

Final Year Project

V-Golf



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Researcher's Submission

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Date: May 27, 2016

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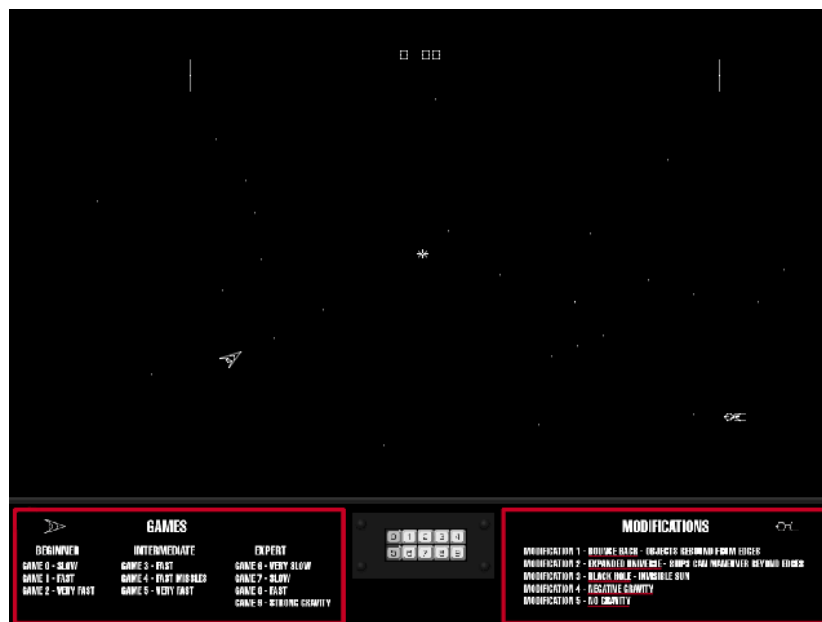
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1. INTRODUCTION:

V-Golf is an augmented reality android based game which provides interactive as well as physical experience to its users using Augmented and Virtual Reality.

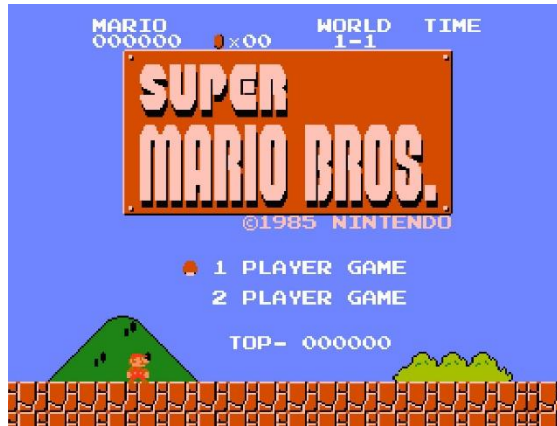
1.1. Background:

Computer games have their roots as far back as the 1950s, when very basic computer games and simulations were designed in academic institutions as a part of computer science research. In fact, Spacewars-widely credited as the first computer game-was developed in 1962 at MIT and programmed primarily by a single computer scientist named Steve Russel.



A screenshot from Spacewars, the first videogame.

Games have come a long way since then, as is evident with the decreasing time gap between console generations and the regular release of increasingly sophisticated, meticulously designed graphic cards. Videogames today are a huge market, the global games market being worth USD 74.2 billion as of May 2017. Gaming has evolved rapidly over the past few decades, shifting from 8 bit and 16 bit consoles in the late 80s to 32 and 64 bit versions in the 90s and by the 2000s ultimately dropping the low resolution three-dimensional polygons in favor of high definition, meticulously rendered games with immersive, expansive and more interactive environments with improved artificial intelligence and realistic physics.



A screenshot from Super Mario Bros. for the Nintendo Entertainment System, an 8-bit game.



Left: A scene from a 64-bit polygon based game, The Legend of Zelda. Right: A more modern, high definition, detailed and graphically advanced game. Screenshot is from The Last of Us.

The increasing widespread popularity of touch screen devices and the release of Nintendo Wii in 2006 were both key factors in moving games into a direction with more emphasis on user interactivity and immersion. The Wii's gesture recognition and touch screen inputs in tablet computing made for simpler, easy-to-grasp controls that allowed a more mainstream audience to enter the realm of video gaming.



Tablet gaming and Wii's gesture based controls allowed gaming to be introduced to more mainstream audiences.

This brings us to now; as of October 2015, we stand on the cusp of the Virtual and Augmented reality revolution, with Oculus, HTC, Sony and Samsung all set to release their own flagship VR headsets in the first quarter of 2016. There is no doubt that these exciting new technologies will shape the future of gaming and inspired from this new generation V-Golf was visualized first and foremost as an application that was unlike any before it.



The oculus rift developer kit 2 in action.

1.2 What is Augmented Reality?

In essence, augmented reality is a view (direct or indirect) of an actual, real world environment that is supplemented by computer-generated sensory input that can include graphics, sound or video. It's differentiated from Virtual Reality in that it functions by enhancing the users current perception of reality while VR replaces the real world with a simulated one.



2. Literature Review

2.1 Game Engine Selection

After careful consideration Unity and Unreal engine 4 were the two engines that were finalized by the team for the project. From there, the final choice of game engine to be used was made in accordance to certain factors that included familiarity, ease of use, and compatibility and adaptability of the engine to our augmented functionality. What follows is a careful comparison and analysis of both engines that lead to the final decision.

2.1 .1 Unreal 4

The fourth iteration of Epic Games' famed engine brings with it a plethora of features adding upon the already extensive list of the previous versions. For long the choice of many major game studios, the Unreal Engine has been used to create such award winning titles as Gears of War and Bioshock Infinite. Unreal allows the crafting of meticulously detailed worlds with a focus on graphical power.

2.1.2 Unity 5

Unity emphasizes portability, targeting APIs such as Direct3D and OpenGL for windows and OpenGL ES on Android. It allows specification of texture compression, as well resolution settings for all supported platforms, supporting bump mapping, reflection mapping, parallax mapping, screen space ambient occlusion (SSAO), dynamic shadows using shadow maps, render-to-texture and full-screen post-processing effects. Unity 5 extended the features list to include real-time global illumination based on the Geomerics Enlighten technology, physically-based shaders, HDR sky-boxes, reflection probes, a new audio mixer with effects and enhanced animator workflows. Programmers can use UnityScript (a custom language with ECMA Script-inspired syntax, referred to as JavaScript by the software), C#, or Boo (which has a Python-inspired syntax).

Unity is notable for its ability to target games to multiple platforms. Within a project, developers have control over delivery to mobile devices, web browsers, desktops, and consoles. Supported platforms include BlackBerry 10, Windows Phone 8, Windows, OS X, Android, iOS, Unity Web Player (including Facebook), PlayStation 3, PlayStation 4, PlayStation Vita, Xbox 360, Xbox One, Wii U, Nintendo 3DS line and Wii. Unity 5 adds support for Android TV, Samsung Smart TV, Oculus Rift, HTC Vive and Gear VR

Unity is a versatile and user-friendly tool that has steadily gathered steam over the past decade to become one of the most popular engines available today.

2.1 .3 Final Decision

Ultimately, we decided to go with Unity, as our focus was on making a relatively small scale augmented reality based golf experience, not a graphically advanced triple A title that the Unreal engine is more suited for. Furthermore, and more importantly, although Unreal has released an SDK supporting virtual reality, it has yet to release one for augmented reality support.

2.2 3D Modelling Software

2.2.1 Maya vs 3Ds Max. Which to use?

Autodesk offers Maya and 3ds Max, which are both powerful 3D modeling, animation, rendering, and simulation software offering a comprehensive range of tools that can be used to create 3D applications such as video games, animated films, or visual effects. Both software have identical rendering capabilities, utilizing the advanced “mental ray” rendering system.

In terms of modelling, 3Ds Max is more forgiving than Maya and easier to grasp for new comers, and offers a robust toolset with a huge library of modifiers making the modeling process easier. 3Ds max offers a powerful architectural visualization program called 3Ds Max Design that offers tools to model interiors and buildings.

However, when it comes to animation, Maya pulls ahead as it offers a wide variety of animation tools that can be customized using scripting languages such as Python and MEL. A major factor separating the two software is the fact Maya is available for Windows, Linux and OSX while 3ds Max is only available for Windows.

