

**Ishihara Racing**

# **Panayiotis Alexandrou**

13 April 2017

A project report submitted in partial fulfilment for the degree of  
**Bachelor of Science in Computing**

**School of Physical Sciences and Computing**  
**University of Central Lancashire**

# Abstract

We live at an era that anxiety hits from a young age and will only continue to grow as you get older. Life as we know it, is increasingly becoming a competition against grades, job offers, time, and more, which only makes it harder for either children, adolescents or adults to perform in everyday tasks as they should. Video game playing, on the other hand, has become a familiar term especially among the young children and adolescents, due to their entertainment value and if used in the correct context and manner, many benefits can come to appearance that can make your life easier, not only when it comes to producing better results when performing a task, but also helping you reach a state of relaxation while enjoying the process as well.

The objective of this project is to welcome video games into our life that can be used outside of the regular context of entertainment, through the implementation of a video game called Ishihara Racing which can be used as a tool to aid doctors and psychologists identify whether an individual is suffering from colour blindness. This project is using an agile methodology with frameworks known as extreme programming, prototyping and rapid application development to help meeting with the agile manifesto rules. As video game applications can be considered as large projects, to help the application reach its objectives, a project plan was created that has helped break large components of the application into smaller sub-sections.

After discussing available literature to get a better understanding of the subject, creating a project plan to allow for delivery of the project on time, and designing and implementing of the product, through the use of testing I was able to justify that the resulting application has met my expectation and meets the objectives of the project.

Regarding the test performed through the application, the results were that if the individual playing the game manages to get more than 50% of the pseudo isochromatic plates correct, the subject is less likely to be suffering from colour blindness. However, the video game should be handled by an expert in the field so that he can further validate such a result.

Finally, even though the final project result can be applied to the commercial world as it is, this application leaves a lot of space for future work to be applied to further improve the main aspects of the game, while the idea of the implementation of the game makes it possible to extend the game to use additional functionality and applicability.

## **Attestation**

I understand the nature of plagiarism, and I am aware of the University's policy on this.

I certify that this document reports original work by me during my University project.

**Signature:**      *Panayiotis Alexandrou*

**Date:** 13/04/2017

## **Acknowledgements**

First of all, I would like to express my gratitude to my supervisor Dr. Paris Kaimakis who has provided me with his knowledge regarding game development and has spent time to arrange meetings whenever I had questions on the subject.

I am also grateful to Dr. Andreas Pamboris that was available to provide me with feedback and tips on this report.

Last but not least, I would like to give a very special thanks to my parents Alexandros and Pantelitsa, who have provided me through moral and emotional support in my life.

# Table of Contents

<b>Abstract</b> .....	<b>i</b>
<b>Attestation</b> .....	<b>ii</b>
<b>Acknowledgements</b> .....	<b>iii</b>
<b>Table of Contents</b> .....	<b>iv</b>
<b>List of Figures</b> .....	<b>vii</b>
<b>List of Tables</b> .....	<b>viii</b>
<b>List of Listings</b> .....	<b>ix</b>
<b>1 Introduction</b> .....	<b>1</b>
1.1 Background and Context .....	1
1.2 Scope and Objectives.....	2
1.3 Achievements .....	2
1.4 Overview of Report .....	2
<b>2 Literature Review</b> .....	<b>4</b>
2.1 Introduction .....	4
2.2 Literature Topics .....	4
2.2.1 The Impact of Technology on Society.....	4
2.2.2 Video Games as Part of Our Lives .....	5
2.2.3 The Benefits of Playing Video Games .....	6
2.2.4 The Impacts of Competitive Game Play .....	7
2.2.5 Education and Video Games .....	8
2.2.6 Overview of Game Engines .....	9
2.2.7 Colour Vision, Deficiencies, and the Ishihara Test .....	9
2.2.8 Summary: .....	12
<b>3 Project Planning</b> .....	<b>14</b>
3.1 Introduction .....	14
3.2 Methodology .....	14
3.3 Requirements .....	19
3.4 Potential Solutions .....	19
3.5 Tools and Techniques .....	19
3.6 Legal and Ethical Issues.....	20
3.7 Summary .....	20
<b>4 Design</b> .....	<b>21</b>
4.1 Introduction .....	21
4.2 System Design.....	21
4.2.1 System Architecture and Data Flow.....	21

4.2.2	Components .....	23
4.2.3	Modules .....	23
4.2.4	Stages and Modes Explanation .....	23
4.3	User Interface Design .....	25
4.3.1	Main Menu .....	25
4.3.2	Loading Screen.....	26
4.3.3	Game and Dialogue.....	26
4.3.4	Pause.....	27
4.3.5	Psychologist/Doctor Tool .....	28
4.4	Summary .....	29
<b>5</b>	<b>Implementation .....</b>	<b>30</b>
5.1	Introduction .....	30
5.2	Asset based work .....	30
5.2.1	Realistic Car Controller.....	30
5.2.2	Dialogue System.....	31
5.2.3	Race Positioning System.....	33
5.2.4	Gaia .....	34
5.2.5	Easy Save 2.....	34
5.2.6	Loading Screen.....	35
5.2.7	Easy Roads 3D Pro .....	36
5.3	Original Work .....	36
5.3.1	Dialogue Handler .....	36
5.3.2	Turns Collision Handler.....	36
5.3.3	Nitrous File Create .....	36
5.3.4	Nos Button Handler .....	37
5.3.5	Count Down Handler .....	37
5.3.6	Pause Controller .....	38
5.3.7	Nos Billboard Handler.....	38
5.4	Summary .....	39
<b>6</b>	<b>Test Strategy .....</b>	<b>40</b>
6.1	Introduction .....	40
6.2	Testing for Bugs.....	40
6.3	Testing for Validation of Colour Blindness Test.....	41
6.4	Summary .....	42
<b>7</b>	<b>Evaluation, Conclusions and Future Work .....</b>	<b>43</b>
7.1	Project Objectives.....	43
7.2	Evaluation .....	43

7.3	Applicability of Findings to the Commercial World.....	43
7.4	Future Work .....	43
7.5	Concluding Reflections .....	44
<b>8</b>	<b>References .....</b>	<b>45</b>
	<b>Appendix 1 – Old Project Proposal .....</b>	<b>49</b>
	<b>Appendix 2 – Old Feasibility Study .....</b>	<b>53</b>

# List of Figures

Figure 1 - Spectral sensitivity of the S-Cone, M-Cone, and L-Cone.....	10
Figure 2 - Colour Vision Deficiencies .....	11
Figure 3 - CVDs based on cones .....	11
Figure 4 – The Waterfall Methodology .....	15
Figure 5 – The PMI/PMBOK Methodology .....	15
Figure 6 - The Event Chain Methodology .....	16
Figure 7 - Lean Methodology Principles .....	16
Figure 8 - Wastes of Lean Methodology .....	17
Figure 9 - The Four Values of Agile .....	17
Figure 10 - The Agile Methodology .....	18
Figure 11 - Use Case Diagram of Ishihara Racing Game .....	21
Figure 12 - State Transition Diagram for Turns Mode .....	22
Figure 13 - Turns Mode Stage 1 .....	24
Figure 14 - Nos Mode Stage 2 .....	24
Figure 15 - Main Menu UI.....	25
Figure 16 - Loading Screen .....	26
Figure 17 - Game and Dialogue UI .....	26
Figure 18 - Pause UI .....	27
Figure 19 - Explorer Tool.....	28
Figure 20 - Ishihara Viewing.....	28
Figure 21 – Dialogue Database Editor .....	32
Figure 22 - Dialogue Inspector .....	32
Figure 23 - RPS Editor .....	34



**List of Tables**

Table 1 - Difference between both tests regarding the number of correct answers in each test.....12

Table 2 - Difference between both tests regarding the screening inefficiency, the categorization into normal or RG-CVD, and the total number of answers in each test .....12

Table 3 - Test Results .....41

## List of Listings

Listing 1 - [RCC_CarControllerV3.cs] Loading Nos Key from Handler File.....	30
Listing 2 - [RCC_CarControllerV3.cs] Adjusting usage of nitrous .....	31
Listing 3 - [setDialogueNames.cs] Dialogue Variable Set .....	33
Listing 4 - [nosFileCreate.cs] Starting conversation through code .....	33
Listing 5 - [nosPositionHandler.cs] Example of use of Race Variables .....	33
Listing 6 – [colliderCheck.cs] Saving with Easy Save 2 .....	35
Listing 7 - [colliderCheck.cs] Loading with Easy Save 2 .....	35
Listing 8 - [dialogueFunctionsHandler.cs] Loading Screen asset Usage .....	35
Listing 9 - [dialogueFunctionsHandler.cs] Car Control Enabler Function .....	36
Listing 10 - [nosButtonHandler.cs] Handle Key Press and Score .....	37
Listing 11 - [nosButtonHandler.cs] Handle Results based on Lap Number .....	37
Listing 12 - [countDownHandler.cs] Disable Controls of a Car .....	38
Listing 13 - [pauseController.cs] Handle Pause Function .....	38
Listing 14 - [nosBillboardsHandler.cs] Handle tag of colliders .....	38
Listing 15 - [nosBillboardsHandler.cs] Handle texture of billboards .....	38

# **1 Introduction**

With the rise of the use of technology in the current generation, it is essential to understand that we should adapt old techniques and methods to support the use of this technological advancement. Even though such techniques might be effective, the current technology allows for improvement in both time and money, while the process of performing such techniques becomes easier and more enjoyable.

The aim of this project was to introduce video games, not only as a hobby, but also as a tool to aid psychologists and/or doctors identify whether an individual is colour blind. Through the use of video games, not only does the test for colour blindness become automated and faster, but it also allows for the subject being tested, to feel more relaxed and comfortable, and therefore producing results that are more accurate and valid the more the subject is playing the game.

Several studies indicate that video games have become part of the everyday life of children and adolescents, without this necessarily being a bad thing. In the United States, 97% of all children and adolescents, spend at least one hour per day playing video games (Granic, Lobel, & Engels, 2014). However, video games are not only played by young adults and children. Shawn Green states that more 40% of Americans spend more than 3 hours a week playing video games, while the 27% of the players are above 50 years of age, and the 44% of the players being female (Green & Seitz, 2015).

## **1.1 Background and Context**

Several people, including myself, tend to feel tense and anxious around people they are not familiar with. When anxiety hits before or during a task, there is a high chance that it will affect your performance, memory capacity, and even decrease your self-confidence (Brooks, 2014). On the other hand, playing video games can lead to gaining benefits such as cognitive, motivational, emotional and social skills improvement (Granic, Lobel, & Engels, 2014). Keeping both of these aspects in mind, using video games in order to complete tasks such as the colour blindness test, would have a major impact on the individual's emotional state and performance.

If a subject is suffering from colour blindness, that means that he/she learns to live with it and in some cases, you might not even realise that you suffer from colour blindness at a young age. While colour blindness does not affect most of everyday life's tasks, the subject might find difficulty in tasks that involve colour and might come across to difficulties in their workspace (Tagarelli, et al., 2004). Having said that, it is crucial to perform the colour blindness test at as young age as possible, in order to avoid future disappointments when

the subject is searching for a job. Since video games are especially popular within the young ages (Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2008), using video games to perform tests such as a colour blindness test, is certain to draw the attention of young individuals and therefore produce the desired results.

The context of this project is a racing game that uses the concept of Dr. Ishihara's colour blindness test. The game includes two different types of game modes, which the player is able to choose from, in order to start playing. While playing any of the game modes, the user will need to follow a set of instructions that will require identification of letters and shapes on billboards that use Ishihara plate texture styles. The game includes dialogues that will guide the player through the game, and once the player finishes a stage of the game, excel files are being created in order to provide the doctor/psychologist with the results. Alternatively, the psychologist/doctor will also be able to use an in-game explorer in order to view these files along with the Ishihara plates.

## **1.2 Scope and Objectives**

The main objective of this project is to introduce games as something more than just hobbies and to exhort their usage in several fields such as when any type of tests or interaction with people is involved. Also, this project aims to point out that video games can also be used to automate such type of tasks in order to reduce the time and effort needed, while making it an easier and more enjoyable process for the individual.

Though this project only covers colour blindness, the applications of the implemented idea can be numerous. For example, video games could be designed for educational purposes or even to perform any types of tests. Since video games improve several aspects of the brain, people should be more open into allowing video games become even a bigger part of their lives. Therefore, the scope of this project is vast with little limitations.

## **1.3 Achievements**

In the final implementation of the game, I have achieved to develop a video game that will draw the attention of any person regardless of age. Once the video game draws the attention of the player, the player can then enjoy playing a video game and compete against his/hers friends through high scores, while the game keeps track of the player's progress regarding the Ishihara plates. The doctor/psychologist can then view this progress in-game or in excel and decide whether a person's colour blind.

