Software Engineering

Unity Project Report
Bowling Alley (VR)

Team No. - 3

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Introduction

Overview of the project

The goal of the project is to create the **Bowling Alley** game in Unity Software and thus run the application in Virtual Reality mode. The project is implemented in a way that all functionalities should be fulfilled properly. It is a single-player game and there are 10 frames in 1 game, 1 frame includes 2 chances of throwing the game. The number of pins which are knocked down gets added to the score. The score is presented on the scoreboard which is displayed on the main screen.

Requirements

- Create a simple single-user – first-person bowling alley game. You may make use of the assets like Pins, Bowl etc. from the UNITY asset store.
- The participant user should have 10 attempts to reach the end of the game
- There should be able to maintain a scoreboard for the single user.
- Maintain Top score details for the last 10 games
- Create a Home Menu to enter and exit the game
- Include at least one audio effect in the entire VR Scene

Team Information and their responsibility

Name	Roll Number	Efforts(in hours)	Role
Siddhant Kulshrestha	2021201052	20	Worked on implementing and maintaining the options and high score screen along with its backend tasks.
Rishabh Malik	2020201074	23	Worked on developing and maintaining the gameplay screen and configuring it along with backend tasks for the game.
Ayushi Maheshwari	2020201053	18	Worked on maintaining backend tasks of the scoreboard, and options screen including all its configurations.
Purnima Grover	2021201014	19	Worked on implementing the main menu screen, UI for the scoreboard, adding audio components and configuring all these.
Kamal Phoolwani	2021201054	22	Worked on developing and maintaining the gameplay screen and configuring it along with backend tasks for the game.

- Submission Date: 23rd April 2022
- GitHub Link - https://github.com/rishabh26malik/SE-VR-Bowling-Game

Requirements Description

- **Req 1:-** Create a simple single-user – first-person bowling alley game. You may make use of the assets like Pins, Bowl etc. from the UNITY asset store.
  - ➔ First, we created a main menu or dashboard from where the game starts. This is the first screen when the VR starts.
  - ➔ There are more screens in the game i.e. Play game, Score, Options
  - ➔ In the game, there is an alley for throwing the ball. On one side, the player throws the ball and on the other side pins are present.
  - ➔ On the left side of the alley, the ball stand is there from where we can pick the ball.
  - ➔ The scoreboard is visible in the front where the score gets updated on each throw of the ball.
  - ➔ After completion of 10 frames, the game gets completed.
  - ➔ On the game screen, there is an option to go back to the main menu and exit the game at any instant time.

- **Req 2:-** The participant user should have 10 attempts to reach the end of the game
  - ➔ There are a total of 10 frames in the complete game.
  - ➔ Each frame in the game has 2 chances.
  - ➔ In the first chance, if there is a strike then the game moves to the next frame.
  - ➔ If there is no strike in the first go then the player gets a second chance to throw a ball.
  - ➔ In the second chance, the remaining pins are knocked down.
  - ➔ The number of pins which get knocked down is added to the cumulative score and shown on the screen board.

- **Req 3: -** Maintain Top score details for the last 10 games
  - ➔ The scores of all the games are stored in a file.

➔ When we click on the score button on the dashboard, all the data in the file is retrieved and stored in the array in the script file.
➔ After that, we will sort the file in descending order.
➔ If entries in the file are more than 10, then the top 10 highest scores are extracted and get printed on the screen.
➔ Else, the entries which are present are printed on the screen and the other things are left blank on the board.

- **Req 4: -** There should be an ability to maintain a scoreboard for a single user.
  ➔ In the whole game, the scoreboard is maintained on the front screen of VR which dynamically changes at each throw of the ball
  ➔ The pins which get down while throwing the ball, events are tracked i.e. how many pins are down then that score gets displayed on scoreboard and gets added in the cumulative score.

- **Req 5: -** Create a Home Menu to enter and exit the game
  ➔ The first screen which is visible at the start of the game is the home menu or dashboard where there are 4 buttons – Play Game, Score, Options and Quit
  ➔ Play game button is used to start the game. After that we enter a new frame where there is an actual game to play in the bowling alley.
  ➔ The Score button displays a high score screen where there are top 10 high scores of all games.
  ➔ The options button is the same as the settings option where we can change the sound and graphics of the game.
  ➔ After entering Quit, the game gets closed.

- **Req 6: -** Include at least one audio effect in the entire VR Scene
  ➔ We added 2 audio effects in the complete game.
  ➔ One sound is on the dashboard, Score and Options Screen.
  ➔ In the main game screen, there is a sound effect when we throw the ball on the pins and the ball hits the pins.

Product Features

- **Home Screen** - The first screen which is visible when the game starts. It has the option to play the game, show high scores, options and exit game. While clicking on the play button the game will start, and the options button will show a new screen with which we can change the sound and the graphics of the game.

- **Game Screen** – The main game window where the pins and balls are present. The player picks up the ball from the stand and then bowls on the alley, the pins which are present on the other side get dropped down and the number of pins which are dropped is stored in the score variable in the first chance of frame. In the second chance of the frame, the bowl is again thrown on the remaining pins, the pins which are down will get added to the score. If all the pins go down at first or second chance then it is a strike. The same steps are repeated for 10 frames. The final score gets added to the file.

