

Graphical Style in Video Games

Portfolio



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TIIVISTELMÄ

Opinnäytetyön tarkoituksena oli tutkia suosituimpien videopelien graafisia tyylejä ja miten erilaisilla menetelmillä tuotettiin grafiikkaa digitaalisiin peleihin. Työssä käsitellään lyhyesti myös videopelien historiaa, jossa ensisijaisesti keskitytään peligrafiikan tyylikeinojen kehittymisvaiheisiin. Lisäksi käydään läpi sitä, miten teknologian parantuminen on vaikuttanut pelien graafisen tyylin kehittymiseen.

Toiminnallisessa osassa esitellään tekemiäni peliprojekteja, joissa olin vastuussa pelin graafisesta suunnittelusta. Projekteissa käydään läpi työkentelymenetelmiä 2D- ja 3D-grafiikan luomisessa, sekä mitä teknisiä ja rajoittavia tekijöitä peligraafikoiden on otettava huomioon luodessaan graafista sisältöä.

Opinnäytetyöni tavoitteena on antaa lukijalle yleiskatsaus videopeleissä käytetyistä graafisista tyyleistä sekä esitellä pelikehitysprosessia peligraafikon näkökulmasta.

Avainsanat Peligrafiikka, videopeli, 3D-mallinnus

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ABSTRACT

The purpose of this thesis was to examine common graphical styles used in video games to analyze the process of how these methods were used to create game content. The thesis briefly covers the history of video games, mainly focusing on how graphical styles and implementation methods have developed over the years. Additionally, this paper examines how the growth of technology has affected the graphical styles in video games.

In the practical part of my thesis I showcase various game projects where I was responsible for the graphic design. I will go through the process of creating 2D and 3D graphics for a game as well as explore the technical limitations a graphics designer must take into consideration when creating game content.

The goal of my thesis project was to provide a general idea about the different graphical styles used in video games and to show the game development process from a graphic designer's point of view.

Keywords Game graphics, video game, 3Ds Max, 3D modeling

Pages 70 pages

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1 INTRODUCTION

The graphical style of a video game is one of the most important things in game development. The visual style of a game often plays a significant part in the player's gaming experience and it is one of the things that make the game interesting and fun to play.

This thesis examines the most common graphical styles and visualization methods and how these methods were used to create content that brought life to the game world while still maintaining the balance between playability and visuals. With the constantly evolving technology, game developers ranging from major companies to small indie studios are able to develop games for many different platforms and hardware. Because of these hardware limitations and the graphic designer's artistic visions, video games today show great diversity in graphical style, as seen in Figure 1.



Figure 1. Stardew Valley (Barone 2016), Overwatch (Zam 2016) and the Witcher 3: Wild Hunt (GeForce n.d.).

As a part of this thesis, I will present my portfolio of the game projects where I was responsible for the graphic design. In these projects, I will go through the decision-making and planning of the visual style of each game as well as describe the documentation of the process of creating the graphics for these games.

2 VIDEO GAME GRAPHICS

A graphic is an image or a visual representation of a character or an object. When talking about computer graphics, people are usually referring to images that are displayed on a computer screen (Christensson 2009). Therefore, video game graphics are the visualized game content shown on the display of the gaming platform. How these images are rendered depends heavily on the used graphics hardware. With better graphics cards, processors and techniques becoming available to game developers and gamers, people can now run more technically demanding and visually breathtaking games than ever before.

2.1 Graphics and gameplay

Gameplay is the generalized term used to describe the overall experience a player has while interacting within a video game, excluding all the audiovisual aspects of it. These experiences can vary from either having an interactive dialogue with an in-game character to swinging a sword and killing an enemy.

The term gameplay is quite broad and should not be confused with game mechanics, which basically means the rules and boundaries of the game - what the player is allowed to do and what he/she is not. A game's overall playability consists mainly of the gameplay, game mechanics and the graphics. More recently the narrative story has also become an important aspect of certain games.

So, what makes a good gameplay? To make a good game, the gameplay must give meaningful interactions for the player and at the same time have rules to make the gaming experience challenging. However, it is important that these boundaries do not hinder the player's desired actions (Masuch & Röber 2005). This is where the importance of game graphics and graphical styles comes in because graphics are the bridge between the gameplay and the player.

2.1 Designing graphics for games

Designing the graphics and the visual content for a game is an important part of the game development process. According to game publishers, game graphics is the most important aspect in marketing the game. After all, graphics are the first thing a player sees and people tend to gravitate more towards graphically eye-catching and impressive games. Whether or not this is true, many game developers today put a lot of time and effort in perfecting the look of their games.

Even though attractive graphics have been proven to help players maintain their interest and excitement towards the game (Rooney 2012), it is the gameplay and game mechanics that heavily dictate a player's overall gaming experience and, ultimately, the success of the game. While mediocre graphics do not ruin a good game, amazing graphics cannot make a game with bad gameplay any better (Masuch & Röber 2005). Thus, it is essential for graphic designers to choose a graphical style that supports the gameplay, fits with the setting and where the game runs smoothly on the platform it is intended to as well.

2.2 Graphical style

Throughout the history of video games, there have been many different methods used to visualize game content. Utilizing these design techniques, game developers and artists have achieved various outcomes in the appearance of video games. These different visual designs are known as graphical styles and it is also the presentational content of the game world that is visible to the player (Lee, Gee & Dolah 2016).

For example, even though *Overwatch* (2016) and *Battlefield 1* (2016) are both team-based first-person shooters, their visual look and overall atmosphere feel quite different to the player because of their distinctively contrasting graphical styles.

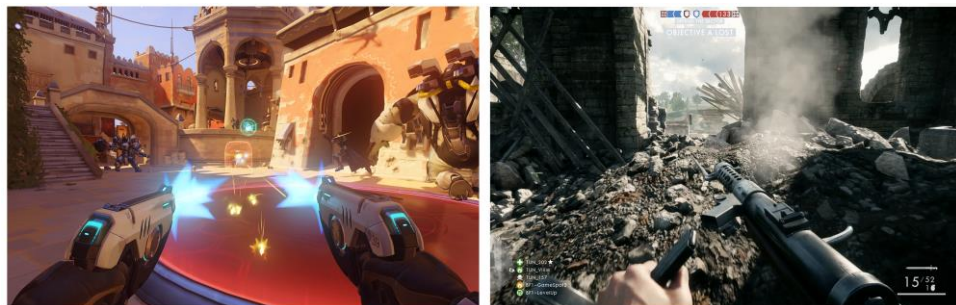


Figure 2. Overwatch (Overwatch Wiki n.d.) and Battlefield 1 (GameSpot 2016).

As can be clearly seen in Figure 2, the environment and character designs in *Overwatch* and *Battlefield 1* are quite different from one another. Blizzard has given *Overwatch* a stylized, colorful and cartoon-like graphical style very iconic to the company's other games. *Battlefield 1* on the other hand has a photorealistic, dark and rough graphical style that succeeds on immersing the player to the World War I time-period where the game is set.

2.2.1 Graphical style categories

Many game scholars such as Järvinen (2009), McLaughlin, Smith & Brown (2010) as well as Egenfeldt-Nielsen, Smith & Tosca (2015, 142.) have found three distinct categories of graphical styles that have been dominating the game industry for years. These styles are abstract, stylized and realistic.

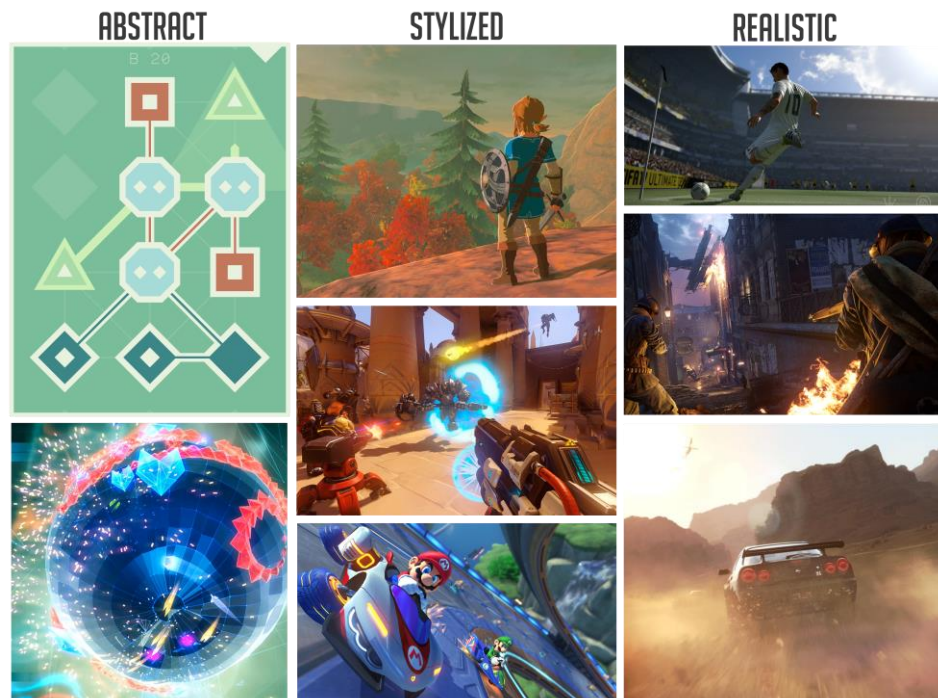


Figure 3. Various graphical styles in modern video games. Games shown in the abstract category are *Lyne* (Bpepermans 2014) on top and *Geometry Wars 3* (GameSpot 2014) on the bottom. Stylized games from top to bottom are the following: *Zelda: Breath of the Wild* (Plante 2017), *Overwatch* (Hot Wink 2016) and *Mario Kart 8* (Perfectly Nintendo 2015). The realistic games illustrated from top to bottom are: *FIFA17* (Origin n.d.), *Battlefield 1* (PCGames 2017) and *Gran Turismo Sport* (GameSpot 2017).

I have gathered a few examples of modern video games and put them in their respective graphical categories, as illustrated in Figure 3. We will now discuss the history and development of these three graphical styles: abstract, stylized and realistic in closer detail.

3 ABSTRACT GRAPHICAL STYLE

Abstractionism is one of the graphical style categories that focuses on representing the game in geometric shapes and forms instead of directly depicting characters, objects or distinct places (Järvinen 2009). A good example of the style is seen in the classic game *Tetris* (1984). In 1989 Nintendo released their version of Tetris for the Nintendo Entertainment System, as seen in Figure 4.

Abstract styles have been implemented in various very successful games. One of these games was *Pong* (1972) which was the game that launched the video game industry in the 1970s. Another notable example is the previously mentioned *Tetris* which still holds the title of the world's best-selling game with more than 100 million copies sold.

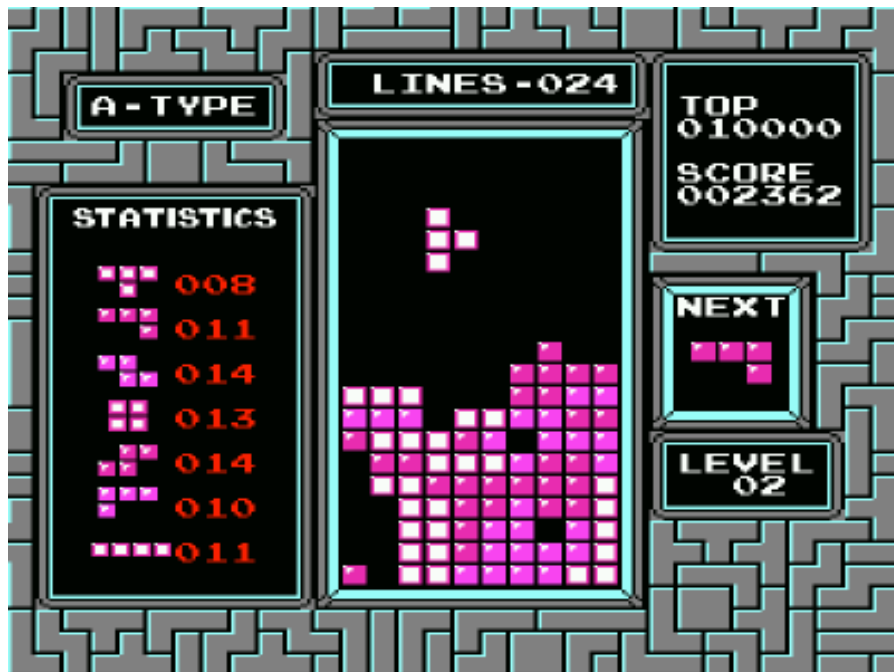


Figure 4. Tetris (Sydlexia n.d.).

Nowadays it is not as common to see video games with abstract styles any more. This is mainly because of the increasing popularity of storytelling and the fact that abstract games are hard to market. Even though it is very unlikely for big budget titles to be purely abstract, the style has been revived in the world of mobile gaming. (Egenfeldt-Nielsen et al 2015, 144.).

3.1 Definition

In art, abstractionism pertains to the formal aspect of art and consists of lines, colors, various geometrical forms and their relationships to one another (Abstract, n.d.). Abstractionism does not represent anything real and does not derive directly from life either.

Thus, abstract video games are rarely truly abstract. As Järvinen stated (2009), at the very least games simulate some sort of an environment. Various abstract puzzle games accentuate forms and shapes but often these forms are heavily stylized instead of being pure abstract.

A good example would be the fly and the aliens depicted in *Yars' Revenge* (1982) as seen in Figure 5. The objects in the game were crudely translated into game graphics due to the hardware limitations at the time. While the game was graphically abstract, the manual gave context to the world because the game graphics themselves could not properly convey what the intended objects were. (Abstract art style, n.d.)

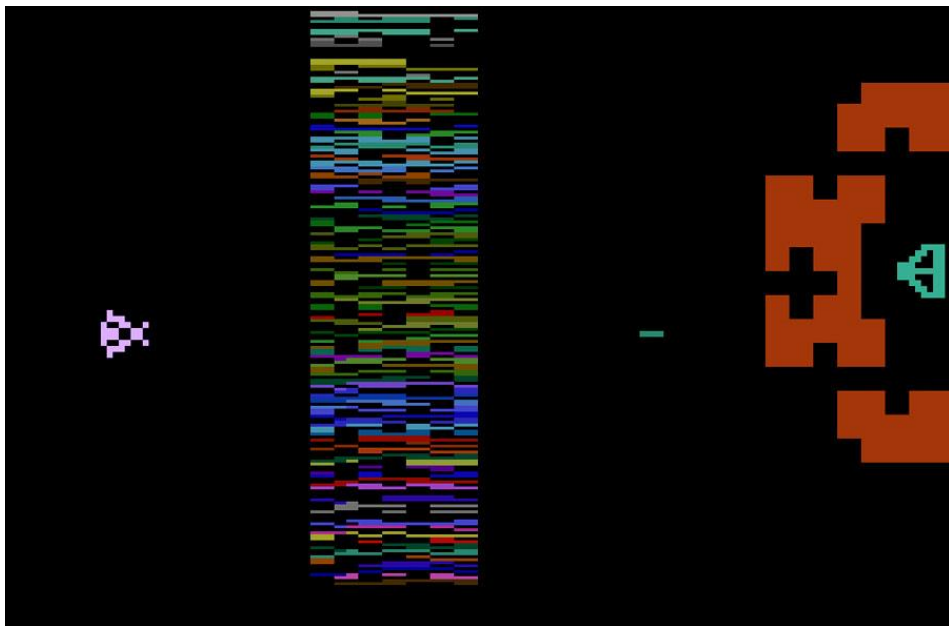


Figure 5. Yars' Revenge (8-Bit Central n.d.).

3.2 Abstractionism at the beginning of the video game industry

The 1970s marked the beginning of arcade and home video games reaching mainstream popularity. Many games from the 1970s were quite minimalistic and abstract when it came to graphic design. This was due to the hardware limitations at the time in which the characters, objects and environments were very simplified to their bare essentials. Most of the games at the time were actually heavily stylized graphics that just resembled abstract style (Järvinen 2009).

A good example of this was *Pong* (1972), a table tennis game where the white 'blocks' represented racquets and the small square represented the ball. *Pong* was a great success because of its simple and entertaining gameplay and it was also the game that launched the video game industry.



Figure 6. Atari Pong console (Wikiwand n.d.) and Pong (Wikipedia 2006).

A home version of Pong was eventually released by the game's developers, Atari, in 1975. Atari Pong can be seen in Figure 6. Because of the game's success, there were many variations of *Pong* made by different companies as well.

3.3 Golden age of abstractionism

The 1980s was an eventful decade for the development of video games. One notable event was the North American video game crash of 1983 which caused a great recession in the game industry due to an oversaturated market of mediocre video games and systems. Thanks to the success of the Nintendo Entertainment System (NES) in 1985 the game industry could finally get itself back up.

Graphically, the 1980s showed a great variety in styles as game developers began experimenting with new technology and games were becoming more complex. During this time, there were many successful abstract games. One of these games was the earlier mentioned *Tetris* which still holds the title for the world's bestselling game. Before that there was a game known for its unique gameplay and vector abstract style, *Tempest*

(1981), developed by Atari Inc. *Tempest* was originally going to be a 3D remake of *Space Invaders* (1978) but was soon scrapped because the early versions of the game had a lot of issues.