## **1.4 Overview of Report**

This report aims to explain the importance of welcoming games into our lives as more than just a hobby. Following the introduction, available literature will be reviewed in order to aid as

a tool to validate the project's effectiveness and correctness, while information is given to the readers regarding work previously done by other, expert in the field, individuals. Further on, the plan followed for the implementation will be discussed. During the next two chapters, 4 and 5, the design and implementation processes will be thoroughly explained, so that the readers can get a better understanding on how the application works based on everything mentioned during the introduction part of this report. During chapter 6 you will read about test strategies that were performed in order to identify and correct bugs and defects within the application. Finally, a conclusion will be available near the end of this report, where you can read about the summary of the findings that were identified throughout this project's life cycle.

## **2 Literature Review**

### **2.1 Introduction**

The history of playing video games goes way back to 1958, when the first game was introduced and it was a simulation of tennis on an oscilloscope screen (Kent, 2001). Ever since then, video games have become a major part of pop culture and one of the most common entertainment medium of choice for millions of people (Ceranoglu, 2010). Through the years, researchers have debated whether playing video games is good or bad for you without finding a fixed answer.

Throughout this chapter of the report, you will read discussions based on existing literature stating the benefits of playing video games and the impact of technology in our lives. As part of this chapter, you will also learn about games in general and how games can aid as tools for educational purposes, psychology aspects, and how they can be used to sharpen your brain.

Another part of this chapter, will be spent in order to help you get a better understanding of colour blindness and the modern techniques used to perform the colour blindness tests.

Finally, this chapter will introduce you into game engines and how they can be used to develop video games.

### **2.2 Literature Topics**

#### **2.2.1 The Impact of Technology on Society**

Technology has, undebatable, become part of our life on a daily basis. From the moment we wake up, until we go back to sleep at night, we use the technological advancement to make our lives easier. One could say, that the more advanced the technology becomes, the more it seems to have control over our lives (Mohammad & Samer, 2015).

If you are a children, the technological investment in schools worldwide has increased more than a hundredfold just in the last two decades, assuming that technology learning environments enhance the students ability to search and analyse information, helps them solve problems, communicate and collaborate with each other (Lim, Zhao, Tondeur, Chai, & Tsai, 2013).

If you are an adult on the other hand, you cannot think and plan a project, business or other initiative without the usage of Information Technology (IT) (Afërdita, 2015). The word technology on its own, has been derived from the Greek words “techne” meaning art or skill, and “logia”, therefore to practise “technology” refers to the use and knowledge of humanity’s tools and techniques (Shoeb, 2014).

Since video games can be considered a product of such a technological advancement, I aim through my project, to show that just like any other technology medium used in schools or in workspace, they can be adjusted to get out of the context of them being a hobby, and instead become a tool into aiding us, either in school or in workspace. As an example, simulation games can aid employees into learning more about their work environment, or even gain better collaboration skills along their co-workers. In schools, games can aid as tools for education and teach young individuals how to communicate and collaborate among each other.

### **2.2.2 Video Games as Part of Our Lives**

Whether male or female, young or old, we have all spent some time in our youth playing video games, whether it was on an Atari, PS4, a mobile or a PC. Who doesn't know the legendary Snake game on the old mobile phones for example? Even though with the advancement of technology it's easier to draw the attention of adolescents and children, we all feel nostalgia when we see a game we used to play when we were younger. As Winnerling and Kerschbaumer state, video games can touch us sufficiently deeply to be labelled an additive hazard by some (Winnerling & Kerschbaumer, 2014).

Even though most of us love video games, regardless our age, as the technology advances children are becoming more and more engaged with video games which has as a result the creation of more realistic and exciting games waiting to get brought into millions of homes (Gentile & Anderson, 2006).

The thing about playing video games, is that players not only do play video games to entertain and enjoy themselves, but also to experience emotions and pursue in-game challenges that when achieved, may not necessarily result to immediate, tangible rewards (Yannakakis & Paiva, 2014). As Salen and Zimmerman state, it is really fascinating that players might also willingly engage in experiences that are likely to involve even negative emotions such as frustration and fear (Salen & Zimmerman, 2003). In addition, Frome states that video game play is viewed by researchers primarily as a tool to simulate real-world environments for training and education. The author also states that, based on the role that the players inhabit during a video game, different types of emotion can be generated and, depending on the emotion type, it can aid psychologists understand people's motivations to play and educators to engage students in learning (Frome, 2007).

Video games became, without a doubt, part of our lives. Besides, video games of the current generation, especially virtual reality games, can simulate emotions that once we didn't consider possible. As the advancement of the technology continues, we can safely assume that video games will continue becoming bigger and bigger part of our lives. Throughout this

project, I have attempted to create a video game that can be up to the standards of today's expectations on graphics and produce emotions such as motivation and enjoyment through the use of the in-game dialogues and the actual gameplay.

### **2.2.3 The Benefits of Playing Video Games**

As mentioned in the introduction part of this chapter, many researchers have debated over the years whether playing video games is something good or bad. Before proceeding further with this report, we must first mention that there is always the case that one can abuse the term of playing video games and that can lead into negative effects such as lower academic performance, risk of childhood obesity, and gaming addiction (Prot, Anderson, Gentile, Brown, & Swing, 2014). This part of the report however will focus on the positive effects one can gain through the moderated use of video game play.

The benefits of playing video games, can be broken down into four major categories. These categories include cognitive, motivational, emotional, and social (Granic, Lobel, & Engels, 2014).

As for the cognitive benefits, video games can affect perceptual and cognitive processing. To be more specific, video games that involve lots of fast motion, items to keep track of simultaneously, and a need to attend to peripheral vision constantly, has been linked to a multitude of gaining benefits from the lowest levels of perception, up to the highest levels of cognition (Eichenbaum, Bavelier, & Green, 2014). It is also worth mentioning, that through a numerous amount of studies, playing such type of video games can have cognitive consequences that have effects on attention skills, perceptual skills, or even higher cognitive functions (Green & Seitz, 2015).

Game Designers can be considered as wizards of engagement, which have mastered the art of pulling people, of all kind of ages, into the virtual environment. (Granic, Lobel, & Engels, 2014). According to Dweck and Molden, if you are praised for the effort you put into a game rather than your traits (through the use of messages like "Wow! You worked really hard to complete the race! Well done!"), it is possible to develop an incremental theory of intelligence that can motivate you into believing that intelligence is malleable, through effort and time (Dweck & Molden, 2005). Providing the players with feedback and rewarding their efforts, is a motivational "sweet spot" that can balance the game's challenge and frustration, so that the users can experience the feeling of success and accomplishment (Sweetser & Wyeth, 2005).

Emotions also play a big part on the actions you take on your everyday life. In a survey performed by Olson and his/her colleagues, 62% of boys and 44% of girls who are engaged into playing video games, they have played games to help them relax, while 45% of boys



and 29% of girls, used games to cope with anger (Olson, 2010). When you come home, it is better to take out your anger in the game, rather than the people surrounded by you.

As anxiety is also part of everyone's life, it has been shown through studies that playing video games can also improve mood and increase the positive emotion that can also act as a method to ward off anxiety (Granic, Lobel, & Engels, 2014).

Last but not least, through the play of games such as MMORPGs (Massively multiplayer online role-playing games), you are engaged into social activities such as organizing groups and co-operate with each other to complete goals within the game. Studies performed on adolescents who play such games, has shown that those people were more likely to be engaged in social and civic movements in their everyday lives (Such as raising money for charity, volunteering, and persuading others to vote) (Granic, Lobel, & Engels, 2014).

Through the play of MMORPGs, you often come across the opportunity to lead. This can aid through gaining leadership abilities such as mediation, persuasion, and motivation (Olson, 2010).

Playing video games in a correct manner and moderation, can provide you with skills and benefits that can help you progress through life. Keeping this in mind, I aimed to create a video game that would follow some of these rules and therefore act as a medium to help its players gain such skills.

#### **2.2.4 The Impacts of Competitive Game Play**

As a game developer myself, one of the questions that I keep asking myself is how to make video games more attractive to the targeted audience. Thinking back on my days where I spent several hours a day playing video games, what drew me into the virtual world and made me love spending countless of hours playing video games, is the competition I had with other friends or individuals that play the same game. Is the completion healthy however?

Well, one of the common answers in most questions, is that it depends. In this section however, I will focus on listing the positive effects, one can gain through healthy competition in video games.

First of all, we must understand that competition is a fact of life. Students compete about grades, employees compete for promotions, researches compete for grants, and of course companies for market share (Kilduff, Elfenbein, & Staw, The psychology of rivalry: A relationally dependent analysis of competition, 2010).

Just like everywhere else, competition and collaboration with friends and other players in a video game, is considered to be one of the most important game mechanics a game should have (Peng & Hsieh, 2012).

At the close of a meta-analysis of 122 studies, indicates that the competitive groups had higher levels of interest in computers, when compared to those who worked individually (Plass, et al., 2013). It is also worth mentioning that studies have linked competition to improve the performance and motivation of individuals, and such researches on the effects, go as back as to 1898, where Triplett has observed that bicyclists were faster when competing with each other, rather than racing alone. (Kilduff, Driven to Win, 2014).

As competition acts as a mean to improve performance and motivate, I made sure to implement high scores in my game, to make the game more attractive to individuals that will play it.

### **2.2.5 Education and Video Games**

In the past sections of the literature review, I mentioned some of the benefits that can come out of playing video. In this section, we will more specifically discuss how and why games are used in schools as educational schools.

As stated by Griffiths, when games are designed to address a specific problem or to teach a certain skill, video games have great potential in addition to their entertainment value (Griffiths, 2002). As video games are great motivational tools, students tend to contribute more when learning through playing. Such games can motivate by challenging and providing curiosity, beauty, fantasy, fun and social recognition (Annetta, 2008).

Schools nowadays largely sequester students from one another and from the outside world, while video games bring players together, competitively and cooperatively, in the virtual world of the game and in the social community of its players (Shaffer, Squire, Halverson, & Gee, 2005). This is what makes video games such powerful tools for learning.

Some more specific skills that may be attained through playing include language skills by discussions, following directions, giving directions, answering questions, and having discussions with visual aids. Mathematical skills can also be sharpened as children learn how to interact with the score counters on video games, reading skills can be obtained through the use of dialogues in the games where the text is printed on the screen, and social skills are developed as video games make it easier for students to communicate and play among each other (Griffiths, 2002).

Finally, I would like to point out that video games are popular are mainly because they are fun and this can easily draw the attention of anyone, especially students as they will seek to find a way on how to relax their brain after a long day of studying. Motivation can easily be combined with the contents of school, therefore, playing video games may have advantages from a pedagogical perspective (Sáez-López, Miller, Vázquez-Cano, & Domínguez-Garrido, 2015).

## **2.2.6 Overview of Game Engines**

In the previous sections of this chapter, I have discussed about the usage of video games and what benefits they can have. Creating a video game that is able to achieve what was mentioned, is no easy task. This section will provide a quick overview of game engines, and how they help developers achieve their goals.

As Ahmad states (Ahmad, 2013), back in the past, the term “Game Engines” did not exist. Video games were considered, by adults, as nothing more than toys. However, nowadays, the video game industry is a multi-billion-dollar industry that can rival even the Hollywood. Game engines are the software that, through the use of fully reusable software development kits, drive these three-dimensional worlds known as games.

As recent trends in the game development fields include reduced time for the development of a game and up-to-date techniques such as 3D, network and multi-media, The necessity of game engines is required to develop a game of high completeness in the aspect of stability (Jongho, Kwanwoong, & Soonyoung, 2012).

To put it simply, the concept of a game engine, is that it is a platform of doing common game related tasks which includes rendering, applying of physics computations, animations et cetera, and allows for the reusability of components so that developers can instead focus on detail and create a game that will be unique (Partha Sarathi, Surajit, & Abhishek, 2012).

In addition, game engines reduce the effort required by developers when it comes to detail simulations of operations. Juang along with his/her colleagues point out that, in the case of simulating construction operations for example, a tremendous number of labour-hours are required in order just to set the key frames of an animation, and considerable computational power will be needed in order to render such an animation frame-by-frame (Juang, Hung, & Kang, 2011).

