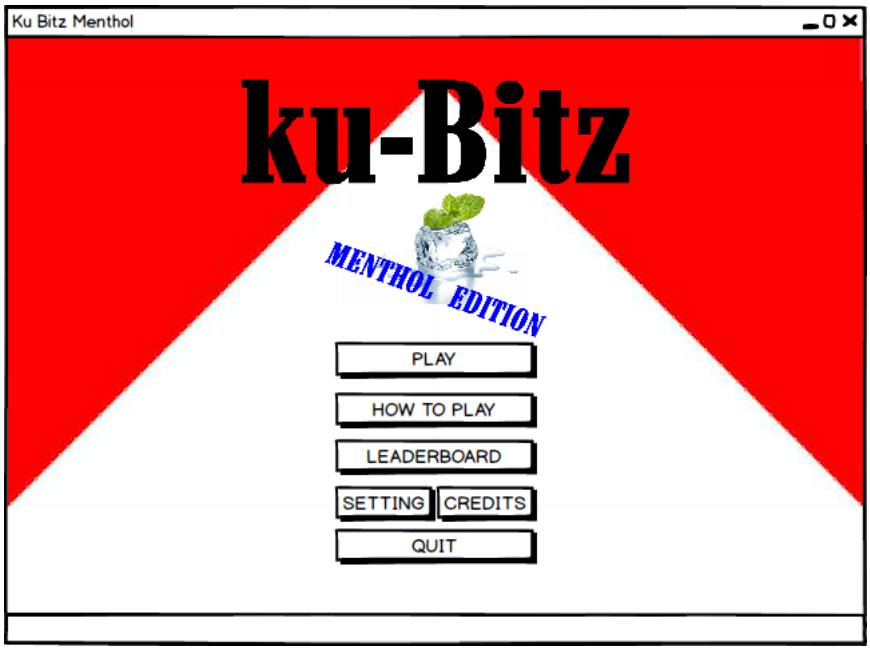


Figure 5.4.1

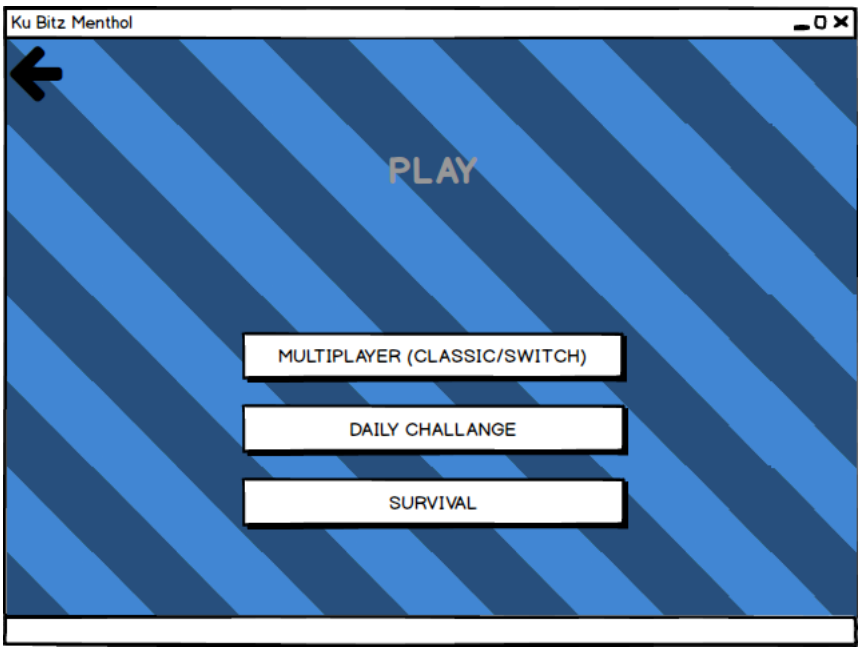
User Interface

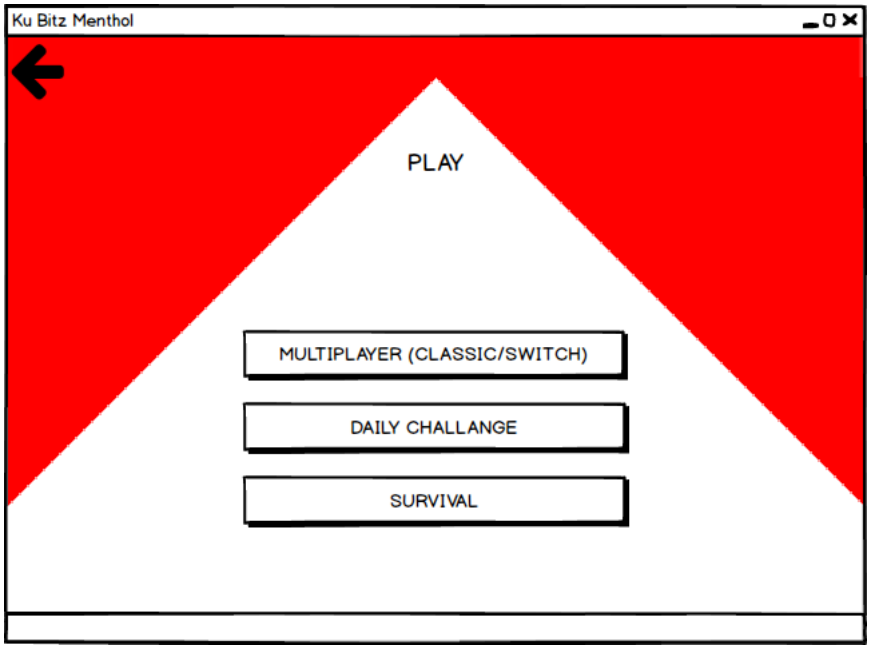
We have designed two themes for each screen that will be chosen by the player.