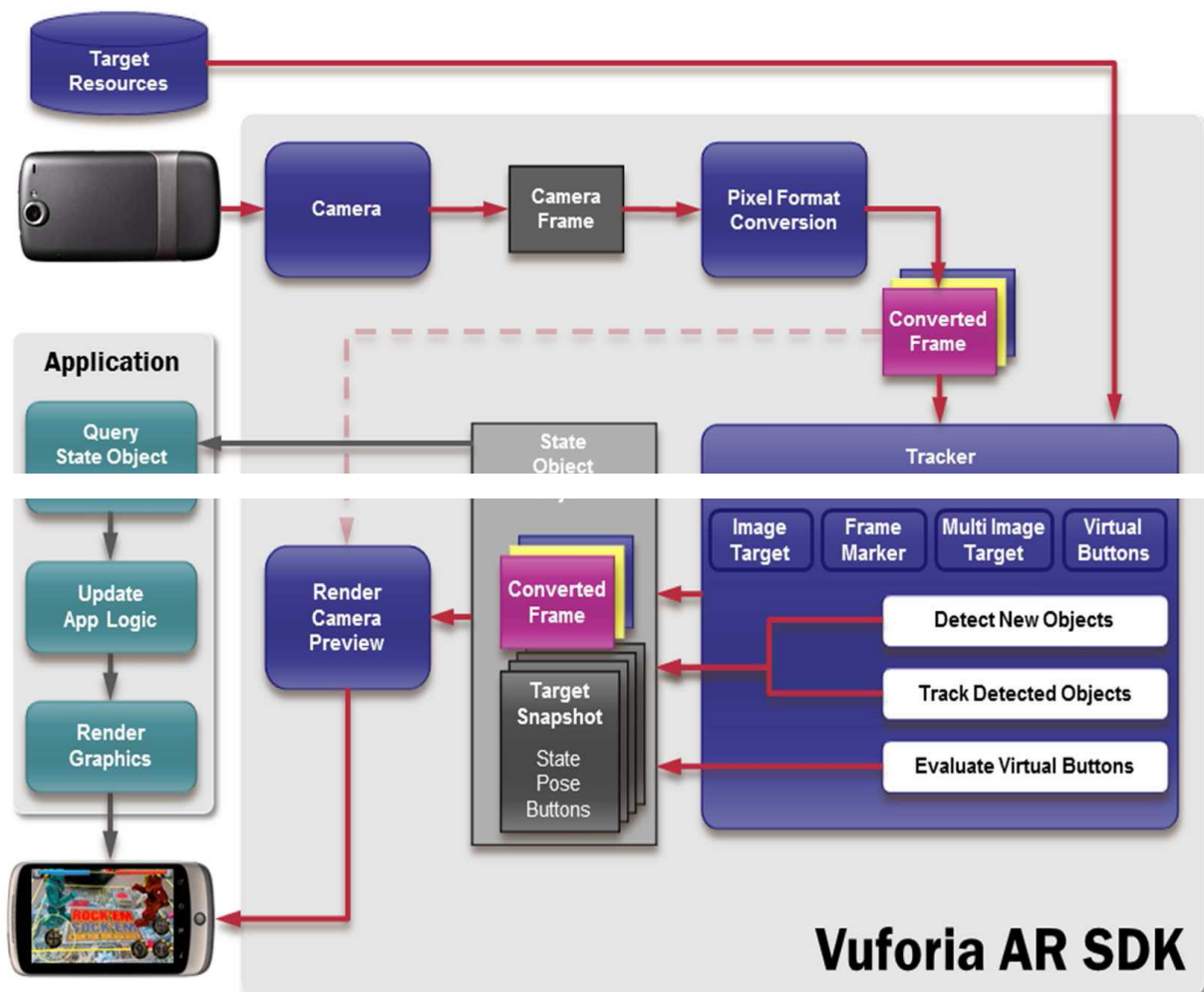
2.3 Vuforia

A key aspect of our application is it’s utilization of Augmented Reality technology to provide a uniquely interactive experience. The Augmented Reality component of our game will be developed using Vuforia, a software development kit for mobile devices that enables the creation of Augment Reality applications. It allows the real-time tracking of simple 3D objects or planer images known as “Image Targets” using Computer Vision technology. This allows the positioning and orientation of virtual models in relation to actual images in the real world when viewed through the camera of a mobile device.

The virtual object appears to be part of the real world scene as it tracks the position and orientation of the image in real-time allowing the user's perspective on the object and the image target to align.

Vuforia supports various 2D and 3D markers, and also multi target configurations. Other features include runtime image target selection, localized occlusion detection and runtime reconfiguration and creation of target sets.

2.3.1 Vuforia Architecture



3. Project Vision

3.1. Problem Statement:

- Lack of physical and interactive experience in video games.
- Main Stream games have been played for too long. People want to experience digital game play in a real world environment.
- Stereotype of “laying and playing”

3.2. Business Opportunity:

Our project is focused on the market of gamers all over the world. Gamers that want change in the gaming industry. Most of the gamers want more immersive and interactive experience so our game will be targeting them.

3.3. Project Scope:

Design and Development of a Mini Golf Android based game which provides interactive as well as physical experience to its users using Augmented and Virtual Reality.

3.4. Constraints:

1. Player needs to be wear Google cardboard.
2. Game can only be installed on Android devices.
3. Gesture Recognition can only be done with in a specific range.
4. Player must have a smartphone of high specs.

3.5. Stakeholders Description:

Player is the sole stakeholder. Player is the one who does all the interaction with the game. Player is the most important user of the game and the points scored in a particular level affects only the player.

3.6. Stakeholders Summary:

The project is wholly dependent on actions of the player. The player uses the stick to hit the ball and the game recognizes this gesture due to which the ball moves. In case of any failure during the whole process, player interests will begin to effect negatively.

4. Software Requirement Specification

4.1. List of Features:

- Unique and Addictive Gameplay.
- Multiple game modes and levels.
- Intuitive Controls and Gesture Recognition.
- Includes true visual augmented reality and amazing game world.

4.2. Functional Requirements

- The user can control the game by gestures and enjoy it to the best.
- User can use the game by smartphone (Android).
- User can also use buttons to control the menu of the game..
- User can get an immersive gaming experience on their smartphone.
- User can select difficulty levels in the game.

4.3. System Related Requirements

The game will ensure that it provides maximum performance to the player and by doing so it may be seen as an effective and efficient computer program.

5. Design Artifacts

5.1 High Level Use Cases:

Use Case: Play Game

Actors: Player

Type: Primary and essential

Description: The initial step for a player to start the game is to select the “Play Game” option. By selecting it, the player will be able to choose different levels to start with.

Use Case: Leaderboards

Actors: Player

Type: Primary and essential

Description: After playing a particular level in the game, user will be able to view the leaderboards which tells that how many points one has scored in a specific level. This helps the player to understand how difficult a level is and also urges the player to play more so that he/she can score as much as possible.

Use Case: Exit Game

Actors: Player

Type: Primary and essential

Description: This use case will help the user to manually exit the game at any point.

Use Case: Help

Actors: Player

Type: Primary and essential

Description: The player will be able to get any help at the moment if one cannot know what to do and how to play the game. As it is not a mainstream game being played by many players all around the world. We expect that players will be needing some help to know how the game actually works.