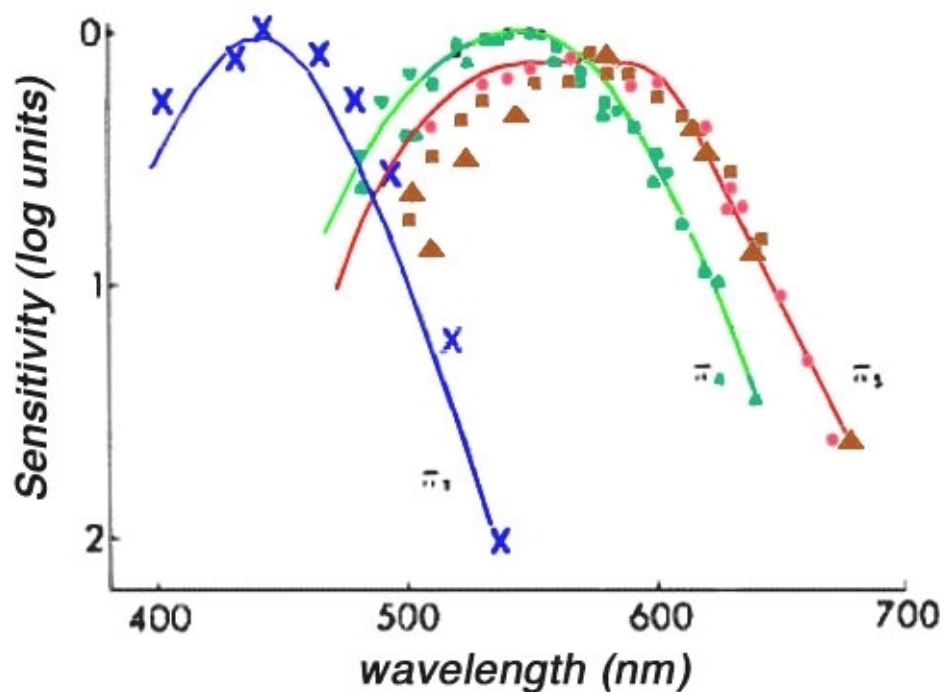
Several Game Engines are available, for either personal or professional usage, with different features and characteristics. In my case, I have chosen the Unity Game Engine, which has a large amount of free and paid assets, to help me develop my application. Given the limitation of time to produce this project, and having more assignments and work to do in parallel, the use of a game engine has helped me towards creating a game that can match the up-to-date standards of video games.

## **2.2.7 Colour Vision, Deficiencies, and the Ishihara Test**

The implementation part of this project aims to help doctors and/or psychologists identify whether an individual suffers from a colour vision deficiency, known as colour blindness, through the use of Ishihara Plates. To get a better understanding on how the application

achieves this, we must first discuss the terms Colour Vision, CVD (Colour Vision Deficiency), and Ishihara Test.

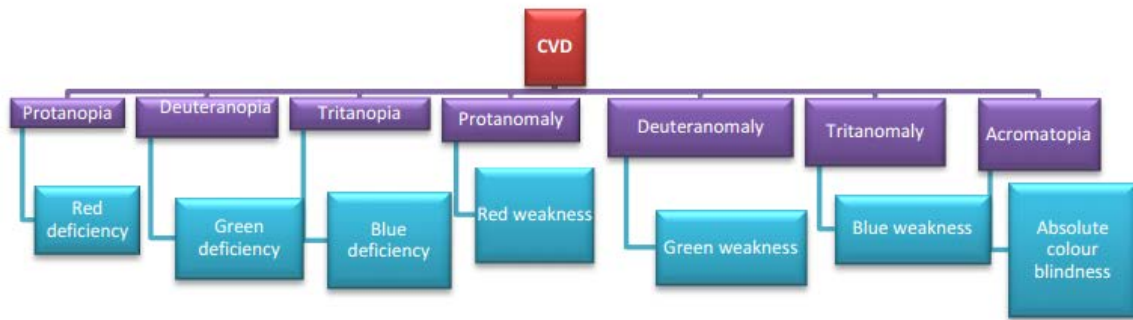
Colour Vision is determined by the discrimination of the three qualities of colour, them being hue, saturation and brightness (Case, 2003). In addition, regarding the perception of colour, the processing of colour vision in a visual system is initiated by the absorption of light by the three different spectral classes of cones. (Michael & Charles, 1995)



**Figure 1 - Spectral sensitivity of the S-Cone, M-Cone, and L-Cone.**

Source: (Michael & Charles, 1995)

Colour blindness is often characterized as the inability of the human eye to distinguish the difference in the colours of the spectrum (Karim & Saleem, 2013). When there is an error in the development of one or more types of retinal cone cells which receive colour in light and then transmit that information to the optic nerve, colour vision deficiency will occur (Chakrabarti, 2015).



**Figure 2 - Colour Vision Deficiencies**

Source: (Chakrabarti, 2015)

Since the perception of colour vision is based on the three different types of cones that were previously mentioned, every perceived colour is a mixture of stimuli of those three cones, colour deficiency will occur if one of those three cones function “poorly” (Karim & Saleem, 2013).

	Normal Vision	L-cone defect	M-cone defect	S-cone defect
<b>Men</b>	<b>91.4%</b>	<b>2.45%</b>	<b>6.1%</b>	<b>0.011%</b>
<b>Women</b>	<b>99.6%</b>	<b>0.04%</b>	<b>0.36%</b>	<b>0.04%</b>
<b>Overall</b>	<b>95.5%</b>	<b>1.25%</b>	<b>3.24%</b>	<b>0.025%</b>

<b>Red</b> <b>Orange</b> <b>Yellow</b> <b>Green</b> <b>Blue</b> <b>Magenta</b>	<b>Red</b> <b>Orange</b> <b>Yellow</b> <b>Green</b> <b>Blue</b> <b>Magenta</b>	<b>Red</b> <b>Orange</b> <b>Yellow</b> <b>Green</b> <b>Blue</b> <b>Magenta</b>	<b>Red</b> <b>Orange</b> <b>Yellow</b> <b>Green</b> <b>Blue</b> <b>Magenta</b>
---	---	---	---

**Figure 3 - CVDs based on cones**

Source: <http://optimalbi.com/blog/2016/07/11/colour-blindness-and-ui-design/>

There are several ways to test whether you are colour blind or not, with some of the tests being the Ishihara Test (Ishihara, 1972), Farnsworth D15 Colour Vision Test, Nagel Anomaloscope, City University Test, and more. The most widely used worldwide, however, is the Ishihara Test through the use of, as they are called, “Ishihara pseudo isochromatic plates” or “Colour Confusion Plates” (Parvizi & Frith, 2008). Through the use of the Ishihara pseudo-isochromatic plates it is possible to detect red-green deficiencies, providing that the subject is given 4 seconds to identify the plates (Hasrod & Rubin, 2015).

The game I have implemented, uses a series of different “Pseudo Isochromatic Plates” to aid the psychologist/doctor identify whether the subject is suffering from colour vision deficiency.

While the plates I am using are not the original Ishihara Plates, but rather an alteration based on the same principals, to effectively identify whether the subject is colour blind or not, an expert in the field will be required to operate the game flow and handle the results. If deemed necessary, an original Ishihara Test might be required to take place as each plate and their order is carefully designed to cover all aspects of Red-Green colour vision deficiency. Finally, I would like to mention that based on a research conducted by Marey and his/her colleagues, the traditional Ishihara Test can be performed electronically through the use of an LCD monitor (Marey, Semary, & Mandour, 2014). The results of this research can be viewed on Table 1 and Table 2 below.

**Table 1 - Difference between both tests regarding the number of correct answers in each test**

Two test difference	Number of difference	Number of volunteers	Total number of volunteers
Number of correct answers more in the computer based test	1	12	15
	2	3	
Number of correct answers more in the paper based test	1	84	102
	2	24	
	3	6	
	4	12	
	5	6	
No difference			150

**Table 2 - Difference between both tests regarding the screening inefficiency, the categorization into normal or RG-CVD, and the total number of answers in each test**

Variable		Paper based test	Computer based test	P value
Screening inefficiency	Mean	0.04	0.05	0.092
	STD	0.02	0.02	
Categorization into	Normal	247	243	0.0912
	RG-CVD	21	21	
Total number of answers	Correct	5376	5310	0.004
	Wrong	231	297	

## 2.2.8 Summary:

We live at an era that anxiety massively starts hitting from a young age and will continue to grow as you become older. Adults get anxious about their health, before an interview, taking care of their family, and for many more reasons, while young adolescents and children get anxious about having to study, performing well at school, making their parents proud, and so on. As much as we would like to rid ourselves from anxiety, it would be naïve to tell ourselves that it does not affect us in our everyday life.

Video games might not be able “cure” anxiety but, through playing, it is possible to attain benefits that include relaxation emotions, improve of the brain, and more, and that can play a massive role on how you handle anxiety and perform in everyday tasks. Through the advancement of technology, video games are easier to become part of our life, and are

becoming more and more realistic making it even easier to get drawn into their virtual world. We all should be more open into welcoming them in our lives since games will continue on existing, whether we like it or not, and be open to the fact that their usage can reach outside of the context of entertainment.

Finally, processes such as performing a colour blindness test, train employees perform a specific task, teach and learn material at school, and more, can be a time consuming and a difficult task that can be improved through the use of video games in order to reduce the labour and time needed to perform those tasks, while in parallel the process on its own becomes more enjoyable and fun.

## **3 Project Planning**

### **3.1 Introduction**

Every project needs to be thoroughly thought if you plan on succeeding. Even if the project is small, milestones should be created, otherwise, even the simplest of tasks will pile up leaving you with little time to implement them and therefore this will have a negative influence on the project's development and satisfaction of the client.

The whole reason for planning your project is that it will help you identify where you currently are, where you want to get, and how to actually get there.

Once you create an effective project plan, through the plan you will be able to break large components of the project into smaller sub-sections that will help you produce a feasible and desired product.

This chapter of the report will give you an overview of the project plan I have created in order to manage in completing the Ishihara Racing video game. At first, you will read about the methodology I have chosen to go through the implementation, while I also give you a brief explanation about it. Further on, I will be listing the requirements I have identified as a necessity in order to produce the desired product and potential solutions that I had found which would have helped me through the process. Next, you will be reading about the tools and techniques I have used to produce the game, while getting a brief explanation about them as well, and potential legal and ethical issues will be discussed. Finally, a brief summary on what you've read can be found at the end of this chapter.

### **3.2 Methodology**

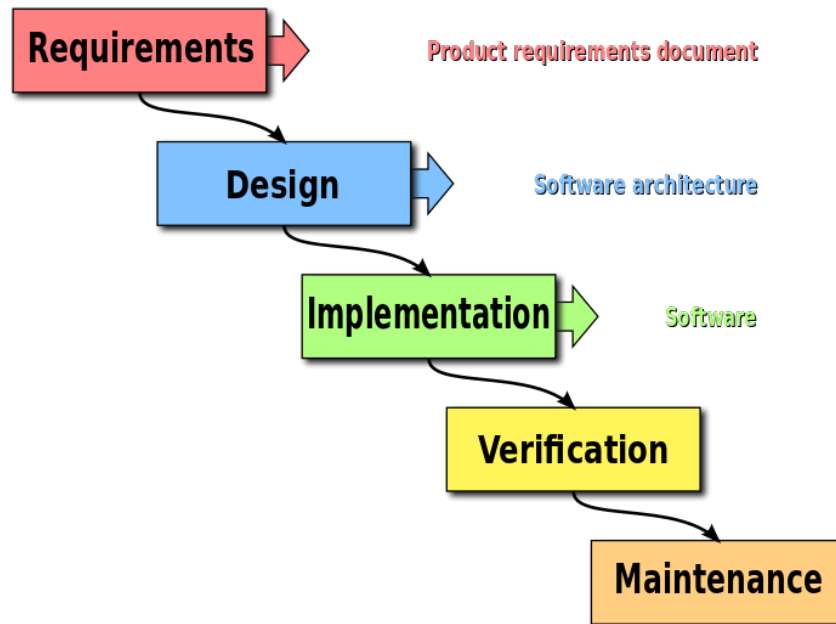
There is a large number of methodologies when it comes to Project Management, each having its own advantages and disadvantages. The top project management methodologies, can be divided into six categories. These categories are the traditional – sequential methodologies, the PMI/PMBOK method, the agile family, the change management methodologies, the process-based methodologies, and the “other” methodologies.

The methodology I had selected for my project is an agile development but before going into detail and explaining the reasons of my selected approach, I would like to provide you with a few examples of each of the categories, so that you get a better understanding on why I decided to go with an agile approach.

Regarding the “Traditional – Sequential” category, the most common method to manage and plan a project is the Waterfall methodology, which simply states that you sequence the tasks of the project and work on them in that sequential order. While this seems simple and effective, an enormous amount of time is spent into pre-planning every single step involved,



and in the case of the customer changing his/her mind, the whole order of the plan gets disrupted, making it very difficult to manage.