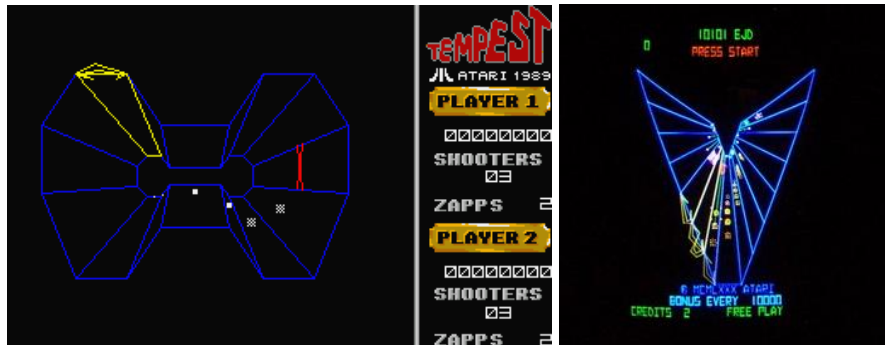


Figure 7. *Tempest* on the Atari ST (Atarimania n.d.) on the left. On the right *Tempest* on the Arcade (AndysArcade.de 2005).

What eventually came out of *Tempest* was a tube shooter game that utilized vector graphics to simulate a three-dimensional perspective. Vector graphics was one of the computer graphic techniques in the 1980s that used geometrical lines, shapes and curves to visualize game content on a vector display. After around 1985 vector graphics became obsolete due to the technological advancements in raster and pixel graphics (Wolf 2007).

Like many games at the time, *Tempest* was a game set in to outer space due of the graphical limitations of the Atari 2600. Other notable games that were set in space were *Space Invaders* (1978), *Space War* (1978) and *Asteroids* (1979). The representation of the environment was quite simple to create with just a black background and some stars, which is why many games at the time chose space as their setting. When it came to the quality of the graphics, the arcade version of the game was usually far superior compared to the home console versions. In Figure 7 *Tempest* is illustrated as an example.

Another successful abstract game at the time was *Marble Madness* (1984) published by Atari Games. *Marble Madness* was an isometric platform game where the player controls a small marble through a course. The game used pixel graphics to simulate the isometric perspective and was one of the most recognizable arcade games at the time. Many have praised its visuals as pure and timeless (Grannell 2008).

By the end of the 1980s, technology had improved so much that the games were becoming graphically quite complex and detailed. Thus abstract style began to become more of an artistic choice rather than a default style (Wolf 2003, 58.).

3.4 Abstract games in the 3D era

The 1990s was an innovative decade for video gaming. The decade marked an era of the rising popularity of home video game consoles and handheld gaming. The era was also notable for game graphics transitioning from sprite graphics to 3D graphics. (1990's The Rise of Video Games, 2014).

Because of this new trend in game graphics, and with designers leaning towards more realistic representations, there were not many abstractly styled games between the 1990s and the 2000s. However, one abstract game that briefly caught the attention of gamers was *Rez* (2001), a musical rail shooter game developed by United Game Artists, seen in Figure 8.



Figure 8. *Rez* on the Sega Dreamcast (Buttonmashing 2009).

In *Rez* the player takes control of a humanoid avatar that travels through a vector-styled polygonal world of various colorful figures and shapes. As the player progresses further in the game, the enemies and environments become more and more complex. For example, at the beginning of the level a figure may start as purely abstract as a wireframe but eventually it can end up as a fully rendered figure, as seen in Figure 9.

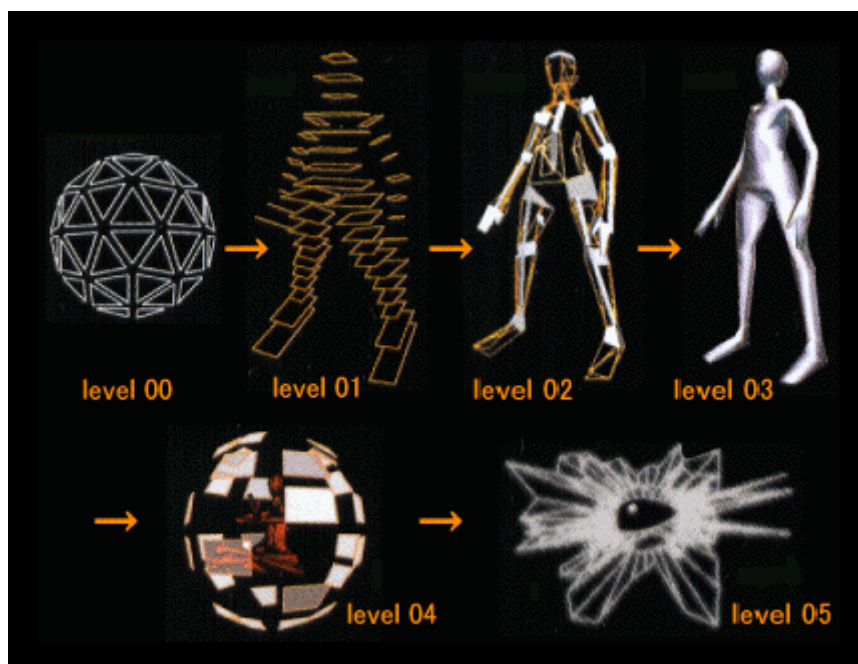


Figure 9. Evolution of the player's avatar in Rez (shmuplations.com 2001)

The game's environments also moved along with the beat of the music and by merging together user input and visual feedback, the game was able to create a unique synesthetic effect. Even though the game was not a commercial success (Egenfeldt-Nielsen et al 2015, 144.), it was praised by game critics for its unique psychedelic visuals and soundtrack. Rez was a prime example of an abstract game at its time and it showed the potential of what could be achieved with abstract graphics at the time.

3.5 Mobile games and the new beginning for abstractionism

The 2000s marked another important era in video gaming. During this decade, the gaming world was mainly dominated by Sony, Nintendo and Microsoft with mostly stylized and realistic graphical styles ruling the market. That was until the late 2000s began the widespread popularity of smartphones, and therefore the popularity of mobile gaming and the return of abstract games. (Wikipedia 2017).

While mobile gaming did exist before the era of smartphones, the selection and the variety of these games were not too great. Often the games came preinstalled on the phone and were usually quite simplistic both gameplay-wise and graphically due to the limited hardware at the time.

In 2008 Apple launched the iTunes App Store that eventually came to define the modern mobile game market. Because of the major technological advances to smartphones, mobile game developers had begun to utilize these improvements in screen resolution, processors, storage and network bandwidth in order to create complex and graphically advanced

games. Apple's iTunes App Store and Google's Google Play eventually became the biggest marketplaces for mobile games, both stores providing over 2 million downloadable applications for the user. (Statista 2017).

What sets normal gaming and mobile gaming apart is the fact that mobile games are portable and easily accessible due to almost everyone owning a smartphone. Mobile gamers often play games to pass time on the bus or during a break so it is essential that the games are not only enjoyable but are simple to pick up and do not take up too much of the player's time. Because of the importance of simplicity in mobile games, abstract graphical styles work favorably in mobile games. In addition to that, many mobile game developers use abstract styles to appeal to casual gamers because the style makes the game more approachable and focuses purely on the gameplay. The style is also easier to implement on different specifications and hardware since abstract games are usually graphically not as demanding as some stylized ones, for example. One of the most popular mobile games utilizing the abstract style is *Geometry Dash* (2013), illustrated in Figure 10.



Figure 10. Geometry Dash (Steam 2014).

Geometry Dash was a rhythm platformer game for the iOS, Android and it was later released for the PC as well. Gameplay-wise, *Geometry Dash* was quite straightforward and it utilized simple tapping controls on the touchscreen of the smartphone.

3.6 Future of abstract games

As mentioned earlier, abstractionism is out of the three graphical styles the least seen in modern major titles. There are multiple reasons why the style has become somewhat obsolete and primitive compared to the others.

One of the problems with abstract games was that they were difficult to popularize to the new generation of gamers. Marketing and merchandising a game's mechanics and gameplay instead of an interesting story or characters proved to be very challenging. (Egenfeldt-Nielsen et al, 2015. 144.). However, arguably the biggest problem with abstract games was their inability to tell a story to the player. Abstract games were always visually more limited compared to the other graphical styles so it was natural that abstractionism was not suitable for narrative contexts. In fact, the development of games has taken storytelling to a more important position than ever before, which is why abstract style might just end up in the past (Järvinen 2009) or will be seen exclusively in mobile gaming.

Even though we may not see abstract games in their purest forms, such as in *Tetris* or *Tempest*, the abstract style is still seen in mobile gaming and will likely continue to exist in this form or slowly develop into a heavily stylized one.

4 STYLIZED GRAPHICAL STYLES

Stylized graphics focus on presenting a person or an object by exaggerating its most prominent features (Egenfeldt-Nielsen et al 2015). Because stylized graphics have always existed since the beginning and could be implemented in so many ways, there is a wide variety of artistic representations in this graphical style compared to the others. One example where stylized graphics define the audiovisuals of the game is in the massively multiplayer online game *World of Warcraft* (2004). Figure 11 shows the distinct cartoon styled environments and characters in *World of Warcraft*.



Figure 11. World of Warcraft (Battle.net 2014).

While the technological advances over the years have made many game developers lean more towards impressive photorealistic styles with accurate physical simulations, however, stylized graphics have always existed alongside realism because they could provide another option when a different audiovisual appearance is the goal (Järvinen 2009). For example, these goals could make the game appeal more to children like in the *Animal Crossing* series (2001-2016) or put an emphasis on a certain atmospheric mood or color palette like in *Firewatch* (2016). Additionally, the style is expressive and flexible, and it is not bound to the limitations of simulating realistic physics. Thus, stylized graphics work well in bringing the focus to the gameplay and the immersion of the game world and environments. The style can be used to accentuate certain aspects of images or sometimes objects without distorting or breaking the atmosphere as realistic games tend to do. (Masuch & Röber 2005). Especially since realistic games are still far from true photorealism, games with stylized graphics are more timeless and age much better over time.

4.1 Definition

In his paper, Järvinen (2009) describes stylized graphics as caricaturism. A caricature is a picture or a representation of an object that is simplified down to its most defining features. In computer graphics, style can also be referred to as non-photorealistic rendering or NPR which means graphics that focus on visualizing the content with specific digital art styles (Winkenbach & Salesin 1994). Unlike photorealism where the goal is to reproduce a life-like image as closely as possible, NPR takes inspiration from paintings, drawings and cartoons.

Despite the style's similarity with cartoons, however, stylized games are not always intended for younger audiences (Egenfeldt-Nielsen 2015). A good example of this kind of a game would be *Super Meat Boy* (2010) which had colorful and cute cartoony art style, but combined the gameplay with gory elements.

Stylized graphics are the most flexible and versatile out of the three graphical style categories. Since it basically fits right between abstractionism and realism, stylized graphics can be tailored to get the most out of the gameplay and to customizing the game's appearance to cater to a certain audience.

4.2 Rise of stylized graphics in the 8-bit era

Stylized graphics have been around since the beginning of the video game industry. As mentioned previously, many video games in the 1970s were actually heavily stylized rather than being pure abstract. And like with abstract graphics, stylized graphics were often the only option in the early years because of the gaming hardware capabilities. Only years later stylized graphics have become an alternative to the three-dimensional photorealistic style (Järvinen 2009).

Stylized graphics began truly detaching itself from abstractionism and developing into its current form around the mid-1980s. After the North American video game crash, the more advanced home video game consoles Nintendo Entertainment System and the Sega Master System provided game designers with more technologically advanced hardware that had substantial graphical improvements compared to the Atari 2600. At the release of the Famicom, later known as the NES, began the third generation of video game consoles also known as the "8-bit era" (Wolf 2007). A few of the popular games in the 8-bit era were Legend of Zelda, Super Mario Bros 3 and Mega Man 2, seen in Figure 12.



Figure 12. Legend of Zelda (Emuparadise n.d.), Super Mario Bros 3 (Emuparadise n.d.) and Mega Man 2 (MobyGames 2004).

The quality of graphics at the time was considerably better compared to the previous generation consoles. With the popularization of these so called 8-bit consoles such as the NES, introduced gamers to many new gameplay styles that had not been seen before. For example, the scrolling screen in platforming games like in Super Mario Brothers (1985) and RPG gameplay in the *Legend of Zelda* (1986). The most notable changes in the capabilities of the new consoles were the increase in screen resolution, a bigger color palette and the number of increased sprites seen on screen.

4.2.1 Pixel art - From retro to modern games

Pixel art was a popular technique used in video games starting from the 1970s till about 1990s. At the time, graphic engines were restricted to a relatively small screen resolution and a color palette of only 256 colors. As a result, most if not all games in the 8-bit era came in a “pixelated” style simply known as pixel art. Pixel art was a major part in defining stylized game graphics, and despite the advanced technology today, the art style is still seen in some modern indie games. A few examples of games that utilized pixel art style were *Super Mario Bros* (1985) on the 8-bit console the NES, *Sonic the Hedgehog* (1991) for the 16-bit Sega Genesis and *Undertale* (2015) for the PC.

In pixel art, a single pixel is the smallest building block of what a screen displays. Pixel art is the arrangement of these blocks on a pixel-by-pixel basis to make images and animations intended for screen display. (Kiwi 2010). Figure 13 is a typical in-game sprite during the 8-bit era that is made in pixel graphics.



Figure 13. Megaman (Smashpedia n.d.).

Characters and environments made in the pixel art style were often cartoony because of limited sprite sizes and bright color palettes that game systems at the time were capable of. Whether or not the cartoony appearance was intentional, many game developers were forced to design characters to be as representative as possible in a small image size. While realistic styles were attempted during 8-bit and 16-bit eras, it was easier for graphic designers to make more memorable characters in a simplified cartoon style instead, which is why many popular game characters at the time were cartoony.

After the third generation of game consoles, pixel art continued to evolve and improve to the 16-bit era and all the way to the 1990s even when three-dimensional graphics started to become more favored over two-dimensional graphics. Despite the new trend, pixel art never became truly outdated like some abstract graphical styles did. Instead, the art style utilized the technological advances like the improvements in screen resolution, data storage and color palette to make the game graphics more detailed and add better animations to the sprites. As a result, the style still managed to look fresh over the years and pixel art was divided into two main categories: retro pixel art and modern pixel art. When referring to retro pixel art, people are referring to the pixel art style that was used in games from the 1970s to about mid-1990s. Figure 14 illustrates a few examples of retro pixel art during different eras of game history.

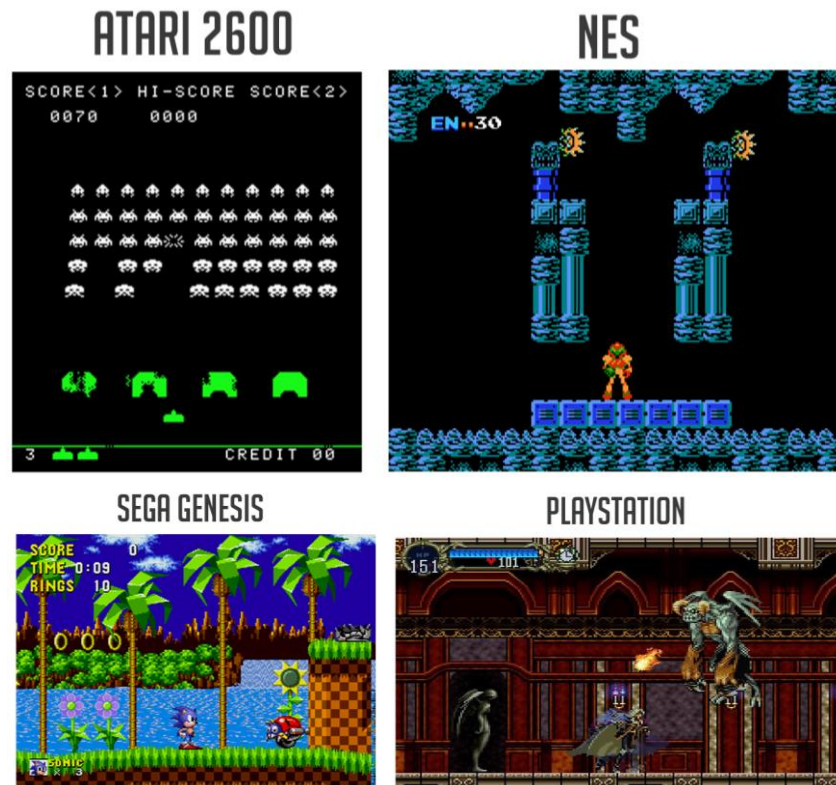


Figure 14. Examples of some retro pixel games: Space Invaders (Wikipedia 2008), Metroid (Retro Nintendo Reviews 2013), Sonic the Hedgehog (Wikipedia 2007) and Castlevania: Symphony of the Night (Emuparadise n.d.).

Modern pixel games have made a resurgence in the recent years of gaming. Even though game developers today were not forced to do pixel art because of graphical limitations, many developers found the style appealing and relatively easy to create. (“Pixel Art”, 2014). Additionally, many designers wanted to emulate the nostalgic feel in retro games. A few examples of modern pixel games are shown in Figure 15.