- **High Scores** – It shows the top 10 highest scores of all games on the new screen. All the scores of the game are stored in the file which is written at the time of showing a high score on the new window. The data present in the file is first fetched and all the scores are sorted in descending order after that top 10 scores are printed on the High Score Screen.

- **Options Screen** – This screen shows the option to increase/decrease the sound and change the graphics of the game to high, low or medium. There is a slider input type for changing the sound of the game. If we shift it to the right side then the sound gets increased and if it is shifted to the left side the sound gets decreased. For the graphics part, there is a dropdown window with high, low or medium graphics.

Specifications

Bowling Pin

	Configuration
Mass	15 kg
Height	0.38 m

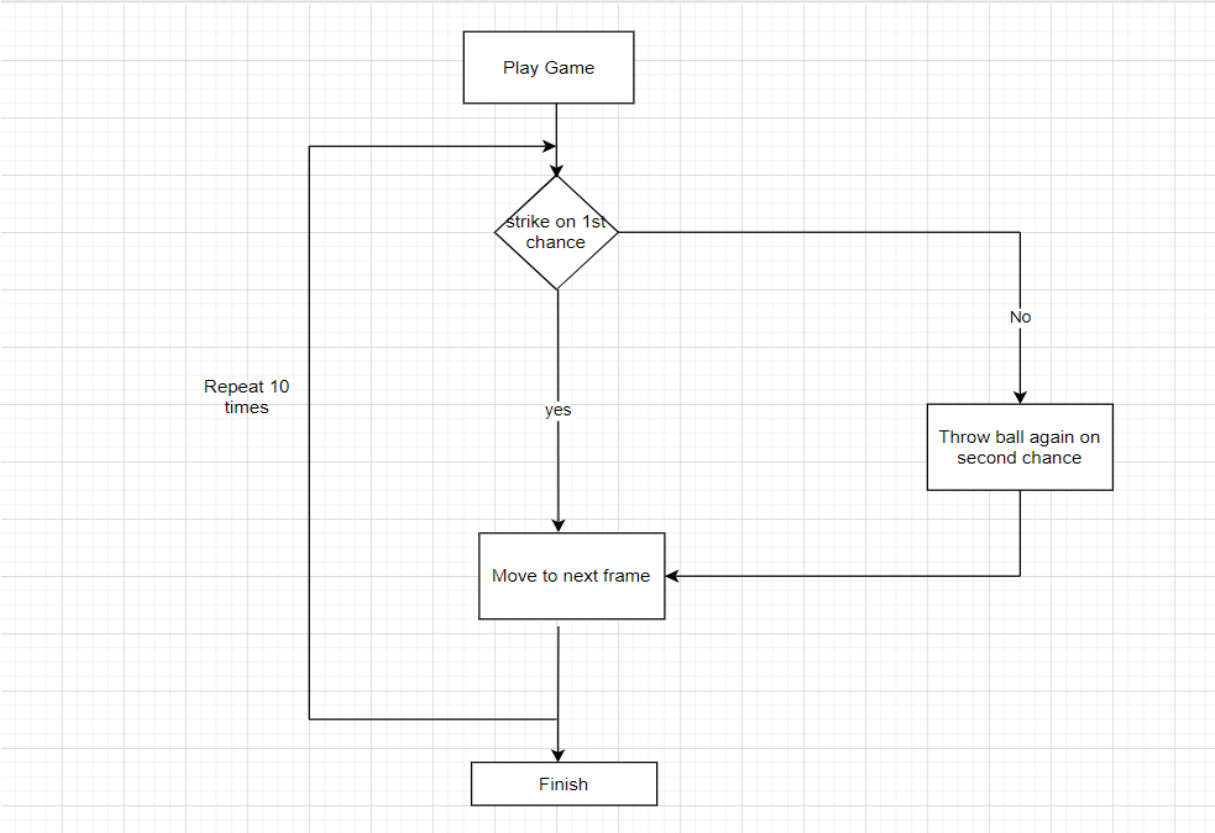
Ball

	Configuration
Mass	25 kg
Diameter	16 cm

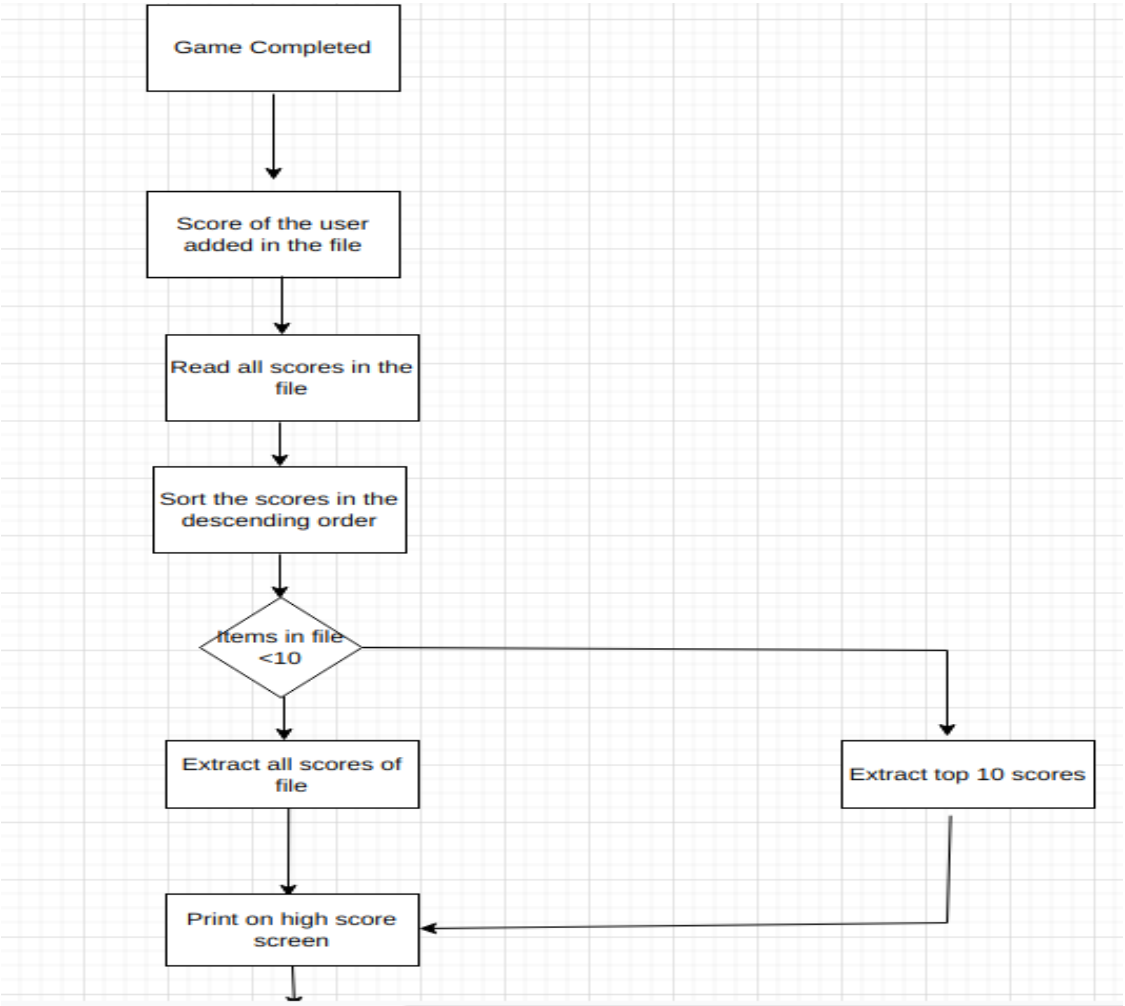
Lane

	Configuration
Length of lane	18 m
Width of lane	10 m

Flow Chart

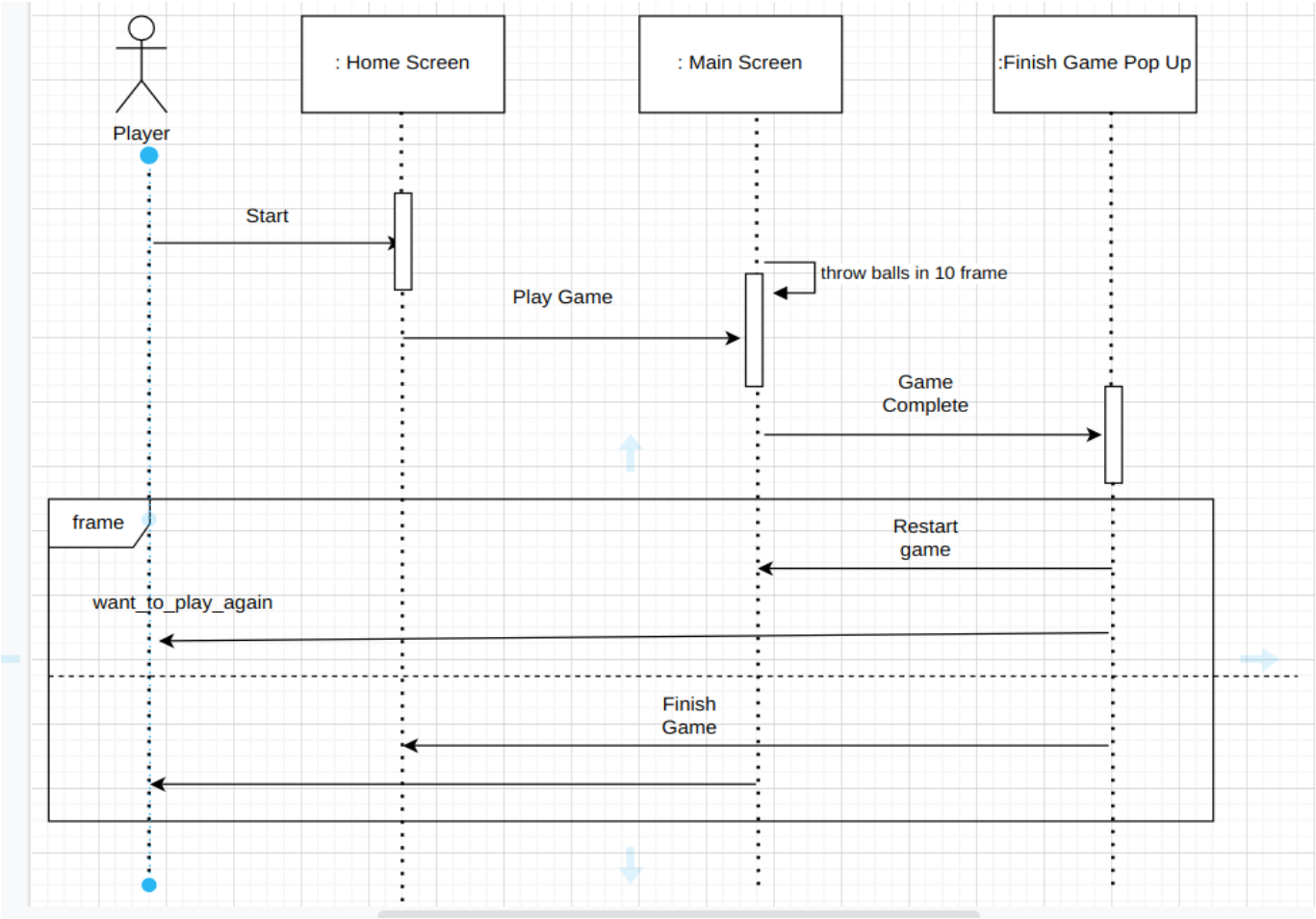


Bowling Alley Flow Chart

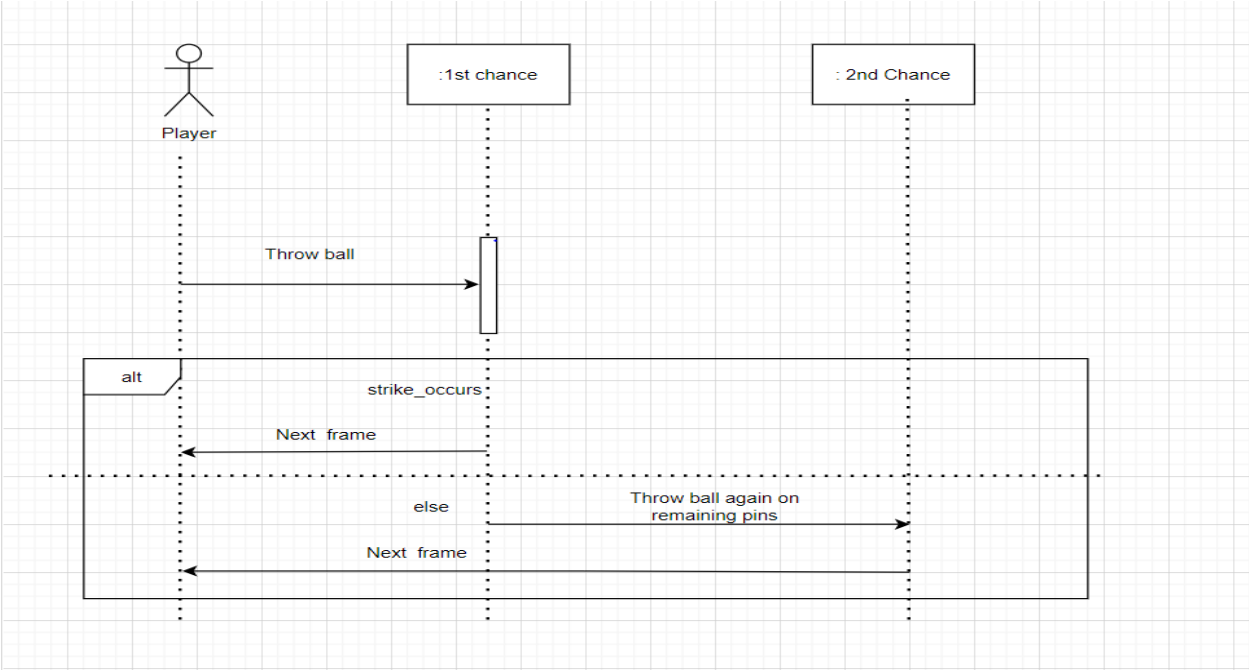


High Score Calculation

Sequence Diagram



Complete Game Flow



Flow of events in 1 Frame

Static Characteristics

Characteristics	**Description**
Alley	The floor area where the ball is thrown
Bowl Stand	The stand where balls are placed and the player picks the ball from there
Gutter Alignment	Side area of the alley where bowl gets down when it is not thrown properly to the pins

Dynamic Characteristics

Characteristics	Description
Pins	Pins which are knocked down are dynamic in nature as knocking off the ball depends on the way the ball is thrown
Score Board	Score Board present in the front of the screen gets changed after each chance.
Ball	The position of the ball gets changed with respect to the player.
Gutter Checking	Box colliders are applied on Gulley entities. Whenever the ball comes in contact with it, it marks the entrance of the ball into the gutter.
Outside Play Area Checking	Box colliders are applied to all three sides (left, right and back) of the play area (Alley). Whenever the ball is thrown outside the alley play area and it comes in contact with the collider applied in the outside area, this check is confirmed.