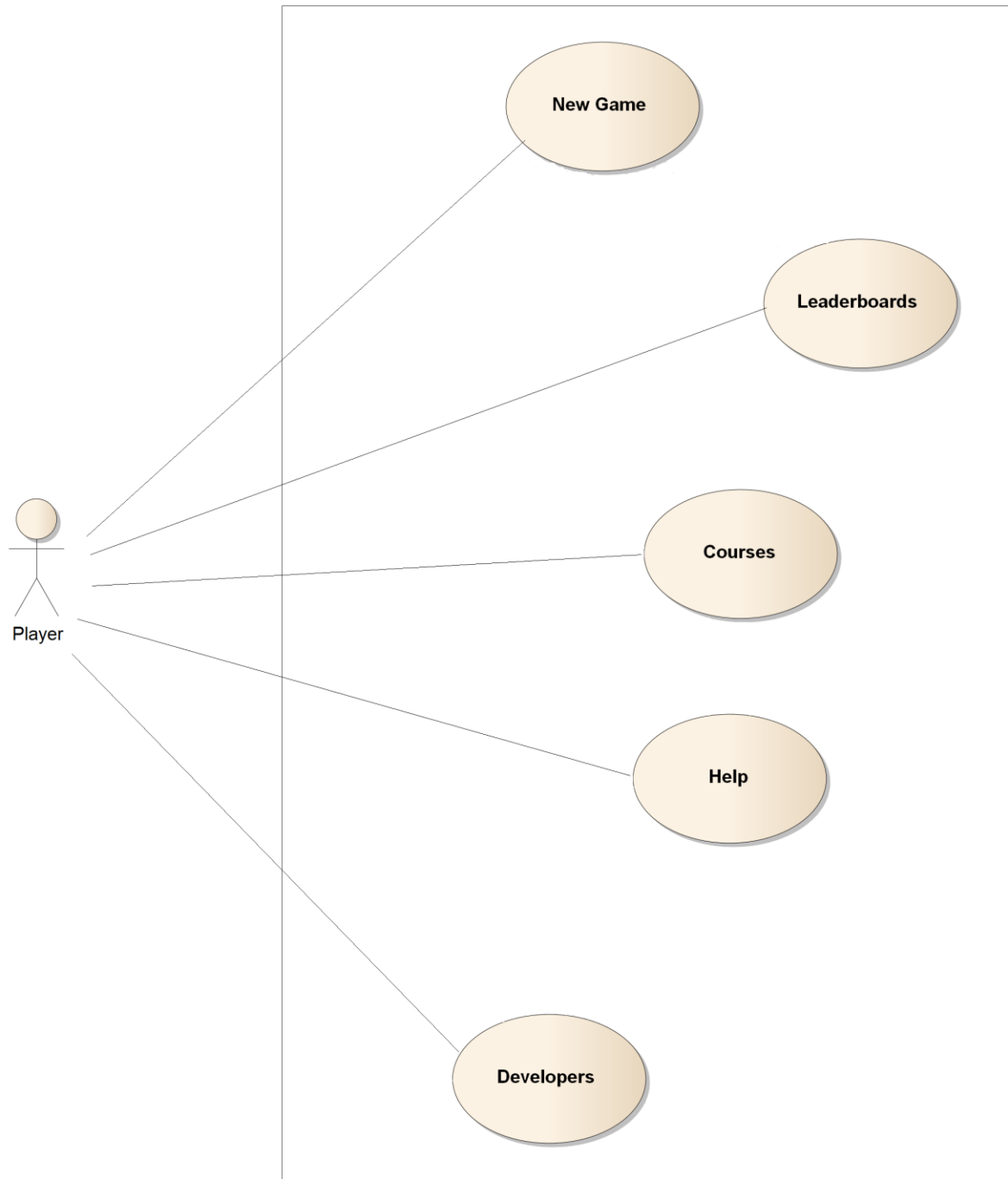
Use Case: Options

Actors: Player

Type: Primary and essential

Description: The player can use options in case of any changes he/she wants in the game i-e if someone want to turn music up or down or if someone want to change the brightness of the screen.

5.2. Use Case Diagram



5.3 Expanded Use Cases

EXPANDED USE CASE: PLAY GAME

Use Case	Play Game															
Scope	V-Golf															
Level	User-Level															
Primary Actors	Player															
Stakeholders and Interests	Player: Player wants to play the game.															
Preconditions	1) Application has to be downloaded and installed on your android device. 2) Application should be running.															
Post Conditions	1) Player is playing the game.															
Main Success Scenario	<table><tr><th>Action</th><th>System Response</th></tr><tr><td>1) Player selects the option of ‘Play Game’ from the main menu.</td><td></td></tr><tr><td></td><td>2) Golf Course menu will be displayed and player will be asked to select a golf course.</td></tr><tr><td>3) Player selects a golf course.</td><td></td></tr><tr><td></td><td>4) Game shows the golf course and golf ball to the player.</td></tr><tr><td>5) Player hits the ball.</td><td></td></tr><tr><td></td><td>6) Game shows the movement of the ball to the player.</td></tr></table>		Action	System Response	1) Player selects the option of ‘Play Game’ from the main menu.			2) Golf Course menu will be displayed and player will be asked to select a golf course.	3) Player selects a golf course.			4) Game shows the golf course and golf ball to the player.	5) Player hits the ball.			6) Game shows the movement of the ball to the player.
	Action	System Response														
	1) Player selects the option of ‘Play Game’ from the main menu.															
		2) Golf Course menu will be displayed and player will be asked to select a golf course.														
	3) Player selects a golf course.															
		4) Game shows the golf course and golf ball to the player.														
	5) Player hits the ball.															
		6) Game shows the movement of the ball to the player.														
Extensions	3a) Player selects to go back into the main menu.															
Frequency of Use	Most frequent															
Technology	Android Mobile Device and Google Card Board.															

EXPANDED USE CASE: Leaderboard

Use Case	Leaderboard	
Scope	V-Golf	
Level	User Level	
Primary Actors	Player	
Stakeholders and Interests	Player: Player wants to view the leaderboard charts and have an idea of scoring points in each level.	
Preconditions	1) Application has to be downloaded and installed on your android device. 2) Application should be running.	
Post Conditions	1) Leaderboard chart will be shown to the player. 2) Each score will be showing of which level it is.	
Main Success Scenario	Action	System Response
	1) Player selects the option of leaderboard charts in the main menu.	
		2) Game shows a screen with list of different level.
	3) Player selects the level of which scores are to be shown.	
		4) Game shows the points of the particular level being selected.

Extensions	<p>2a) If there are no previous high scores then a message will be shown that there are no records available.</p> <p>4a) If there are no previous scores of the selected level then player will be asked to play this particular level and then check the scores.</p>
Frequency of Use	Most frequent
Technology	Android Mobile Device and Google Cardboard.

EXPANDED USE CASE: Exit Game

Use Case	Exit Game					
Scope	V-Golf					
Level	User Level					
Primary Actors	Player					
Stakeholders and Interests	Player: Player wants to exit the game which is currently running.					
Preconditions	1) Application has to be downloaded and installed on your android device. 2) Application should be running.					
Post Conditions	1) Player will be shown the home screen of the android device. 2) Game will be closed.					
Main Success Scenario	<table><tr><th>Action</th><th>System Response</th></tr><tr><td>1) Player selects the option of exit game from the main menu.</td><td></td></tr></table>		Action	System Response	1) Player selects the option of exit game from the main menu.	
Action	System Response					
1) Player selects the option of exit game from the main menu.						

	<table border="1"> <tr> <td></td><td>2) Game closes and home screen is shown for the user.</td></tr> </table>		2) Game closes and home screen is shown for the user.
	2) Game closes and home screen is shown for the user.		
Frequency of Use	Most frequent		
Technology	Android Mobile Device and Google Cardboard.		

EXPANDED USE CASE: Help

Use Case	Help						
Scope	V-Golf						
Level	User Level						
Primary Actors	Player						
Stakeholders and Interests	Player: Player wants to get help about how to play the game.						
Preconditions	1) Application has to be downloaded and installed on your android device. 2) Application should be running.						
Post Conditions	1) Player will be shown the help screen that tells how the game should be played. 2) Player will understand the basics of the game.						
Main Success Scenario	<table border="1"> <tr> <th>Action</th><th>System Response</th></tr> <tr> <td>1) Player selects the option of help from the main menu.</td><td></td></tr> <tr> <td></td><td>2) Game shows the help screen to the player.</td></tr> </table>	Action	System Response	1) Player selects the option of help from the main menu.			2) Game shows the help screen to the player.
Action	System Response						
1) Player selects the option of help from the main menu.							
	2) Game shows the help screen to the player.						

Frequency of Use	Most frequent
Technology	Android Mobile Device and Google Cardboard.