**Figure 4 – The Waterfall Methodology**

Source: [http://www.wikiwand.com/en/Waterfall\\_model](http://www.wikiwand.com/en/Waterfall_model)

Regarding the “PMI/PMBOK method”, which is debatable whether this is a true management methodology, it simply means that the project is broken down into five process groups agreed by the Project Management Institute (PMI) and documented in the guide to the Project Management Body of Knowledge (PMBOK).

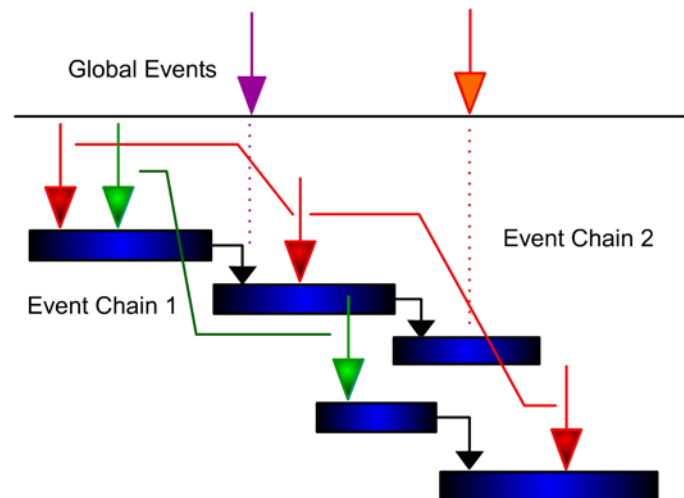


**Figure 5 – The PMI/PMBOK Methodology**

Source: <http://www.mppm.com/project-management-best-practices.php>

As for the “Change Management Methodologies”, while dealing with managing the project there is an extra focus on change management when it comes to planning for risks and controlling changes once they occur. An example of such methodology is the Event Chain Methodology (ECM), which basically means that you plan for potential risks that often lie outside of the project’s scope and that it is important to prepare for such risks and plan what

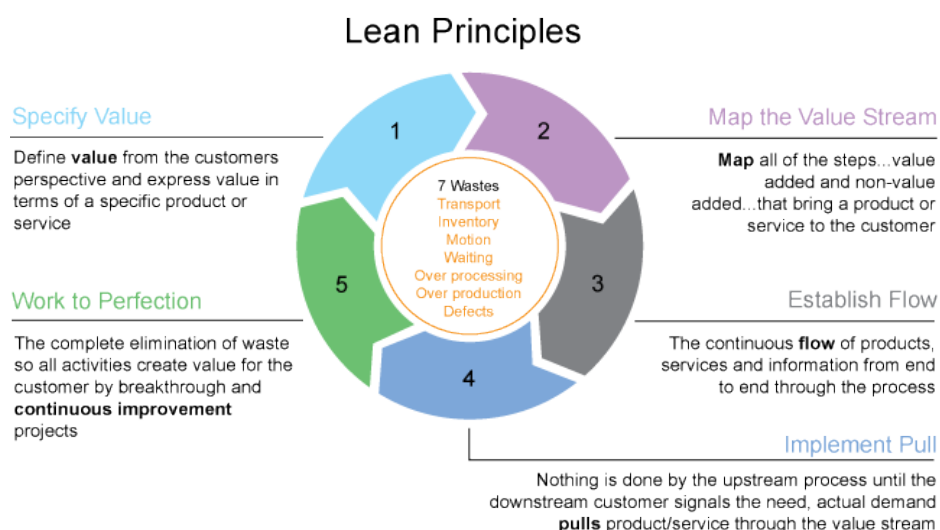
to do if they occur, as they might impact on your schedule, deliverables, and the success of the project.



**Figure 6 - The Event Chain Methodology**

Source: [https://en.wikipedia.org/wiki/Event\\_chain\\_methodology](https://en.wikipedia.org/wiki/Event_chain_methodology)

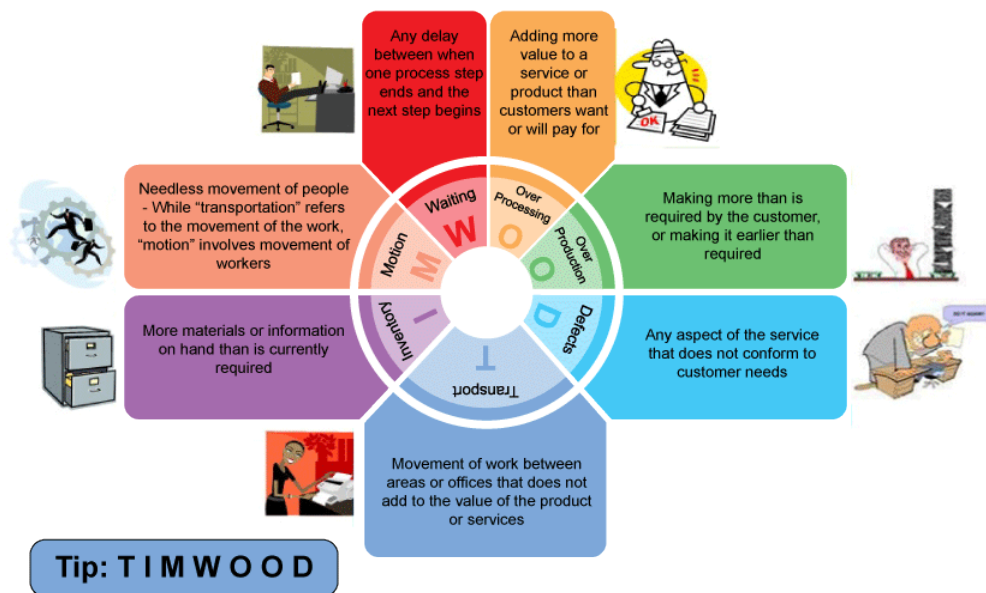
Regarding the “Process-Based Methodologies” category, these are management methods which practically veer into the areas of Business Process Management (BPM). An example of such methodology is Lean, which is a methodology that is focused on streamlining and cutting out the waste. The first step of this methodology is to create a breakdown of the processes in order to identify and eliminate bottlenecks, delays, and the other forms of waste. The objective of this methodology is to be able to do more with less manpower, money, time, et cetera.



**Figure 7 - Lean Methodology Principles**

Source: [https://www.ibm.com/developerworks/bpm/bpmjournal/1308\\_col\\_schume/1308\\_schume.html](https://www.ibm.com/developerworks/bpm/bpmjournal/1308_col_schume/1308_schume.html)

## The 7 Wastes of Lean

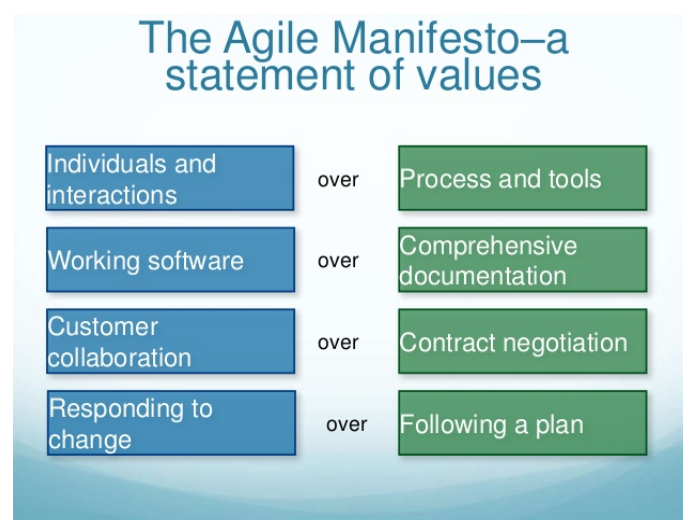


**Figure 8 - Wastes of Lean Methodology**

Source: [https://www.ibm.com/developerworks/bpm/bpmjournal/1308\\_col\\_schume/1308\\_schume.html](https://www.ibm.com/developerworks/bpm/bpmjournal/1308_col_schume/1308_schume.html)

The "Other Methodologies" category includes methodologies such as PRINCE2 (Projects in Controlled Environments), PRiSM (Projects Integrating Sustainable Methods), and Benefits Realization that focuses on whether the deliverable satisfies the benefits of the customer rather than if a product was delivered on time and/or within budget.

Finally, regarding the agile family category, the word agile refers to the four values of Agile Manifesto (Figure 9) as well as the frameworks for implementing them such as scrum, kanban, extreme programming, prototyping, and more.



**Figure 9 - The Four Values of Agile**

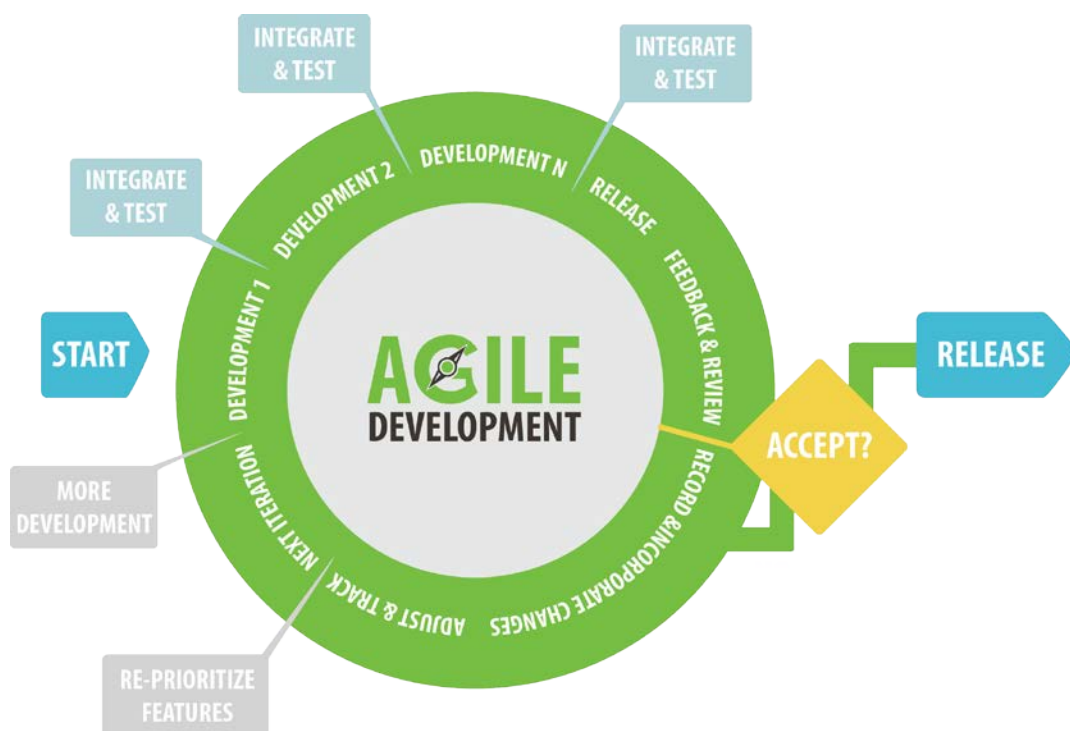
Source: <https://www.slideshare.net/LisetteZZOUNON/agile-methodologies-scrum>

In the case of this project, since the time we were given to implement the project was limited and we had other projects and assignments in parallel, an agile approach was selected in order to be able to deliver within the time boundaries and in order for the final product to be able to be modified in order to better answer the requirements of this project. The frameworks that were used to implement the values of agile, includes extreme programming, prototyping, and Rapid Application Development.

Extreme Programming is a methodology that helps improve the quality and simplicity of a software through work sprints, while changes are possible to happen within sprints.

Prototyping is when you create prototypes of the software such as incomplete versions, in order to get feedback from the stakeholders involved in the project.

Rapid Application Development is somehow an alteration of the waterfall methodology. Instead of emphasizing on planning, you put more effort into the actual process.



**Figure 10 - The Agile Methodology**

Source: [http://www.solutionguidance.com/?page\\_id=1579](http://www.solutionguidance.com/?page_id=1579)

### **3.3 Requirements**

In order to come up with a “working as expected” product, several requirements need to be noted.

Since the game should be able to act as a tool for doctors/psychologists to identify whether an individual is colour blind, the use of known and working methods that support this feature must be applied.

In order to create a video game application that is up to the standards of the current generation’s gaming community, knowledge and usage of game engines must be applied as part of the development of the product.

Given the limitation of time, assets to support characteristics of the game such as car physics, NPC AI (Non Player Character Artificial Intelligence), terrain creation et cetera should be made available.

In order to identify whether this project is feasible, a SWOT analysis shall be performed to identify my strengths and weaknesses. (Can be viewed at Appendix 2 as SWOT Analysis)

The use of time boxes and milestones shall be applied to ensure that the project is progressing as planned. (Can be viewed at Appendix 2 as Progress Plan)

### **3.4 Potential Solutions**

Based on the requirements mentioned above, I have identified potential solutions that will aid the implementation of such requirements.