Pin hitting check	A sphere is applied on the 10 pins covering all of them with a radius of 0.55. When the ball enters this sphere, a function is run to check how many pins have fallen.
Counting Pins	For checking this, we use the rotation angle of the x and z-axis of the pins. If these angles are in the range [5, 355] degrees then we have considered the pin to have fallen. Along with this condition, the pin also should be in the active state. This is to ensure that when a pin falls, its active state is set to false so that it's not counted again in the next turn of the same frame.
Resetting after each turn	When the ball enters the gutter or outside the play, area resetting is done. There are 2 ways of resetting. When the 1st turn of a frame is played only standing pins are displayed and fallen ones are made inactive. On the 2nd turn on the frame, all pins are reset to the default state. The ball is always reset to its original position.

Scripts used

- **Main Menu**
  - ➢ This script is applied on the canvas on which Main Menu UI is built.
  - ➢ It performs the following operations:
    - The primary function is to display the main menu display at the start of the game.
    - Loading the options menu by clicking the “Options” button.
    - Loading the top 10 scores menu by clicking the “Scores” button.
    - Quitting the game by clicking the “Quit” button.

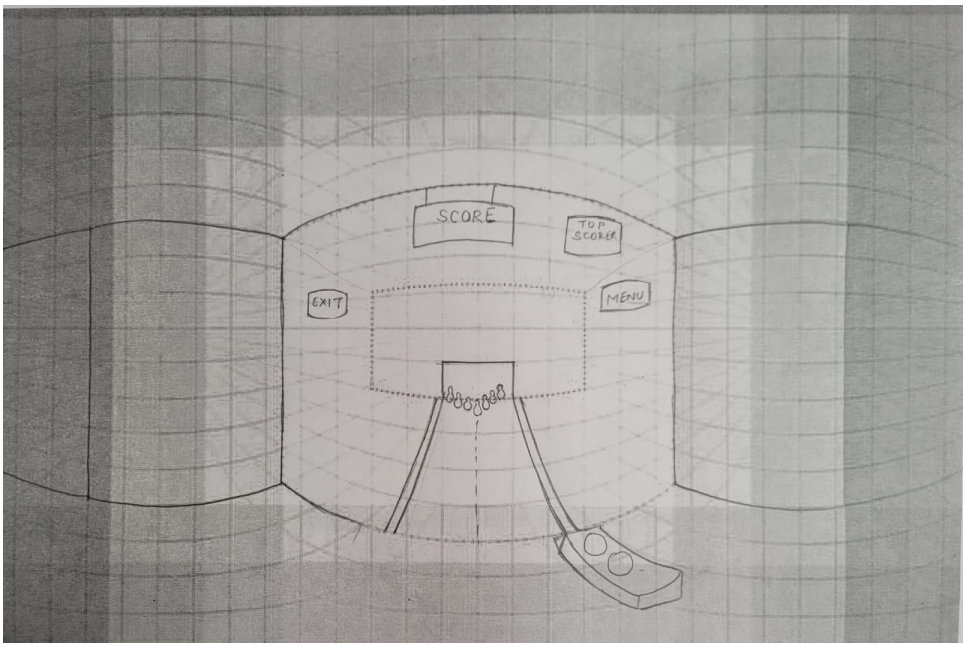
- **Game Manager**
  - ➢ This is the main script of the application.
  - ➢ It manages the entire game.
  - ➢ It performs the following tasks:
    - Stores the original position of the ball and pins to be used later for resetting.
    - Calculation of score for each throw.
    - Stores scores for all frames of the game.
    - Writes the final score of the game in the file at the end of the game.
    - Count the number of pins fallen with the ball colliding with the pins.
    - Updates scores on the scoreboard dynamically during the game.
    - Keep track of the ball, and where it goes. Checks if the ball goes outside the play area or enters the gutter.
    - Performs resetting after each turn and frame.
    - Contains a back button which allows us to leave the game in between and go to the main menu.

- **Options**
  - ➢ Contain functionalities to increase/decrease volume and graphics.
  - ➢ Volume can be changed using a slider.
  - ➢ Graphics can be altered to high/low/medium.