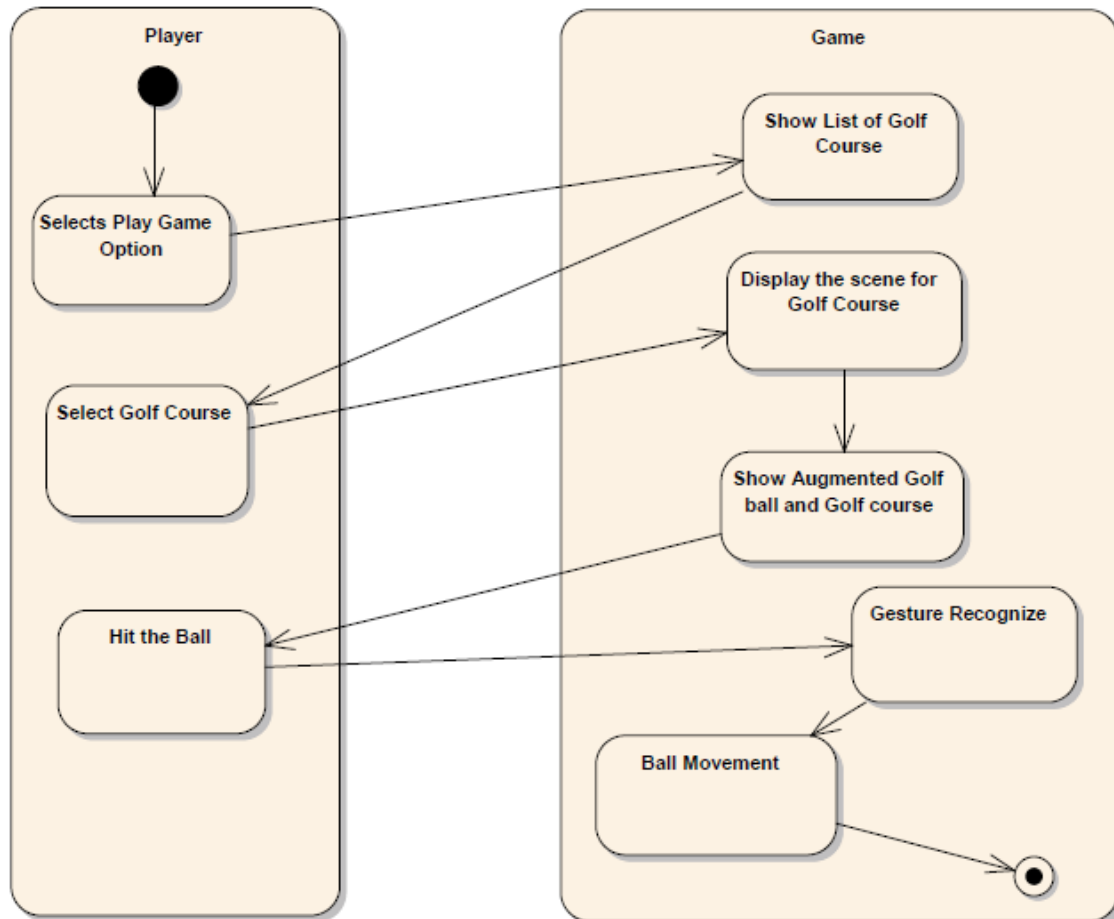
EXPANDED USE CASE: Options

Use Case	Options					
Scope	V-Golf					
Level	User Level					
Primary Actors	Player					
Stakeholders and Interests	Player: Player wants to turn music up or down and also wants to change the brightness of the screen.					
Preconditions	1) Application has to be downloaded and installed on your android device. 2) Application should be running.					
Post Conditions	1) Player will be able to hear to what changes he has made to the music. 2) Player will be able to see the changes made in the brightness of the screen.					
Main Success Scenario	<table><tr><th>Action</th><th>System Response</th></tr><tr><td>1) Player selects options on the main menu.</td><td></td></tr></table>		Action	System Response	1) Player selects options on the main menu.	
Action	System Response					
1) Player selects options on the main menu.						

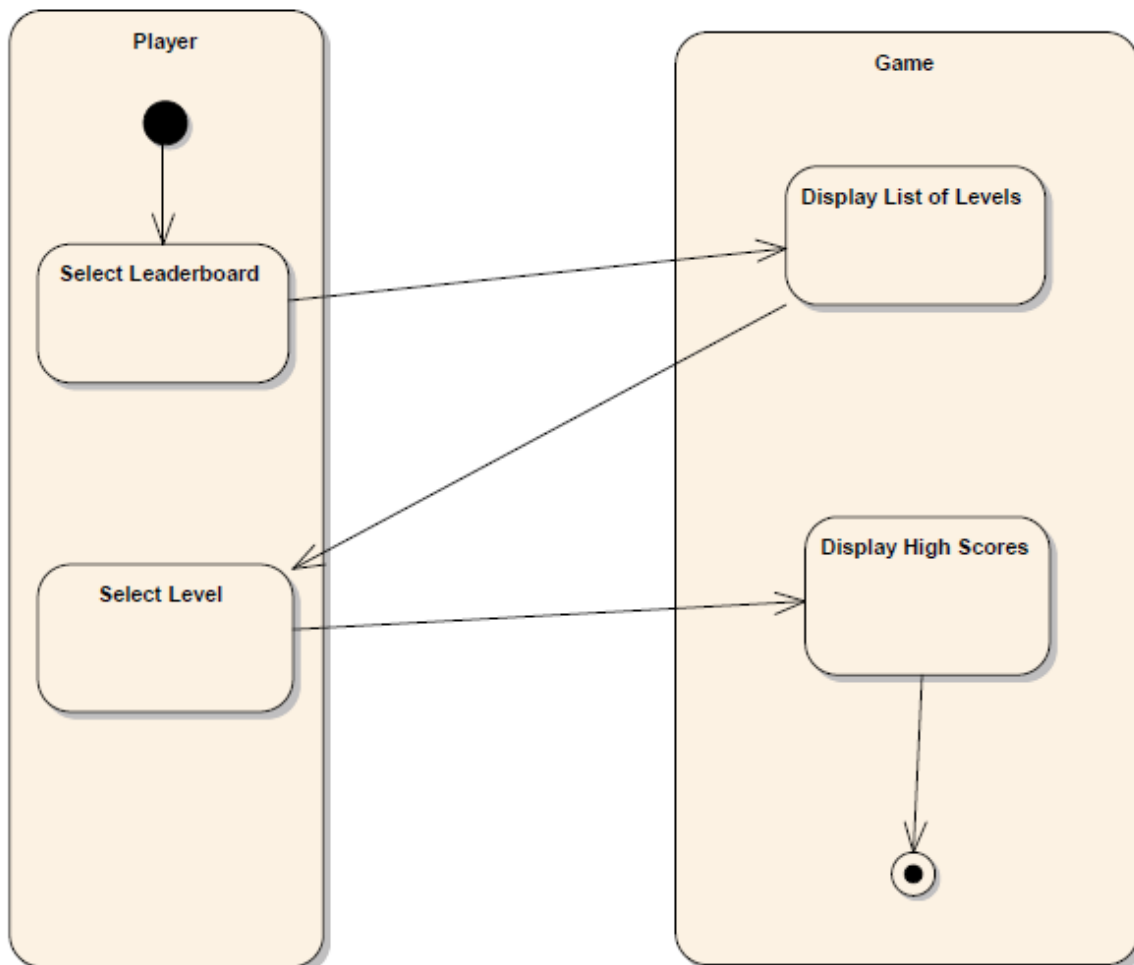
			2) Game shows two options whether to change music or brightness.
		3) Player make changes to music or brightness.	
			4) Game shows the changes as required by the player.
Frequency of Use	Most frequent		
Technology	Android Mobile Device and Google Cardboard.		