Main Menu

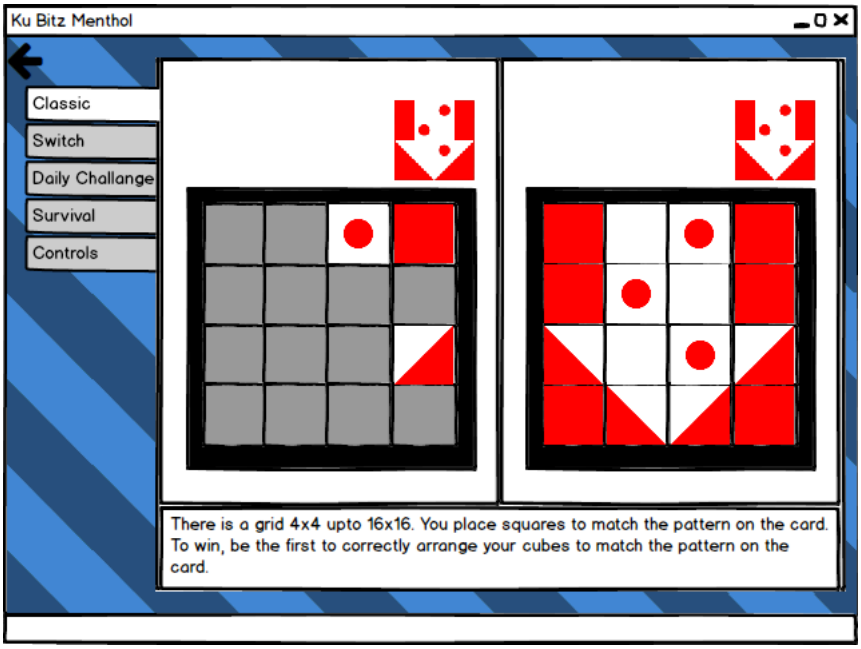


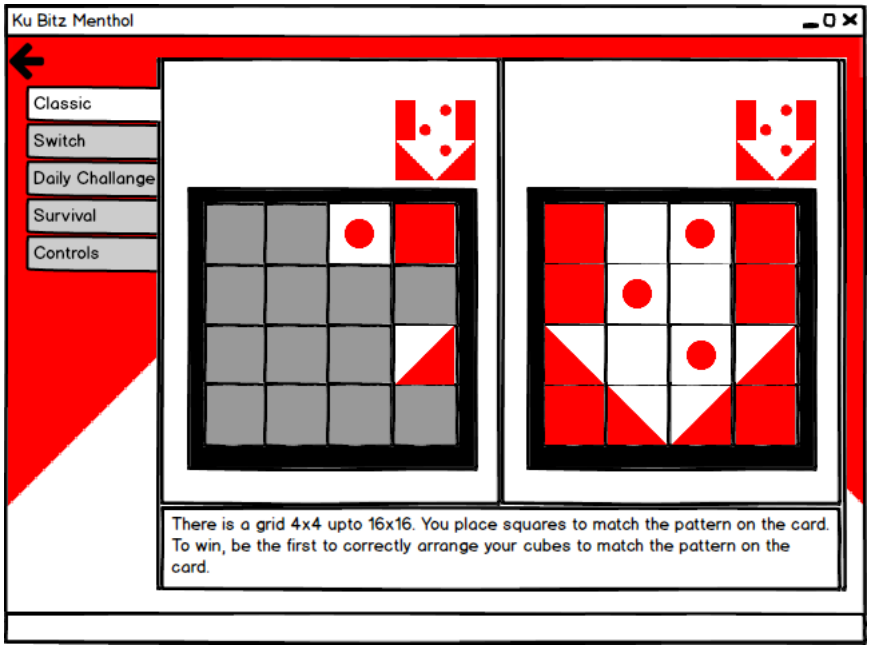
Play Screen


Ku Bitz Menthol
PLAY
MULTIPLAYER (CLASSIC/SWITCH)
DAILY CHALLANGE
SURVIVAL

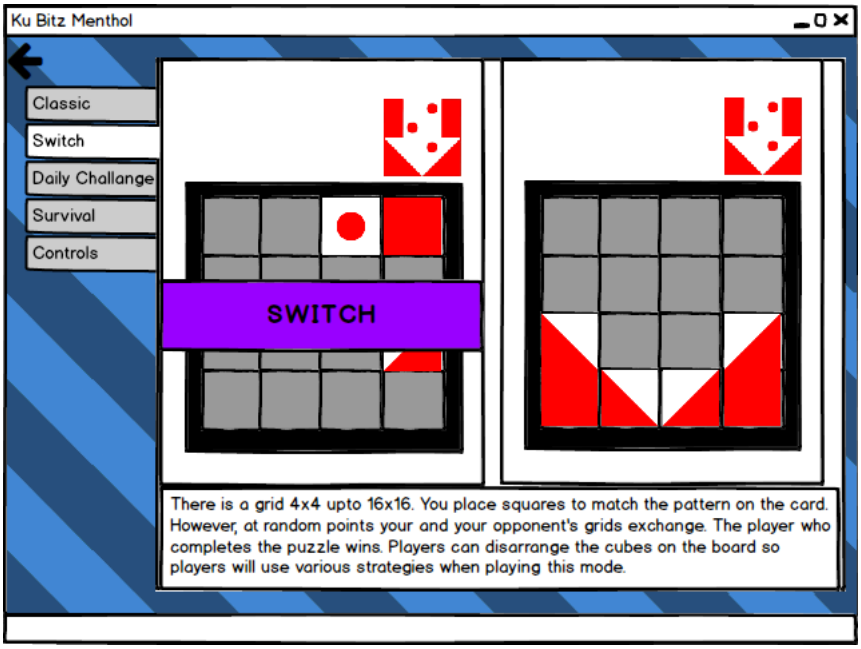

Ku Bitz Menthol
PLAY
MULTIPLAYER (CLASSIC/SWITCH)
DAILY CHALLANGE
SURVIVAL