Regarding the colour blindness identification methods, I will be using the Ishihara Colour Blindness Test which is a working methodology and it’s the most commonly used to identify Red-Green colour blindness.

Finally, as for the use of game engines and asset support, I have decided to use Unity Game Engine which has a massive community providing with assets (Free and Paid) and tutorials on how to use them. I had also purchased several assets that I will give further information about during the implementation chapter.

### **3.5 Tools and Techniques**

The tools required to implement this game is an IDE (Integrated Development Environment) and a Game Engine.

The game engine I decided to use is the Unity Game Engine. Unity is a cross-platform game engine that is used to develop video games for several platforms such as mobile devices, PCs, consoles et cetera. The main reason I decided to use Unity is the fact that they support an enormous amount of free and paid assets, along with tutorials to help you learn how to

use them. It is also worth mentioning that Unity supports writing scripts in both C# and JavaScript but for the implementation of this project, I only used C# scripts.

As for the IDE, I decided to use Microsoft's Visual Studio 2015 to write and edit the C# scripts. Visual studio is used to develop programs for Microsoft windows, mobile apps, windows forms et cetera, while it can also produce both native code and managed code.

### **3.6 Legal and Ethical Issues**

This project has no potential legal or ethical issues. All of the tools used to implement the project and write this report are legally obtained (Assets, IDE, Office Tools and Models).

### **3.7 Summary**

A Project Plan is mandatory if you aim on creating an application up to the standards of the customers. There is a number of methodologies out there that will help you work better through the implementation of the project, and selecting the right one based on the project's requirements, you can end up producing the desired product.

When choosing a project plan, you must first identify the requirements of the project while keeping in mind the tools and techniques you will use to implement them. Finally, to avoid copyrights and lawsuits, all of the legal and ethical issues should be thoroughly thought and identified.

## 4 Design

### 4.1 Introduction

The design part of a project can be considered the most important as it's the step that will give you the green light on the customer's perspective and it will define whether your application is of commercial quality.

This chapter of the report will focus on providing you with an overview of the system design explaining what the components, features, processes, and data flow of the application are, and further on giving an overview of the user interface design and the reasons that I chose to implement it the way I did. Finally, a summary will follow at the end of this chapter that will briefly summarize the chapter.

### 4.2 System Design

System Design is the process that will define the architecture, components, modules, and data flows for the system. Designing the system is one of the most important steps of the project's life cycle as it will define whether the application will be able to satisfy the specified requirements.

#### 4.2.1 System Architecture and Data Flow

System architecture is a model that allows the behaviour and structure of the system to be viewed. In order to get a better understanding on how the system behaves, a Use Case diagram (Figure 11) and a state transition diagram (Figure 12) are provided, along with a brief description of them.

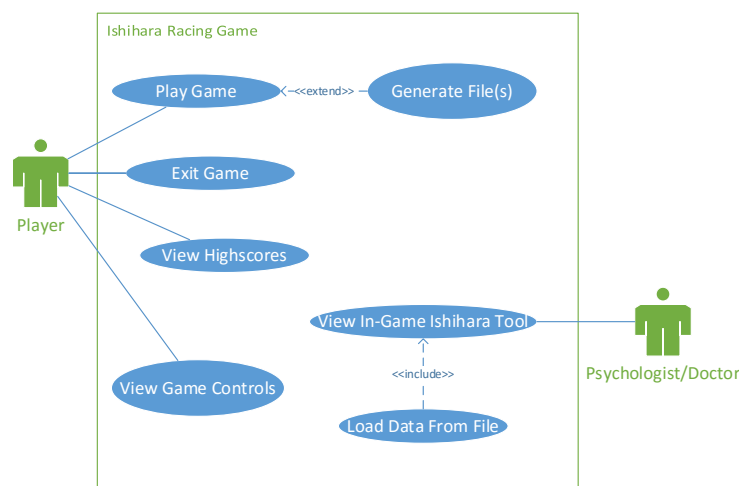
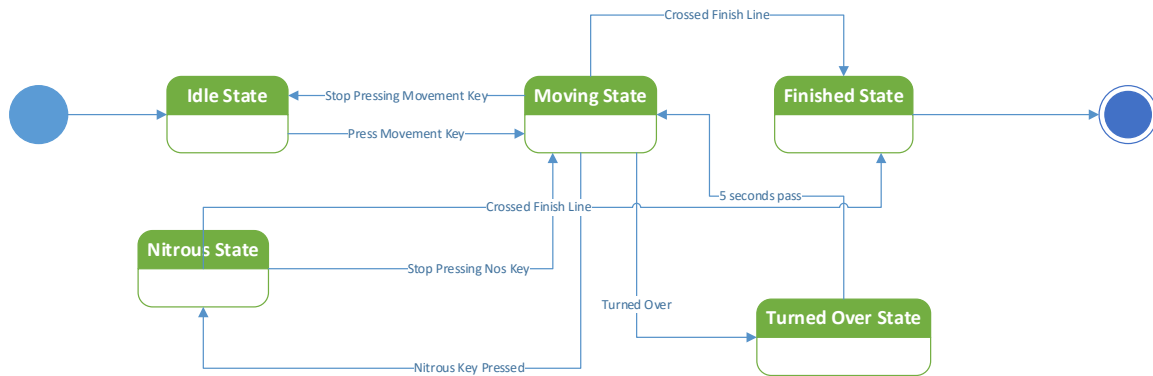


Figure 11 - Use Case Diagram of Ishihara Racing Game



**Figure 12 - State Transition Diagram for Turns Mode**

As you can notice on the Use Case Diagram, once the user opens up the application, he/she is prompted to a “Main Menu”, where he/she will be able to select from a list of operations. These operations include playing the game, exiting the game, viewing high-scores, viewing game controls, and starting the in-game tool for psychologists/doctors. In the case of the user selecting to play the game, he/she is asked to fill in a text box with his/her full name, and once he/she has filled it in with proper value, he/she is able to select the game mode he/she wants to start playing. If the user has selected to view the high-scores, he/she is prompted to select a game mode and a stage, and then the top ten high-scores for that specific stage and mode will be printed on the screen. If the user has selected to view in-game controls, the controls will then be printed on the screen. In the case the exit game button is pressed, the game exits. Finally, if the user has selected to view the in-game tool for psychologists/doctors, a new screen will open printing in screen step-by-step explanation on how to use the tool.

In the case of the user playing the game once he/she reaches the finishing line, both an excel file and a text file will be created, at unity’s persistent folder, named as the user’s full name and the stage’s/mode’s name, containing the Ishihara Plate results (Correct or Wrong) for that specific stage and mode. The excel file can be viewed by the psychologist/doctor by manually going into unity’s persistent folder (mentioned in the steps printed on the screen), otherwise he/she can use the in-game tool to be able to view the ishihara textures as well.

Regarding the behaviour of the game, as you can see in the state transition diagram, my application is working like most available racing games out there. The player car starts in idle state until the user presses the buttons that control it. If the user presses the correct button for Nitrous, the car will go into nitrous state until he runs out of nitrous. In the case the player has managed to turn the car upside down by crashing on walls et cetera, he/she loses control of the vehicle and needs to wait five seconds for the vehicle to automatically turn in



the correct manner. Finally, in the case that the user has crossed the finishing line, he/she stops having control of the vehicle and enters the finishing state.

### **4.2.2 Components**

Regarding the components of the video game, we can break them down into two main categories, being Human Components and Software/Hardware components.

Human components can be considered as anyone that is interacting with the system, including the creator, designer, player, and the psychologist/doctor.

As for the Software and hardware components, this application is using the hardware on the PC it is installed on, input devices such as the keyboard, and output devices such as the monitor for the graphics and speakers for audio.

### **4.2.3 Modules**

Since this game is creating using Unity Game engine, the modules of the game can be considered as the C# scripts used to implement the behaviour of the game. It is also worth mentioning that most of the C# scripts inherit from Unity's MonoBehaviour base class.

### **4.2.4 Stages and Modes Explanation**

This game implements a total of two game modes which include two stages each. It is also worth mentioning that in both game modes a total of five AI (Artificial Intelligence) cars will also take part of the race, to make it more fun and competitive to the player. In addition, to make the game more balanced when played by individuals that do not suffer from colour blindness, I am using pseudo isochromatic plates that are easier to be viewed by colour blind people as well, in a lower frequency of use.

#### **4.2.4.1 Turns Mode**

The main objective of this game mode is to follow the shortest route. Every while the track will be splitting into two and if you follow the correct path, you will be one step closer to reaching the finishing line. In order to indicate the correct path that the player is required to turn, arrows will be indicated on billboards which will also act as pseudo isochromatic plates. Also, to make some turns harder than others, three type of shapes are used as arrows that will make it harder for the individual to view them if he is colour blind. Both the player and the AI, each have their own counter that acts as a timer for the game and will continue to increase until the reach the end of the course. The sooner the player completes the track, the higher his/her chances are to get his name and time shown at the high-scores screen. You can see a sample of one of the Turn Mode tracks listed as Figure 13 at the next page. The colliders (green outlined transparent rectangles) are the collision points that will identify whether the player took a correct turn.



**Figure 13 - Turns Mode Stage 1**

#### 4.2.4.2 Nitrous Mode (Nos Mode)

The main objective of this game mode is for the player to finish first and get as high score as possible. Throughout the race track, several colliders will act as collision points that will allow the player to enable nitrous with the letter indicated on the billboards while the player car is colliding with them. Once the player has clicked the correct button that is indicated through pseudo isochromatic plates on the billboards, nitrous is enabled and as much as the player clicks the button, his/her score will add up. This game mode requires that the player completes a total of three laps, while the pseudo isochromatic plates and the colliders change every lap to avoid the player trying different buttons every lap or re-using nitrous out of memory. A sample of a nitrous stage is provided as figure 14. The green rectangles indicate the colliders where the player can enable nitrous.



**Figure 14 - Nos Mode Stage 2**

## 4.3 User Interface Design

In order to be able to accomplish the goals of this project, the user must be able to understand how to use the game. Therefore, a good interface design will maximize the user's experience and usability with the game.

Keeping in mind this, my goal when creating the interface design was to keep the design as simple and efficient as possible. To get a better understanding of the interface, figures are provided.

### 4.3.1 Main Menu



**Figure 15 - Main Menu UI**

Regarding the main menu, I had created a very simple design that clearly states what the user can do when clicking on the buttons. To implement the starting menu of the game, the canvas uses several panels that are being enabled and disabled based on what the user clicks. For example if the user wants to view the high-scores, when he clicks on "View Highscores" button, the current panel gets disabled and next panel will become enabled. Also, to provide the user with feedback when a button is pressed, the menu makes use of sound effects for hovering and clicking a button.

### 4.3.2 Loading Screen



Figure 16 - Loading Screen

To provide the user with feedback when switching between scenes, my application makes use of loading screens and sounds/buttons when the button is clicked or hovered over. As a bonus feature, the loading screen includes a brief explanation of the objectives of the selected stage, along with tips that players might find funny or even useful through their game play.

### 4.3.3 Game and Dialogue UI



Figure 17 - Game and Dialogue UI

At the start and end of each stage, a dialogue is prompted to the user to provide him/her with instructions of the game and/or motivational messages. Once the computer is done talking, the user is able to select an “answer” to the dialogue giving him/her the ability to perform tasks such as restart level, go to next level, listen to the dialogue again, and more. Also, the user can see on the canvas several information about the car including speed, how much nitrous he/she has left, revolutions per minute, et cetera. Finally, the user is also able to see the information about his timer (or position, lap, and score in the case he/she is playing the nitrous mode).