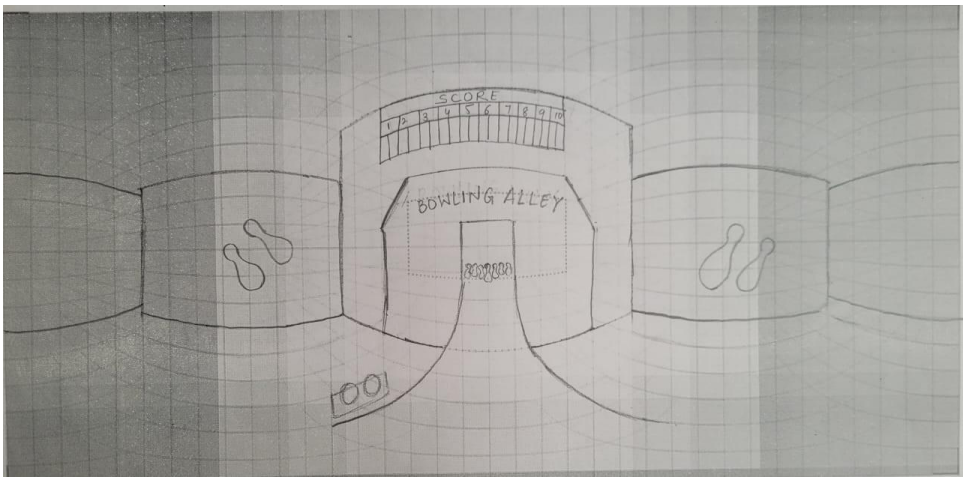
- **Show-Score**
  - Displays top 10 scores of all time from high to low.
  - This is done as explained in the steps below:
    - Implemented using a file to ensure persistence.
    - At end of a game, the player's score is appended to the file.
    - When the Scores button is clicked from the main menu, the file is loaded at runtime, and the top 10 scores from it are displayed on the screen.