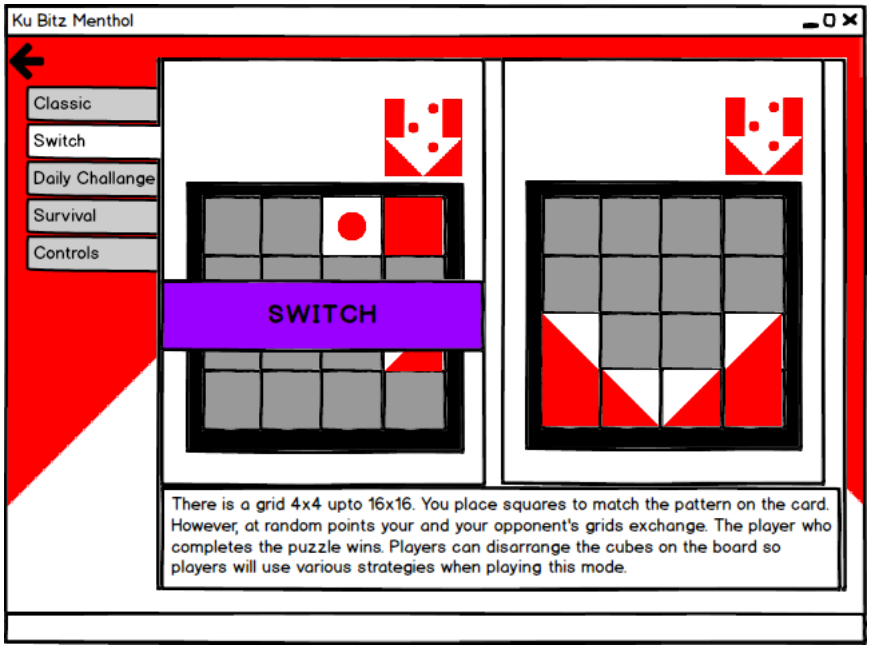
Tutorial Screen of Classic Mode



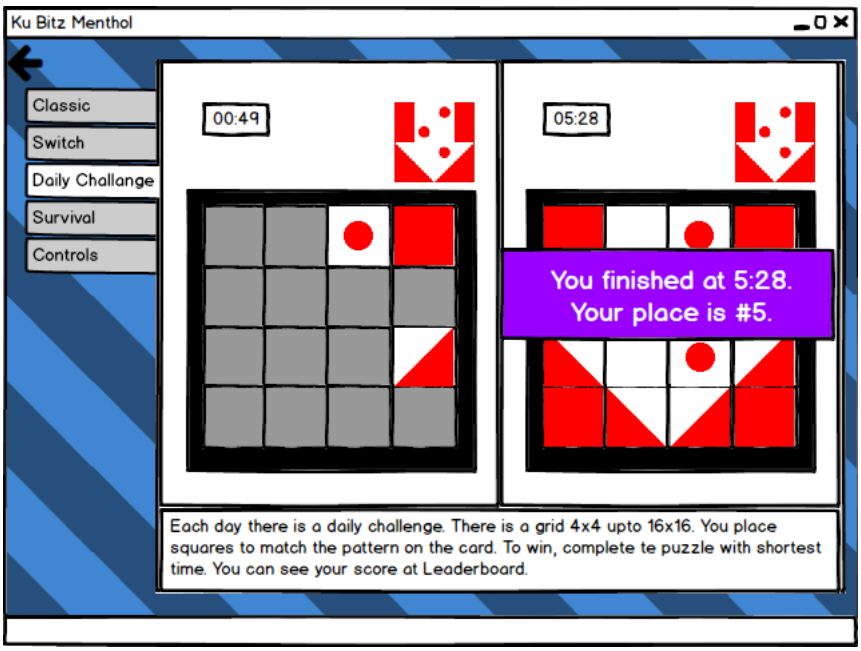


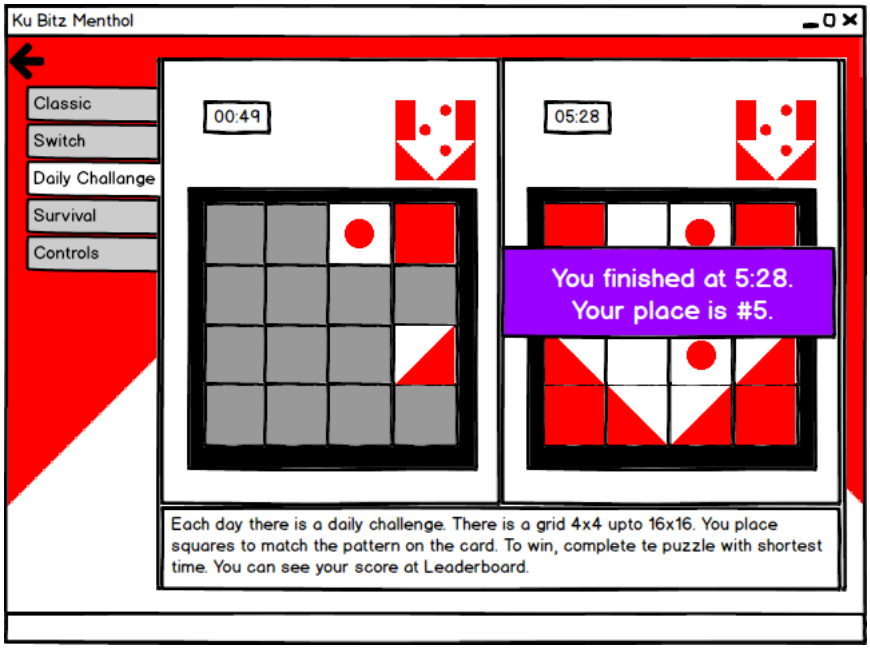
Tutorial Screen of the Switch Mode



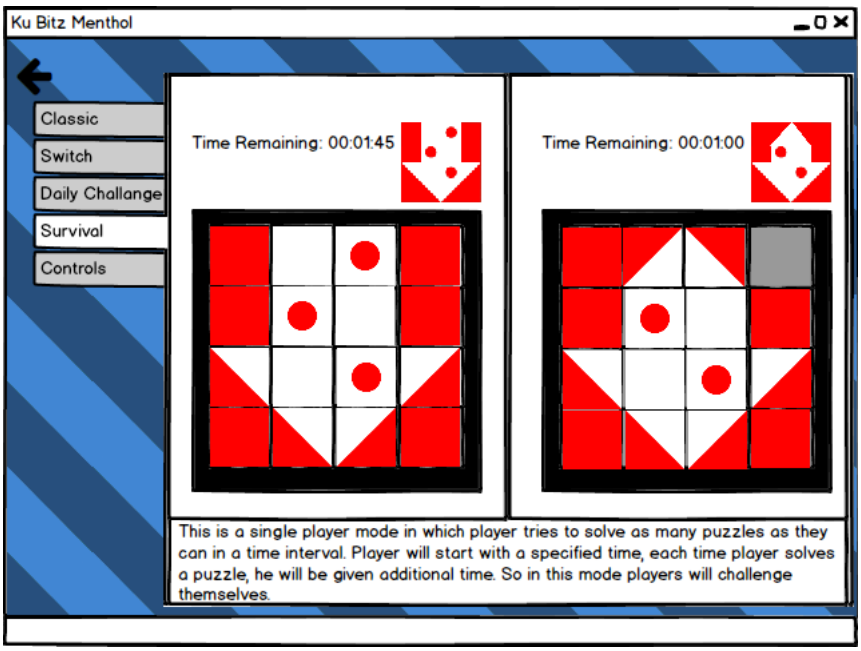


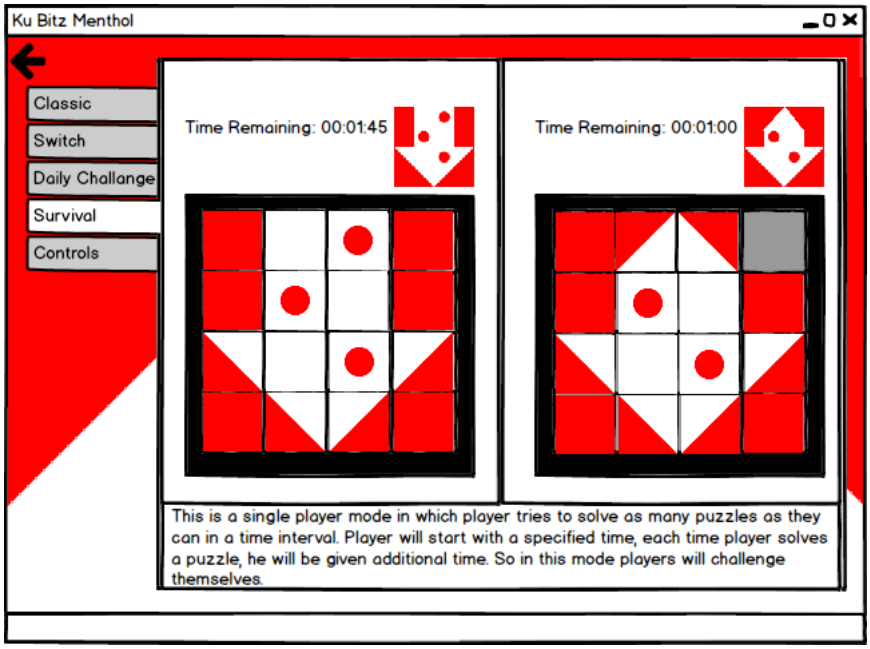
Tutorial Screen of the Daily Challenge Mode