#### 4.3.4 Pause

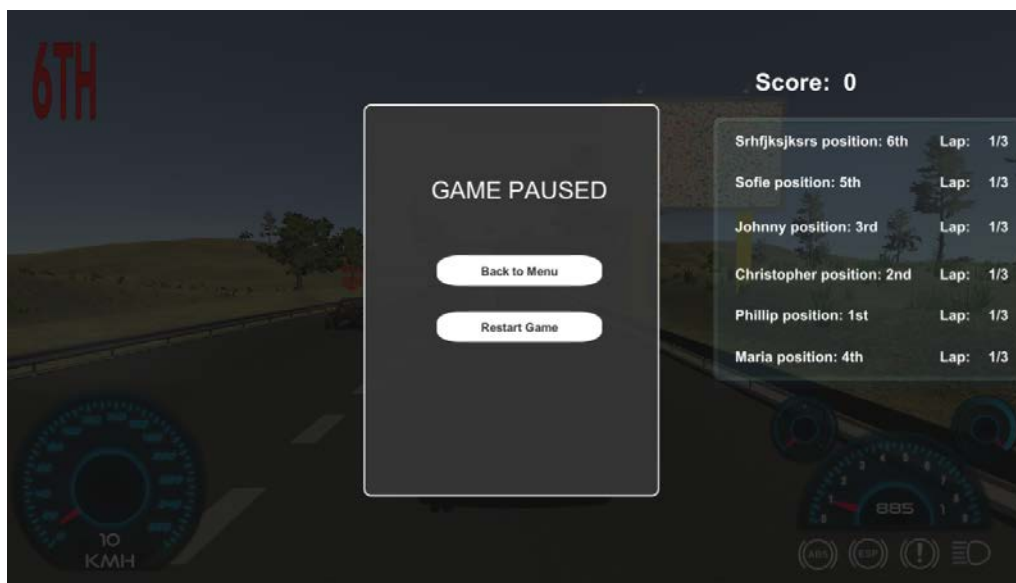


Figure 18 - Pause UI

If the user presses the escape button while playing a stage, the screen becomes darker and a menu appears giving the user the ability to either go back to the menu or restart the current stage.



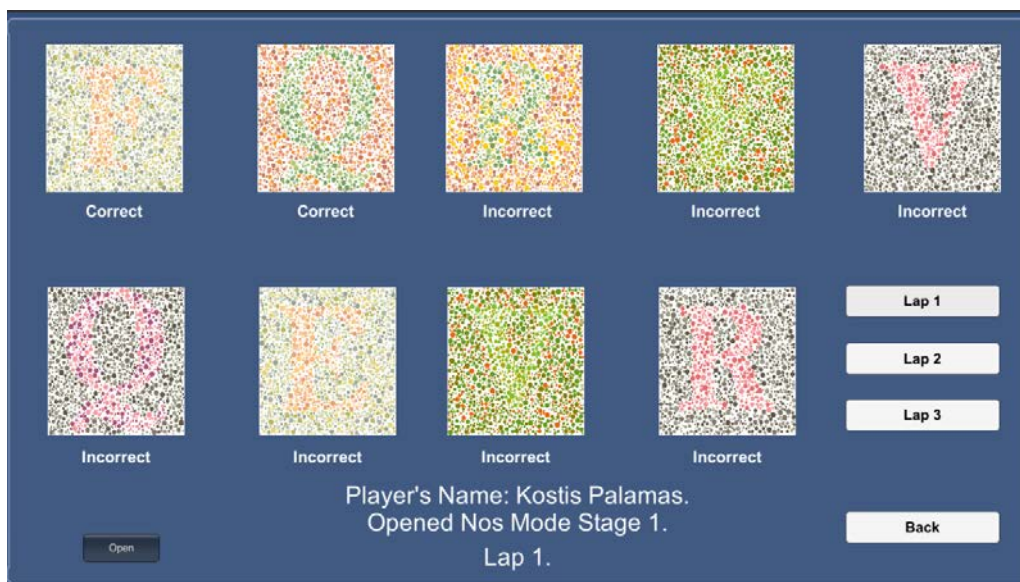
### 4.3.5 Psychologist/Doctor Tool



**Figure 19 - Explorer Tool**

When the Psychologist/Doctor click on the “Psychologist” button from the main menu, this scene will start. While this scene is active, the user is able to click on the Open button to open the in-game explorer to select the file he/she wants to view. The file explorer will only show the persistent unity folder by default and will not allow the user to select multiple files at once to avoid errors.

Once the user has selected a file, a new UI appears as indicated on Figure 20 showing the ishihara pseudo isochromatic plates for the stage indicated on the file’s name, and shows the results of the individual.



**Figure 20 - Ishihara Viewing**

## **4.4 Summary**

A Video Game's Interface is the first thing a user is going to come across with. In order for a game to be enjoyable and be able to draw the user into the virtual world, known to be good interface design practises should be included.

Although my project does not use the best of practises when it comes to interface designing, the instructions are clear making it easy for the project to reach its requirements.

# 5 Implementation

## 5.1 Introduction

The implementation stage of a project is where your vision is actually created. The implementation will also act as the sandbox for trying things out and pruned in order to finally reach the stage where the requirements are implemented.

Through this chapter, you will be reading about the implementation part of my application. Assets and original work that was used as part of the implementation will be mentioned and explained.

Also keep in mind that as video games can be very large projects, not every single asset/original work will be mentioned, and only parts of the code will be listed if necessary.

## 5.2 Asset based work

### 5.2.1 Realistic Car Controller

RCC (Realistic Car Controller) is one of the most popular paid assets in Unity's asset store and it is developed by Bonecracker Games. This asset has helped me implement the controls of the player car, along with the AI of the NPC cars. The scripts provided by this asset are highly customizable and therefore has helped me implementing specific mechanics of the game such as adjusting the button required to enable nitrous for the Nitrous Game Mode. It is also worth mentioning that the asset provides full customizability through the inspector as well.

```
if(SceneManager.GetActiveScene().name.Equals("NosMode1") ||
SceneManager.GetActiveScene().name.Equals("NosMode2"))
{
    nosButtonHandler nosHandlerScript = GetComponent<nosButtonHandler>();
    boostInput = nosHandlerScript.boostInput;
}
else
    boostInput = Input.GetKey(RCCSettings.boostKB) ? 2.5f : 1f;
```

**Listing 1 - [RCC\_CarControllerV3.cs] Loading Nos Key from Handler File**

Listing 1 shows the part of the code that I had changed in order to make the nitrous button adjustable if the player is playing any of the two nitrous game mode stages.

At Listing 2 below, you can see the part of code that I had changed in order to make it so that when the user is playing one of nitrous game mode stages, nitrous usage will be infinite. During a turns mode stage, nitrous is limited and the recharge is based on delta time and the consumption variable.



```

if(boostInput > 1.5f && _gasInput >= .8f && NoS > 5){
    hasNoS = true;
    if (SceneManager.GetActiveScene().name.Equals("TurnsMode1") ||
SceneManager.GetActiveScene().name.Equals("TurnsMode2"))
    {
        NoS -= NoSConsumption * Time.fixedDeltaTime;
        NoSRegenerateTime = 0f;
    }
    if(!NOSound.isPlaying)
        NOSound.Play();
}else{
    hasNoS = false;
    if(NoS < 100 && NoSRegenerateTime > 3)
        NoS += (NoSConsumption / 1.5f) * Time.fixedDeltaTime;
        NoSRegenerateTime += Time.fixedDeltaTime;
        if(NOSound.isPlaying){
            NOSound.Stop();
            blowSound.clip =
RCCSettings.blowoutClip[UnityEngine.Random.Range(0,
RCCSettings.blowoutClip.Length)];
            blowSound.Play();
        }
}
}

```

**Listing 2 - [RCC\_CarControllerV3.cs] Adjusting usage of nitrous**

It is also worth mentioning that this asset provides a customizable UI prefab that was used on my application to show the car's information, such as the speed et cetera, on the interface.

### 5.2.2 Dialogue System

Dialogue System for Unity is a paid asset that makes it rather easy to add interactive dialogues to a game along with a lot more features that were not used as part of this game's implementation. Dialogue System is implemented by Pixel Crushers and the asset package includes well documented and optimized C# scripts.

I have used this asset in my game's implementation to aid me in implementing dialogues for the game. The editor allows you to easily create a database where you can store and create dialogues as indicated on Figure 21.

When you select a specific field from the conversation, you can perform various actions through the inspector such as creating a list of events to be executed when the dialogue reaches that specific field, as indicated at Figure 22 below. It is also worth mentioning that this asset supports variables that can be used in the conversation through the use of a class that implements lua scripting, as indicated on Listing 3 below.

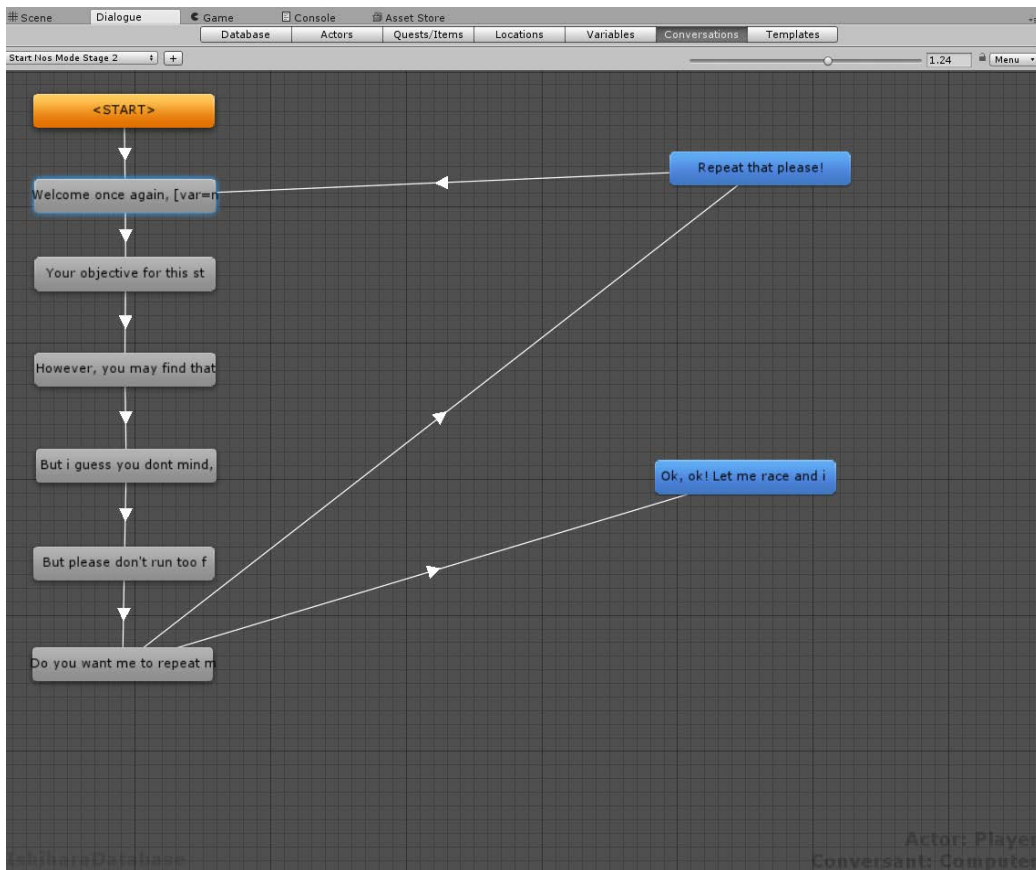


Figure 21 – Dialogue Database Editor

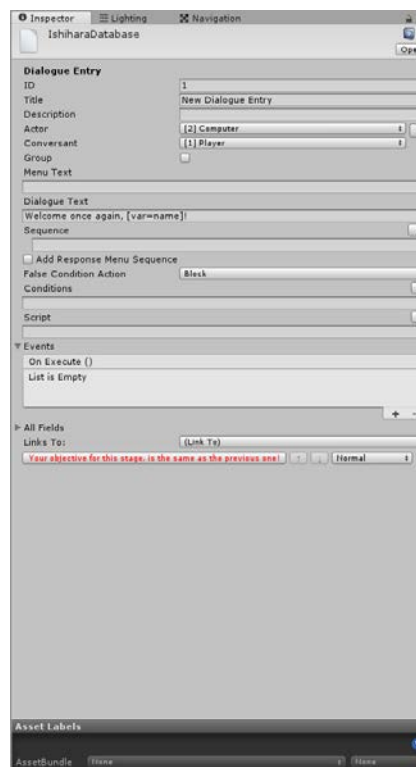


Figure 22 - Dialogue Inspector

```
private void Start()
{
    persistentScript = persistentObject.GetComponent<getPersistence>();
    DialogueLua.SetVariable("name", persistentScript.firstName);
}
```

**Listing 3 - [setDialogueNames.cs] Dialogue Variable Set**

```
if (stageName.Equals("Nos Mode Stage 1"))
{
    DialogueManager.StartConversation("Finish Nos Mode Stage 1");
}
```

**Listing 4 - [nosFileCreate.cs] Starting conversation through code**

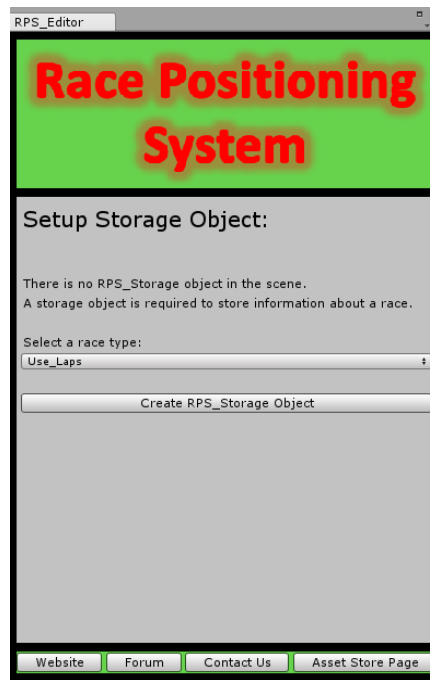
### 5.2.3 Race Positioning System

Race Position System is a paid asset developed by Unity Solution Studios for turning the scene into a race.