5.4 Activity Diagrams

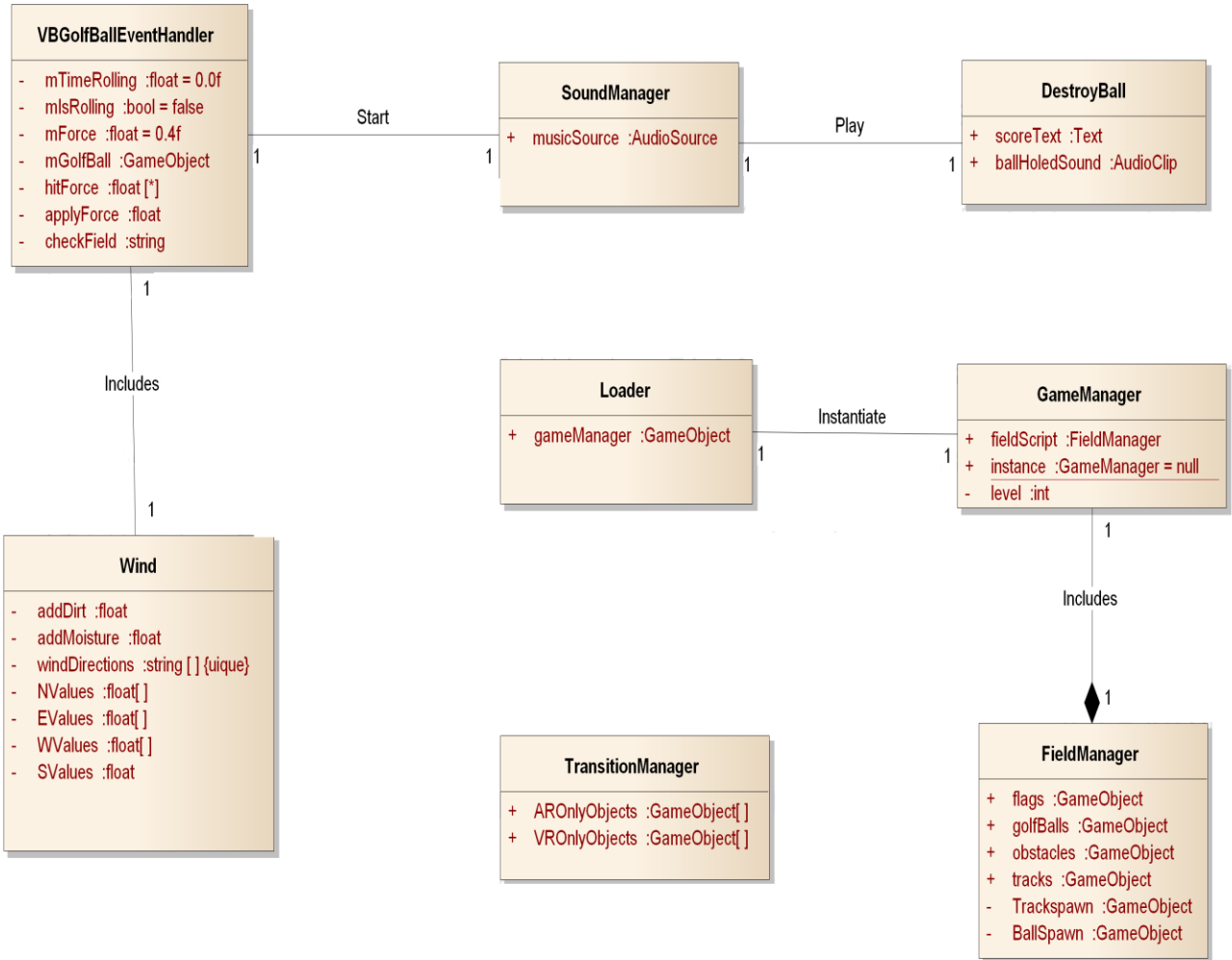
Activity Diagram: Play Game



Activity Diagram: Leaderboard

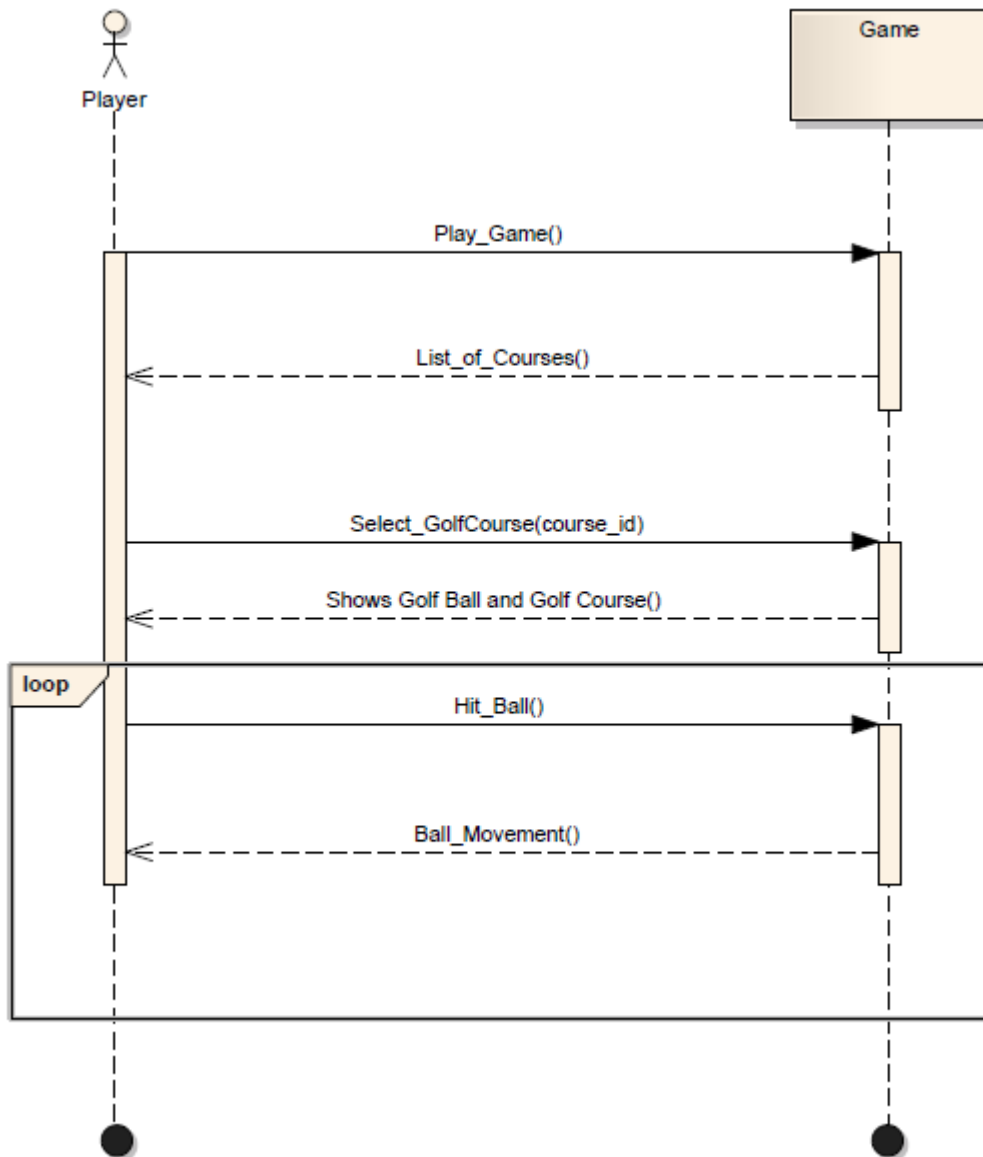


5.5 Domain Model

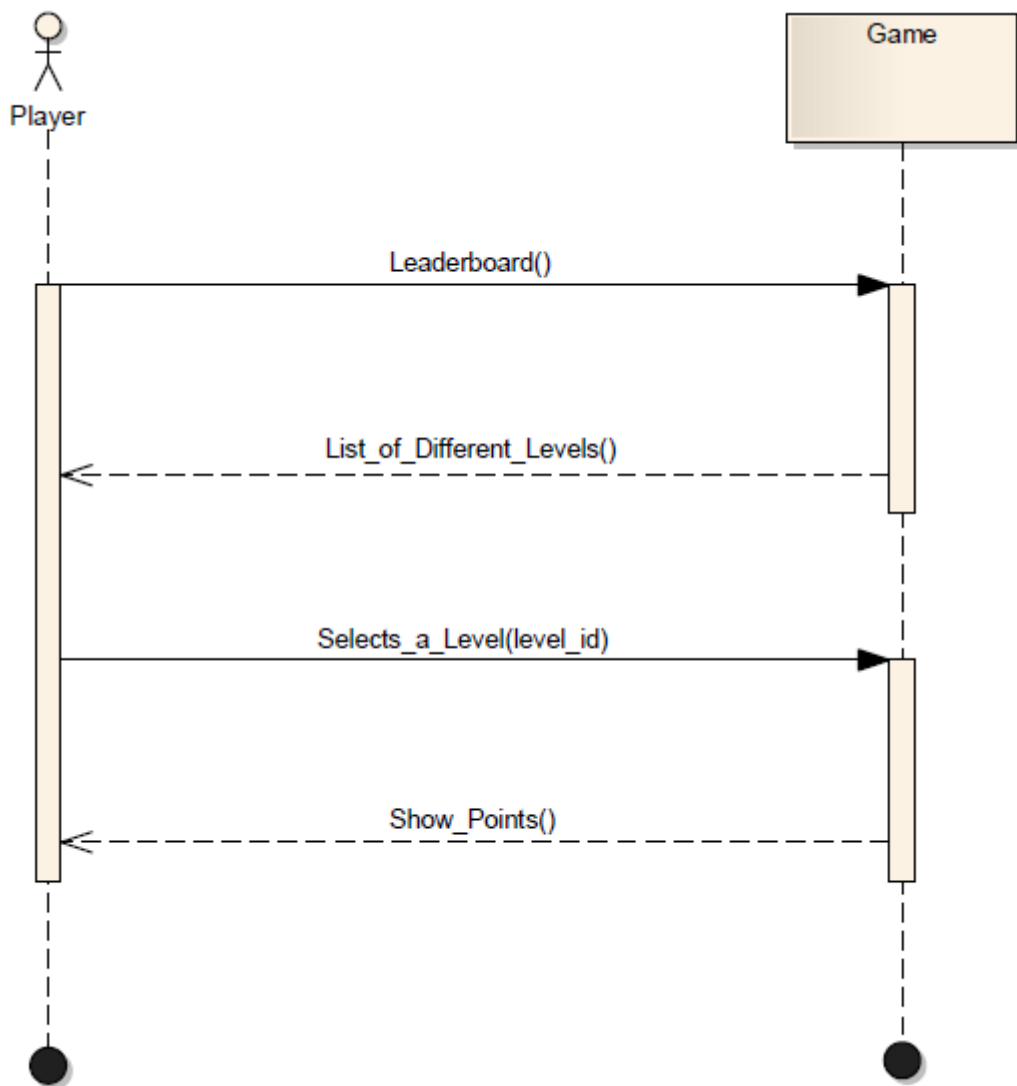


5.6 System Sequence Diagrams:

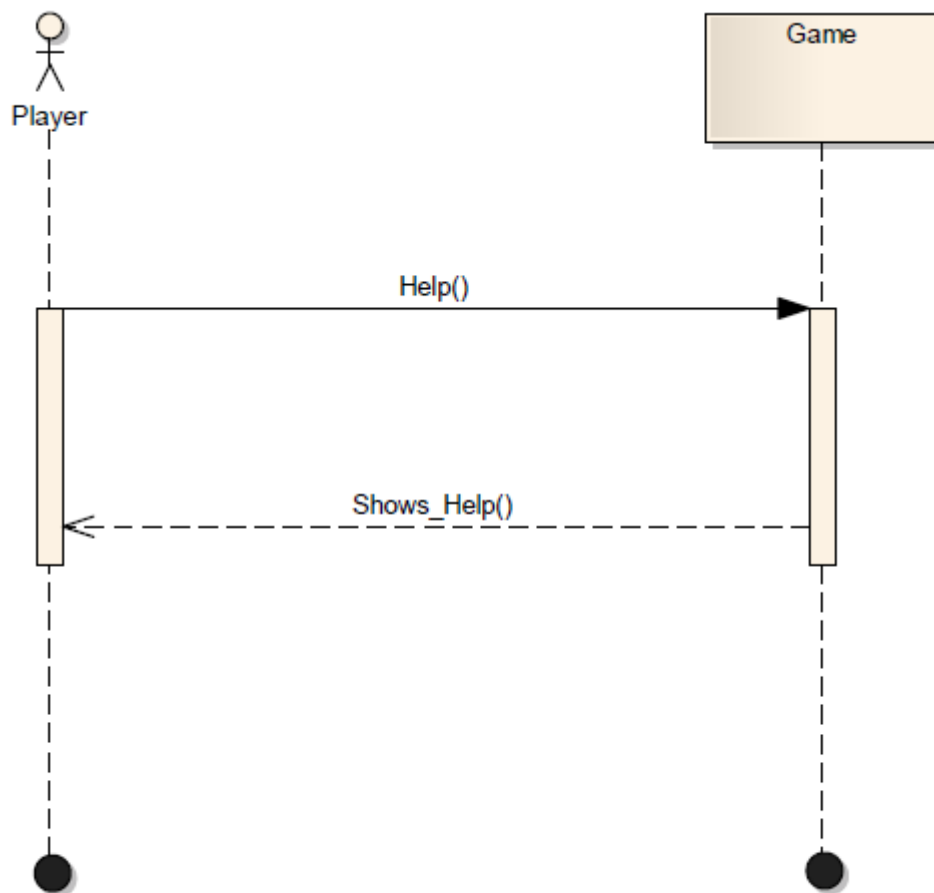
SYSTEM SEQUENCE DIAGRAM: Play Game



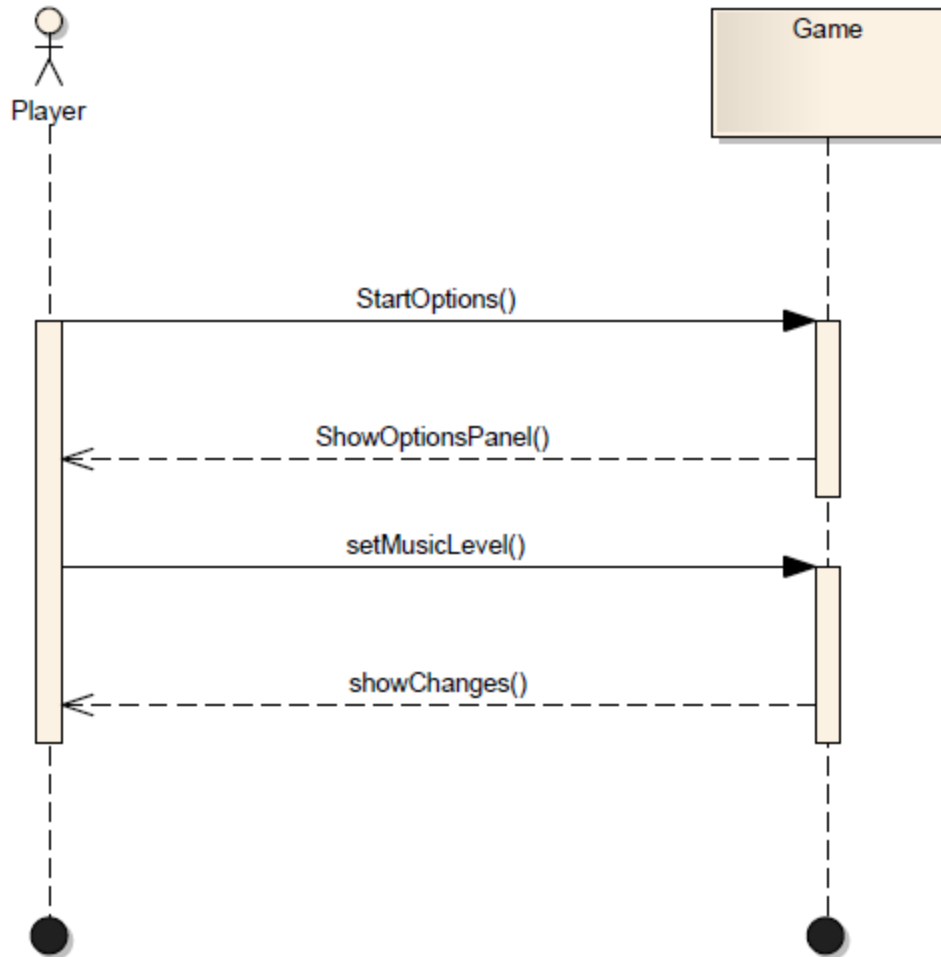
SYSTEM SEQUENCE DIAGRAM: Leaderboard



SYSTEM SEQUENCE DIAGRAM: Help



SYSTEM SEQUENCE DIAGRAM: Start Options



5.7 Operation Contracts:

OPERATION CONTRACT: PlayGame

Name:	PlayGame
Operation:	PlayGame()
Responsibility:	Shows the player different levels that one can play.
Pre-Conditions:	1) Player must have started the game.
Post-Conditions:	1) A play game instance was created. 2) Attributes of play game were initialized.

OPERATION CONTRACT: Leaderboard

Name:	Leaderboard
Operation:	Leaderboard()
Responsibility:	Shows the high score of each level to the player.
Pre-Conditions:	1) Player must have started the game.
Post-Conditions:	1) A leaderboard instance was created. 2) Attributes of leaderboard were initialized.

OPERATION CONTRACT: Help

Name:	Help
Operation:	Help()
Responsibility:	Shows the basics of the game and tells the user how to play the game.
Pre-Conditions:	1) Player must have started the game.
Post-Conditions:	1) A help instance was created. 2) Attributes of help were initialized.

OPERATION CONTRACT: Select_GolfCourse

Name:	Select_GolfCourse
Operation:	Select_GolfCourse(course_id)