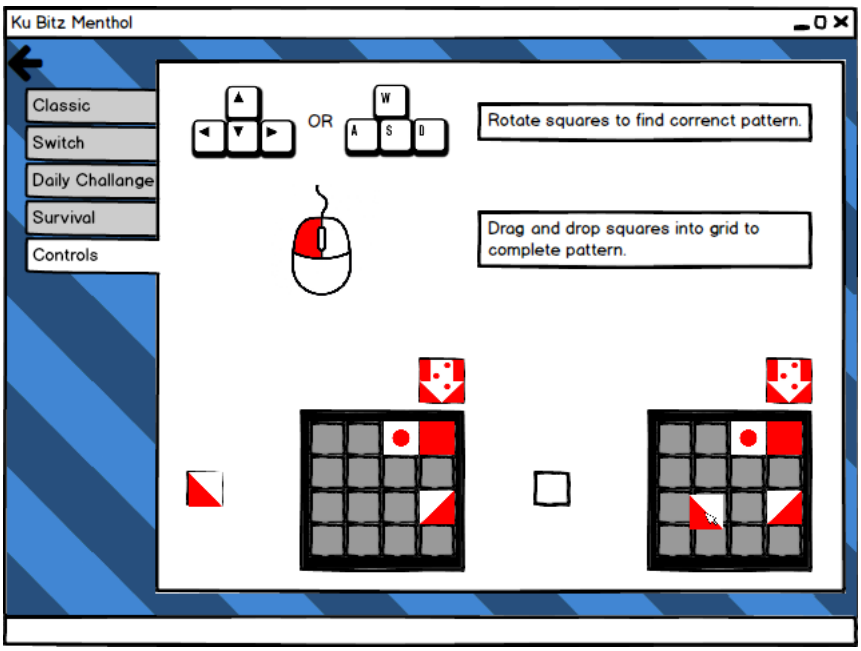


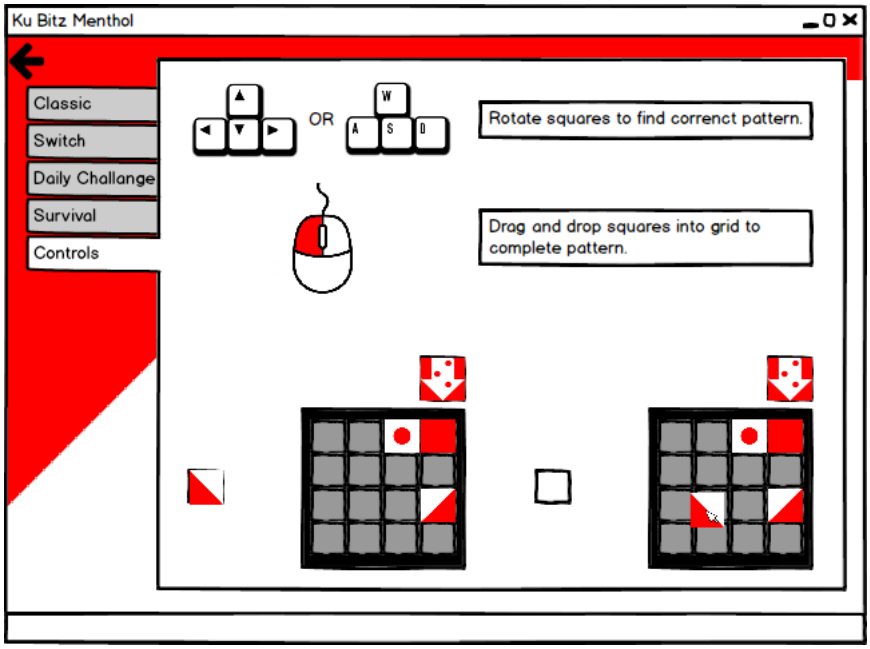
Tutorial Screen of the Survival Mode



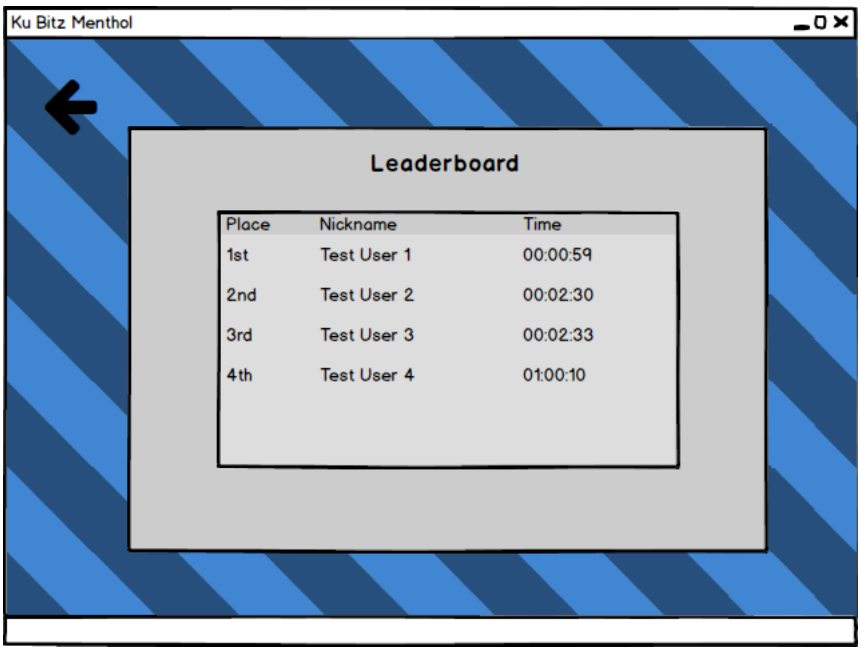


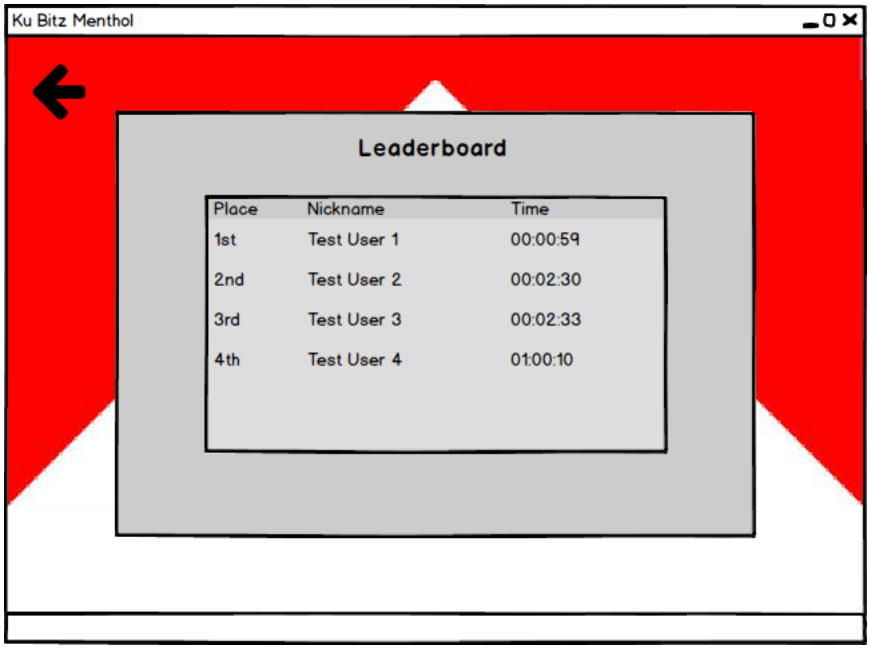
Tutorial Screen of the Controls



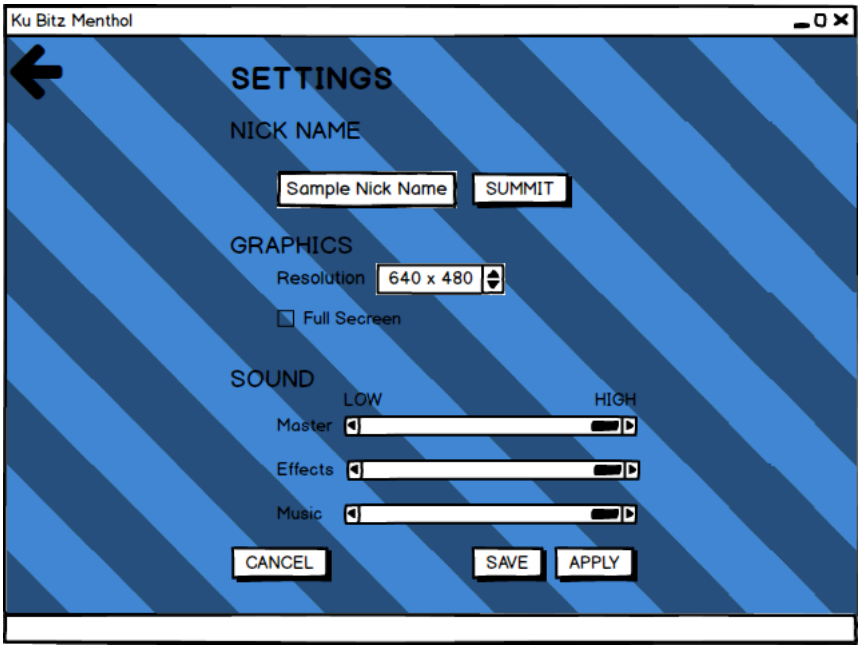


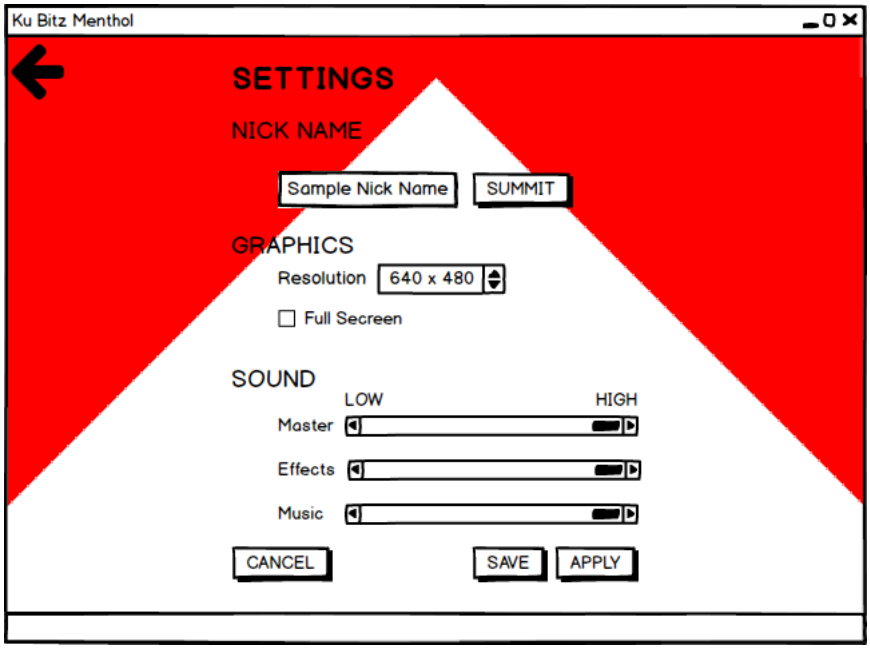
