

- Gesture Based User Interface Group Project -
Breakout Vuforia Android Game

Oskar Ciebien - G00369579 & Owen Kelly G00366614

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[GitHub Repository Link \[Click Here\]](#)



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Contents

1 Purpose of the application	3
1.1 The User Interface	3
1.2 Main Menu	3
1.3 Options Menu	4
1.4 Pause Menu	4
1.5 Death Menu	5
1.6 Game Scene	6
1.7 Levels & Powerups	6
1.8 Testing Plan	7
2 Gestures identified as appropriate for this application	8
2.1 Gesture Ideas	8
2.2 Gestures Used	8
3 Hardware used in creating the application	9
3.1 Android Device – Mobile Phone	9
3.2 PC – Unity Editor / Development Device	9
4 Architecture for the solution	9
4.1 Libraries Used in the Project	9
4.2 Tutorials Used	10
4.3 Communications	10
5 Conclusions & Recommendations	10
5.1 What has been achieved?	10
5.2 What has not been achieved?	11
5.3 Recommendations	12
5.4 What have we liked and learned?	12
5.5 Extras	12
5.6 Future Improvements	12
5.7 Conclusion – Oskar	12
5.8 Conclusion – Owen	13

1 Purpose of the application

This application utilises the user's mobile phone to display an augmented reality experience of a custom variant of the classic 70's arcade game Breakout. The application accesses hardware from the mobile device to project the game so that it may be experienced in any setting and completely independent from any external hardware or software.

Each component of the game, and subsequently the application, was designed with these principles in mind. The following descriptions detail what was done to adhere to the application requirements to a satisfactory level.

1.1 The User Interface

The user interface was designed to accommodate the Android platform. All menus were scaled and sized to the platform's native resolution and interactions with the user interface were identified with the platform in mind. All UI screens attempt to keep in line with a specific theme which was identified as a simplistic neon aesthetic.

1.2 Main Menu



Figure 1: Main Menu Screen

The Main Menu screen features options and menus all accessible using the phones touch screen interface. The player is also greeted with stunning particle effects, colour matching elements and aesthetic music which keep in line with the theme of the game. The user is presented with the following choices on the main menu:

- **Play** – Will move the player to the main gameplay screen.
- **Quit** – Will exit out of the game.
- **Options Button** – Will navigate the player to the options menu.

An aim of this project was that the game was to be very appealing to the player, so the simple aesthetic should result in simple and seamless navigation.

During development, a feature that was ultimately cut from the main menu and eventually the entirety of the user interface was voice controlled navigation. This was considered because of the requirement of implementing various gesture technologies into the application and attempting to utilise as many features from the mobile phone as possible. Unfortunately, some aspects of the game took longer than expected which resulted in voice control being a scrapped idea.

1.3 Options Menu



Figure 2: Options Menu in Main Menu and in Game

The Options Menu is accessible from the main menu and features options to manipulate the audio of the application. These options include:

- **Music Slider** – a slider which manipulates the game music.
- **Slider** – a slider which manipulates the sound effects of the game.
- **Sound Mute** – a toggle for muting all sounds.

The user is also presented with the options to:

- **Go back** - Go back to the main menu.
- **Save** - Save the values for the sound, these values persist through each session of the game.

1.4 Pause Menu



Figure 3: Pause Menu and Pause Menu Options

The pause menu is accessible from the Game Scene at any point during gameplay by tapping the large pause button situated at the top right-hand side of the screen. The pause menu offers a few options. Those are:

- Having access to the options menu.
- Resuming the game.
- Going back to the main menu.

To make the pause menu more visually appealing, a particle system was added which only plays when the pause menu is active.

1.5 Death Menu



Figure 4: Death Menu

This menu is only accessible after the player has depleted all their lives. Lives can also be acquired through collectibles, however the maximum amount of lives that can be obtained is set to three. Additional lives collected through collectibles will not make a difference if the lives have reached the max amount. The death menu gives the player information on their score, as well as two options to pick from. The two options are the following:

- **Restart** – This will transfer the player back to the game scene. This will reset the players lives to the max amount and set the score to zero.
- **Main menu** – This option will bring the player back to the main menu.