Responsibility:	Shows the Golf ball and Golf course of a particular level so that one can play the game.
Pre-Conditions:	1) Player must have started the game.
Post-Conditions:	1) A course_id instance was created. 2) Attributes of help were initialized. 3) Attributes of course_id were changed.

OPERATION CONTRACT: HitBall

Name:	HitBall
Operation:	HitBall()
Responsibility:	Shows the movement of the ball to the player in the game.
Pre-Conditions:	<ol style="list-style-type: none">1) Player must have started the game.2) Player must have pressed 'Play Game' button.3) Player must have chosen a level to play.
Post-Conditions:	<ol style="list-style-type: none">1) A ball instance was created.2) Attributes of ball were initialized.3) Attributes of ball were changed.

OPERATION CONTRACT: Selects_a_Level

Name:	Selects_a_Level
Operation:	Selects_a_Level(level_id)
Responsibility:	Shows the points scored in that level by the player.
Pre-Conditions:	1) Player must have started the game.
Post-Conditions:	1) A level_id instance was created. 2) Attributes of levl_id were initialized. 3) Attributes of level_id were changed.

Name:	StartOptions
Operation:	StartOptions()
Responsibility:	Shows two options to the player so that he/she can make changes to the music level.
Pre-Conditions:	1) Player must have started the game.
Post-Conditions:	1) A show panel instance was created. 2) Attributes of show panel were initialized. 3) An optionsPanel was created. 4) optionsPanel was set to true.