Leaderboard Screen



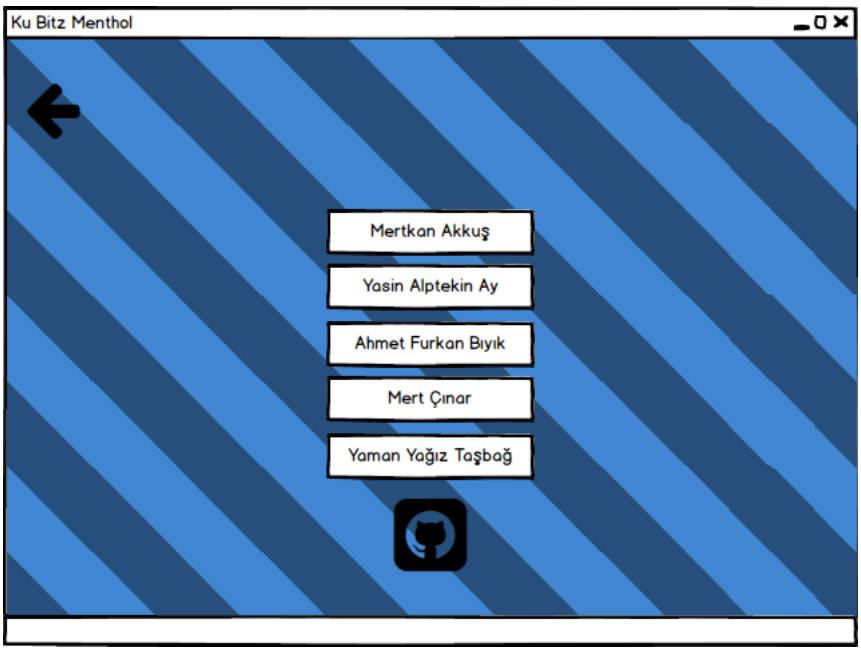


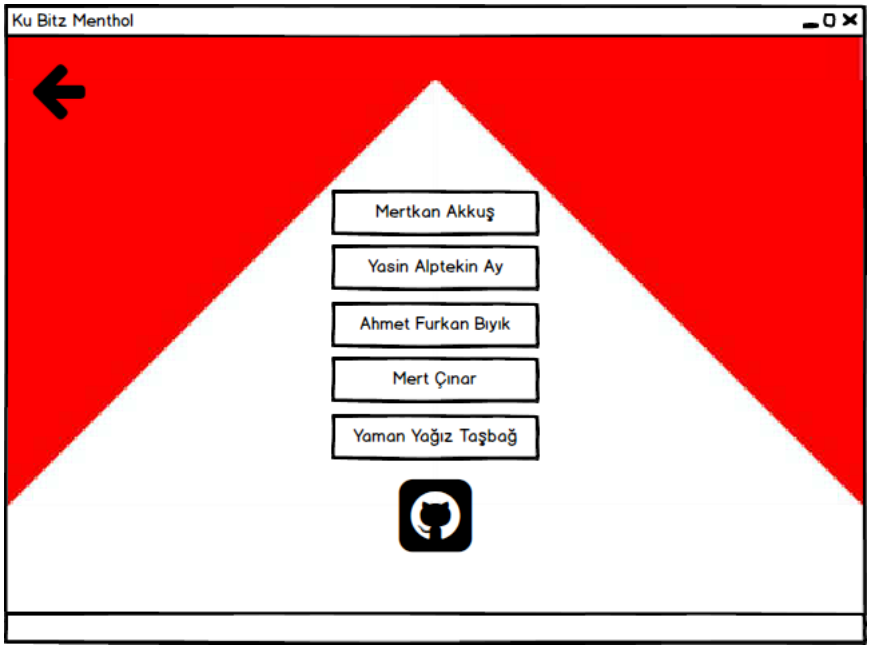
Settings Screen



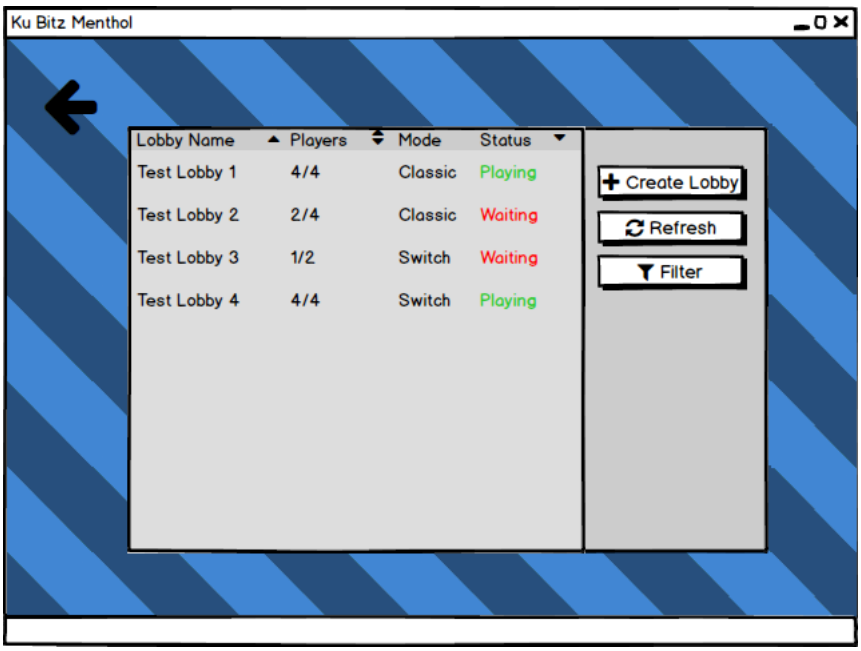


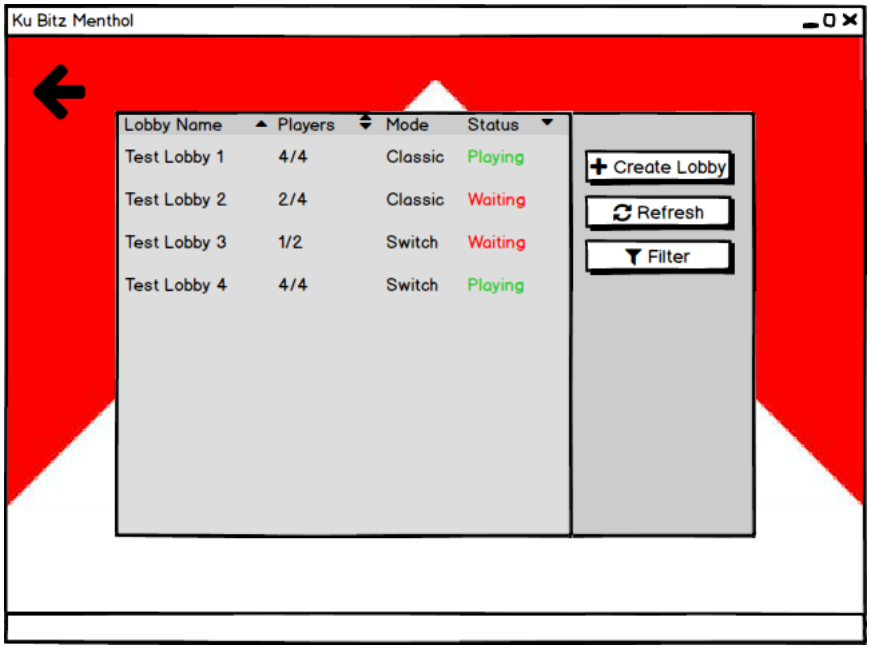
Credits Screen



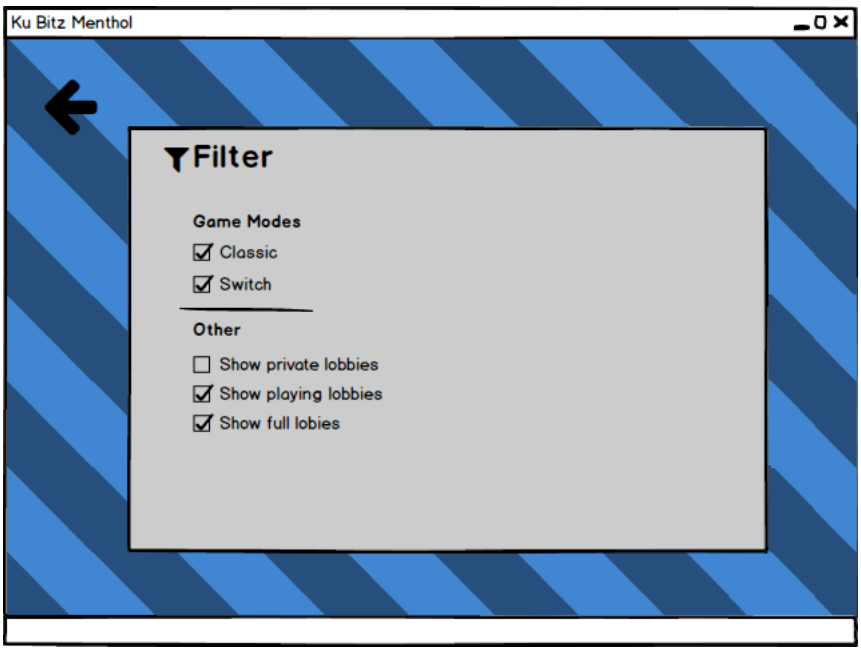


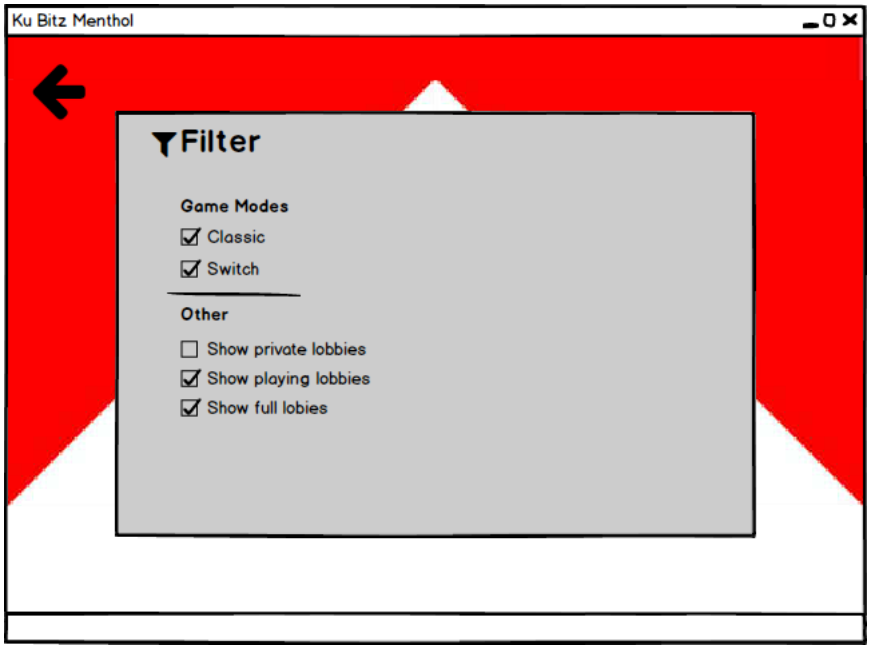