1.6 Game Scene

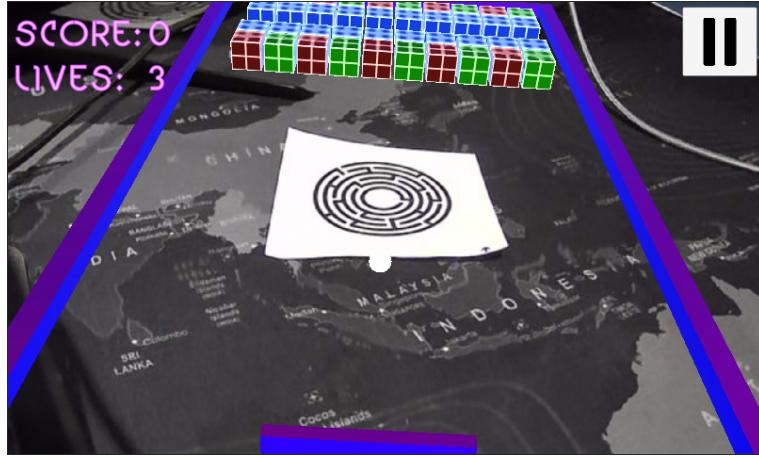


Figure 5: Game Scene

The game scene is responsible for the main gameplay loop of the application. Initially, the player is asked to scan the image of a maze which is available on the project's GitHub repository [[here](#)]. Once the image is focused, the text asking to scan the image disappears and the game board including the ball, paddle, blocks, and borders will display.

Vuforia was utilised in this project so that the player will be able to alter the orientation of the camera in order to see where and what the ball is colliding with. The board was intentionally made not to occupy the full space of the screen as it encourages the player to realign the camera.

1.7 Levels & Powerups

This application features an endless level type of gameplay style. This is evident through the way the levels are created as the blocks that which the player breaks are generated from a set of random configurations. Each time the player completes a level by breaking all remaining blocks, the game will reset and display a random combination of blocks for the player to break again.

The objective of the game is to get as low of a score as possible. This design decision was made to make this variant of Breakout more unique. The score represents the seconds that have passed since the start of the game. The power-ups that are obtainable compliment this design decision.

There are four collectibles that can be obtained, two beneficial and two negative. The collectibles have 30% drop rate upon breaking a block. The two beneficial collectibles are as follows:

- **Extra Life** - Adds an extra life but no more than the max obtainable amount of lives.
- **Score Rate Decrease** - Decrease the score, can only be obtainable if the double score count collectable was already collected.

The two negative collectibles are as follows:

- **Double Score Count** - Doubles the rate at which your score increments. This negative effect lasts the whole level and can only be obtained once.
- **Freeze** - Freezes the player in place for two seconds.

1.8 Testing Plan

For this application, testing was taken in an iterative approach. Small, gradual changes to the application were implemented to each feature based on insights from previous changes. The commit history of this project's GitHub showcases the small, gradual changes added to each feature. Using this method, features can be checked for bugs thoroughly (5).

2 Gestures identified as appropriate for this application

2.1 Gesture Ideas

Using augmented reality to display the game meant many gestures could have been used in many different ways. Unfortunately, due to time and hardware restraints, some ideas could not have been added to this application (6).

The gesture ideas that were identified during the planning phase of this project are as follows:

- **Tap** – For buttons, navigation, game control.
- **Swipe** – Pausing game.
- **Swipe with another image** - Moving the paddle left or right.
- **Tilting / Freehand** - Allowing the player to move the camera in any direction, to see the game board better at different angles, for example allowing the player to see where the blocks and the ball is headed.
- **Voice control** - An alternative to some taps, for menu navigation and settings.

2.2 Gestures Used

With a vast array of options to choose from, the following gestures were identified that suited the game the most. These were considered to be the most comfortable for this type of game:

- **Tap** - Was used for interacting with menu options, navigation and the starting of the game.
- **Swipe** - Controls the movement of the paddle.
- **Tilt** - Used to get a better picture of the game as the game does not fit on the entire screen.
- **Freehand Movement** - To get that full 3D experience with the use of Vuforia. Player is allowed to move around freely, as long as the target image is still connected.