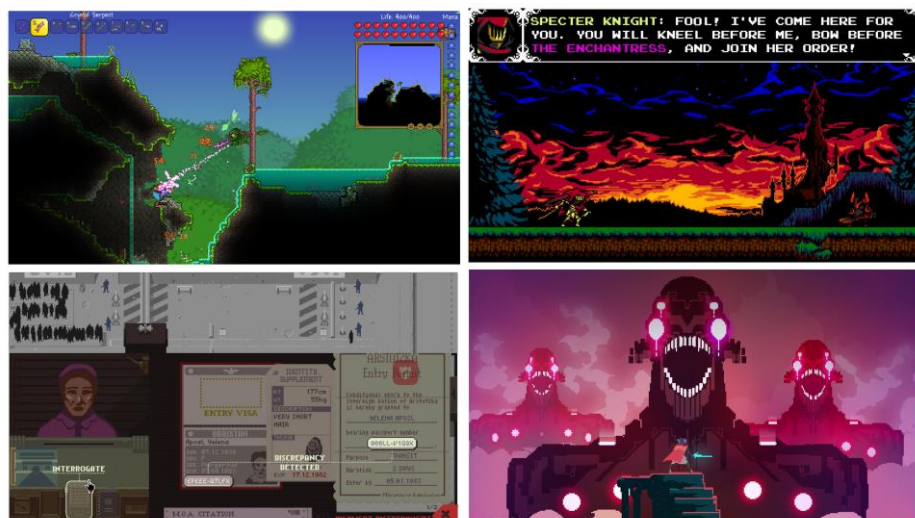


Figure 15. Modern pixel game examples: Terraria (Steam 2011), Shovel Knight (Steam 2014), Papers Please (Gamespot 2013) and Hyper Light Drifter (Heart Machine n.d.).

4.3 Stylized graphics in other two-dimensional games

From the 1990s till today, stylized graphics continued to exist in various two-dimensional video games. Many of these games were usually meant to be played in one perspective, the most popular choices were top-down, side-scroller and isometric. Because most of the games were viewed in one angle, drawing-styled sprites, artistic visuals and cartoon styles worked favorably. Some of the more recent two-dimensional games actually utilize 3D models but because of the perspective, it gave an illusion of the two-dimension. Like in pixel graphics, most of the two-dimensional games were made in an artistic style. An example of drawing-styled graphics in an isometric perspective is seen in *Don't Starve*, shown in Figure 16.

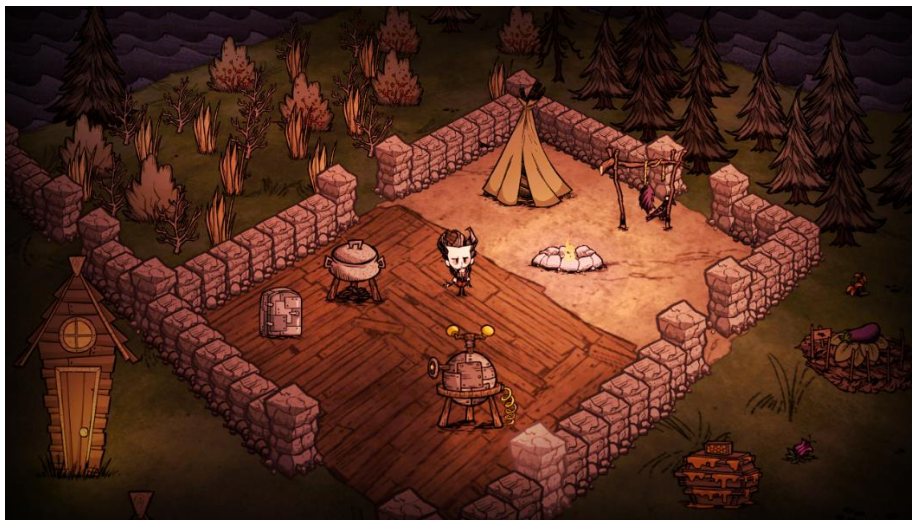


Figure 16. *Don't Starve* (Klei Entertainment n.d.) uses an isometric perspective.

Another notable example of stylized graphics was seen in the award-winning puzzle platformer, *Limbo*. *Limbo* was a game released on 2010 that completely focuses on the aesthetic and narrative immersion. With a fully black and white palette, *Limbo* pulls the player into its world as the game has no map, dialogue, descriptions and not even HUD to distract the player, seen in Figure 17. (Giant Bomb 2017)



Figure 17. Limbo (Steam 2011).

Limbo was a prime example of how a story can be told with simple stylized visuals. Because of the aesthetics, atmosphere and gameplay making the game so successful, there were many games that tried to imitate Limbo's silhouette visuals. Other game genres that utilized drawing styled graphics were point-and-click adventure games, educational games and interactive visual novels.

4.4 Three-dimensional stylized graphics

The 1990s was often dubbed as one of the most innovative eras in gaming. Video game graphics began its transition from pixels and sprites into fully rendered 3D graphics. The emulation of real life physics, realistic characters and environments became the new trend, with many game developers utilizing the technique to its fullest, competing in what seemed like an endless race against one another on who could create the most realistic graphics.

Because of this, stylized graphics were able to co-exist, providing an alternative to photorealistic style. The exaggerated comic book styled graphics stood out from the massive amounts of realistic games. Additionally, stylized graphics were very versatile and could be executed in variety of techniques. The most popular sub-categories for 3D stylized graphics were cel-shading, cartoon and semi-realistic. A couple notable examples of stylized games at the time were Mario 64 and the Final Fantasy series.

4.4.1 Cel-shading

Cel-shading, also known as toon shading is a 3D technique that recreated the look of traditional two-dimensional media with the use of flat colors for shading 3D objects. (Unreal Engine n.d.). Cel-shading is mainly used for making 3D models appear hand-drawn like in comic books and drawings. For example, Guilty Gear Xrd uses this technique to mimic the game's previous titles' iconic 2D drawing style to create a new fresh look to the franchise. The graphic designers execute this particularly well, as seen in Figure 18.



Figure 18. Guilty Gear Xrd (Nishikawa 2014). The comparison between a normally shaded 3D model compared with the model with cel-shading.

Naturally, cel-shading works well with exaggerated, colorful and caricatured styles, making cel-shaded games really stand out from the crowd of realistic styled games. A few notable games that utilized the style are shown in Figure 19.



Figure 19. Jet Set Radio (SEGAbits 2017), Okami (Polygon 2013) and The Legend of Zelda: The Wind Waker (Metro 2017).

The Legend of Zelda: Wind Waker was a successful game and known for its cel-shading style. However, at the time of the game's release in early 2000s, Wind Waker was actually subject to a big controversy regarding its graphical style.

It all started in the year 2000 at Nintendo's trade show event Space World when a tech demo of the upcoming Legend of Zelda game was first shown. The video displayed an impressive semi-realistic style, creating hype and excitement for the fans of the franchise. But as the next year rolled around, many were let down as a new trailer was shown and the fans were given a cartoony and cel-shaded style instead. (Drake 2011). A comparison of the two is shown in Figure 20.



Figure 20. Comparison of the tech demos shown in Space World 2000 (Nintendo Everything 2017) and the final released version of Zelda: Wind Waker (TechnoBuffalo 2013).

Despite the controversy, the game was actually well received after its release and even after many years, the graphics have aged well and remain timeless. Because of the success of the game Wind Waker also inspired many other cel-shaded games in later years, some of these games being Okami and the Prince of Persia reboot (Carter 2017).

Today, cel-shading is not a very commonly seen technique but it does occasionally make its appearance, such as in Nintendo's recently released and highly praised Zelda: Breath of the Wild for the Nintendo Switch. According to the franchise's producer, Aonuma, the game takes a strong graphical influence from the HD version of Wind Waker. (Carter 2017). As a result, Breath of the Wild was given refreshing, beautiful visuals with modernized cel-shading style. Proving that cel-shaded games can still hold up to today's graphical standards.

4.4.2 3D Cartoon graphics

Cartoon graphics are exaggerated, caricature and comic styled visualizations of game characters and environments. The word cartoon itself means a drawing that is intended to be a satire or humor ("Cartoon", n.d.). But unlike using flat colors to create a drawing-like style with cel-shading, the 3D techniques used to shade and render cartoon styled

models had more intricate textures and were more realistic in simulating shadows and highlights of the game objects.

At the beginning of 3D computer graphics becoming mainstream, the first 3D games that had cartoon graphics heavily resembled their 2D counterparts from a design perspective. A few examples of heavily stylized cartoon graphics are shown in Figure 21.



Figure 21. Super Mario 64 (Mostly Playing 2016), Crash Bandicoot (GameSpot 2015), Little Big Planet (MediaMolecule 2008) and Minecraft (Mojang 2016).

In many aspects, Nintendo's Super Mario 64 was one of the most influential and revolutionary three-dimensional games. The game set a standard for the character and camera movement in a third-person game and it was also the first Mario game that was in 3D. Perfecting the controls in the game was so important that Nintendo allegedly delayed the release of the Nintendo 64 so that the game's creator and principal director Miyamoto could finish the game. (Stanton 2015).

In addition to perfecting the controls of Super Mario 64, during the development of game, Miyamoto's design philosophy was to add more details to the game world, putting an emphasis on creating a more immersive environment and showing character's expressions. Miyamoto also described that he wanted the game feel like a 3D interactive cartoon. (Next Generation 1996, 45.). In the end, the game's graphical style stayed very true to the previous Mario games despite the leap from 2D to 3D.

Since the sixth generation of games till today, cartoon styled graphics continued to develop into a more realistic direction for the big budget titles. Modern cartoon games often put an emphasis on the aesthetic and atmosphere or a very specific style. A few examples of the cartoon styles seen in today's games are shown in Figure 22.



Figure 22. Team Fortress 2 (Steam 2007), Overwatch (PlayOverwatch n.d.), Firewatch (FirewatchGame n.d.) and Kingdom Hearts 3 (GameSpot 2015).

Blizzard Entertainment was well known for using cartoon style since the release of Warcraft 3: Reign of Chaos. The style defines the Warcraft universe and has since become a signature look for the company's other games as well, as seen in Figure 23. Now, Blizzard does it again and ties together a completely new concept with the classic Blizzard style in their latest game, Overwatch.



Figure 23. Blizzard's signature cartoon style seen in Diablo III (Battle.net 2011), StarCraft 2 (Battle.net n.d.), Heroes of the Storm (Meri-Station n.d.) and Hearthstone (Battle.net n.d.).

Blizzard's former producer and lead programmer Patrick Wyatt explains the reason the style was originally chosen was because the game's colorful and bright world helped Warcraft stand out from many similar games that used a more realistic and muted color palette at the time (Kotaku 2012). He also adds that many artists at Blizzard had worked on Super Nintendo and Sega Genesis games where the games required to use more bright colors due to the monitors at the time.

The Japanese video game company, Square Enix, is also known for their unique cartoon style that focuses a lot on the character design. Square Enix's style is known for combining both western and eastern art styles, the Final Fantasy and Kingdom Hearts series being the prime examples of the iconic look as illustrated in Figure 24.



Figure 24. Square Enix's trademark style seen in Final Fantasy VII (Steam 2013) and Kingdom Hearts HD 2.5 Remix (Morris 2014)

The graphical style seen in Kingdom Hearts and Final Fantasy VII onwards are more futuristic, dark and sci-fi compared to the previous titles. The game and character designer for these games, Tetsuya Nomura, created this style that most players associate to be the trademark look in Square Enix games. Nomura's iconic character design style usually featured long hair, oversized weapons and very detailed clothing. (Plunkett 2015).

4.5 Stylized graphics today and in the future

Stylized graphics are a popular style across all common gaming platforms: computers, consoles and mobile devices. Because of its visual adaptability, the style works well with any game genre and it can be altered to suit nearly every gamers' needs, whether the target audience was an adult or a child. Often stylized graphics were technically less demanding, which allowed the games to run on older hardware as well, thus increasing the player base for the games.

Even though the style is often treated as an alternative option to realistic graphics, stylized graphics have an advantage over realism with their ability to put focus on the gameplay or narrative while at the same time remaining timeless for a long time. It is hard to say how stylized graphics will develop in the future but as long as there is realistic graphics there will be always be a need for an alternative and artistic styled games and thus there will always be a place for stylized graphics in one form or another.

5 REALISTIC GRAPHICAL STYLES

Realism emulates game characters, objects and environments with as much likeness to reality as possible. Realism became a major trend in the 1990s when three-dimensional visualization became the new standard for game graphics. Since then, realism is still arguably the most desired look for modern games. It seemed that many game designers characterized the idea of ‘the more photorealistic the images are, the better they are’ (Järvinen 2009). This kind of mentality has always been around in the game industry, just look at the ‘console war’ between Nintendo and Sega back in the 16-bit era (Kelion 2014). Because so many game developers have engaged in the photorealism trend, it has almost become a required and an expected style for new AAA titles. There are many examples of revolutionary games that utilized and revolutionized the realistic style. A few examples of recent realistic games are illustrated in Figure 25.

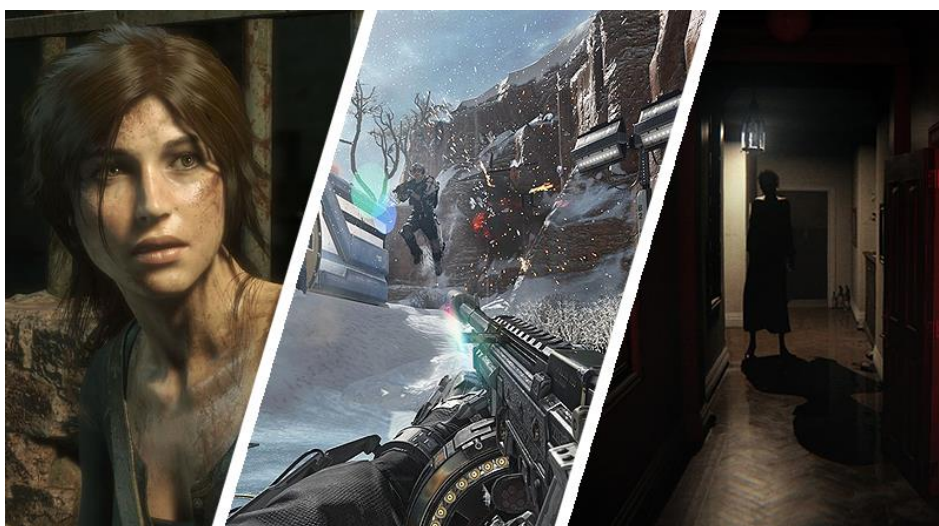


Figure 25. Rise of the Tomb Raider (DualShockers 2015), Call of Duty: Advanced Warfare (The Advanced Warfare n.d.) and P.T. (Crave 2014).

Even though realistic graphics was the favored look, the style was heavily restricted when it came to hardware and gameplay limitations. For example, realistic graphics worked the best with only specific video game genres, these included but were not limited to: third-person adventure games, first person shooters, simulations, racing games, survival horror and sports games. In addition to this, making realistic 3D graphics up to par with the modern standards was usually very time consuming. From modeling, texturing, lighting and animating the model with motion capture, the process required much more effort compared to other style alternatives, therefore most photorealistic games were usually developed by medium-sized to big game companies. These highly realistic games also required advanced hardware for rendering the game content, hence why the style is not often seen in mobile and handheld games.

The reason for the pursuit of photorealism in games lies within human nature itself. In art, pursuing realism has always been an important aspect in developing other artistic styles, after all realism is what we humans know the best. When games resemble real life, the players feel immersed in its world and additionally, the process of trying to achieve photorealism in games is one of the most effective factors in developing and evolving the technology in the future. Realistic games are very impressive when it achieves its goal.

5.1 Definition

In art and literature, realism means the true representation of subjects without any idealization or artificiality (Realism, n.d.). Photorealism is a subgenre of realism that takes the style one step further. In art, photorealism produces the image as realistically as possible, often making the artist study a photograph closely and then attempting to reproduce it (Photorealism, n.d.). Another subgenre of realism is semi-realism which is a style that is mostly realistic but has exaggerated, simplified and stylized aspects.

Additionally, realism can be divided into two more sub-categories: televisualism and illusionism. (Järvinen 2009). Televisualism is a style that tries to recreate television broadcasts with the use of multiple cameras and instant replays. The style uses photorealistic graphics and are mostly seen in sports and racing games. The FIFA series is a prime example of a televisualistic game. Illusionism on the other hand uses photorealistic graphics to recreate and simulate non-realistic and fictional content. Illusionism is often seen in fantasy role-playing games and sci-fi games, one good example of an illusionistic game would be Witcher 3.

Realism has been studied for many years in computer graphics in the form of simulations but only till the 1990s did realistic graphics become mainstream in video games. Most of the games were three-dimensional and strived for photorealism as game developers attempted to bring out the most of what the systems at the time were capable of.

5.2 Realism in 2D graphics

Due to the graphical limitations during the 1970s and 1980s, realism was not a very sought-after graphical style. However, realism and photorealism have always fascinated gamers since the beginning and even before the 3D era of gaming, there were a few games that were able to achieve realistic visuals using a variety of uncommon methods.

5.2.1 Digitized sprites

One of the earliest realistic games were made with the technology of digitized sprites. Unlike drawn sprites, digitized sprites utilized real photos of actors and models portraying as the game characters. Then these pictures were put into the games as sprites, giving the game the look of realistic graphics. (Digitized sprites, n.d.). The technique emerged in the late 1980s but fell out of favor in the 1990s when 3D graphics became the new trend. A popular game that popularized digitized sprites was *Mortal Kombat*, as seen in Figure 26.



Figure 26. Ultimate Mortal Kombat 3 (GotGame 2012)

Due to the sprites having clunky animation and being so out of place from the background, the style has not aged very well over the years. At the time, games made with digitized sprites were really eye-catching in the arcades. The realistic human-like characters were impressive and this level of detail was unseen in video games back then.

5.2.2 Full motion video

Another graphic technique that emerged around the same time as digitized sprites was full motion video or FMV. Full motion video games were made by first filming real actors in sets and then using these pre-recorded video files as the background of the video game (Järvinen 2009). Many FMV games were also referred as interactive movies. There were many games in the style that were considered photorealistic, a couple of examples being *Mad Dog McCree* and *the 7th Guest*.