Lobby List Screen



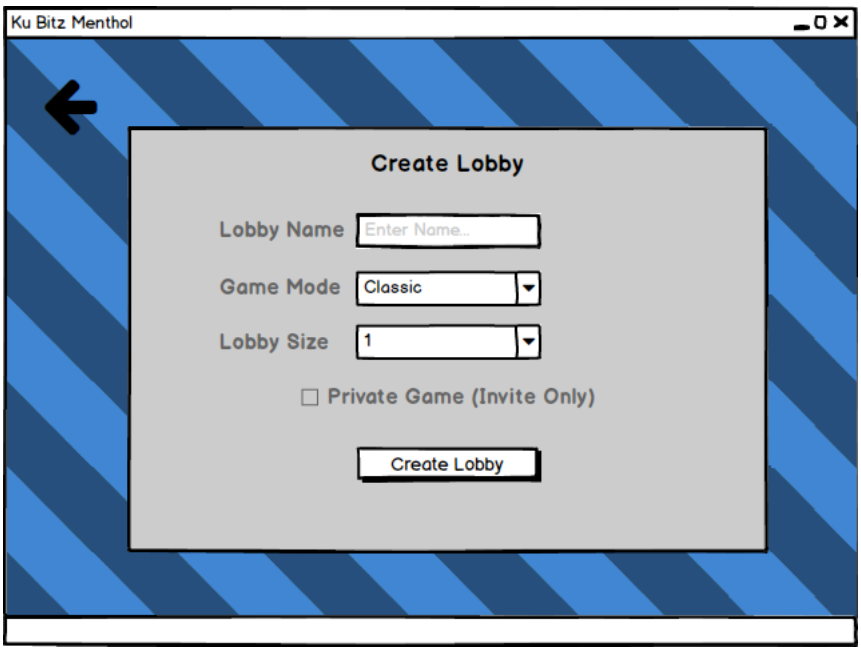


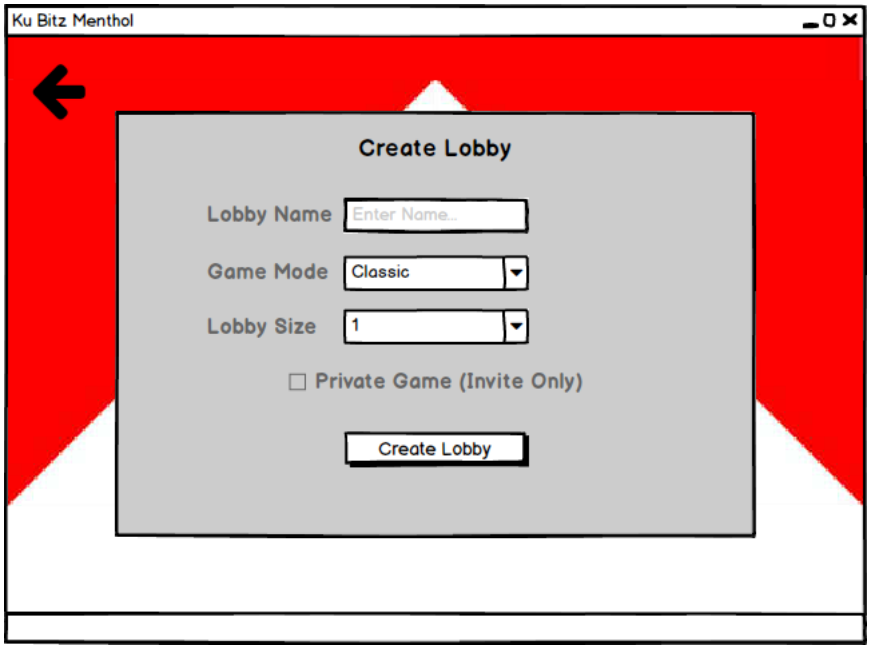
Lobby Filter Screen



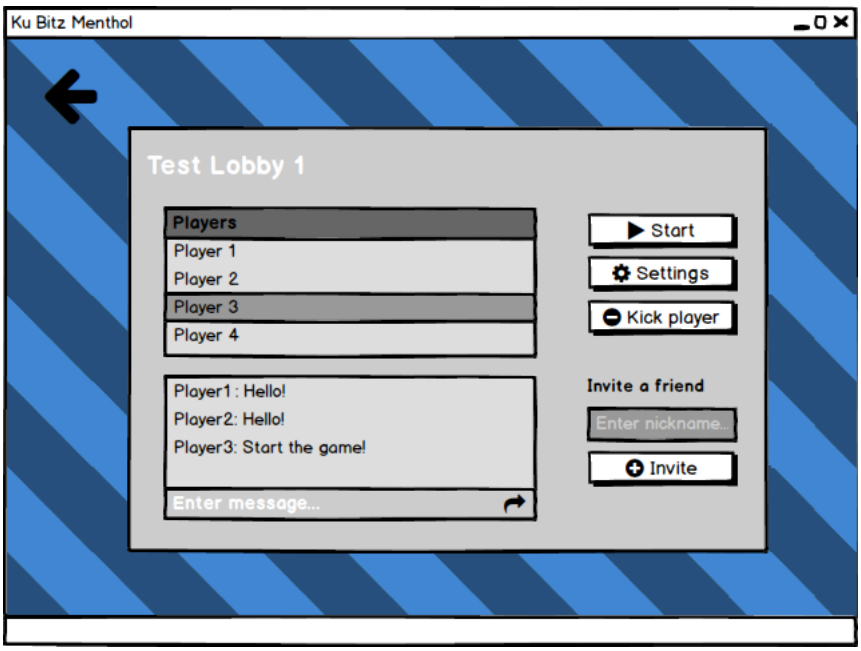


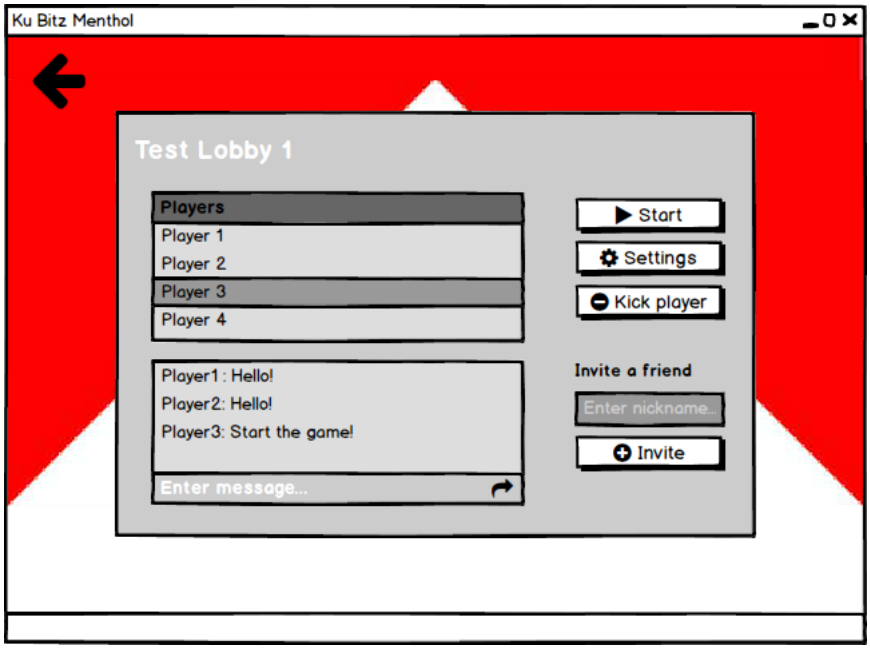
Create Lobby Screen



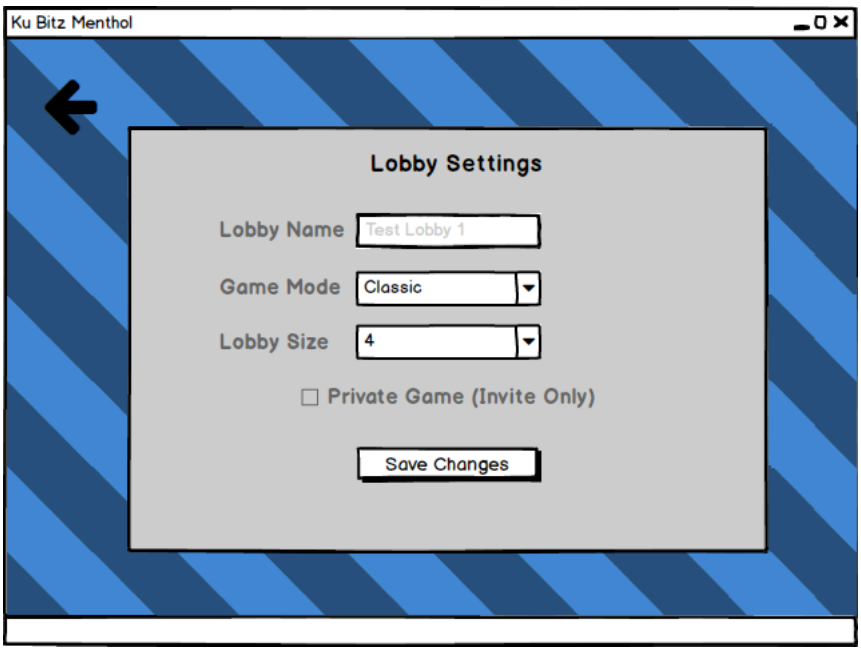


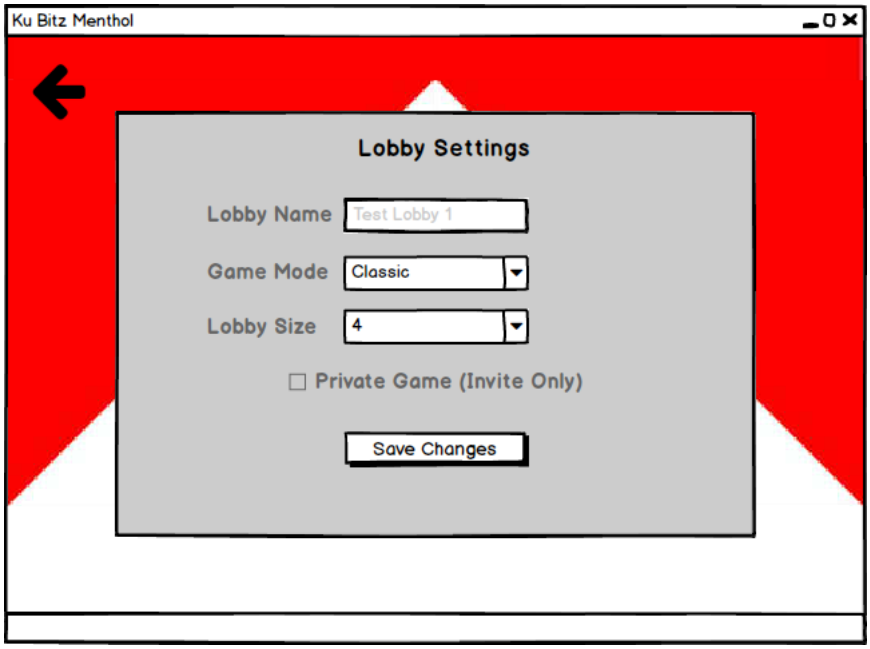
Lobby Screen