3 Hardware used in creating the application

3.1 Android Device – Mobile Phone

Unity Remote 5 was used to test the application. This is a free application to be downloaded on Google Play Store which allows the game scene from the Unity Editor to be displayed on native hardware. After every major change in the game, the application was built onto android devices to be able to render the game components in a native environment rather than streaming the game through a medium. This helped in familiarising with the game and coming up with more ideas and fixes for certain parts of the project.

3.2 PC – Unity Editor / Development Device

For developing the main gameplay loop of the application and longer developing periods, the Unity Editor was used without the use of Vuforia components. Using iterative development to test the application whilst attempting to link a camera to a target image proved to be a difficult task, so the basic application was built using native Unity components before being ported to an augmented reality environment.

4 Architecture for the solution

4.1 Libraries Used in the Project

Most of the libraries that were used in this project are the libraries that have been covered in the Gesture Based UI Development and Mobile Applications Development modules. The libraries used in this project are the following:

- **TMPPro** – Which is a very important library to use, when trying to add high quality text design into a project. It provides many features and formatting options as well as it is very simple to use. This library was used to specifically enhance the appearance of our text fields and buttons. We were able to set custom fonts, and style them a lot better than with the standard Text/UI library in Unity (1).
- **SceneManagement** – This is a library which allows to most importantly change from scene to scene, for example when a player decides to start the game and presses on the Play button on the Main Menu scene, the game transfers the player to the Game Scene. There are many more features which this library provides, such as getting the number of currently loaded scenes, creating scenes at runtime and many more (2).
- **Vuforia** – A Software Development Kit (SDK), used for creating Augmented Reality Applications or Games. It recognises images and objects, and therefore can have many different applications or uses, such as interacting with the real world. In this project, Vuforia was used to connect with our Breakout game, through an image, and therefore allowing us to have a view of the game, while seeing our surroundings through the camera. Vuforia was used to have a better view of the game board and on what is exactly happening in the game. (3).

4.2 Tutorials Used

Thanks to the carried out research, the following tutorials helped in development of this project:

- **Breakout Tutorial** – This youtube tutorial has been used in order to gain knowledge on the game as well as well as to understand the game logic. Some of the code in these videos has been adapted in the project (4).

4.3 Communications

The developers stayed up to date on the project work by having multiple meetings every day. Pair Programming was utilised to share knowledge on problems and pitfalls encountered in the project.