Mock Up Screens

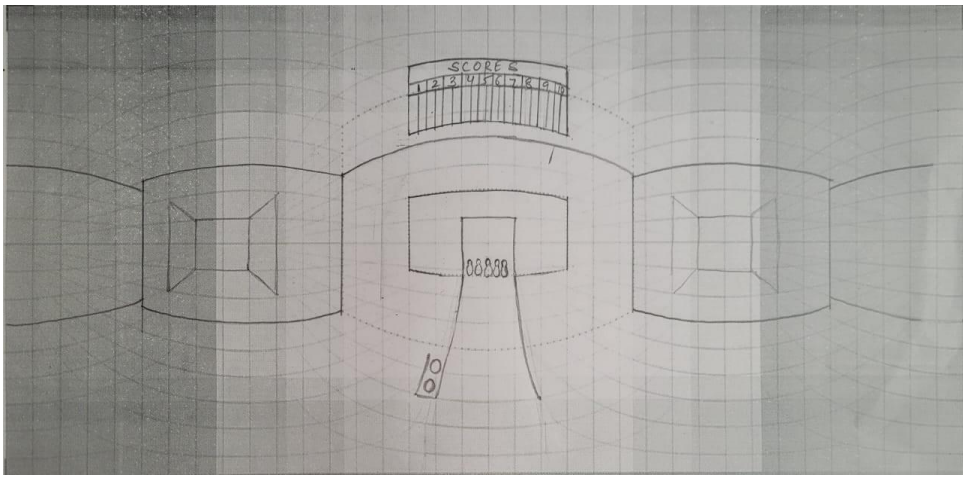
- Siddhant Kulshrestha – 2021201052



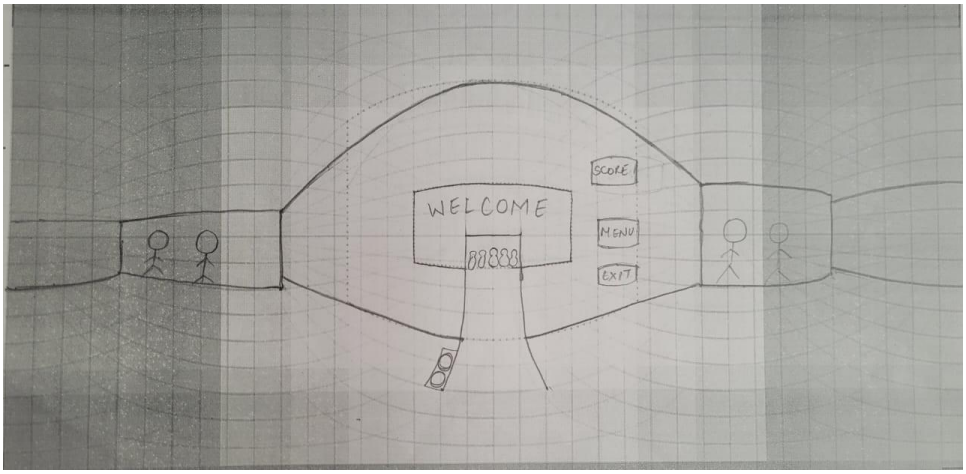
- Rishabh Malik – 2020201074



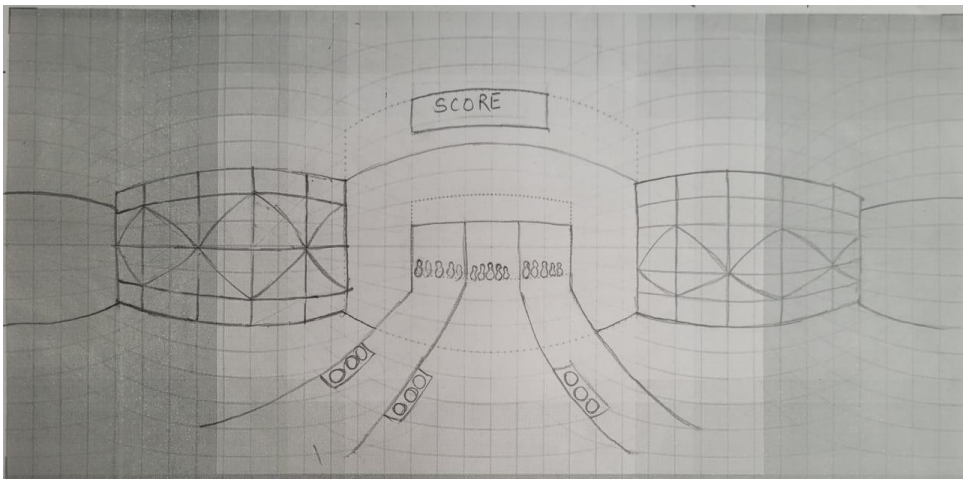
- Ayushi Maheshwari – 2020201053



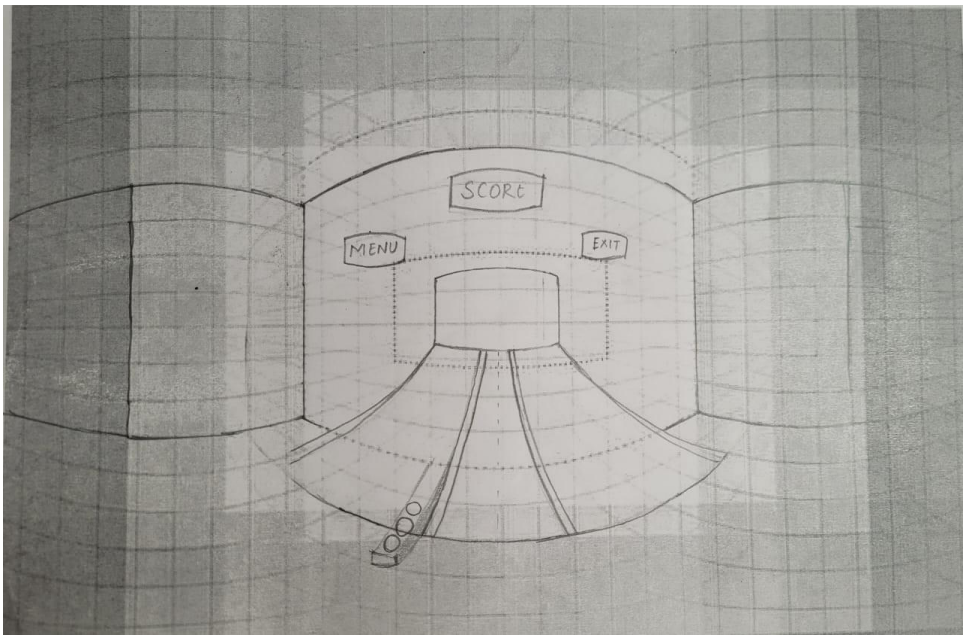
- Purnima Grover - 2021201014



- Kamal Phoolwani – 2021201054