I have used this asset in my implementation to create the race implemented in the nitrous game mode stages, along with the lap system. This asset is written in C#, making it very customizable and easy to handle racing variables for various features that were used in my game such as printing current lap and position of AI on the screen's interface. In addition, this asset provides advanced editor windows and inspectors that help save time.

```
switch (rpsPos.currentRacePosition + 1)
{
    case 1:
        positionText.text = carName + " position: " + "1st";
        break;
}
```

**Listing 5 - [nosPositionHandler.cs] Example of use of Race Variables**



**Figure 23 - RPS Editor**

## 5.2.4 Gaia

Gaia is one of Unity's most popular paid assets developed by Adam Goodrich. Gaia is a tool that helps with the creation of terrains, giving you massive control over texture, game object, trees, and more auto generation. Gaia also provides you with a stamper tool that allows you to deform the terrain in order to form fields, hills, et cetera.

I have used this asset in my implementation in order to help me create better looking terrains for my game.

## 5.2.5 Easy Save 2

Easy Save 2 is a paid Unity asset developed by Moodkie that helps saving and loading files.

I used this asset in my application to help me save and export spreadsheet document and text files (.csv and .txt files), as well as loading the text files to use for the in-game psychologist/doctor tool. The asset provides well written documentation that has helped me understand how to use the classes and functions provided with the asset to support the requirements of this game. Listing 6 below shows how the asset can be used in code to save a table as both a spreadsheet file, and a text file. Listing 7 shows how the asset can be used to load a file.

```

ES2Spreadsheet sheet = new ES2Spreadsheet();
for (int i = 0; i < stageTurns; i++)
{
    sheet.SetCell(0, i, "Turn " + (i + 1));
    if (turns[i] == false)
        sheet.SetCell(1, i, "Wrong");
    else
        sheet.SetCell(1, i, "Correct");
}
sheet.Save(persistentScript.persistentField.text + " - " + stageName + ".csv");
ES2.Save(turns, persistentScript.persistentField.text + " - " + stageName +
".csv" + ".txt");

```

**Listing 6 – [colliderCheck.cs] Saving with Easy Save 2**

```

List<string> Highscores = new List<string>();
try
{
    Highscores = ES2.LoadList<string>("highscores - " + stageName + ".txt");
}
catch (System.Exception e)
{
}

```

**Listing 7 - [colliderCheck.cs] Loading with Easy Save 2**

## 5.2.6 Loading Screen

Loading screen is a paid drag and drop system asset in Unity's Asset Store, that allows you to create great looking loading screens, and can be customized to fit the taste of the application.

I have used this asset in my application to create the loading screens between the scenes. This asset was fully customizable and well documented, making it easy to understand how it works. An example on how it is used in code to load the screen is shown at Listing 8.

```

cameraListener.enabled = false;
loaderListener.enabled = true;

if (sceneName.Equals("MainMenu"))
{
    Destroy(GameObject.FindGameObjectWithTag("persistentObject"));
    Destroy(GameObject.FindGameObjectWithTag("persistentField"));
    bl_SceneLoaderUtils.GetLoader.LoadLevel(sceneName);
}

```

**Listing 8 - [dialogueFunctionsHandler.cs] Loading Screen asset Usage**

Regarding listing 8, it is also worth mentioning that I am using two listeners in each scene so that I am able to disable the music/sound effects of the game and focus on the sounds of loading screen during the asynchronous loading of the next screen. The above listing also

uses the Destroy() function in the case the user loads the main menu, so that the persistent object gets destroyed. This is done in order to be able to change the player's name when you go back to the main menu.

### 5.2.7 Easy Roads 3D Pro

Easy Roads 3D Pro is a paid asset that provides you with models and an inspector tool to help you create roads with side objects.

Just like the Gaia asset, this asset is to be used with the editor and the inspector to help with the terrain creation. I have used this asset to create the roads of each stage of the game.

## 5.3 Original Work

Besides the work I had done through the use of the assets, there is a total of about twenty five C# scripts that I have created from scratch in order to implement the requirements of my game. Some of the scripts I used are listed below.

### 5.3.1 Dialogue Handler

The Dialogue Handler script (dialogueFunctionsHandler.cs) is used to provide functions that can be called by the dialogue. Such functions include enabling control for the cars, disable control for the cars, enable score, load scenes, and more. An example of the car control enabler function can be viewed by listing

```
public void carControlEnabler()
{
    countDownManager = GameObject.FindGameObjectWithTag("countDownObject");
    countDownHandler = countDownManager.GetComponent<countDownHandler>();
    countDownHandler.startCounting();
}
```

**Listing 9 - [dialogueFunctionsHandler.cs] Car Control Enabler Function**

### 5.3.2 Turns Collision Handler

This script (colliderCheck.cs) has a number of purposes. These purposes include keeping track of the correct turns the user takes, stopping the timer when the user finishes the track, save files for the Highscores and the results, starting conversations at the end of the track, and manipulating the high-scores files so that the scores are sorted in proper order and only top ten are saved.

### 5.3.3 Nitrous File Create

This script (nosFileCreate.cs) has responsibilities similar to the turns collision handler script. This includes starting dialogues at the end, keeping track of the results based on how the user does during the race, creating the files and handling the high scores. The only

difference is that the collisions are being done in a different script, as it was more complicated than the turns game mode.

### 5.3.4 Nos Button Handler

The purpose of this script (nosButtonHandler.cs) is to handle, the collisions, the button presses and the score through the game, so that I can send the information from this script to both Nitrous File Create script to create the file with the results, and the Realistic Car Controller script to know whether to enable nitrous or not.

```
if (other.CompareTag("nosR"))
{
    if (Input.GetKeyDown(KeyCode.R))
    {
        boostInput = 2.5f;
        checkLapAndCorrectTurn(other.transform.GetChild(0).tag);
    }
    if (Input.GetKeyUp(KeyCode.R))
        boostInput = 1.0f;

    if (boostInput == 2.5f && carController.hasNoS == true)
        score += Time.deltaTime * 10;
}
```

**Listing 10 - [nosButtonHandler.cs] Handle Key Press and Score**

```
switch (colliderTag)
{
    case "Turn1":
        switch (rpsPos.currentLapNumber)
        {
            case 1:
                correctNos[0] = true;
                break;
            case 2:
                correctNos[0 + 9] = true;
                break;
            case 3:
                correctNos[0 + 18] = true;
                break;
            default:
                break;
        }
        break;
}
```

**Listing 11 - [nosButtonHandler.cs] Handle Results based on Lap Number**

### 5.3.5 Count Down Handler

The purpose of this script (countDownHandler.cs) is to disable the controlling of both the AI and the player car, until the dialogue has finished and the countdown of the game has reached zero.

```
ai1CarController = aiCar1.GetComponent<RCC_CarControllerV3>();  
ai1CarController.canControl = false;
```

**Listing 12 - [countDownHandler.cs] Disable Controls of a Car**

### 5.3.6 Pause Controller

The purpose of this script (pauseController.cs) is to handle everything that will happen once the player has clicked the escape button while playing. This script includes functionality that change the timescale of the application, handle listeners of the game, pausing and unpausing the dialogues, loading of scenes to implement the restart and back menu buttons, and more.

```
public void OnPause()  
{  
    AudioListener.pause = true;  
    DialogueManager.Pause();  
    Debug.Log("TestPause.OnPause");  
    timeScale = Time.timeScale;  
    Invoke("StopTime", pauseDelay);  
}
```

**Listing 13 - [pauseController.cs] Handle Pause Function**

### 5.3.7 Nos Billboard Handler

The purpose of this script (nosBillboardsHandler.cs) is to handle the textures appearing on the billboards as pseudo isochromatic plates. Since in Nitrous Game Mode the race consists of three laps, this script also makes sure to change the collider tags and the textures every lap

```
if (SceneManager.GetActiveScene().name.Equals("NosMode1"))  
{  
    collider1.tag = "nosF";  
    ...  
}
```

**Listing 14 - [nosBillboardsHandler.cs] Handle tag of colliders**

```
billboard1.GetComponent<Renderer>().material.mainTexture =  
texture11;
```

**Listing 15 - [nosBillboardsHandler.cs] Handle texture of billboards**



## **5.4 Summary**

The implementation of a video game can be a painful process, especially if you are implementing a project on your own where you have to handle both the designing and the developing process.

Throughout this chapter, I have briefly described how the use of a game engine and assets have helped me implement a game that is somehow up to the standards of today's generation video games and this is what has made me able to deliver a completed game on time.

## 6 Test Strategy

### 6.1 Introduction

No game has ever been released free of bugs. Even the biggest of game development companies, frequently update their games to fix defects and bugs that might appear in their game. Since video games are large projects that usually require months or even years of work, identifying all of the bugs in the application can be considered an impossible task.

Testing a game can be considered as the process that improves the quality of the game itself and in order to perform the testing process, you require a number of factors including computing expertise, analytic competence, critical evaluation skills, and endurance/patience.

Due to the lack of time to perform a number of tests for the application I have developed, I have only managed to perform two different type of tests on a rather small amount of individuals. This chapter of the report will provide a brief overview of the results I have gathered through my tests.

### 6.2 Testing for Bugs

As mentioned in the introduction, creating a bug-free application is an impossible task. In order to try and find bugs and defects that I had missed while developing the application, a total number of 7 individuals were asked to play the game for a total of about 10 minutes, while trying to identify any possible bugs.

After noting down the outcomes of this test, I have managed to fix two bugs that appeared in my application.

These bugs are as follows:

1. The first time the user was changing to a lower resolution on the computer the UI would scale properly. However, when the user was starting the game again with a different resolution on his/her computer, the UI would not scale. This bug occurred because of the player preferences of the game. The only thing that was required to fix this was executing the code `PlayerPrefs.DeleteAll();`
2. For some computers (not all) when the player was finishing the first turns mode stage, the default camera listener would not get disabled as it should. I did not manage to identify the reason that this was occurring on some computers, but I have managed to fix it by pausing the listener instead of disabling it.

### 6.3 Testing for Validation of Colour Blindness Test

In order to validate the effectiveness of the pseudo isochromatic plates, a total number of 7 individuals were selected to play the application for a total of about 20 minutes. Three out of the seven individuals, are known to be suffering from colour blindness before the test begins. The results of this test can be found on the table listed below.

**Table 3 - Test Results**

Subject	Stages Finished	What Stages?	Correct / Wrong Plates	Known to be Colour Blind?
Individual 1	3	T1, T2, N1	34/43	No
Individual 2	4	T1, T2, N1, N2	62/70	No
Individual 3	2	T1, N1	11/36	Yes
Individual 4	3	T1, T2, N1	32/43	No
Individual 5	2	T1, N1	10/36	Yes
Individual 6	4	T1, T2, N1, N2	25/70	Yes
Individual 7	3	T1, N1, N2	48/63	No

Before discussing the results, let me first explain what the third row means. T1 stands for Turns Mode Stage 1, T2 stands for Turns Mode Stage 2, N1 stands for Nos Mode Stage 1 and N2 stands for Nos Mode Stage 2.

Now as the results from this table suggest, the individuals that are known to be suffering from colour blindness get less than fifty percent correct turns or button presses. Additionally, I have also noticed that the test subjects were more likely to get wrong answers during the nitrous stages. I believe that this is happening because of two reasons:

1. Since I am having 5 different type of key presses, the subjects can't simply "guess" the correct button.
2. Since Nos mode is made out of three laps, the subject gets bored while playing and stops paying as much attention as he/she should.

Finally, I would like to mention that during these tests, all of the subjects were able to follow the instructions as indicated through dialogue in the game. No individual found it necessary to ask me for additional information while he/she was playing the game.

## **6.4 Summary**

As I have mentioned at the start, due to the lack of time, I did not manage to perform as many tests as I was hoping I would. This makes my results not as valid as I was hoping they would. However, as the colour blindness test suggests, playing the video game makes it possible to identify whether a subject suffers from colour blindness or not in general. In order to validate and identify what type of colour blindness (such as protanopia, protanomaly et cetera) he/she suffers from, further testing of the application and order of the ishihara textures should be considered.