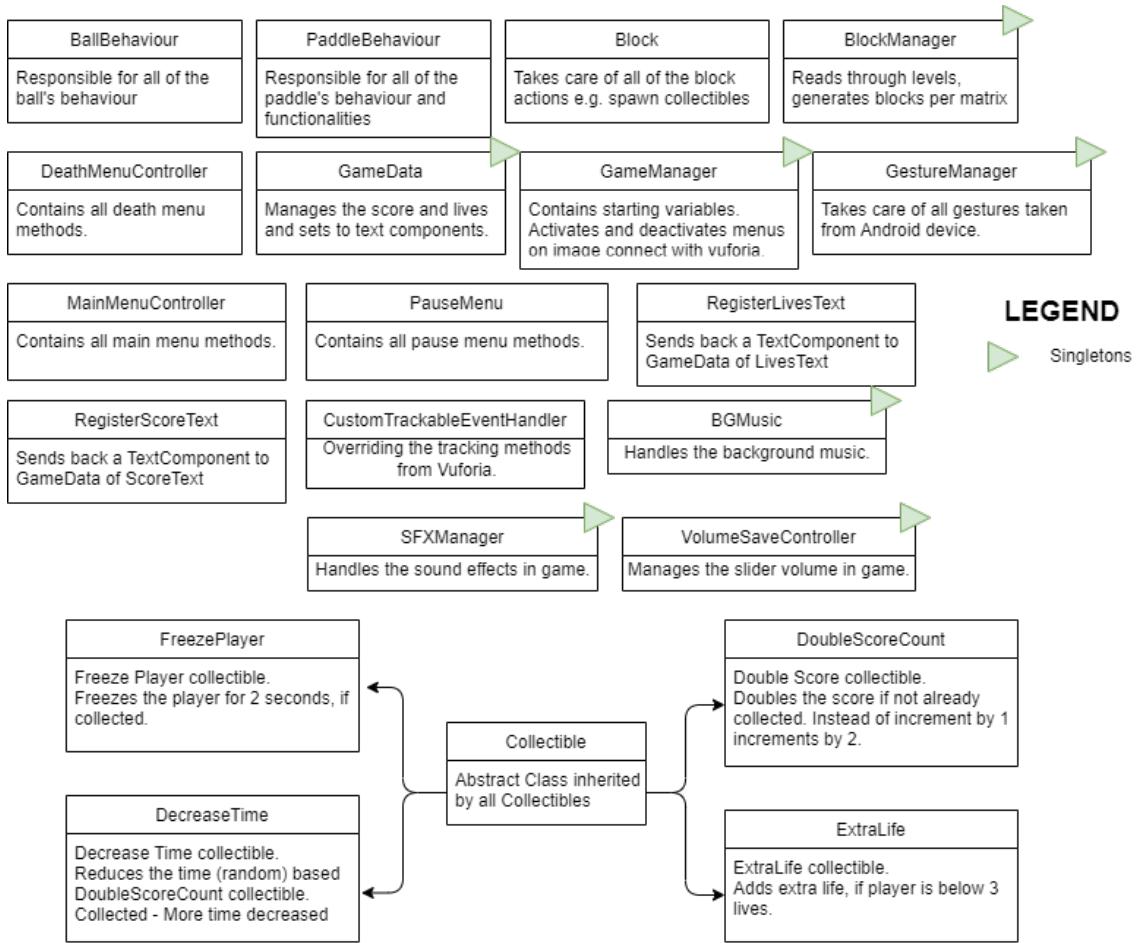


Figure 6: Class Diagrams.

5 Conclusions & Recommendations

5.1 What has been achieved?

As a team we were able to finish this project to a stage where we have both been happy. There is always room for improvement, but unfortunately other deadlines and the time was not on our side and some features took more work than expected, as well as Unity

and git merging caused some problems, therefore only one of us was able to work on the game at any one time, where the other person worked on the wiki, research or the documentation.

5.2 What has not been achieved?

Unfortunately we were not able to achieve all of our goals. The things that we have not achieved are as follows:

- **Collisions** - The collisions with the paddle and the left and right border do not work as we have expected them to work. They differ from gameplay to gameplay as the connections depend on the Vuforia's image focus. If Vuforia is not connected properly it does not give us the right distances. But the distances and coordinates are correct, as they have been tested without Vuforia and sometimes it does connect as expected and the game works fine.
- **Post Processing** - We added Post Processing into our project to make the visuals of the project look much better. We were forced to remove it as performance to a major hit when rendering the project to android devices.