5.2.3 Pre-rendered graphics

Following these techniques, realism was also notably seen in many point-and-click games in the 1990s. One of these games was the highly successful graphic adventure puzzle video game, *Myst*, which used pre-rendered

3D images to visualize the game content. The graphics consisted of individual shots of fully rendered rooms that were modeled and rendered in StrataVision 3D and later post-processed in Photoshop 1.0. (Miller, Rand & Robyn 1993). The result was very impressive realistic looking graphics that could run on graphically limited hardware as well as seen in Figure 27.



Figure 27. Myst (Giant Bomb n.d.).

5.3 Realism in 3D graphics

As mentioned earlier, in the current era of video games the game developers have chosen to produce photorealistic graphics in 3D due to its superior appearance, convenience and adaptability to the interaction of video games. When it comes to defining realism in game graphics, there are four main factors that make the game look realistic: the number of polygons, texture, lighting and animation (Guide to Realistic Game Art, 2015). Next we will go through how realism as a style was achieved in different 3D visualization techniques.

5.3.1 Photorealism

Photorealism is a graphical style that tries to simulate reality with as much photographic likeness as possible (Järvinen 2009). A few examples of photorealistic games are shown in Figure 29.



Figure 28. Battlefield 1 (GameSpot 2016), Gran Turismo Sport (GameSpot 2017) and the Last of Us (Giant Bomb n.d.).

A big majority of current three-dimensional video games are rendered using a technique called rasterization. This technique is basically an algorithm that renders a 3D scene on a 2D display. (Scharr 2013). The lighting and shadows are then simulated separately by calculating from a specified light source. This technique is a lot of work for the graphics designers and while the end results are great, many have speculated that future photorealistic video games will utilize another rendering technique called ray tracing.

Ray tracing is a rendering technique that has been used for years in rendering highly realistic 3D scenes for movies and animations. Unlike in rasterization, the lights and shadows do not have to be simulated manually as ray tracing models the light rays themselves. What this means is that the light rays can bounce from one object to another, creating a very complex and realistic scene as shown in Figure 30. (Hruska 2012). However, there are many limitations in the current technology, which is why ray tracing has not been applied to video games yet.



Figure 29. Ray tracing (Wikipedia 2006).

The game industry is in the middle of transitioning from rasterization to ray tracing. With ray tracing, the finished result for the graphics will be more realistic than ever and it will be less work for the graphics designers. The biggest problem is that the technique requires a lot of processing power from the computer. (Scharr 2013).

These techniques were not the only ways to create realistic graphics; The Vanishing of Ethan Carter was a horror adventure game known for its impressive and hyper-realistic graphics unseen at the time. The game's de-

velopers, the Astronauts, utilized an uncommon technique called photogrammetry. The technique involved taking many photos of the objects and locations in order to have a view of every single angle of the subjects. After that, the photos were put into a 3D rendering software that build the realistically textured 3D models of the photographed subjects, seen in Figure 30.



Figure 30. A 3D model of a church from the game *The Vanishing of Ethan Carter* (The Astronauts 2014).

Andrzej Poznanski from the Astronauts writes “With photogrammetry, we no longer create worlds while isolated from the world, surrounded by walls and screens. We get up, go out there and shot photos, lots of photos.”. And while photogrammetry may sound like a simple process, Poznanski says that the technique is quite hard to master.

Just the process of acquiring the photos can be very time consuming. The background and lighting must be static so sometimes it meant waiting for the sun to get behind the clouds and the tree leaves to stop moving with the wind. After getting the required photos, the images would often need post-processing and manual editing. (Poznanski 2014). Then, the generated 3D model would have about 2 to 20 million triangles that would need to be simplified down to a low poly mesh. After all this work, the Astronauts managed to create a visually immersive and realistic world unlike any other game. See the final screenshots of the game in Figure 31.

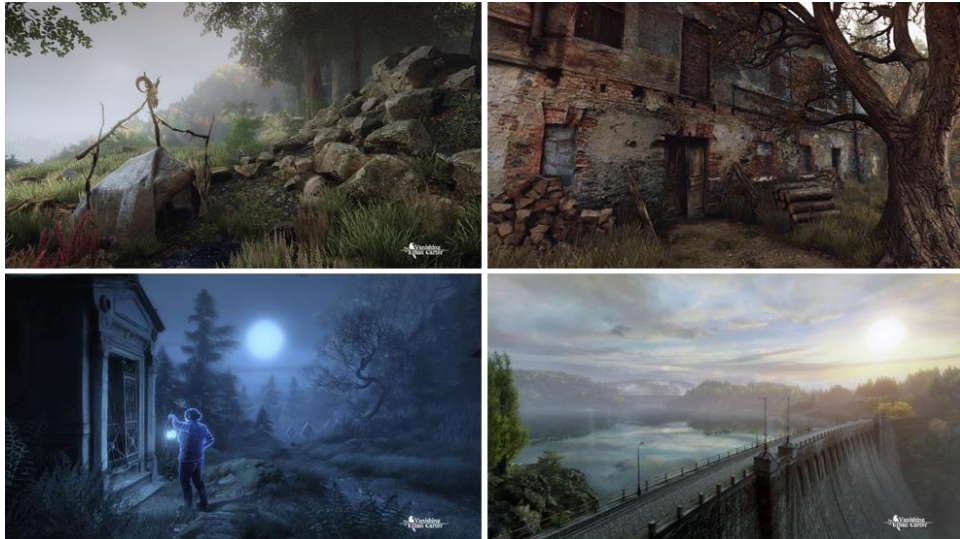


Figure 31. The Vanishing of Ethan Carter (The Astronauts 2013).

Throughout the many years in the gaming industry, game developers have been on a never-ending hunt in trying to achieve a truly photorealistic world that would be completely indistinguishable from a real-life scene. However, due to the limited processing power of today's technology, there are many problems the graphics designers must face while trying to achieve this goal. (Orland 2012).

5.3.2 Problems with photorealism

Despite current technological advances of game graphics, no game today has yet achieved true photorealism. Tim Sweeney, founder and programmer of Epic Games, speculated that during our lifetimes we will have enough computing power to be able to simulate reality very accurately. Sweeney added that in order to achieve true photorealism, game graphics technology must be at the same level as physical limits of the human eye, which could take at least two more generations. (Orland 2012).

According to Henrik Wann Jensen, a researcher at the University of California, true photorealism will not be achieved in another ten years. Jensen says the reason for this lies in the demanding ray tracing technique and our current processing power. In computer graphics, it is possible to render images with ray tracing that are truly photorealistic, however, rendering these images took a very long time. In video games this rendering process had to be done in real time. Jensen adds that if game developers want to achieve photorealism, there is no way around ray tracing and, so far, trying to get the technique render in real time has been a major challenge for the graphic artists. (Scharr 2013).

Furthermore, while characters in realistic games are very detailed and look close to a real human, many people still feel like the characters are artificial and that there is something missing. Because the fact that the

character looks so much like a human but there is just that minor thing that feels off; it could be the lifeless eyes, stiff animations or appearance inaccuracies. These factors can make the player's emotional response turn from positive to revulsion. This phenomenon is called 'the Uncanny Valley', a term identified by robotics professor Masahiro Mori back in 1970. According to Mori, the closer we get to true photorealism, even the tiniest inaccuracies become increasingly disturbing to us. (Mori 2012, 98-100.) While the portrayal of people in current video games are impressive, the technology is not quite there yet. According to the managing director of Ubisoft Reflections studio Gareth Edmondson, the game developers will cross the uncanny valley one day and when they do, games will be a big step closer to real photorealism, thus evolving and improving the player's gaming experience in the future (Gaudiosi 2011).

5.3.3 Stylized realism

Stylized realism or semi-realism is a hybrid style of stylized and photorealistic graphics. The style is defined by having some exaggerated features found in cartoon and artistic styles, but at the same time possessing strong photorealistic elements. In three-dimensional video games, the style is often achieved by graphics designers first creating the artistic and exaggerated 3D models and animations and then rendering these models with photorealistic textures, shaders and lighting settings. (Stylized Realism, 2016).

The key elements that make a game classified as stylized realism are the following; the game must have either stylized characters, spaces or objects and the graphics must utilize realistic materials, textures and advanced lighting in the 3D environment. (Stylized Realism, 2016). It is sometimes hard to categorize some semi-realistic games and whether they belong in the stylized or realistic category. A few examples of stylized realistic games are seen in Figure 28.



Figure 32. Bio Shock Infinite (Video Gamer n.d.), Final Fantasy XIII-2 (DualShockers 2011) and DmC: Devil May Cry (GameFaqs 2013).

The graphical style in the recent titles of the Final Fantasy franchise showcases stylized realism very well. The game usually depicts photorealistic and futuristic environments while the character design is still somewhat stylized and exaggerated. Many of the unrealistic elements in the character design are seen in the face and body proportions, over the top oversized weapons and attire design.

Due to the nature of stylized graphics in general, the games were not usually as demanding as pure photorealistic games were. Additionally, by idealizing and exaggerating the character design, the developers managed to avoid the had-to-conquer phenomenon uncanny valley. Because of these reasons, games made in stylized realism managed to age well compared to photorealistic games.

5.4 Realism and beyond - The future of game graphics

We have already established that photorealism has become the standard graphical style in current video games. It is also speculated that the style will remain as the popular option for quite some time.

According to the principal software engineer of Havok, Dag Frommhold, there is still a lot to improve in stylized and photorealistic graphics. He also adds that we are quite far from true photorealism, a few of the obstacles being the screen size, the uncanny valley and ray tracing. Therefore, in the near future we will need to put a lot of research and development effort in those before we can achieve true photorealism. (Freeman 2015). But what comes after we do achieve true photorealism?

Even though photorealism has been the most favored style in past years, it is hard to imagine what will come next. Many researchers have speculated that when we have overcome the challenges in photorealism, game developers will start making games that are less focused on realism. AMD's chief gaming scientist, Richard Huddy, speculates that we will start seeing games with different graphical styles in about a decade after true photorealism becomes a reality. (Freeman 2015).

6 MY PORTFOLIO

In the second part of my thesis I present some of my own work from a graphic designer's perspective. During my studies, I took part in several game projects in which I was responsible for the graphic design of the game. In my portfolio, I am hoping to showcase my capabilities in utilizing versatile art styles, as well as my proficient use of graphic software, tools and different implementation methods. I will go through my role in each game project in a chronological order, explaining my design philosophy and describing my workflow in detail.

6.1 My background in art

I am a self-taught artist who simply enjoys drawing in her free time. Drawing has been one of my hobbies for years but I started taking it seriously once I got a drawing tablet for the PC. I consider my style to be anime influenced realism, but I am also capable of drawing in a caricatured cartoon style. Examples of my art are shown in Figure 33.

Earlier I used the SAI Paint tool for drawing and Photoshop 7 for post processing but now I have upgraded to Clip Studio Paint and Photoshop CS6. For 3D modeling I used Blender earlier, but I have now switched to 3DS Max. Recently I have also taken some time to learn to use zBrush since it excels in modeling organic subjects such as people and monsters.



Figure 33. Some of my work.

7 ART DESIGN OF “MENTAL HOSPITAL ESCAPE”

The first game project I was a part of was called *Mental Hospital Escape*. The project was a first-person survival horror game where the main character, as the name suggests, tries to escape from an abandoned mental hospital. A screenshot of the game is seen in Figure 34.

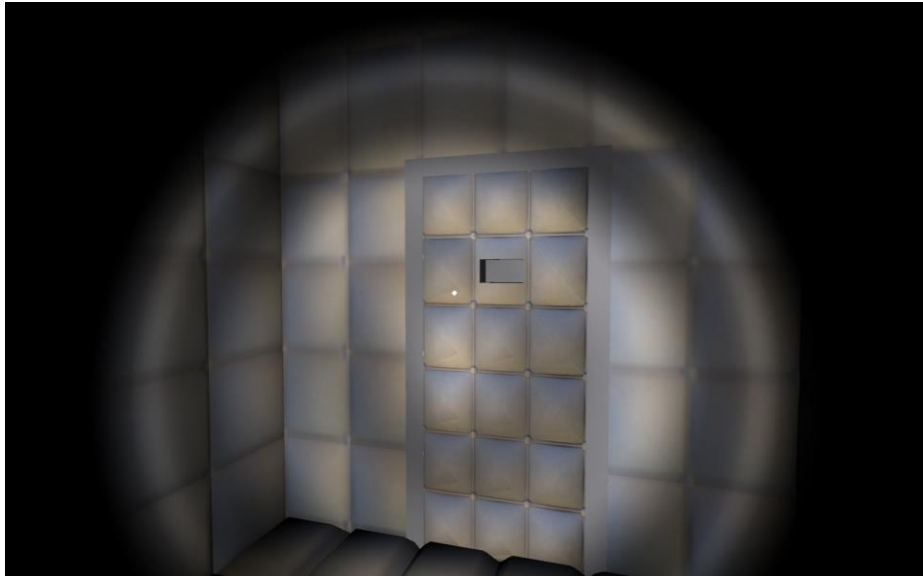


Figure 34. Mental Hospital Escape.

Our group had originally planned several features for the game but unfortunately we did not get to implement all of them. Many of the things we planned were inspired by common horror game characteristics; puzzle solving, a monster chase scene and an immersive story.

7.1 My responsibility in the team

Our team initially consisted of four people. We had planned the general ideas for the game together and divided roles and tasks for each person. The role assigned for me was to operate as the art director. A few of my responsibilities included making concept art, 3D modeling and texturing.

Unfortunately, at the very beginning of our project, two members of our team dropped out, leaving only two members to finish the game. This and our lack of experience in game development and in creating 3D graphics were the main reasons we could not implement all our original plans for the game in the given time span we had. Therefore, in the final version we excluded the monster, the chase scene and we also simplified the storytelling elements.

7.2 Graphical style and concept

In the early phases of our designing process, our team decided that we were going to make a three-dimensional game on the PC using the Unity Engine. The game was going to be in first-person and the genre survival horror. Since this was our team's first game project, we wanted to stick to the basics and create a somewhat stereotypical horror game with semi-realistic graphics.

At the time, there were many horror indie games in first-person that were set into a dark environment with just a dim flashlight guiding the player. Many of these games also relied on jump-scares, one notable example being *Slender: The Five Pages*. The color palette in these kinds of games was usually very muted, realistic and neutral. Since we were going for very typical horror game aesthetics, we decided to go for this style. With all this information and the fact that the setting was going to be a mental hospital, we had a quite straightforward idea of the overall concept and the look of the game.

Before the game was called 'Mental Hospital Escape', its placeholder name was simply 'Project Emily'. Emily was the protagonist of the game and the only playable character. When coming up with a plot for the game we made up Emily; a mysterious girl who at the beginning of the game wakes up in one of the cells in an abandoned mental hospital without any memories of what happened to her before that. Our original idea was that she would find clues of her past while progressing further into the mental hospital but as mentioned earlier we did not have enough time to polish the story as much as we wanted.

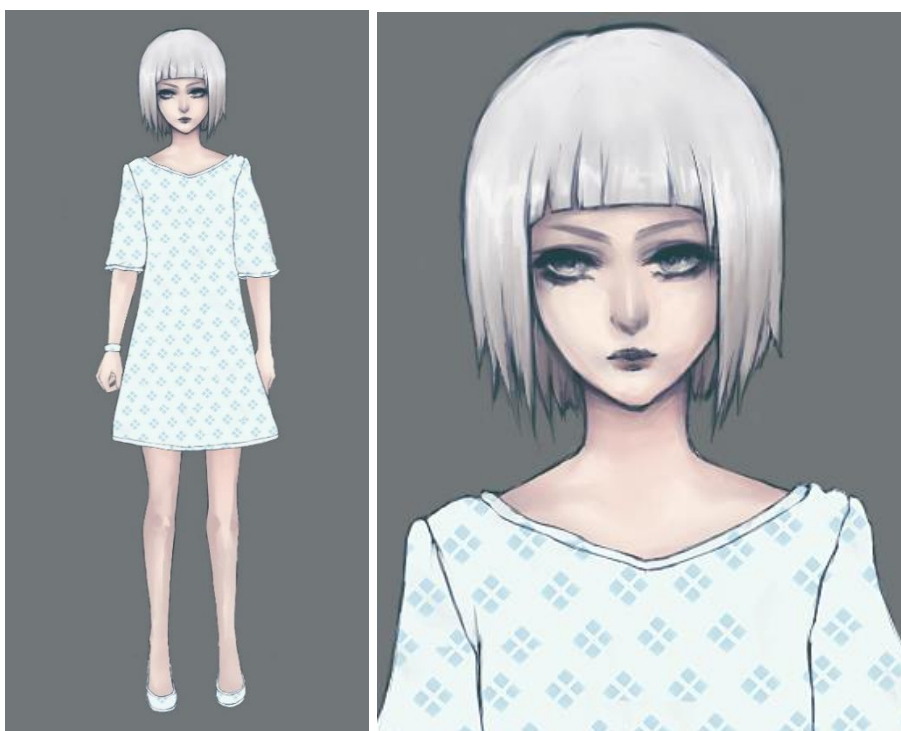


Figure 35. Sketch of the main character - Emily.

Despite knowing that the main character was never going to be seen in the actual game, I sketched Emily while brainstorming ideas for the overall style of the game, illustrated in Figure 35.

7.3 Designing and texturing the hospital

One of the most important parts of the game was creating the mental hospital itself. Since the whole game was set in the hospital, our group had to design the structure of the hospital to be large enough to hold all our puzzles, create enough suspense for the player and pace the game-play properly when entering from one area to another. Me and my group began sketching a rough idea of the map at an early phase in our development process, as seen in Figure 36.