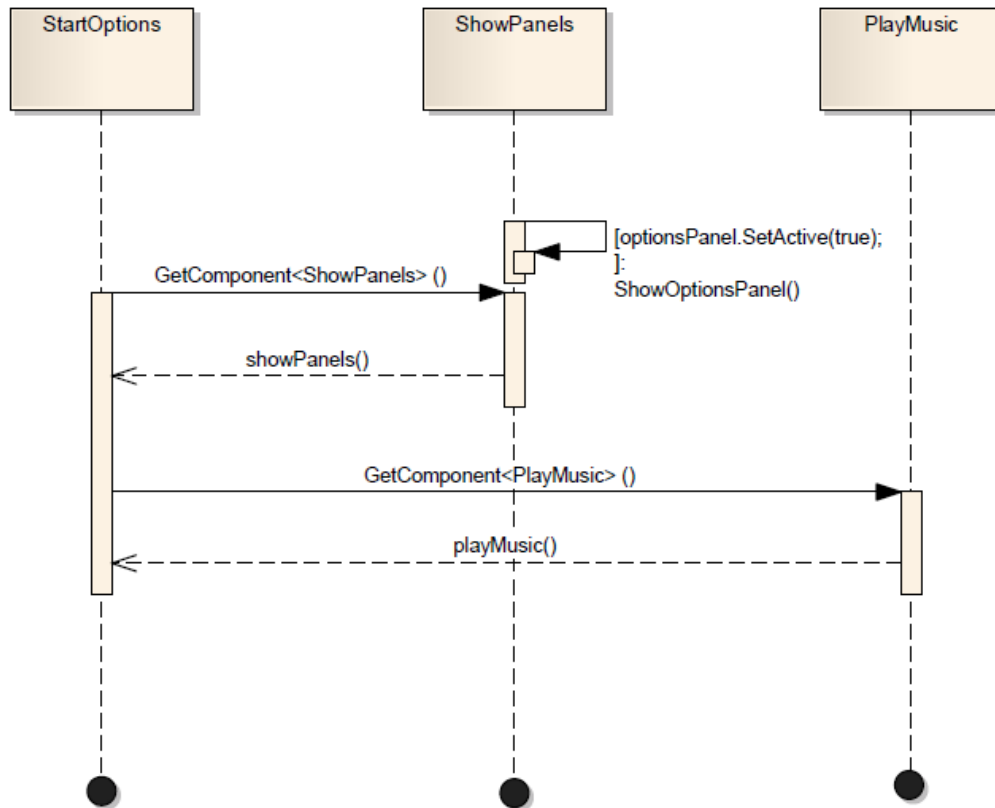
OPERATION CONTRACT: StartOptions

Name:	setMusicLevel
Operation:	setMusicLevel()
Responsibility:	Allows the player to turn the music up or down.
Pre-Conditions:	1) Player must have started the game.
Post-Conditions:	1) A main Mixer instance was created. 2) Attributes of main Mixer were initialized. 3) Attributes of main Mixer were changed.