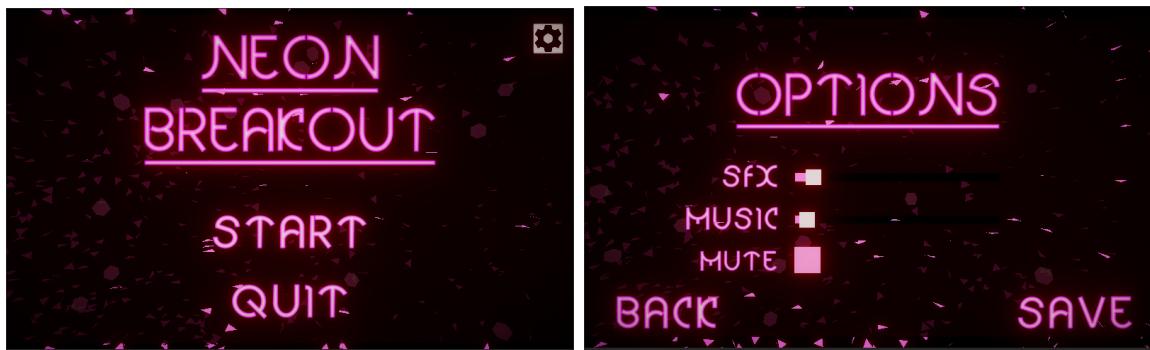


Figure 7: Main and Options Menu with Post Processing

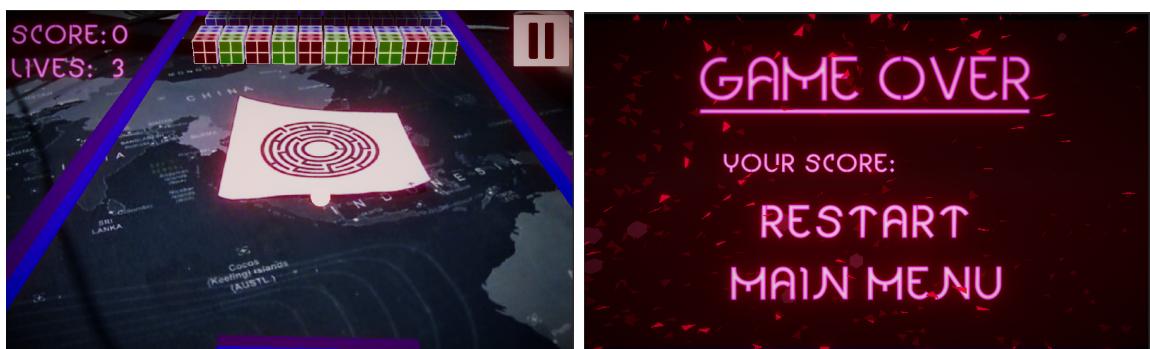


Figure 8: Game Scene and Death Menu with Post Processing

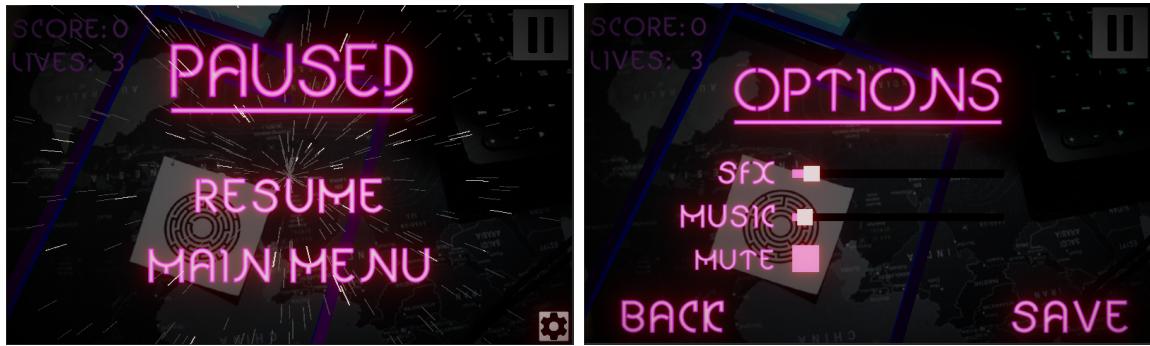


Figure 9: Pause Menu and Pause Menu Options with Post Processing

5.3 Recommendations

If we were to undertake this project once again, we would definitely spend more time on research, as we believe this is what wasted a lot of our time. We were developing and researching at the same time, which caused more backlogs.

5.4 What have we liked and learned?

As a team we have definitely learned about a new technology, which we briefly worked on in the class labs. We liked how we both made equal attempts at fixing issues and helped each other out whenever it was necessary.

5.5 Extras

For our extras part of this project, we have decided to make wiki pages on certain topics on the project's GitHub repository. The player can have a read through instructions on how to play the game, how to contact us, general information about this game etc. The wiki is available [[here](#)].

5.6 Future Improvements

As a team we believe that this project has potential into becoming something bigger and better and hopefully should be made available to a wider audience.

5.7 Conclusion – Oskar

In my opinion working on this project was a fantastic experience. Any grouped projects will have their positive and negative moments to which the team has to find solutions to. I found that as a team we have worked really well, we separated tasks among ourselves very well with no conflicts. The communication which is in my opinion the most important factor when it comes to managing a project and working on a team was good.

5.8 Conclusion – Owen

Following the development of this project, I believe that the game we produced provides an interesting take on the classic Breakout arcade game.

In using augmented reality to display the game, there are a variety of ways the breakout formula can be altered. This project showcases how the player manipulates the camera when the game information is limited by it.

The experience of developing software whilst also taking into account the physical world around you was an interesting challenge. Making sure that appropriate lighting and space were available for the game display presents an interesting challenge that I had never experienced as a developer before.

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