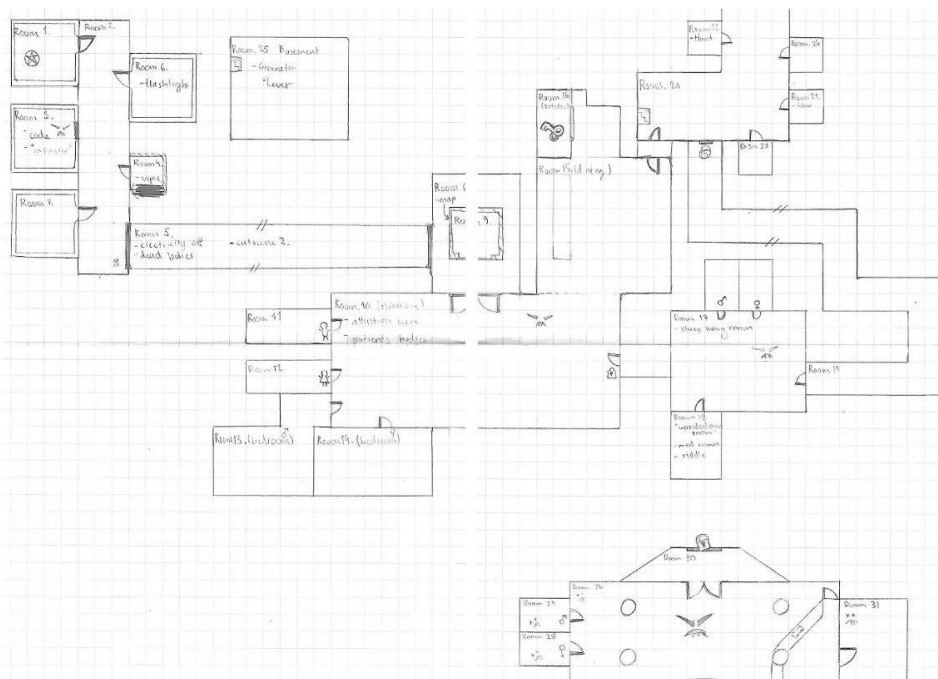


Figure 36. First draft of the map of the mental hospital.

As seen from the first draft, we planned most of the locations of the puzzles on the map as well as wrote down there which rooms we wanted in our game. In the final version of the hospital, most of these remained unchanged, see Figure 37.



Figure 37. Finished model of the hospital (Viksten 2014).

After the 3D model of the hospital was done by another group member, I was given the task of doing the textures for it. We had earlier established that the game's graphical style and color palette were going to be realistic so I decided to make the textures in Photoshop CS6 by using realistic materials and by editing them in Photoshop to match each other. The texture of the whole mental hospital consisted of two parts: the walls and the floors. A few details of the textures I made are shown in Figures 38 and 39.



Figure 38. Bathroom floor texture.

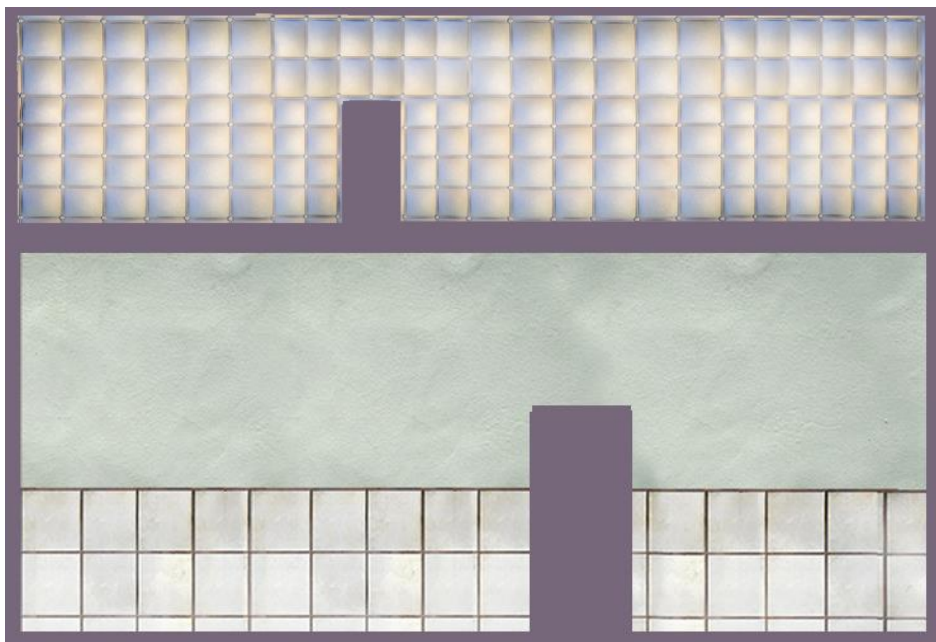


Figure 39. Cell room wall and the bathroom wall textures.

The texture making process mainly consisted of me hopping between Photoshop CS6 and 3DS Max; alternating between creating, drawing and editing the texture and then viewing it in 3D environment with a basic light setup in 3DS Max. I used lots of assets, patterns and brushes from Photoshop to create a rough and realistic looking surface on the walls and floors. Since it was my first time working with 3D technology on my own, I faced several challenges that I had to solve by either reading some tutorials or just coming up with solutions of my own. Some of these challenges were keeping the consistency between the materials in different areas, trying to draw and recreate realistic art in Photoshop and staying on schedule. By working independently, I learned a lot about the basics of 3D modeling and texturing process including making a basic low poly 3D mesh, unwrapping the texture map, applying the texture on the model and choosing materials in 3DS Max. The finished textures can be seen in the game's screenshots in Figure 40. In addition to texturing the mental hospital model, I also textured a few models made by my group members and modeled some 3D models on my own.

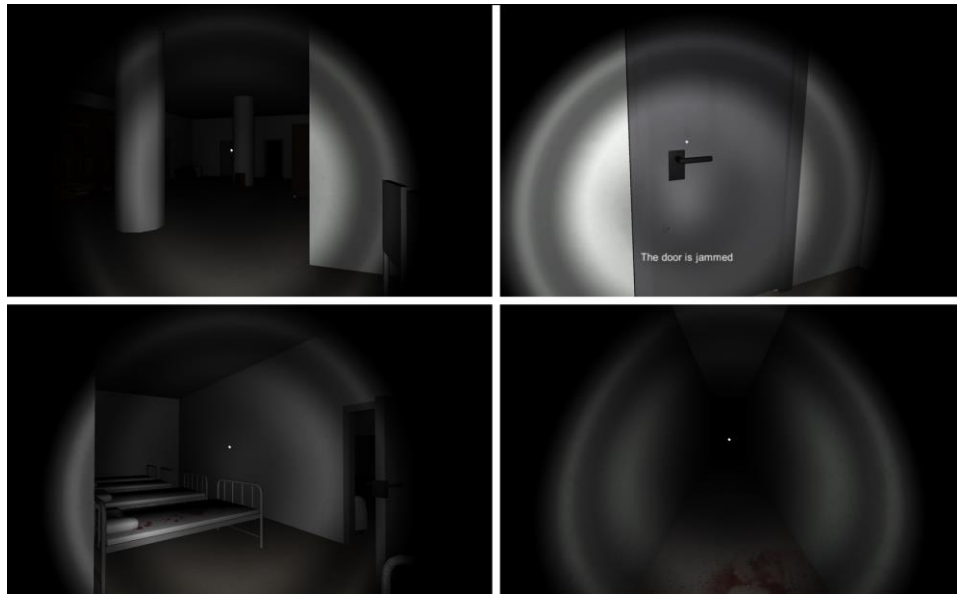


Figure 40. Screenshots of the finished game.

7.4 Summary of project “Mental Hospital Escape”

When it came to the quality of the graphics, it was clear that *Mental Hospital Escape* left much to be desired. Additionally, our failure to implement all the intended features in the given time left the game feeling rough and unfinished.

Looking back at my contribution as the graphics designer, I felt that my limited experience and lack of knowledge in 3D modeling and texturing process shows in the final product. Having been used to illustrating images in cartoon style using 2D tools, I felt I was unable to capture my true vision and style in the realistic 3D form. Had I taken more time to study and become more familiar with creating 3D graphics, I would have been able to contribute to the project much more and therefore would have become a more valuable group member.

Even though the game’s graphics were a little more plain and lifeless than what I would have liked, the dark and unsettling atmosphere of being trapped or even stalked was there. I feel proud having been a part of the development team and that we could create a playable game fully in 3D graphics. I have learned many valuable things during the entire process that I could only take and improve upon.

8 ART DESIGN OF “BUTTONS”

Buttons was my second game project. The game was a third person puzzle-adventure game about a girl who tries to retrieve her lost companion. The player takes control of the main character and must solve various puzzles to advance in the game. A few screenshots of *Buttons* are seen in Figure 41.



Figure 41. Screenshots of Buttons.

The game was made using the Unity Engine for the PC. The development of *Buttons* started about a year after *Mental Hospital Escape*. This time, our team felt like we had more experience in game development and graphic design so we decided to be more ambitious with the creation of *Buttons*. Some of the features we wanted to implement were story driven gameplay with visual-novel style dialogue, puzzles that involved interacting with objects, simple platform jumping and cutscene animations.

8.1 My responsibility in the team

This time our group consisted of three people in total, including myself as the graphics designer and game artist. My responsibilities were mainly to create the visual elements for the game such as: concept art, 2D illustrations, 3D models and cut scenes. *Buttons* had a lot of different types of graphics so I had to use many tools like SAI Paint Tool and Adobe Photoshop for drawing and Blender and 3DS Max for 3D modeling. Additionally, I took the time to learn the basics of Adobe Premiere for animating the cut scenes.

Since we had some difficulties in time management during our earlier game project, we decided to create a detailed timetable with separate goals for each week starting from the early drafting stages till the finished game.

8.2 Graphical style and concept

Some of the defining features we wanted to have in the game were puzzle solving and dialogue-driven interactions between characters. So, while deciding about the visual appearance of *Buttons*, we wanted to pick a graphical style that would work well with this kind of gameplay, fit the story and be original. In the end, we decided to go for a specific kind of stylized graphics; a combination of cute and eerie art style with a dark and muted color palette. One of the inspirations for the graphical style came from a movie called *Coraline*, as seen in Figure 42.



Figure 42. Coraline (Fanpop n.d.)

Using the basic idea of having buttons instead of eyes for the characters, we began polishing the world of *Buttons*; the design of the characters, plot, puzzles and the environments of the town. Sketching ideas for the main character and the non-playable characters was one of the first things our team did, as illustrated in Figures 43 and 44.



Figure 43. Some of the earliest sketches of the characters (Viksten 2015).

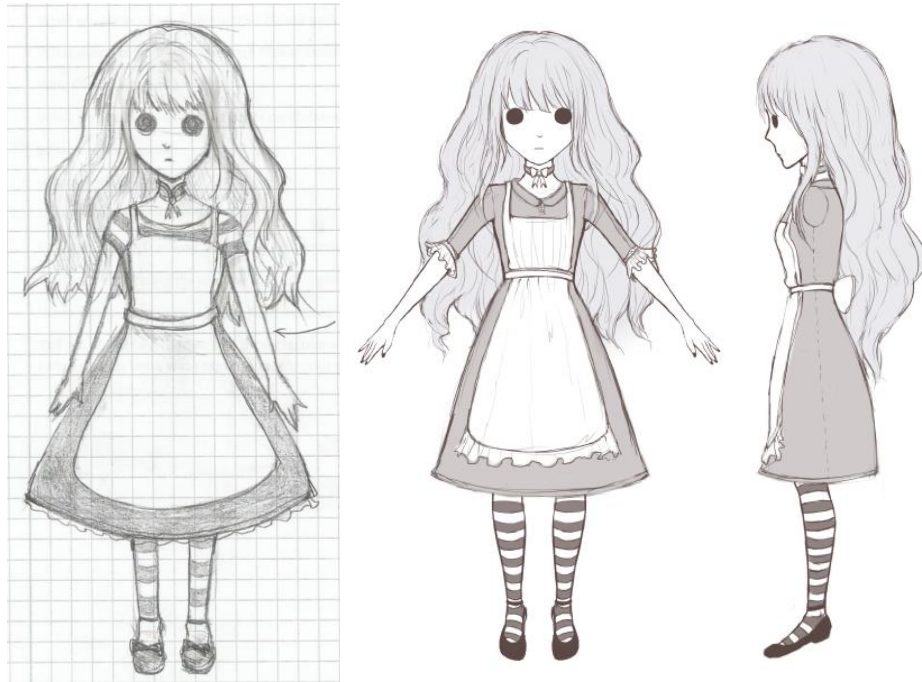


Figure 44. Sketches of the main character.

The game's protagonist and the only playable character is a girl. At the beginning of the game, the girl's mischievous pet rat runs away from her to the other side of the town's locked gate. The only way for her to get past the gate is through the gatekeeper who is a giant spider. Unfortunately, the gatekeeper has lost all his six button eyes and cannot see to unlock the gate. The girl then offers to find all his missing eyes if he opens the gate in return. After that, the goal of the game is to find these buttons by conversing with other characters in town, by solving puzzles and exploring the town.

8.3 2D Graphics

Even though Buttons is in 3D graphics for the most part, the game's cartoony style, overall atmosphere and some parts in the gameplay worked favorably with drawn graphics. Therefore, we decided to utilize 2D graphics in the following parts of the game; character art for the dialogue segments, cutscene animations and the HUD in the user interface.

8.3.1 Character art for the dialogue segments

Exploring the town and conversing with other characters were some of the most fundamental parts in the game. To interact with other characters, the player must simply walk to them and then press the key assigned to the interaction to start the conversation. The design of the dialogue layout is shown in Figure 45.



Figure 45. Dialogue layout.

In the dialogue segment, there are two drawn sprites representing the speakers and a text box with the actual dialogue. This kind of layout is very commonly seen in visual novels. In Buttons, the sprite of the character who is speaking is highlighted and enlarged.

The creation of the sprites was generally a straightforward process for all the characters. After deciding about the graphical style and overall color scheme for the game, I began sketching the character itself. Since I knew that the speakers were going to be facing each other, I drew the girl facing to the left while the rest of the non-playable characters were facing to the right.

For drawing I used SAI Paint Tool, Photoshop 7 and a Wacom Bamboo drawing tablet but any software with a basic soft brush and a multiple layer feature should achieve similar results. My workspace is shown in Figure 46.

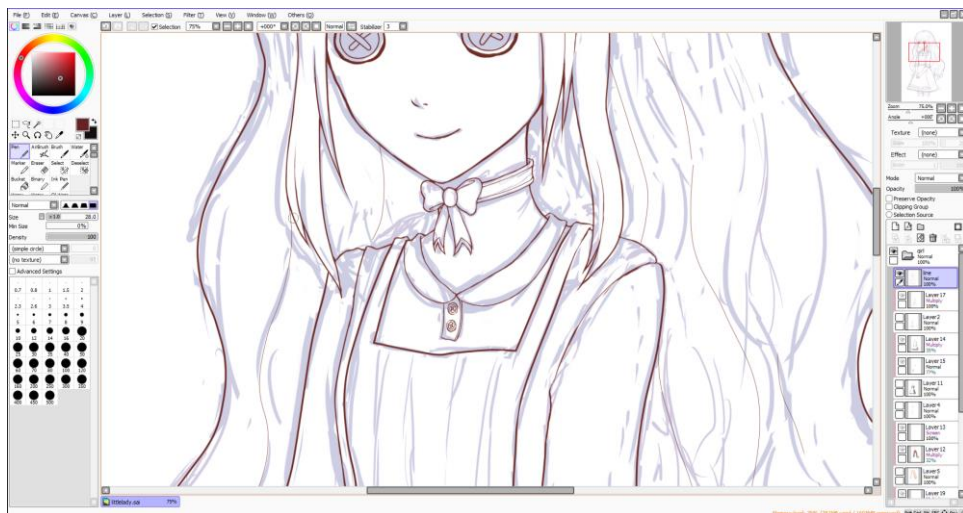


Figure 46. Drawing lineart on top of the sketch in SAI Paint Tool.

As good tips when drawing I could state that you should always draw on a bigger canvas than you need and work with many layers. I always draw on a canvas two to three times bigger than the final size because the quality of the final image will then be much better and also because it is easier to add small details there. It is also very useful to work with many layers because this saves a lot of time and it is also more flexible when you want to fix or change certain things later on, such as the coloring.

For the drawing process itself, I usually work in similar steps; sketching, doing the lineart, adding the base color, shading, highlighting and then post-processing. Each step is shown in Figure 46.