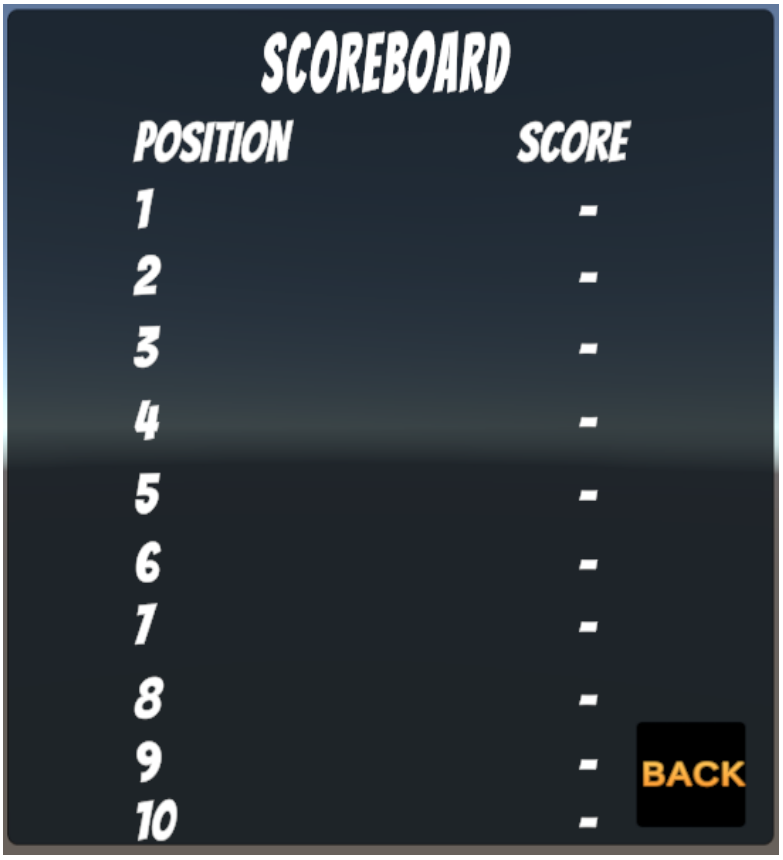
- Final Screen

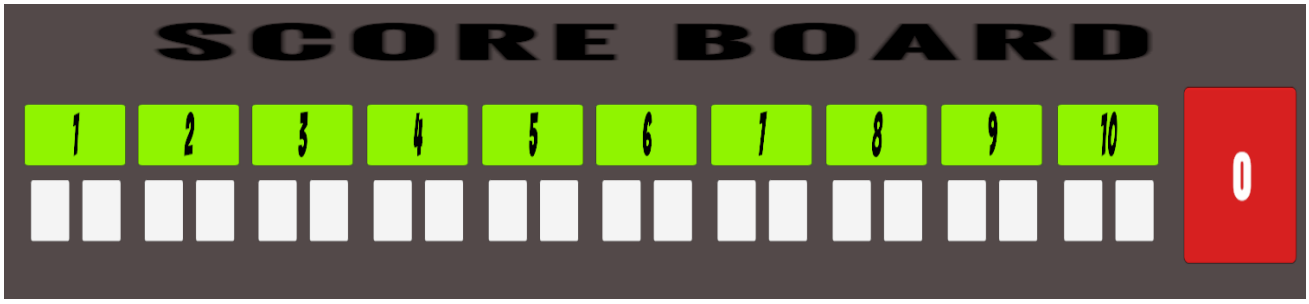


Original Game Screenshot

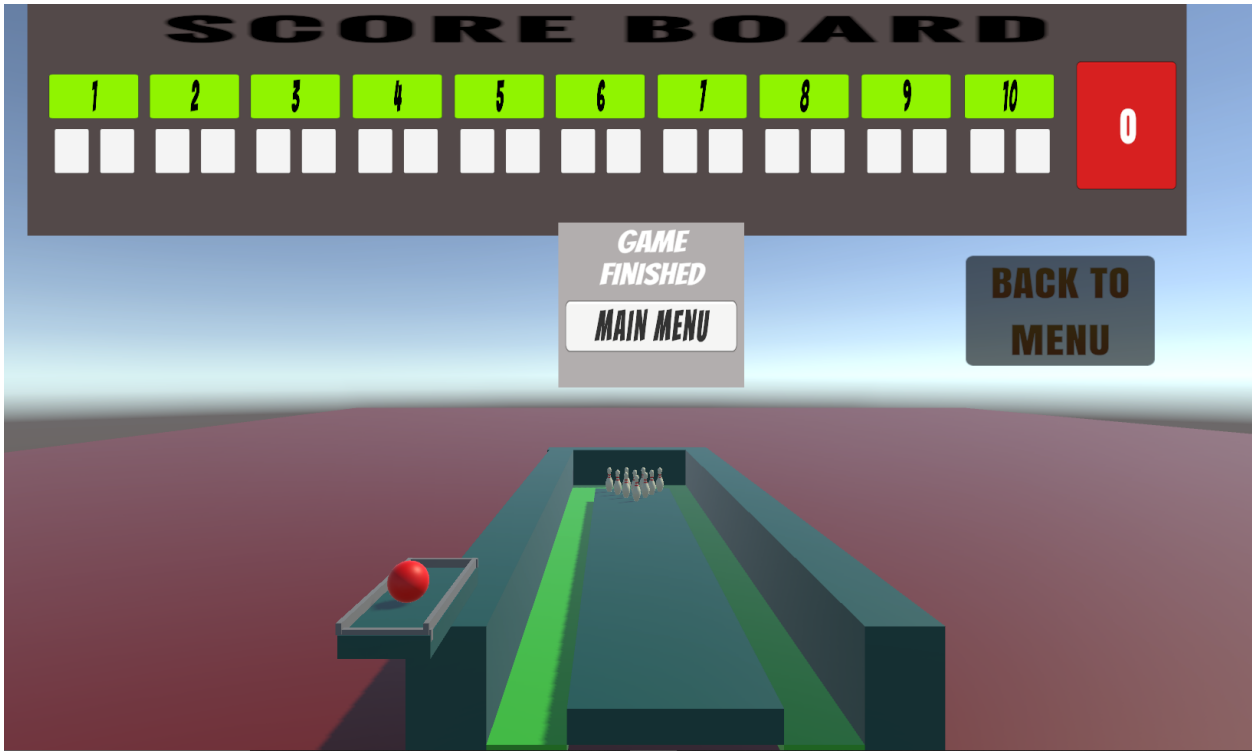
DashBoard

Options


SCOREBOARD
POSITION
SCORE
1 -
2 -
3 -
4 -
5 -
6 -
7 -
8 -
9 -
10 -
BACK


SCORE BOARD
1
2
3
4
5
6
7
8
9
10
0

Scoreboard



End of Game

References

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