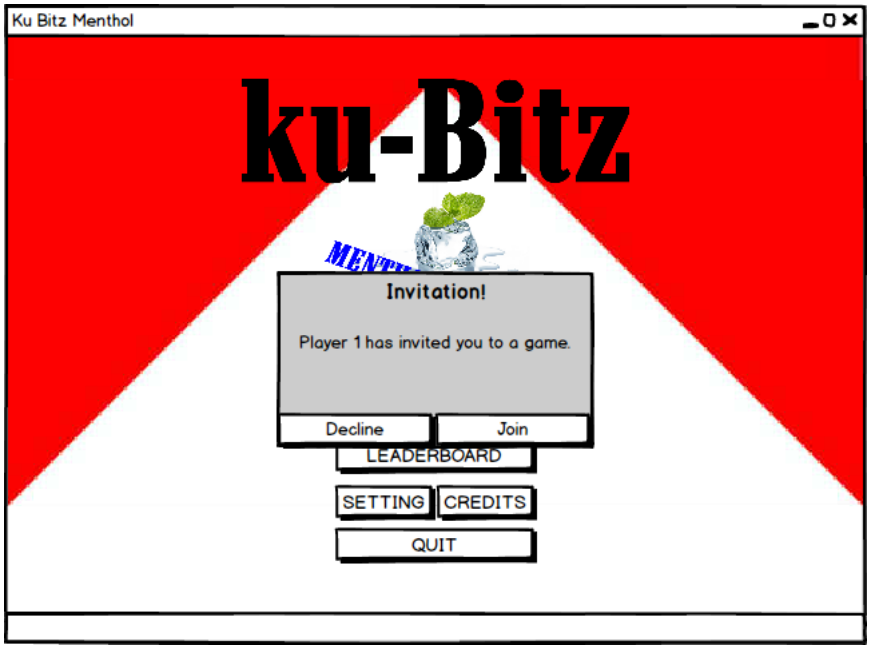


Lobby Settings Screen

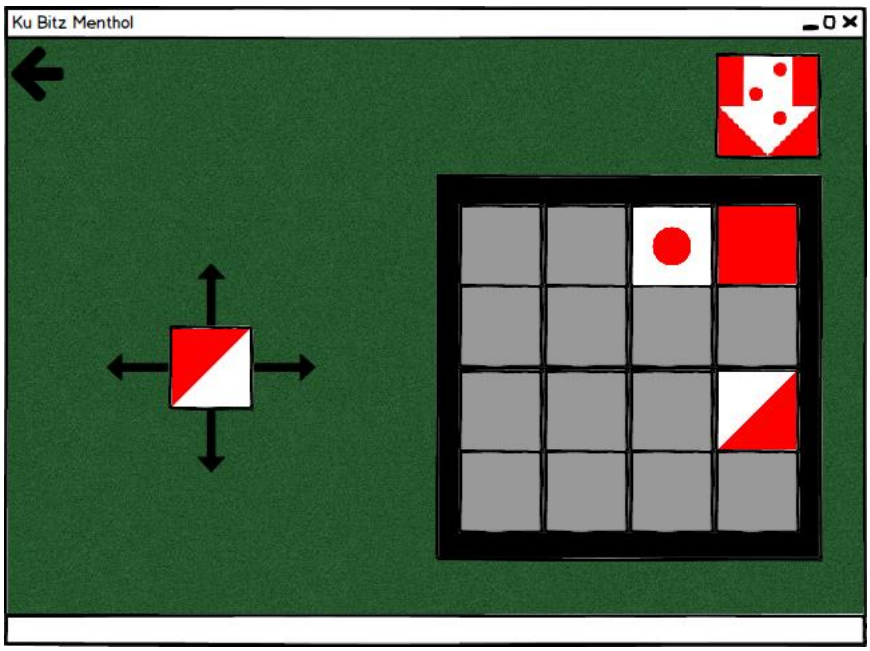


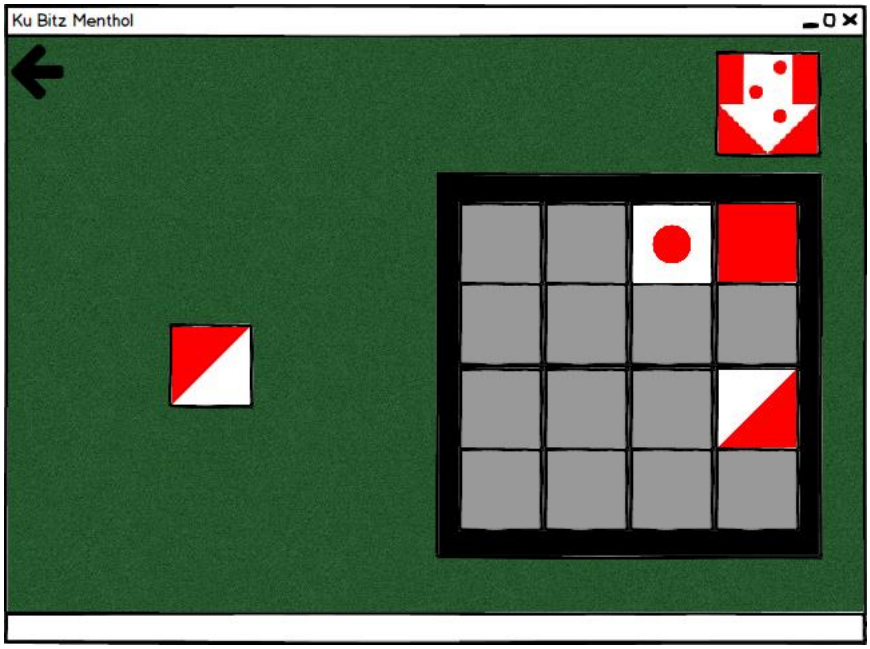


Invitation Screen

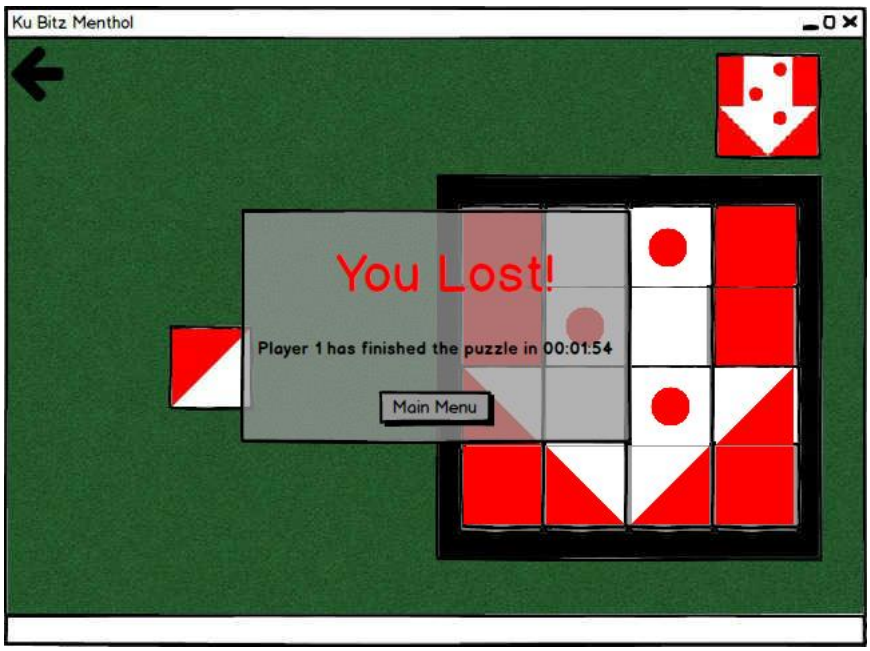


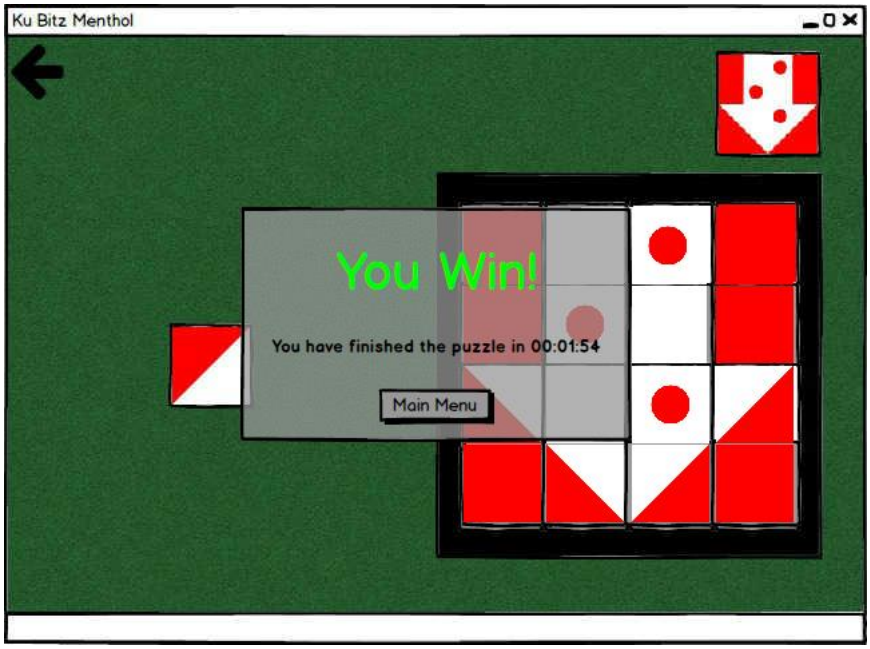
Game Play Screen





Win/Loss Screen





References

1) https://www.mindware.orientaltrading.com/q-bitz-a2-44002.fltr
2) http://sburngdl.weebly.com/uploads/8/8/9/0/88900840/arrow_orig.png
3) http://pngimg.com/uploads/cursor/cursor_PNG91.png
4) https://www.kisspng.com/png-ice-mint-melting-menthol-wallpaper-ice-522060/
5) https://image.freepik.com/free-icon/mouse-ios-7-symbol_318-38753.jpg