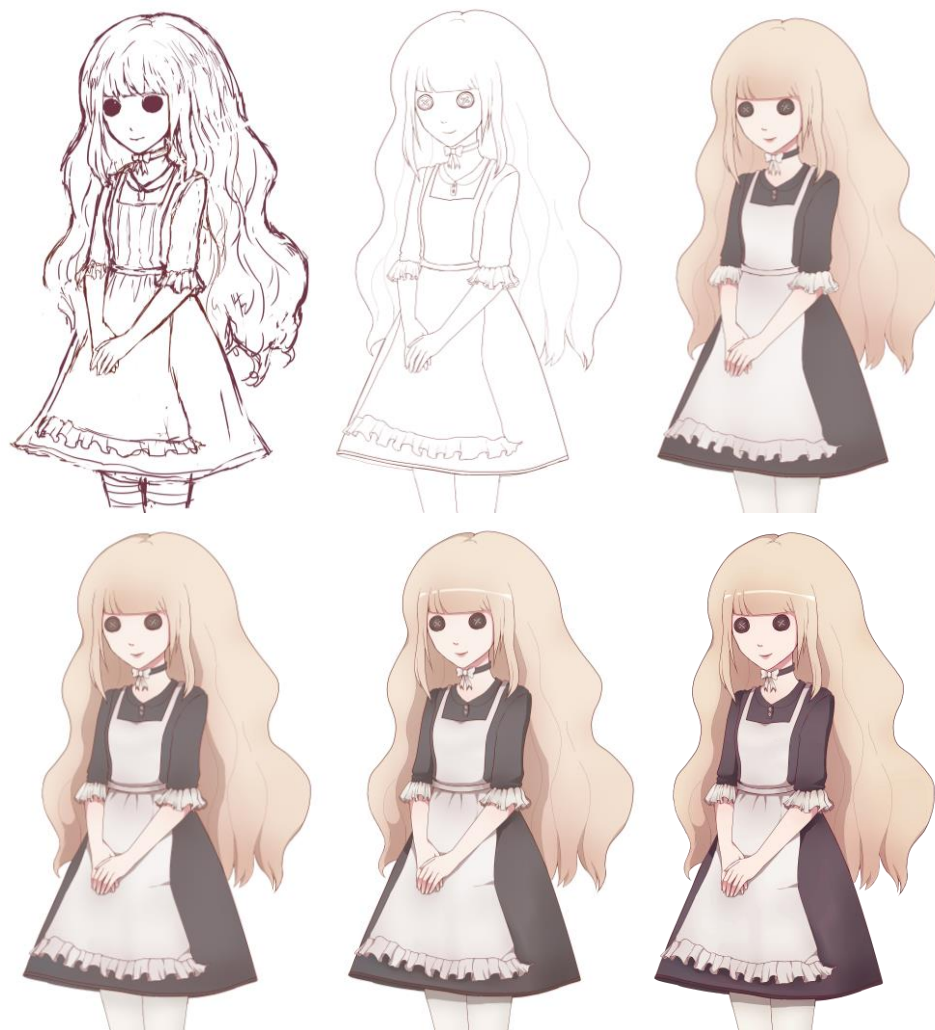


Figure 46. A step by step process of drawing the girl's sprite.

Using these same steps, I have drawn all the other character sprites for the game, as seen in Figure 47. For these specific sprites, I saved the drawing in a .png format with a transparent background so that it would look seamless and fit in with the rest of the game.



Figure 47. Sprites of the non-playable characters.

8.3.2 Cut scenes

Buttons had two cut scenes with fully drawn 2D graphics; the opening and the ending. In our original plan, we wanted to draw many frames and a detailed background but once again, due to the time limit, we had to cut down most of the plans. An example of a few frames of the animation is seen in Figure 48.



Figure 48. A simple animation of the rat turning his head.

I worked on the cut scenes closely with the other group members. The storyboard was drawn by one group member and the sprites were animated with the help of another member who had more experience with the used software, Adobe Premiere. The working space of Adobe Premiere is seen in Figure 49.

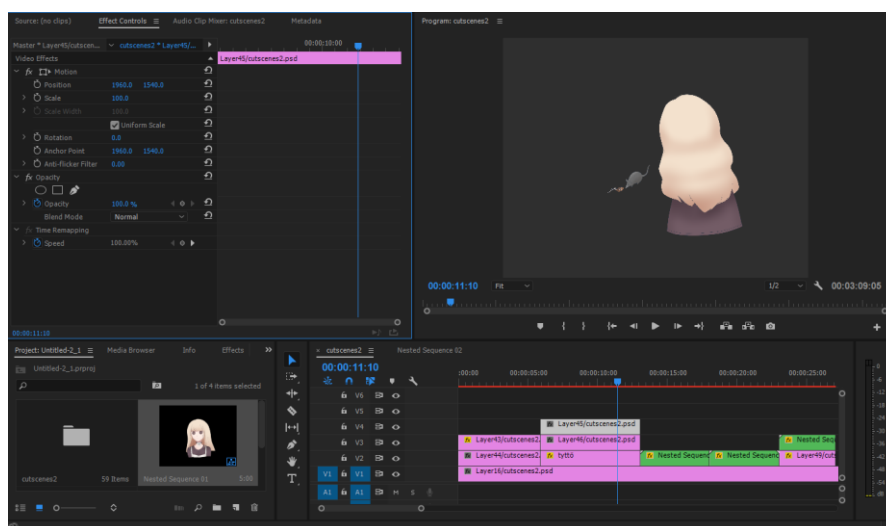


Figure 49. Putting the sprites into Premiere.

While working on the sprites for the cutscene animations, I followed similar steps like in the creation of the character dialogue art. A few things I took note of while drawing for the animation were the final video's resolution (1080p), the pacing of the animation, the composition and staging of the scene. Examples of still frames in the ending cutscene are seen in Figure 50. The area that is seen by the viewer is inside the lighter gray box.

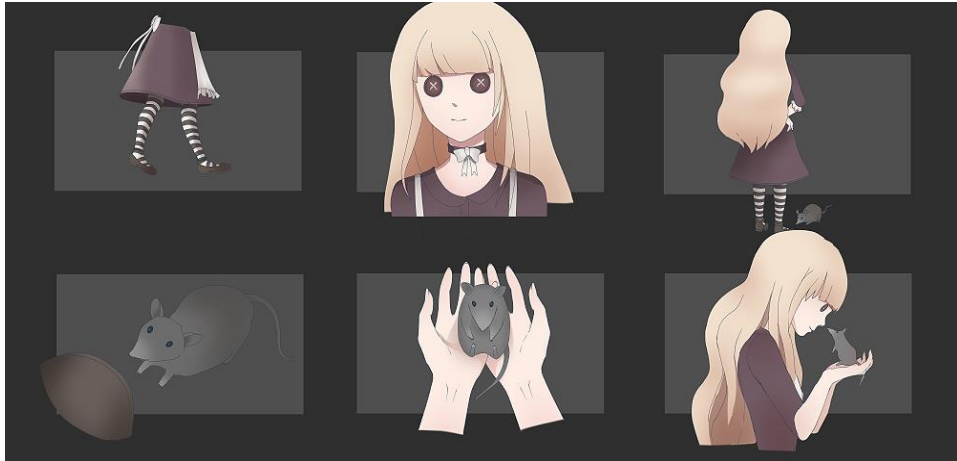


Figure 50. Still frames of the ending cutscene.

8.3.3 User Interface

Another thing our team decided to implement in 2D was the HUD or head-up display. I used Photoshop 7 to make the HUD elements: the logo, the controls for keyboard and controller, dialogue box and the title screen buttons, as seen in Figures 51 and 52.



Figure 51. User interface designs.



Figure 52. Buttons' title screen.

8.4 3D modeling

Creating the 3D content for the game was one of our group's biggest challenges. Just the sheer volume of work with character and environment modeling we had to do in such a short time forced every member in our group to work with 3D modeling in one way or another.

My own contributions consisted of modeling and texturing a couple of the game's characters and additionally working on some of the environments as well, as seen in Figure 53.



Figure 53. Some other models I made for the game.

This was my first time modeling and texturing a character. I started with drawing a silhouette of the character's body in a T-pose from the front and from the side. Then, I took the sketch to Blender and started building simple shapes such as spheres and squares on top of the sketch, manually adding more polygons to mimic the shape of the character's silhouette. Then I took the model to 3Ds Max for the finishing touches. This process is shown in Figure 54.



Figure 54. Silhouette of a character used as a reference for 3D modeling.

I just kept adding more and more details until I was happy with the result. It is also important to remember that when making 3D models for games, you want to keep the number of polygons as low as possible without compromising the look of the character too much. Since 3D graphics must be rendered in real time, high-poly models can be very taxing for older computers. Low poly models, however, tend to look very 'harsh' but using smoothing groups you can make the model look even and smooth, giving it an illusion of more polygons. In Figure 55 there is the finished model of a character with the smoothing groups on.



Figure 55. Finished 3D model of the Artist.

After I had finished with the model itself, I moved onto texturing. The texturing process is quite simple when the graphical style is as simple and cartoony like in Buttons. I used 3DS Max to 'unfold' the model with a method called Unwrap UVW. What it does is basically peel the model on a flat 2D surface so we can lay the texture on it. I exported the empty unfolded base in to which I painted the texture with Photoshop 7, see Figure 56. After texturing the model, it was moved to Unity Engine by the programmer and the character was finished, as shown in Figure 57.



Figure 56. Texturing process.

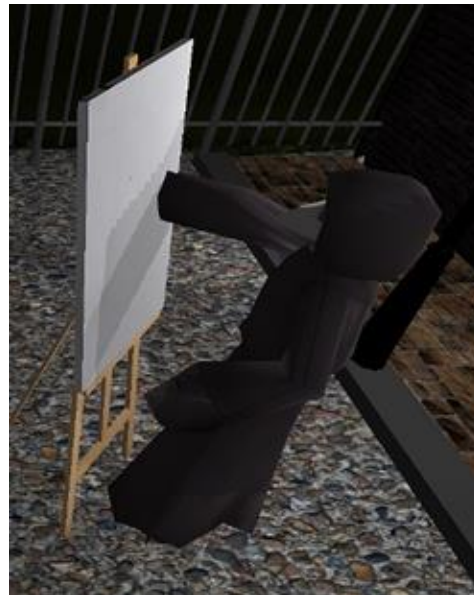


Figure 57. Fully finished character in-game.

8.5 Summary of project “Buttons”

Buttons was a much bigger project than any of my previous games. All in all, I was really happy with the outcome of both the graphics and the game as a whole. Unlike with *Mental Hospital Escape*, our group managed to implement most of our ideas there due to better time management and deeper experience with game development and creating graphics. Even though the game was a big improvement compared to our previous creation, our group still struggled with time, and therefore, there were a few minor issues in the gameplay and graphics.

One of my biggest challenges in the game project was keeping the graphical style consistent. Since there were so many different kinds of graphics: drawn 2D art and 3D models, I had to constantly make sure that my

drawings were consistent and worked well with the art style of the rest of the world. Still another major challenge was managing the time. I feel if we had had more time we could have ironed out a few of the problems in the game. Personally, I would have liked to make the cut scenes better by actually drawing more frames and also to polish out some of the textures I made.

Me and my group learned many things while developing *Buttons*, and all in all, we were really happy and proud of the result. *Buttons* was a ambitious project that had a lot of the key components of a major production game: goal-oriented gameplay, a story, cut scenes and a lot of 2D and 3D graphics.

9 ART DESIGN OF “ELEMENTAL”

Elemental is the latest game project that I am working on. The game is quite different from my other games since its genre is a turn-based trading card game. Unlike most card games where two players battle against one another, in *Elemental*, two players must join forces and team up to take down strong boss monsters also known as ‘Elementals’. Since the game is still in an early development phase, I drew a sketch of how I imagined the game to look like, see Figure 58.



Figure 58. Rough idea of the color palette and the overall style of the game.

Elemental was a personal game project that I created as a platform to practice creating game graphics. During my studies, I have made some content for the game including character designs, 2D illustrations, 3D models and user interface elements.

9.1 Gameplay

At its core Elemental is a cooperative trading card game. Two players must create decks that synergize with each other and counter strong boss monsters called “Elementals”. These monsters have their own devastating decks that will punish any unprepared challengers. Defeating an Elemental will grant both players rewards such as cards, skins and in-game currency.



Figure 59. Rose, Lotus and Camellia type cards with placeholder drawings and text.

The deck building and gameplay is based around three card types or classes; Rose, Lotus and Camellia, seen in Figure 59. In addition to these card types, there are special cards that all classes can use. Each of these classes have their own specialty and some synergize better with others.

9.2 Graphical style and concept

Making a game like Elemental has been in my mind for quite a long time. Being a fan of card games like Hearthstone, Magic the Gathering and Duelyst, I have always wanted to make a trading card game myself. Another reason why specifically digital card games appealed to me was because of their extensive use of different graphical techniques: 2D illustrations in the card art and 3D models in the board, card structure, objects and animations. Additionally, designing the HUD for a digital card game is very important and something I wanted to practice designing as well.

When it came to the graphical style, I decided to go with a style I was quite comfortable with but with a dark twist; a fantasy world with colorful and stylized cartoon graphics. During several courses in my studies, I made a few illustrations to conceptualize the graphical style of the game, illustrated in Figure 60.



Figure 60. Various art for the cards.

On my free time, I began sketching and designing the shape of the card itself in SAI Paint Tool. In a digital card game, it is important for the card to give enough information for the player. The most important information should be seen immediately; such as the name, mana cost, text and the drawn artwork.

I went through various designs for the cards. For example, one of the rejected ones is shown in Figure 61. In this particular design, the card consisted mostly of the art and once the player hovered on top of the card, it would then show more information. Needless to say, it was scrapped fast due to its impracticality.

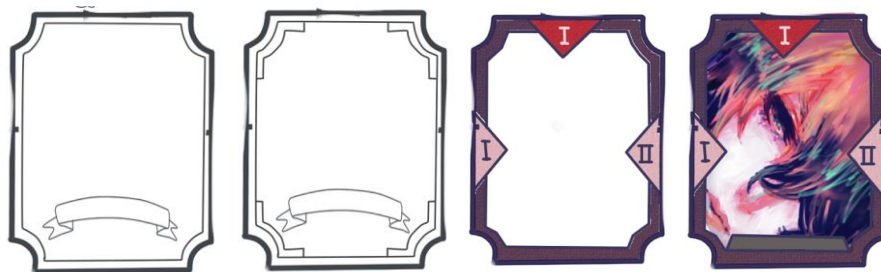


Figure 61. Rejected card design that required the mouse to hover on top to see the text.

The next design I went for is a bit more traditional, see Figure 62. Without putting too much thought into it, I simply put together a layout and painted all the elements on it. As seen from the slight bevel effect in the card, I am thinking of making the frame of the card in 3D so it will be more convenient later on when making the animations for the cards.

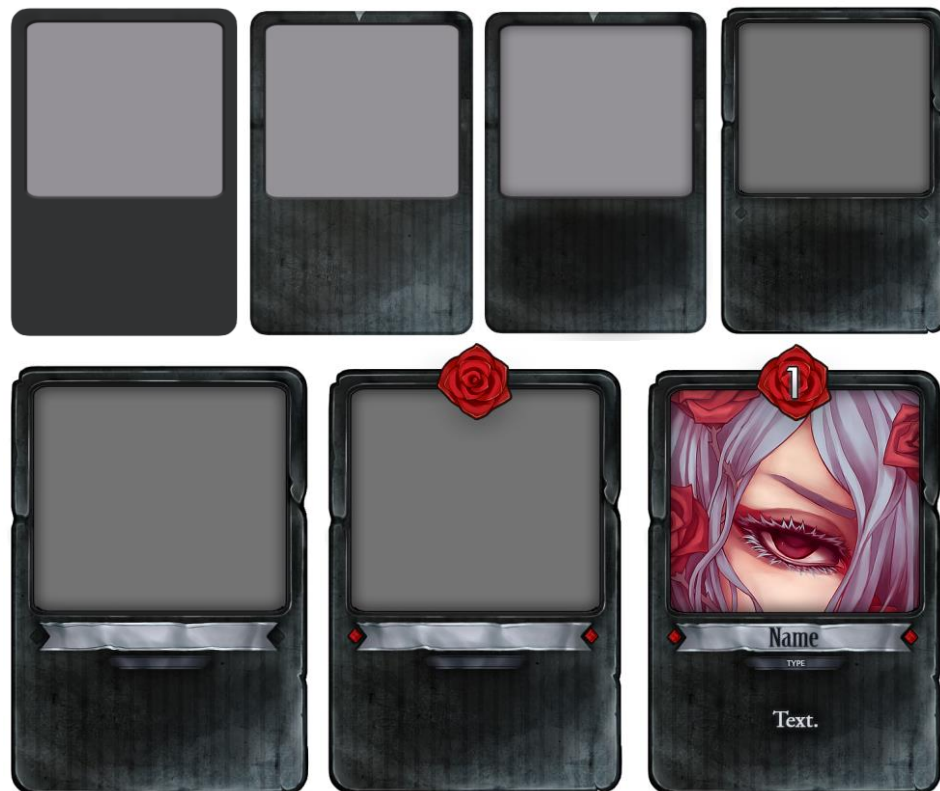


Figure 62. Step by step working process of the current card design.

9.3 Creation of “Whirlwind the Magical Axe”

I have never been fully satisfied with my 3D models. In my previous game projects, I have always felt that my models looked dull, uninteresting and did not seem consistent with my drawn art style. So, for the final project in my 3D modeling class I decided to create a low poly model for Elemental. My goals in creating this weapon were; developing my skills in 3D modeling, using new techniques I have not used before and I also attempted to make the model in my art style. I chose to model ‘Whirlwind’ a magical axe which is one of the cards in the game that transforms into a weapon that the player can equip.

9.3.1 Modeling

I began my work by first sketching the ideas for the weapon in SAI Paint Tool. I think of the colors, the materials the axe is made out of and the physics of the objects. In the end, I decided to make the axe from a dark stone-like material with ancient carvings, a brown cloth wrapped around the handle and a floating bright blue crystal in the middle of it. The sketches of the axe are seen in Figure 63.



Figure 63. Sketches of the weapon.

Only after I had the sketch done, I moved to 3DS Max where I modeled the axe using the sketches as my reference. As usual, I began modeling by first making basic shapes such as cylinders and squares which I then proceeded to add more detail with tools like extrude, chamfer and weld. In the final model, seen in Figure 64, the model has less than 1000 polygons, though I could have gotten even less polygons if I simplified the handle of the axe.