## **7 Evaluation, Conclusions and Future Work**

### **7.1 Project Objectives**

Throughout the project's life cycle the objectives of this project have not changed. The main objective of this project was to introduce games as more than just hobbies, but rather as tools that can be used in a vaster context that they have been known to be used so far. Available literature, along with the tests performed for this application, suggest the use of games in the context that my application was aiming for.

### **7.2 Evaluation**

Reaching the final steps of this project, it is time to stand back and evaluate what I have achieved.

We all know what video games are, and all of us have eventually played a video game for its entertainment value. However my objective through this application was to introduce video games as tools to be used out of the entertainment context.

Through the use of available literature, I have discussed previous works on the subject to point out that many researches have been performed on this same subject, with the results favouring my objective. Further on, to provide the readers with actual data, a test has been performed to gather such data, making them available to compare the objective against actual test finding data.

### **7.3 Applicability of Findings to the Commercial World**

Video games have already become part of our lives and will continue to do so as technology keeps on existing. The video game community can be considered as one of the biggest, due to the fact that more than 90% of the population are either active video game players or has at least played a game before. Based on this, the idea and implementation of this video game can be applied to the commercial world with low failure rates.

### **7.4 Future Work**

Due to the limitation of time and resources for completing this project, it is only natural that my implementation is not perfect. This can be considered as the first version, and in the future expansion packs and updates can be released to either improve the performance of the already existing features or adding new features.

As an example of a feature that I wanted to implement but I could not, due to the lack of time, regarding the ishihara tool for the psychologist/doctor, I would like to add an extra feature that allows them to also create and use their own created ishihara pseudo isochromatic

plates. This will increase the validity of the colour blindness test aspect of the game, as the experts in the field can manipulate this part.

Besides adding extra features to the game, in order to make it more enjoyable and accurate, more stages and game modes can be added so that the psychologists/doctors can even use the default thirty eight pseudo isochromatic plates of Dr. Ishihara.

Finally, I would also like to mention that this application could be extended (given the proper time and resources) to aid in the identification of more types of deficiencies, such as dyslexia.

## **7.5 Concluding Reflections**

Throughout this project, I have gained several values that will help me advance through life as a software/video game developer. As the time to complete this project was limited, I became better with time management. Also, as video games can be considered as large projects, I would like to mention that I am eager to become a part of a team instead of completing a whole video game on my own. In addition, since this project required several hours of research, I became familiar to searching for available literature in order to support my work, while I perform tests to gather data and critically evaluate the project. Finally, I have learned how to read and find my way through documentations to understand how the work of other people works, and also I became better when it comes to software engineering which also includes testing and debugging the code to find errors and defects.

## 8 References

- Afërdita, B.-S. (2015). Impact of Information Technology and Internet in Businesses. *Academic Journal of Business, Administration, Law and Social Sciences*, 73-79.
- Ahmad, F. (2013). An Overview Study of Game Engines. *Int. Journal of Engineering Research and Applications*, 3(5), 1673-1693.
- Annetta, L. (2008). Video Games in Education: Why They Should Be Used and How They Are Being Used. *Theory Into Practice*, 47(3), 229-239.
- Bailey, K., West, R., & Anderson, C. (2009). *The Influence of Video Games on Social, Cognitive, and Affective*. Iowa: Iowa State University.
- Blinka, L., & Mikuška, J. (2014). The role of social motivation and sociability of gamers in online game addiction. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 8(2), Article 6. doi:10.5817/CP2014-2-6
- Brooks, A. W. (2014). Get Excited: Reappraising pre-performance anxiety as excitement. *Journal of Experimental Psychology: General*, 143(3), 1144-1158. doi:10.1037/a0035325
- Case, B. (2003). *Color Blindness*. San Antonio: Pearson Education, Inc.
- Ceranoglu, T. (2010). Video Games in Psychotherapy. *Review of General Psychology*, 14(2), 141-146. doi:10.1037/a0019439
- Chakrabarti, A. (2015). A Review on Color Vision Deficiency. *International Journal of Recent Research in Life Sciences*, 2(3), 24-27.
- Chuang, T.-Y., & Chen, W.-F. (2009). Effect of Computer-Based Video Games on Children: An Experimental Study. *Educational Technology & Society*, 12(2), 1-10.
- Clemenson, G., & Stark, C. (2015). Virtual Environmental Enrichment through Video Games Improves Hippocampal-Associated Memory. *Journal of Neuroscience*, 35(49), 16116-16125. doi:10.1523/jneurosci.2580-15.2015
- Dunifon, R., & Gill, L. (2013). *Games and Children's Brains: What is the Latest Research?* New York City: Cornell University.
- Dweck, C., & Molden, D. (2005). *Handbook of competence and motivation*. New York: Guilford Press.
- Eichenbaum, A., Bavelier, D., & Green, C. (2014). Video Games: Play that can do serious good. *American Journal of Play*, 7(1), 50-72.
- Frome, J. (2007). *Eight Ways Videogames Generate Emotion*. Georgia: University of Georgia.
- Gentile, D. (2011). The Multiple Dimensions of Video Game Effects. *Child Development Perspectives*, 5(2), 75-81.
- Gentile, D., & Anderson, C. (2006). Video Games. *Encyclopedia of Human Development*, 3(1), 1303-1307.

- Granic, I., Lobel, A., & Engels, R. (2014). The benefits of playing video games. *American Psychologist*, 69(1), 66-78. doi:10.1037/a0034857
- Green, C., & Seitz, A. (2015). The Impacts of Video Games on Cognition (and How the Government Can Guide the Industry). *Policy Insights from the Behavioral and Brain Sciences*, 2(1), 101-110.
- Greenberg, B., Sherry, J., Lachlan, K., Lucas, K., & Holmstrom, A. (2008). Orientations to Video Games Among Gender and Age Groups. *Simulation & Gaming*, 41(2), 238-259. doi:10.1177/1046878108319930
- Griffiths, M. (2002). The educational benefits of videogames. *Education and Health*, 20(3), 47-51.
- Gunawardhana, L., & Palaniappan, S. (2015). Psychology of Digital Games and Its Effects to Its Users. *Creative Education*, 6(16), 1726-1732.
- Hasrod, N., & Rubin, A. (2015). Colour vision: A review of the Cambridge Colour Test and other colour testing methods. *Afr Vision Eye Health*, 74(1), Article 23.
- Ishihara, S. (1972). *Tests for Colour-Blindness*. Tokyo . Kyoto, Japan: Kanehara Shuppan Co., Ltd.
- Jae-Hwan, B., & Ae-Hyun, K. (2014). Design and Development of Unity3D Game Engine-Based Smart SNG. *International Journal of Multimedia and Ubiquitous Engineering*, 9(8), 261-266.
- Jongho, J., Kwanwoong, K., & Soonyoung, J. (2012). A Study on the Game Programming Education Based on Educational Game Engine at School. *Journal of Education and Learning*, 1(2), 282-287.
- Juang, J., Hung, W., & Kang, S. (2011). Using game engines for physics-based simulations - A Forklift. *Journal of Information Technology in Construction*, 16(1), 3-22.
- Karim, K., & Saleem, M. (2013). Prevalence of Congenital Red-Green Color Vision Defects among Various Ethnic Groups of Students in Erbil City. *Jordan Journal of Biological Sciences*, 6(3), 235-238.
- Kent, S. (2001). *The ultimate history of video games: From Pong to Pokemon and beyond. The story behind the craze that touched our lives and changed the world*. New York: Three Rivers Press.
- Kilduff, G. (2014). Driven to Win. *Social Psychological and Personality Science*, 5(8), 944-952. doi:10.1177/1948550614539770
- Kilduff, G., Elfenbein, H., & Staw, B. (2010). The psychology of rivalry: A relationally dependent analysis of competition. *Academy of Management Journal*, 53(5), 943-969.
- Liang, S., Li, H., & Yang, X. (2014). The Video Game from the Perspective of Positive Psychology. *Open Journal of Social Sciences*, 2(8), 57-60.
- Lim, C.-P., Zhao, Y., Tondeur, J., Chai, C.-S., & Tsai, C.-C. (2013). Bridging the Gap: Technology Trends and Use of Technology in Schools. *Educational Technology & Society*, 16(2), 59-68.



- Marey, H., Semary, N., & Mandour, S. (2014). Ishihara Electronic Color Blindness Test: An Evaluation Study. *Ophthalmology Research: An International Journal*, 3(3), 67-75.
- McLean, L., & Griffiths, M. (2013). The psychological effects of videogames on young people: A review. *Aloma*, 31(1), 119-133.
- Michael, K., & Charles, L. (1995). The Perception of Color. In *Webvision: The Organization of the Retina and Visual System*. Salt Lake City: University of Utah Health Sciences Center.
- Mohammad, B., & Samer, A.-Z. (2015). The Impact of Technologies on Society: A Review. *Journal of Humanities and Social Science*, 20(2), 82-86.
- Neitz, J., Carroll, J., & Neitz, M. (2001). Color Vision: Almost Reason Enough for Having Eyes. *Optics and Photonics News*, 12(1), 26. doi:10.1364/opn.12.1.000026
- Olson, C. (2010). Children's Motivations for Video Game Play in the Context of Normal Development. *Review of General Psychology*, 14(2), 180-187. doi:10.1037/a0018984
- Partha Sarathi, P., Surajit, G., & Abhishek, B. (2012). History and comparative study of modern game engines. *International Journal of Advanced Computer and Mathematical Sciences*, 3(2), 245-249.
- Parvizi, S., & Frith, P. (2008). Expert Review: Examination of Colour Vision. *The Journal of Clinical Examination*, 7(1), 1-8.
- Patil, P., & Alvares, R. (2015). Cross-platform Application Development using Unity Game Engine. *International Journal of Advance Research in Computer Science and Management Studies*, 3(4), 19-27.
- Peng, W., & Hsieh, G. (2012). The influence of competition, cooperation, and player relationship in a motor performance centered computer game. *Computers in Human Behavior*, 28(6), 2100-2106. doi:10.1016/j.chb.2012.06.014
- Plass, J., O'Keefe, P., Homer, B., Case, J., Hayward, E., Stein, M., & Perlin, K. (2013). The Impact of Individual, Competitive, and Collaborative Mathematics Game Play on Learning, Performance, and Motivation. *Journal of Educational Psychology*. doi:10.1037/a0032688
- Prot, S., Anderson, C., Gentile, D., Brown, S., & Swing, E. (2014). *Media and the Well-Being of Children and Adolescents*. New York: Oxford University Press.
- Sáez-López, J., Miller, J., Vázquez-Cano, E., & Domínguez-Garrido, M. (2015). Exploring Application, Attitudes and Integration of Video Games: MinecraftEdu in Middle School. *Educational Technology & Society*, 18(3), 114-128.
- Sagarmay, D. (2014). Information Technology, Its Impact on Society and Its Future. *Advances in Computing*, 4(1), 25-29. doi:10.5923/j.ac.20140401.07
- Salen, K., & Zimmerman, E. (2003). *Rules of Play: Game Design Fundamentals*. MIT Press.
- Shaffer, D., Squire, K., Halverson, R., & Gee, J. (2005). Video Games and the Future of Learning. *Phi Delta Kappan*, 87(2), 104-111.

- Shoeb, A. (2014). Technology in organizations. *International Journal of Research in Business Management*, 2(7), 73-80.
- Sweetser, P., & Wyeth, P. (2005). GameFlow: A model for evaluating player enjoyment in games. *Computers in Entertainment*, 3(3), Article 3A. doi:10.1145/1077246.1077253
- Tagarelli, A., Piro, A., Tagarelli, G., Lantieri, P., Risso, D., & Olivieri, R. (2004). Colour blindness in everyday life and car driving. *Acta Ophthalmologica Scandinavica*, 82(4), 436-442. doi:10.1111/j.1395-3907.2004.00283.x
- Tavárez, C. (n.d.). The Effect of Video Games on Memory: A Meta-Analysis. *McNair Scholars Journal*, 186-197.
- Thiebaud, J. (2010). Effects of Technology on People: Living F2F Conversation and Social Interaction. *Proceedings of the Media Ecology Association*, 11(1), 117-128.
- Thomas, D., & Brown, J. (2007). The Play of Imagination. *Games and Culture*, 2(2), 149-172. doi:10.1177/1555412007299458
- Todd, A., Forstmann, M., Burgmer, P., Brooks, A., & Galinsky, A. (2015). Anxious and egocentric: How specific emotions influence perspective taking. *Journal of Experimental Psychology: General*, 144(2), 374-391. doi:10.1037/xge0000048
- Winnerling, T., & Kerschbaumer, F. (2014). *Early Modernity and Video Games*. Newcastle, UK: Cambridge Scholars Publishing.
- Yannakakis, G., & Paiva, A. (2014). *Emotion in Games*. London, U.K: Oxford University Press.