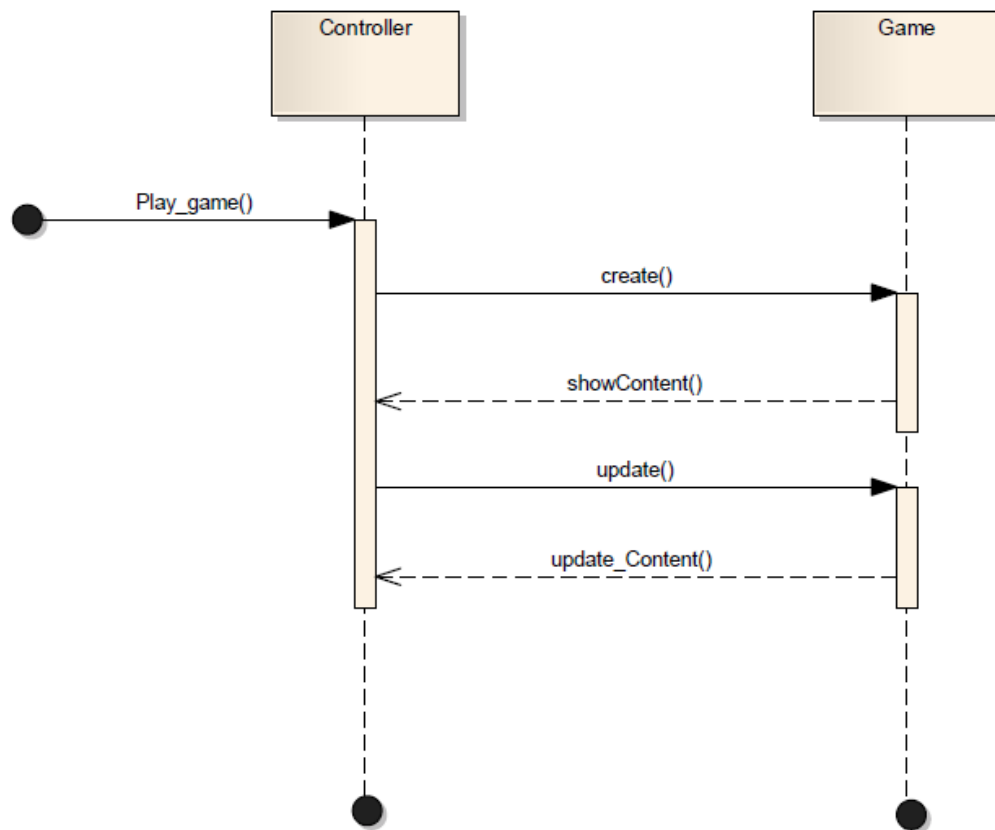
OPERATION CONTRACT: setMusicLevel

5.8 Sequence Diagrams:

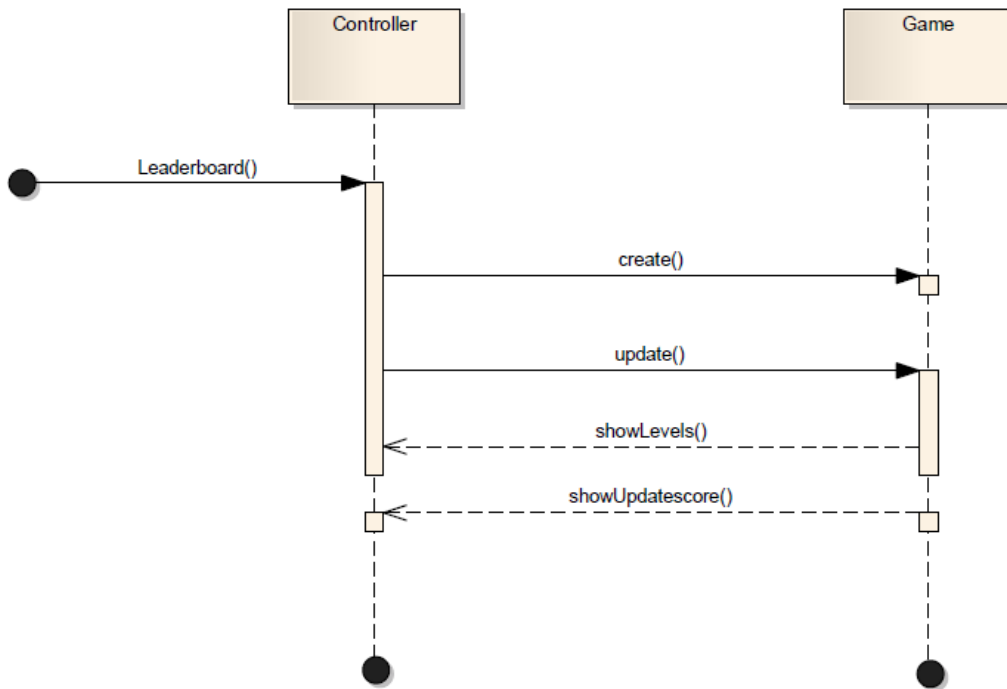
SEQUENCE DIAGRAM: Options



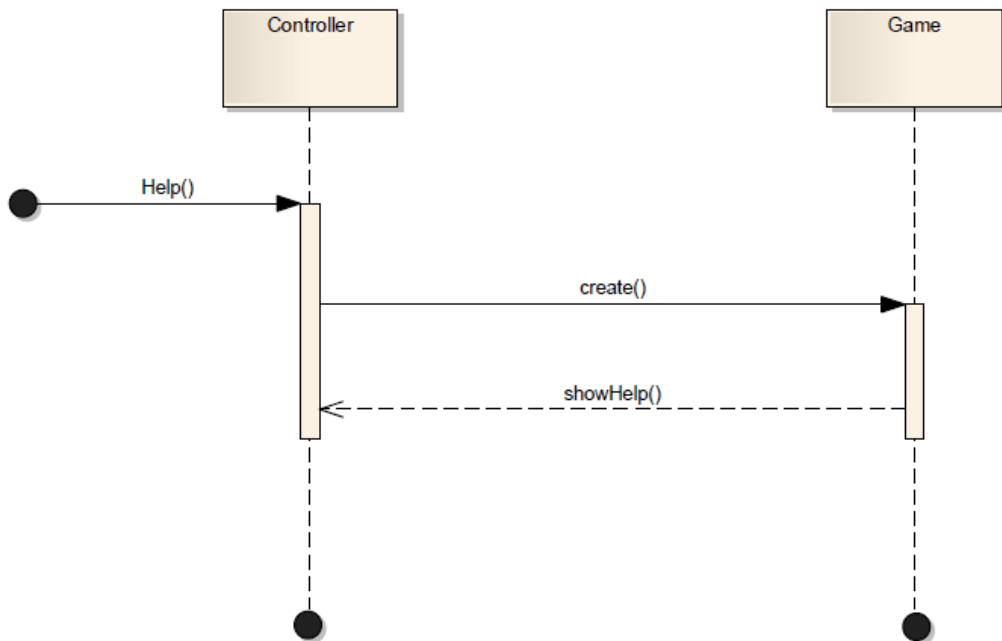
SEQUENCE DIAGRAM: Play_game



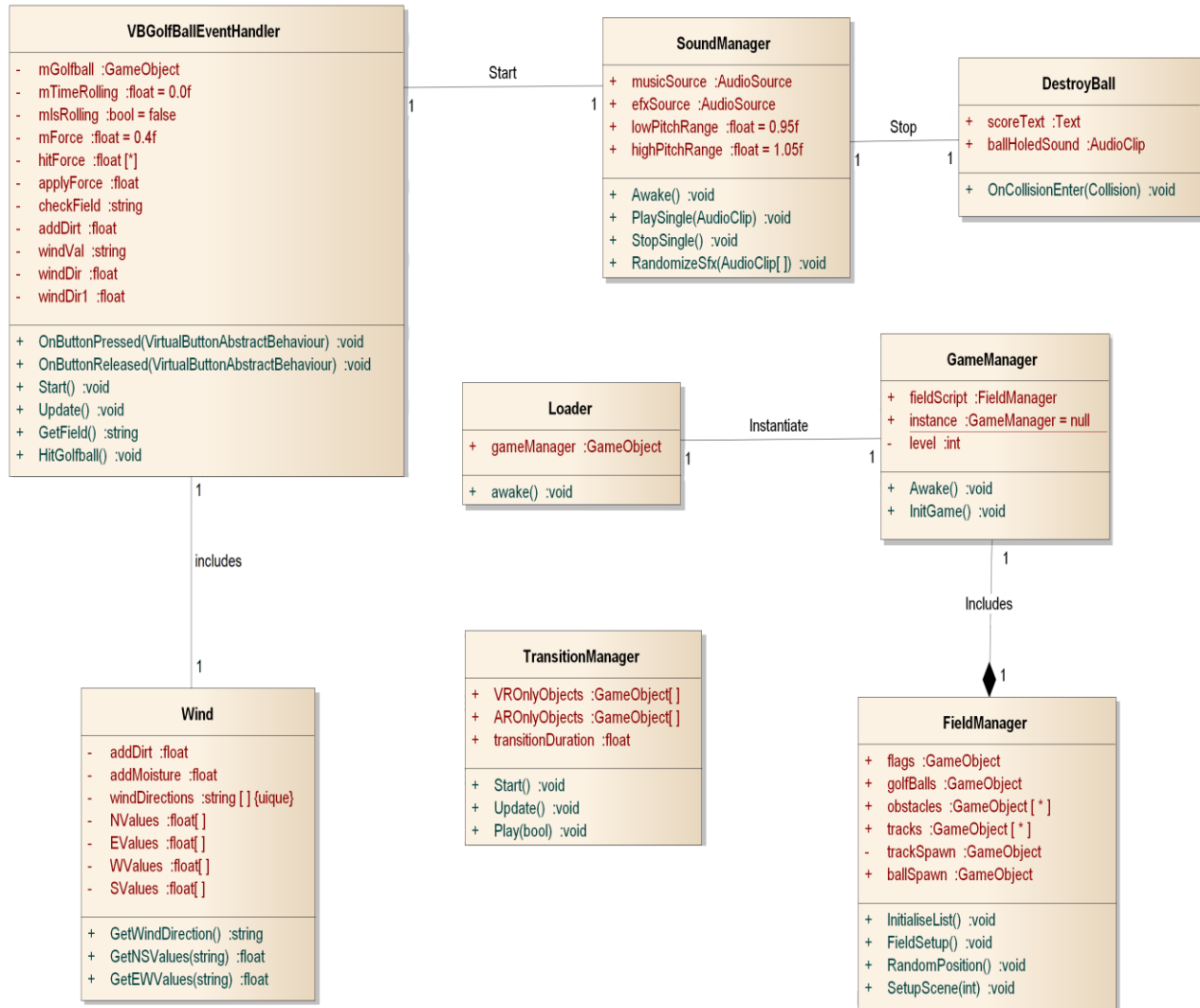
SEQUENCE DIAGRAM: Leaderboard



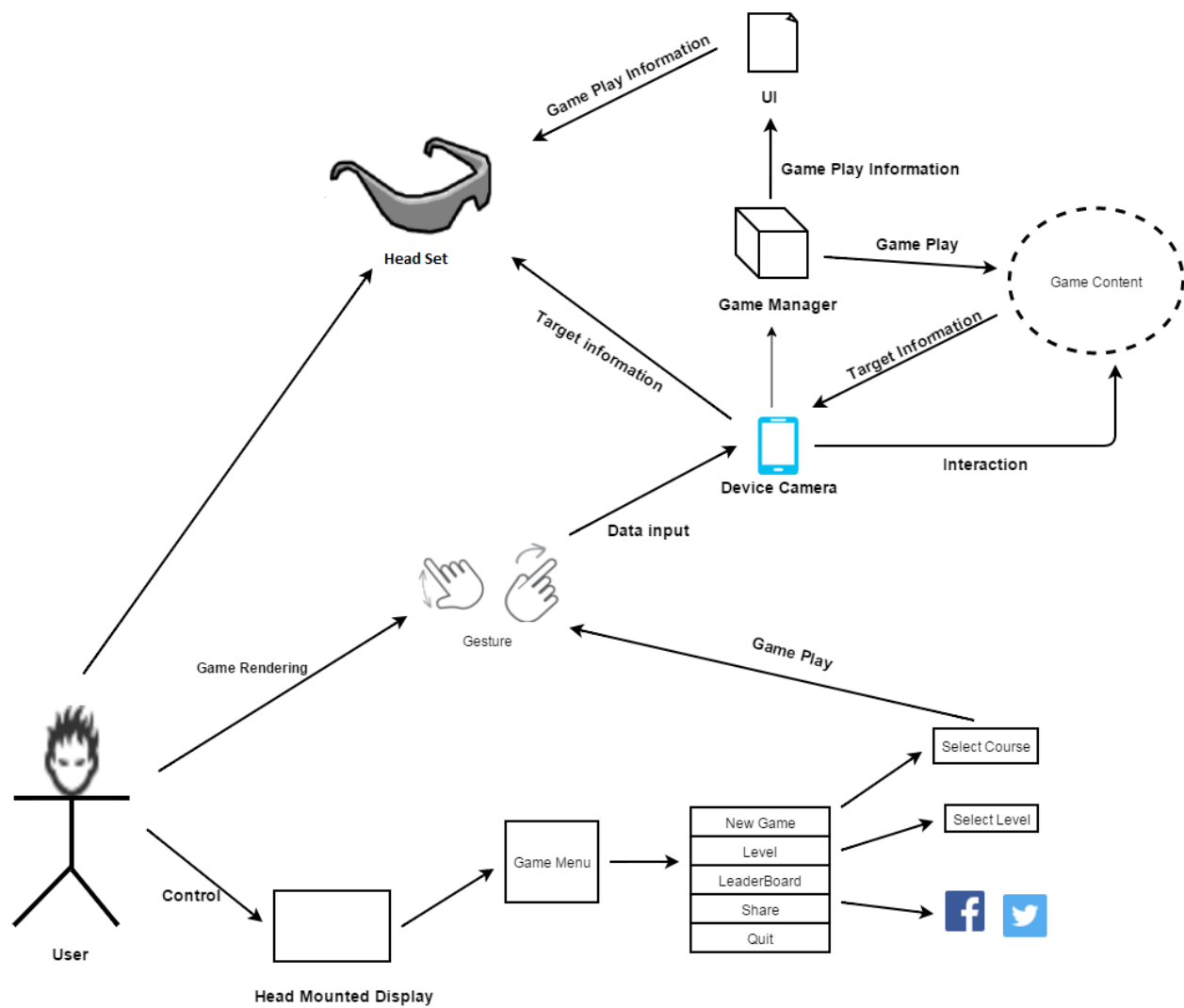
SEQUENCE DIAGRAM: Help



5.9 Class Diagram:



5.10 Architecture Diagram



6. References

1. https://en.wikipedia.org/wiki/Space_Wars#/media/File:SPACEWAR.png
2. <http://static.giantbomb.com/uploads/original/13/135838/2582697-5115863547-Screes.jpg> (last of us)
3. http://static.gamesradar.com/images/mb/GamesRadar/us/Games/L/Legend%20of%20Zelda%20Ocarina%20of%20Time%203D/Everything%20Else/Comparison/Oca_05--article_image.jpg
4. <http://www.gambitmag.com/wp-content/uploads/2015/06/886619.jpg> (mario)
5. <http://www.roadtovr.com/wp-content/uploads/2014/08/war-thunder-oculus-rift-dk2.jpg>
6. <http://i1-news.softpedia-static.com/images/news2/AMD-s-New-Tablet-Could-Be-the-Downfall-of-Gaming-Consoles-409230-2.jpg>
7. http://graphics8.nytimes.com/images/blogs/well/posts/wiitennis_533a.jpg
8. https://en.wikipedia.org/wiki/Augmented_reality#/media/File:AR_EdiBear0001390_1.jpg