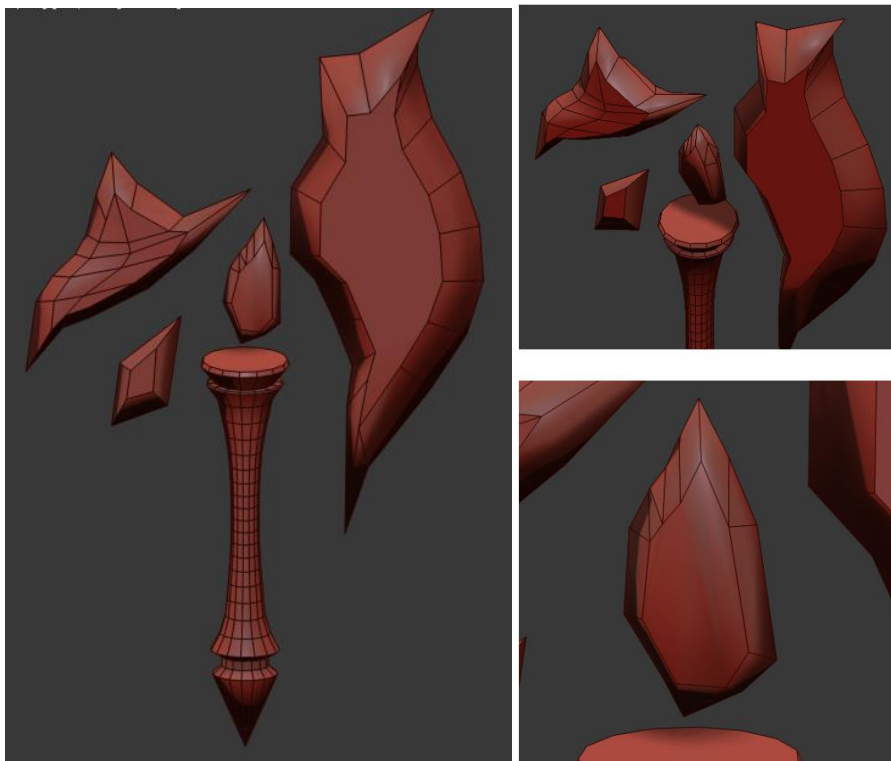


Figure 64. The finished model shown in clay effect.

9.3.2 Texturing

After the model was finished, I began my texturing process. Using the tools in 3DS Max, I unwrapped the model using a technique called UVW-mapping, see Figure 65. The green parts in the unwrapped texture are the seams of the object that are used to ‘connect’ the flattened surfaces together. When choosing the seams for the model, it is important to keep the map as consistent and even as possible.

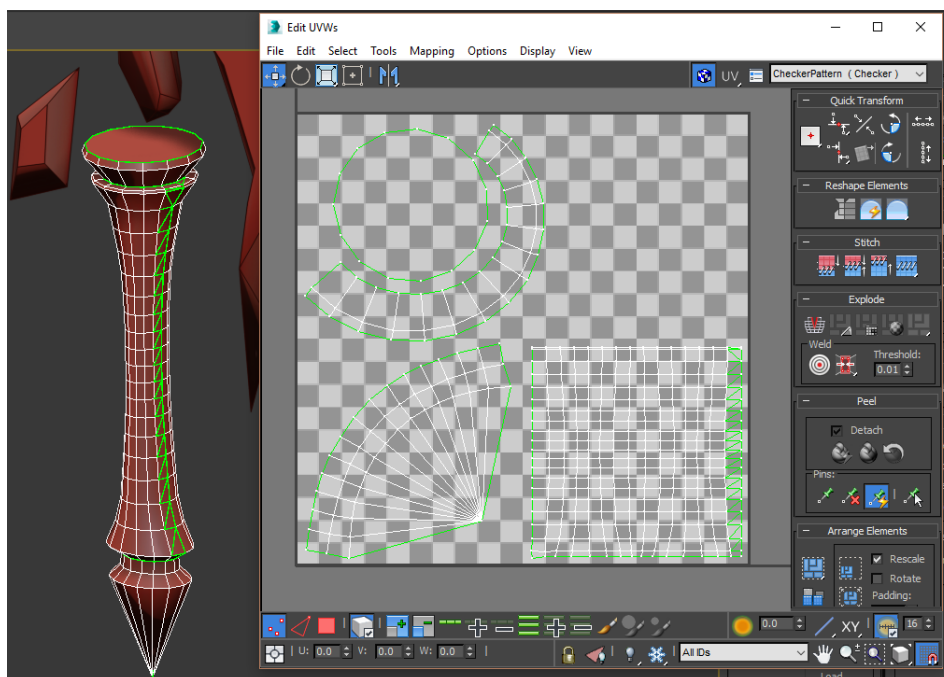


Figure 65. Editing UVWs in 3DS Max.

After I have unwrapped every object of the axe separately I move on to the actual texturing part. Loading the empty UVW maps into Photoshop 7, see Figure 66, I create a new layer and begin painting the textures following the guidelines of the UVW map. Since I wanted the 3D model match the cartoony world of Elemental, I decided to paint the texture in a similar way if I were to draw them. Therefore, I used all the same brushes and techniques in my drawings to create a rough and stylized look.

If you saved the texture file in .TIFF format and used the same file directly in 3DS Max, the texture could be viewed in real time on the 3D model while painting. This was one of the new things I learned while working on this model and this made the whole process much more convenient and fast.

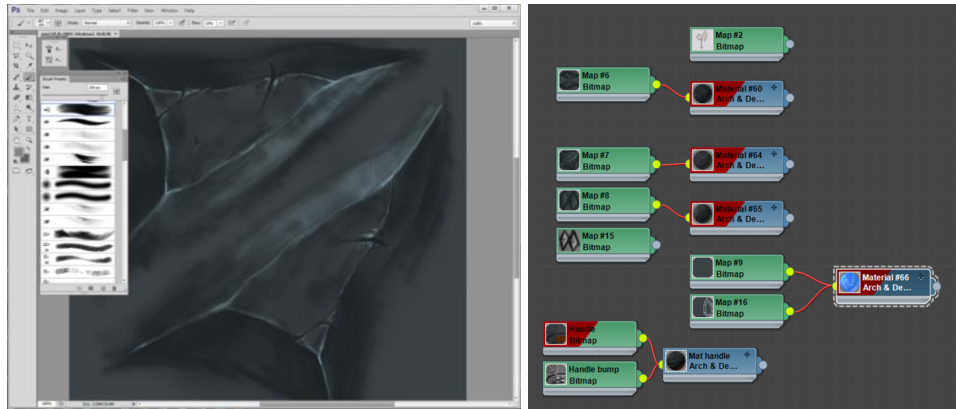


Figure 66. Using the texture file in Photoshop 7 in 3DS Max Materials.

After that I used these same steps for each object of the axe. My process from the UVW mapping, texture painting and finally viewing the texture on the model are seen in Figure 67. When putting the textures in 3DS Max, I made sure to set each material correct, for example a matte surface works well with the stone pieces while slightly transparent and reflective materials works well for the crystal object.

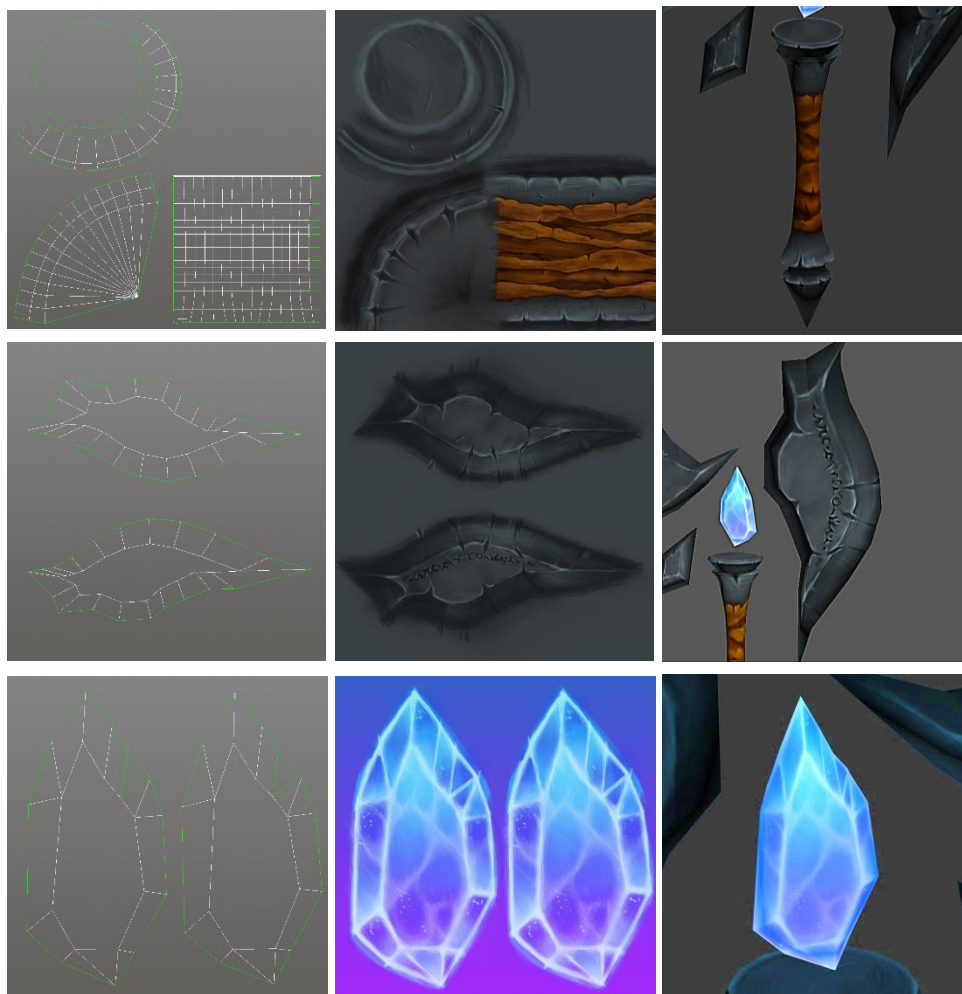


Figure 67. Painted textures shown on the model using UVW maps.

9.3.3 Rendering and post-processing

After texturing and optionally animating the model, I consider the model to be finished. The final model is shown in Figure 68 in various angles. I used a basic studio lighting setup and Mental Ray to render these images.



Figure 68. The finished model.

This next step is optional but since the 3D model was the final project for my 3D course, I had to render and post-process one image of my finished axe. So, I decided to draw a very simple background and add some light effects in Photoshop 7. Additionally, I brightened up the model a bit. The whole process is seen in Figure 69 and the finished post-processed model in Figure 70.

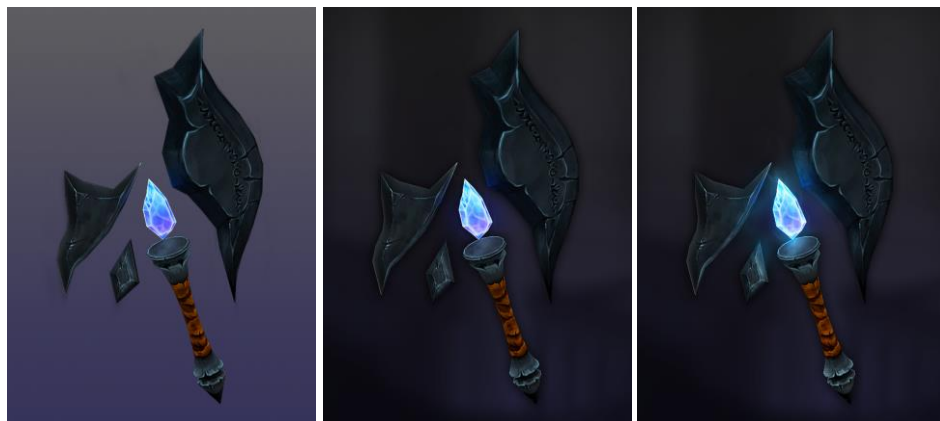


Figure 69. Step by step post-processing in Photoshop 7.



Figure 70. Finished image of the axe model.

9.4 Development ideas

Elemental started as a simple game project where the main goal was to improve my artistic skills in game graphic creation. During my studies and free time, I have created a lot of 2D and 3D art for the game and I have tried to push myself to make things in a way I have not before. As a result, I got familiar with many new tools, such as zBrush for modeling and Clip Studio Paint for drawing.

When I was working on Elemental I got the chance to fully focus on the graphical aspects of the game. In previous game projects, me and my group members were often forced to doing many things at once due to the time limit. Personally, I was unable to give enough attention to the quality of each individual model, which is why I felt like my models lacked character and originality. In Elemental, I got to take my time in exploring and pushing my skill and art style. In the end while making the model for the magical axe, I was finally able to find my preferred style in 3D graphics. Additionally, I learned to work faster on my models and acquired some new techniques to make them look better.

Overall, I have been working on Elemental quite casually; creating content here and there without a certain direction or schedule. After all, I never intended Elemental to be anything more than a carefree platform for practicing graphic creation. However, the game concept and graphical style are what I like and enjoy working on, so I have decided that the next step for me will be to continue developing the game further. My new goal for the future is to build a playable prototype of the game utilizing Unity Engine.

10 CONCLUSION

Graphics are one of the most important elements to a video game. The visual fidelity of a game has been in a critical role in marketing and selling games for years. This is definitely the case in AAA games, where many game designers and artists take a major amount of time and money to perfect every detail of a game's visuals. It seems like game graphics are more important now than ever.

Throughout the many years of technological advancements in digital visualization methods, game graphics have evolved tremendously compared to what they were back in the 1970s. Starting from barely recognizable abstract graphics to the detailed photorealistic graphics of today, games have experimented several of different artistic approaches. These different artistic styles are simply known as graphical styles. In my thesis, I have gathered information about the best known graphical styles in video games and divided them into three main categories: abstract, stylized and realistic.

As an enthusiast of both arts and games, it was interesting to conduct extensive research on graphic design and graphical styles for my thesis. Not only was I able to expand my knowledge of graphic design, artistic styles and their implementation methods, while making my thesis I also found several new 3D styles and methods that I would like to try out in my future projects. I was also surprised by the amount of varying styles in the gaming industry. It was impressive to see how two games in the same genre can have a completely different feel when the graphical style is different. It taught me how graphical styles can be a very powerful tool in shaping the player's gaming experience.

In the second part of the thesis I have moved from analyzing game graphics to creating them. It turned out that making games is not as easy as playing them, as I have learned with experience. In my portfolio, I have presented some of the games I made during my studies, putting a focus on the graphic design and my contribution. The goal of my portfolio was to showcase the versatile styles I can create and to document my learning journey of creating game graphics as I got to experiment with many different tools and methods during my studies. It has been a major learning experience being a part of the game developing process: designing, creating, implementing graphics and pacing my workflow. Hopefully I will be able to utilize these skills and share my artistic vision in the form of making enjoyable and visually more stunning games in the future.

REFERENCES

- Abstract. (n.d.). Dictionary.com Unabridged. Retrieved 10.5.2017 from <http://www.dictionary.com/browse/abstract>
- Abstract art style. (n.d.). Giant Bomb. Retrieved 11.5.2017 from <https://www.giantbomb.com/abstract-art-style/3015-1558/>
- AndysArcade.de (2005). Tempest. Retrieved 16.5.2017 from <http://www.andysarcade.de/data/picseries/tempest/overview.html>
- Atarimania (n.d.). Tempest. Retrieved 16.5.2017 from http://www.atari-mania.com/game-atari-st-tempest_10497.html
- Barone, E. (2016). Stardew Valley. Retrieved 23.2.2017 from <http://stardewvalley.net/post-launch-progress-update-version-1-1-and-more/>
- Battle.net (2014). World of Warcraft. Retrieved 23.5.2017 from <http://us.battle.net/wow/en/media/screenshots/screenshot-of-the-day/warlords-of-draenor?view=warlords-of-draenor-ss0061>
- Battle.net (n.d.). Hearthstone. Retrieved 30.5.2017 from <http://us.battle.net/hearthstone/en/>
- Battle.net (n.d.). StarCraft 2: Legacy of the Void. Retrieved 30.5.2017 from <http://us.battle.net/sc2/en/legacy-of-the-void/>
- Battle.net (2011). Diablo 3. Retrieved 30.5.2017 from <https://us.battle.net/d3/en/media/screenshots/?page=3>
- 8-Bit Central (n.d.). Yars' Revenge. Retrieved 11.5.2017 from <http://www.8-bitcentral.com/reviews/2600yarsRevenge.html>
- Bpepermans (2014). Lyne. Retrieved 15.5.2017 from http://www.bpepermans.com/_lyne-game-solution/
- Buttonmashing (2009). Rez. Retrieved 22.5.2017 from <http://buttonmashing.com/2009/09/11/cast-off-your-dream-rez/>
- Carter, J. (2017). Breath of the Wild Redeems Wind Waker's Controversial Art Direction. Retrieved 28.5.2017 from <http://twinfinite.net/2017/03/breath-of-the-wilds-art-shows-that-legend-of-zelda-should-keep-cartoony/>
- Cartoon. (n.d.). Merriam Webster. Retrieved 29.5.2017 from <https://www.merriam-webster.com/dictionary/cartoon>

- Christensson, P. (2009). *Graphics Definition*. Retrieved 5.4.2017 from <https://techterms.com/definition/graphics>
- Crave (2014). P.T. Silent Hills demo. Retrieved 1.6.2017 from <http://www.craveonline.com/site/743581-8-horrifying-user-screenshots-p-t-silent-hills-demo#/slide/1>
- Didi Games (2014). 1990's The Rise of Video Games. Retrieved 21.5.2017 from <http://alldidigames.com/1990s-the-rise-of-video-games/>
- Digitized sprites. (n.d.). Giant Bomb. Retrieved 1.6.2017 from <https://www.giantbomb.com/digitized-sprites/3015-2288/>
- Drake, A. (2011). A Tale of Redemption – The Legend of Zelda: Wind Waker. Retrieved 28.5.2017 from <http://www.ign.com/articles/2011/02/16/a-tale-of-redemption-the-legend-of-zelda-wind-waker>
- DualShockers (2011). Final Fantasy XIII-2. Retrieved 3.6.2017 from <http://www.dualshockers.com/new-final-fantasy-xiii-2-screenshots-appear-time-travel-and-lightnings-backstory-officially-detailed/>
- DualShockers (2015). Rise of the Tomb Raider. Retrieved 1.6.2017 from <http://www.dualshockers.com/rise-of-the-tomb-raider-gets-lovely-1080p-screenshots-lara-is-beautiful-even-when-shes-dirty/>
- Guide to Realistic Game Art: Pros/Cons and Best Practices. (2015). Concept Art House. Retrieved 2.6.2017 from <http://www.conceptart-house.com/news/2015/8/20/game-art-realistic-concept-art-house>
- Egenfeldt-Nielsen, S, Smith, H.J & Tosca, P.S. (2015). *Understanding Video Games: The Essential Introduction*. Abingdon: Routledge, Taylor & Francis Group.
- Emuparadise (n.d.). Castlevania: Symphony of the Night. Retrieved 26.5.2017 from [https://www.emuparadise.me/PSX_on_PSP_ISO/Castlevania_-_Symphony_of_the_Night_\(USA\)/163439](https://www.emuparadise.me/PSX_on_PSP_ISO/Castlevania_-_Symphony_of_the_Night_(USA)/163439)
- Emuparadise (n.d.). Legend of Zelda. Retrieved 24.5.2017 from [https://www.emuparadise.me/Nintendo_Entertainment_System_ROMs/Legend_of_Zelda,_The_\(Europe\)/56066](https://www.emuparadise.me/Nintendo_Entertainment_System_ROMs/Legend_of_Zelda,_The_(Europe)/56066)
- Emuparadise (n.d.). Super Mario Bros 3. Retrieved 24.5.2017 from [https://www.emuparadise.me/Nintendo_Entertainment_System_ROMs/Super_Mario_Bros._3_\(Japan\)/57078](https://www.emuparadise.me/Nintendo_Entertainment_System_ROMs/Super_Mario_Bros._3_(Japan)/57078)

- Fanpop (n.d.). Coraline. Retrieved 8.6.2017 from <http://www.fanpop.com/clubs/coraline/images/6474271/title/other-mother-photo>
- FirewatchGame (n.d.). Firewatch. Retrieved 29.5.2017 from <http://www.firewatchgame.com/>
- Freeman, W. (2015). The future of game graphics. Retrieved 4.6.2017 from <http://www.develop-online.net/tools-and-tech/the-future-of-game-graphics/0201807>
- GameFaqs (2013). DmC: Devil May Cry. Retrieved 3.6.2017 from <https://www.gamefaqs.com/pc/605602-dmc-devil-may-cry/images/27>
- GameSpot (2016). Battlefield 1. Retrieved 9.5.2017 from <https://www.gamespot.com/reviews/battlefield-1-review/1900-6416555/>
- GameSpot (2015). Crash Bandicoot. Retrieved 29.5.2017 from <https://www.gamespot.com/articles/whats-the-first-game-you-bought-with-your-own-mone/1100-6428472/>
- GameSpot (2014). Geometry Wars 3: Dimensions. Retrieved 15.5.2017 from <https://www.gamespot.com/geometry-wars-3-dimensions/images/>
- GameSpot (2017). Gran Turismo Sport. Retrieved 4.6.2017 from <https://www.gamespot.com/forums/system-wars-314159282/gran-turismo-sport-is-the-best-looking-racing-game-33385425/?page=3>
- GameSpot (2015). Kingdom Hearts 3. Retrieved 29.5.2017 from <https://www.gamespot.com/articles/new-kingdom-hearts-3-screenshot-features-obscure-t/1100-6431969/>
- Gamespot (2013). Papers Please. Retrieved 27.5.2017 from <https://www.gamespot.com/papers-please/images/?tag=Screenshots>
- Gaudiosi, J. (2011). *How Video Games Will Look in 2021*. Retrieved 1.6.2017 from <http://www.ign.com/articles/2011/08/23/how-video-games-will-look-in-2021>
- GeForce (n.d.). The Witcher 3: Wild Hunt. Retrieved 23.2.2017 from <http://www.geforce.com/games-applications/pc-games/the-witcher-3-wild-hunt>
- Giant Bomb (2017). *Limbo*. Retrieved 27.5.2017 from <https://www.giantbomb.com/limbo/3030-30380/>
- Giant Bomb (2008). Marble Madness. Retrieved 21.5.2017 from

<https://www.giantbomb.com/marble-madness/3030-9566/images/>

Giant Bomb (n.d.). *Myst*. Retrieved 2.6.2017 from <https://www.giantbomb.com/myst/3030-3970/images/>

GiantBomb (n.d.). *The Last of Us*. Retrieved 4.6.2017 from <https://www.giantbomb.com/the-last-of-us/3030-36989/images/>

GotGame (2012). *Ultimate Mortal Kombat 3*. Retrieved 2.6.2017 from <https://gotgame.com/2012/02/06/mortal-kombat-arcade-kollection-arrives-on-pc/>

Grannell C. (2008). *The Making of Marble Madness*. Retro Gamer. Imagine Publishing.

Heart Machine (n.d.). *Hyper Light Drifter*. Retrieved 27.5.2017 from <http://www.heart-machine.com/>

Hot Wink (2016). *Overwatch*. Retrieved 15.5.2017 from <http://hotwink.com/gadgets/overwatch-adding-ranked-play-next-month>

Hruska, J. (2012). Investigating ray tracing, the next big thing in gaming graphics. Retrieved 4.6.2017 from <https://www.extremetech.com/gaming/135788-investigating-ray-tracing-the-next-big-thing-in-gaming-graphics>

Järvinen, A. (2009). *Gran Stylistissimo: The Audiovisual Elements and Styles in Computer and Video Games*. Retrieved 5.5.2017 from <http://www.digra.org/wp-content/uploads/digital-library/05164.35393.pdf>

Kelion, L. (2014). *Sega v Nintendo: Sonic, Mario and the 1990's console war*. Retrieved 1.6.2017 from <http://www.bbc.com/news/technology-27373587>

Kiwi. (2010). *Intro*. Retrieved 20.4.2017 from <http://2dwillneverdie.com/intro/>

Klei Entertainment (n.d.). *Don't Starve*. Retrieved 28.5.2017 from <https://www.kleientertainment.com/games/dont-starve/gallery>

Kotaku. (2012). *The Inside Story of the Making of Warcraft, Part 2*. Retrieved 27.5.2017 from <http://kotaku.com/5935230/the-inside-story-of-the-making-of-warcraft-part-2>

Lee, L., Gee, S. & Dolah, J. (2016). *Graphic Styles Appearance in Educational Games to Enhance Malaysian Students Learning: A Preliminary*

Study. Retrieved 5.5.2017 from https://www.researchgate.net/publication/301678773_Graphic_Styles_Appearance_in_Educational_Games_to_Enhance_Malaysian_Students_Learning_A_Preliminary_Study

Masuch, M. & Röber, N. (2005). *Game Graphics Beyond Realism: Then, Now, and Tomorrow*. Retrieved 17.5.2017 from <http://www.digra.org/wp-content/uploads/digital-library/05150.48223.pdf>

McLaughlin, T., Smith, D., & Brown, I.A. (2010). *A framework for evidence based visual style development for serious games*. Retrieved 5.5.2017 from https://www.researchgate.net/publication/234801197_A_framework_for_evidence_based_visual_style_development_for_serious_games

MediaMolecule (2008). Little Big Planet. Retrieved 29.5.2017 from <http://www.mediamolecule.com/games/littlebigplanet>

MeriStation (n.d.). Heroes of the Storm. Retrieved 30.5.2017 from <http://www.meristation.com/pc/heroes-of-the-storm/imagenes-juego/1535989?page=1>

Metro (2017). The Legend of Zelda: The Wind Waker. Retrieved 28.5.2017 from <http://metro.co.uk/2017/04/12/speedrunners-find-incredible-glitch-to-skip-through-zelda-the-wind-waker-hd-6570568/>

Miller, R. C. & Miller, R. (1993). *The Making of Myst (CD-ROM)*. Cyan, Inc./Brøderbund.

MobyGames (2004). *Mega Man 2*. Retrieved 24.5.2017 from <http://www.mobygames.com/game/nes/mega-man-2/screenshots/gameShotId,83372/>

Mojang (2016). Minecraft. Retrieved 29.5.2017 from <https://mojang.com/2016/11/on-consoles-this-holiday-elytra-end-cities-and-amped-up-terrain/>

Mori, M. (2012). *The Uncanny Valley* (MacDorman, K. F., Norri, K. Trans.). New York: Institute of Electrical and Electronics Engineers.

Morris, T. (2014). Kingdom Hearts HD 2.5 Remix. Retrieved 30.5.2017 from <http://www.gamezone.com/originals/kingdom-hearts-2-vs-kingdom-hearts-hd-2-5-remix-screenshot-comparison-jrc5>

MostlyPlaying (2016). Super Mario 64. Retrieved 29.5.2017 from <http://mostlyplaying.com/articles/the-nintendo-time-machine>

Nintendo Everything (2017). Zelda tech demo in Space World 2000. Retrieved 28.5.2017 from <http://nintendoeverything.com/artists-on-why-nintendo-didnt-move-forward-with-realistic-zelda-on-gamecube-after-spaceworld-tech-demo/>

Nishikawa, Z. (2014). *Graphics Analysis of Guilty Gear Xrd -SIGN-*. Retrieved 16.4.2017 from <http://www.4gamer.net/games/216/G021678/20140703095/>

Origin (n.d.). FIFA 17. Retrieved 15.5.2017 from <https://www.origin.com/fin/en-us/store/fifa/fifa-17/standard-edition>

Orland, K. (2012). How close are we to truly photorealistic, real-time games?. Retrieved 3.6.2017 from <https://arstechnica.com/gaming/2012/02/how-close-are-we-to-truly-photorealistic-real-time-games/>

Overwatch Wiki (n.d.). Overwatch. Retrieved 9.5.2017 from <http://overwatch.wikia.com/wiki/Tracer/Gallery>

PCGamesN (2017). Battlefield 1. Retrieved 15.5.2017 from <https://www.pcgamesn.com/battlefield-1/battlefield-prise-de-tahure-map>

Peckham, M. (2016). Why Nintendo Had to Destroy Tradition to Create the New 'Zelda'. Retrieved 28.5.2017 from http://time.com/4369527/zelda-breath-wild-open-world/?utm_source=dlvr.it&utm_medium=twitter

Perfectly Nintendo (2015). Mario Kart 8. Retrieved 15.5.2017 from <http://www.perfectly-nintendo.com/mario-kart-8-trailer-for-the-second-dlc-pack-videos-music-recordings-update-changelog-and-screens/>

Photorealism. (n.d.). Wikipedia. Retrieved 1.6.2017 from <https://en.wikipedia.org/wiki/Photorealism>

Pixel Art. (2014). Giant Bomb. Retrieved 28.5.2017 from <https://www.giantbomb.com/pixel-art/3015-7753/>

Plante, C. (2017). The Legend of Zelda: Breath of the Wild. Retrieved 15.5.2017 from <https://www.theverge.com/2017/3/17/14957460/the-legend-of-zelda-breath-of-the-wild-nintendo-switch-future-games>

PlayOverwatch (n.d.). Overwatch. Retrieved 29.5.2017 from <https://play-overwatch.com/en-us/media/>

Plunkett, L. (2015). The Iconic Final Fantasy Art Of Tetsuya Nomura. Retrieved 30.5.2017 from <http://kotaku.com/the-iconic-final-fantasy-art-of-tetsuya-nomura-1686180995>

Polygon (2013). Okami. Retrieved 28.5.2017 from <https://www.polygon.com/2013/8/12/4615232/hideki-kamiya-discusses-the-road-to-wonderful-101-in-new-iwata-asks>

Poznanski, A. (2014). Visual Revolution of the Vanishing of Ethan Carter. Retrieved 4.6.2017 from <http://www.theastronauts.com/2014/03/visual-revolution-vanishing-ethan-carter/>

Racing Game Central (2014). The Crew. Retrieved 15.5.2017 from <http://www.ign.com/videos/2014/07/29/ign-plays-the-crew-jumping-the-grand-canyon>

Realism. (n.d.). Merriam-webster.com. Retrieved 1.6.2017 from <https://www.merriam-webster.com/dictionary/realism>

Retro Nintendo Reviews (2013). Metroid. Retrieved 26.5.2017 from <http://www.retronintendoreviews.com/metroid-nes-review/>

Scharr, J. (2013). *The Tech Challenges to Photorealistic Games*. Retrieved 1.6.2017 from <http://www.tomsguide.com/us/photorealism-ten-years-why,review-1915.html>

Shmuplations.com (2001). Player avatar's evolution in Rez. Retrieved 22.5.2017 from <http://shmuplations.com/about/>

SEGAbits (2017). Jet Set Radio. Retrieved 28.5.2017 from <http://sega-bits.com/blog/tag/jet-set-radio/>

Smashpedia (n.d.). Mega Man sprite. Retrieved 25.5.2017 from http://supermashbros.wikia.com/wiki/Mega_Man

Stanton, R. (2015). What made Super Mario 64 so special?. Retrieved 29.5.2017 from <http://www.eurogamer.net/articles/2015-04-12-what-made-super-mario-64-so-special>

Statista (2017). Number of apps available in leading app stores 2017. Retrieved 21.6.2017 from <https://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/>

Steam (2013). Final Fantasy VII. Retrieved 30.5.2017 from http://store.steampowered.com/app/39140/FINAL_FANTASY_VII/

Steam (2014). Geometry Dash. Retrieved 23.5.2017 from http://store.steampowered.com/app/322170/Geometry_Dash/

Steam (2011). Limbo. Retrieved 27.5.2017 from <http://store.steampowered.com/app/48000/LIMBO/>

Steam (2014). *Shovel Knight: Treasure Trove*. Retrieved 27.5.2017 from http://store.steampowered.com/app/250760/Shovel_Knight_Treasure_Trove/

Steam (2007). Team Fortress 2. Retrieved 29.5.2017 from http://store.steampowered.com/app/440/Team_Fortress_2/

Steam (2011). *Terraria*. Retrieved 27.5.2017 from <http://store.steampowered.com/app/105600/Terraria/>

Stylized Realism. (2016). How to not suck at game design. Retrieved 3.6.2017 from <http://howtonotsuckatgamedesign.com/2016/01/stylized-realism/>

Sydxlexia (n.d.). Tetris. Retrieved 4.5.2017 from <http://www.sydxlexia.com/nes100/nes14.htm>

TechnoBuffalo (2013). *Zelda: Wind Waker*. Retrieved 28.5.2017 from <https://www.technobuffalo.com/reviews/zelda-wind-waker-hd-review/>

The Advanced Warfare (n.d.). *Call of Duty: Advanced Warfare*. Retrieved 1.6.2017 from <http://www.theadvancedwarfare.com/aw/screenshots/>

The Astronauts (2013). *The Vanishing of Ethan Carter*. Retrieved 4.6.2017 from <http://www.theastronauts.com/2013/09/reveal-first-game-screenshots/>

Unreal Engine (n.d.). Stylized Rendering Post Processing. Retrieved 28.5.2017 from <https://docs.unrealengine.com/latest/INT/Resources/Showcases/Stylized/PostProcessing/index.html>

Video Gamer (n.d.). *BioShock Infinite*. Retrieved 3.6.2017 from <https://www.videogamer.com/games/bioshock-infinite/screenshots>

Wikipedia (2017). 2000s in video gaming. Retrieved 21.6.2017 from https://en.wikipedia.org/wiki/2000s_in_video_gaming

Wikipedia (2006). Pong. Retrieved 15.5.2017 from <https://en.wikipedia.org/wiki/Pong>

Wikipedia (2006). Ray Tracing. Retrieved 4.6.2017 from [https://en.wikipedia.org/wiki/Ray_tracing_\(graphics\)](https://en.wikipedia.org/wiki/Ray_tracing_(graphics))

Wikipedia (2007). *Sonic the Hedgehog*. Retrieved 26.5.2017 from [https://en.wikipedia.org/wiki/Sonic_the_Hedgehog_\(1991_video_game\)](https://en.wikipedia.org/wiki/Sonic_the_Hedgehog_(1991_video_game))

Wikipedia (2008). *Space Invaders*. Retrieved 25.5.2017 from https://en.wikipedia.org/wiki/Space_Invaders

Wikiwand (n.d.). Atari Pong console. Retrieved 15.5.2017 from http://www.wikiwand.com/es/Atari_Pong

Winkenbach G. & Salesin. D.H. (1994). *Computer-Generated Pen-and-Ink Illustration*. Retrieved 24.5.2017 from <ftp://ftp.cs.washington.edu/tr/1994/01/UW-CSE-94-01-08b.d/UW-CSE-94-01-08b.pdf>

Wolf M.J.P. (2003). *Abstraction in the Video Game*. Retrieved 21.5.2017 from http://www.phil-fak.uni-duesseldorf.de/fileadmin/Redaktion/Institute/Kultur_und_Medien/Medien_und_Kulturwissenschaft/Dozenten/Szentivanyi/Computerspielanalyse_aus_kulturwissenschaftlicher_Sicht/WolfAbstraction.pdf

Wolf M.J.P. (2007). *The Video Game Explosion: A History from PONG to Playstation and Beyond*. Santa Barbara: Greenwood.

Zam (2016). Overwatch. Retrieved 23.2.2017 from <http://www.zam.com/article/562/overwatch-guide-how-to-play-as-tracer/>