



DEVELOPMENT PROCESS OF THREE-DIMENSIONAL CHARACTER DESIGN AND MODELING FOR MOBILE GAMES

MOBİL OYUNLAR İÇİN ÜÇ BOYUTLU KARAKTER TASARIMI VE MODELLEMESİNİN GELİŞTİRİLME SÜRECİ

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Abstract

This research focuses on the development process of three-dimensional character design and modeling in mobile games with the rapid development of the game market in the world and in Turkey. The rapid development of the game market has led to an increase in the number of these companies and the necessity to create, develop and improve the infrastructure of the games by programming mobile games and adding new design elements with the increasing number of companies invested or acquired by important national or international companies. Undoubtedly, the visuality used in games is very important in terms of increasing the demand for them and the pleasure they will give to the player. Especially three-dimensional character design ranks first among the criteria that increase the appreciation of the game. Characters should be well designed and original in order to be adopted and preferred by users. This study aims to reveal the development process of three-dimensional character design for mobile games. With this research, it is aimed to draw attention to the design and modeling stages of three-dimensional characters produced for mobile games. The data obtained as a result of the research on the subject show that character design, which is one of the design steps that determine the success of a game, has important contributions from the development stage of the game to the marketing stage. The effectiveness of the character reinforces the bond that the users establish with him/her and thus enables them to internalise and adopt the game they play. For this reason, it has been determined that while character design is critical to the success of a game, it should also be considered that it includes various other elements that also affect the overall game experience.

Keywords: Mobile game, Three-dimensional modeling, Character design, Concept design, Digital game.

Öz

Bu araştırma, Dünyada ve Türkiye’de oyun piyasasının hızlı gelişimiyle birlikte mobil oyunlar özelinde gerçekleştirilen üç boyutlu karakter tasarım ve modellemesinin geliştirilme sürecini konu almaktadır. Oyun piyasasının hızlı gelişimi bu şirketlerin sayıca artmasına ve önemli ulusal ya da uluslararası şirketler tarafından yatırım alması veya satın alınmasıyla birlikte sayıca artan şirketlerin mobil oyunları programlama ve yeni tasarım öğeleri ekleyerek oyunların alt yapısını oluşturma, geliştirme ve iyileştirme gerekliliğini doğurmuştur. Kuşkusuz oyunlarda kullanılan görsellik onlara olan talebi ve oyuncuya yaşatacağı hazza arttırması bakımından oldukça önemlidir. Özellikle üç boyutlu karakter tasarımı oyunun beğenisini arttıran kriterler arasında ilk sırada yer almaktadır. Karakterler kullanıcılar tarafından benimsenmesi ve tercih edilmesi için iyi tasarlanmış ve özgün olmalıdırlar. Çalışma, mobil oyunlar için tasarlanan üç boyutlu karakter tasarımının geliştirilme sürecini ortaya koymayı amaçlamaktadır. Bu araştırma ile mobil oyunlar için üretilen üç boyutlu karakterlerin tasarım ve modelleme aşamalarına dikkat çekilmek istenmektedir. Konuyla ilgili yapılan araştırmalar sonucunda elde edilen veriler bir oyunun başarısını belirleyen tasarım adımlarından olan karakter tasarımının özgün, çekici ve benzersiz karakterler şeklinde tasarlanmasının oyunun geliştirilmesi aşamasından pazarlama aşamasına kadar önemli katkılarının olduğunu göstermektedir. Karakterin etkililiği kullanıcıların onunla aralarında kurdukları bağı pekiştirmekte ve bu sayede oynadıkları oyunu daha da içselleştirerek benimsemelerini sağlamaktadır. Bu nedenle karakter tasarımı bir oyunun başarısı için kritik öneme sahip olmasıyla birlikte, genel oyun deneyimini de etkileyen çeşitli diğer unsurları da içerdiğini değerlendirmek gerektiği tespit edilmiştir.

Anahtar Kelimeler: Mobil oyun, Üç boyutlu modelleme, Karakter tasarımı, Konsept tasarım, Dijital oyun.



INTRODUCTION

As one of the most important developments of the 21st century, technology and digitalization have brought a rapid transformation by penetrating into all areas of human life and led to the emergence of new and various digital fields. Examples of developments in the digital field are; augmented and virtual reality, artificial intelligence, machine learning blockchain technology, cyber security and 5G technology. Digital gaming also takes its place at the forefront of this developing and transforming technology world. This process, which started with computer games, the first examples of which we started to see in the 1950s, has reached very different dimensions with the emergence of various programmes today.

Thanks to the development of portable devices and the unlimited possibilities they provide, smartphones and tablets are now widely positioned as an integral part of our lives. Today, with the integration of games into tablets and phones, the mobile gaming sector has found a wide market for itself, and the number of mobile game applications has reached numbers exceeding tens of thousands. As a matter of fact, especially the market share of mobile games seems to have expanded considerably on a global scale in 2023. Mobile Games 49% \$90.5Bn, Console Games 29% \$53.1Bn, 21% Downloaded/Box PC Games \$38.4Bn, 1% Browser PC Games \$1.9Bn. If we look at the total game revenues of 2023, we see \$184.0Bn. (Game Market Reports and Forecasts, 2024). Considering all these figures, it is understood how big and powerful the gaming industry and ecosystem is.

It should be said that the situation is not different in Turkey. In 2023, despite the economic instability and contraction developing in Turkey, it is observed that it does not affect the progress of the gaming industry in general. So much so that the 2023 Turkish market data shows that a revenue of 580 million dollars was obtained. Although this revenue seems to have decreased in dollar terms compared to 2022 (\$625 million), it has increased in Turkish lira equivalent (Turkey Game Market 2023 Report, 2023, p. 38). Again, when we look at the data of 2023, we can see that mobile games are played by people of almost all ages in Turkey, and especially the young adult population between the ages of 18 and 35 constitute an important place in this group (Turkey Game Market Report, 2023). As such, the rapid development of the game market has brought the number of game companies to a considerable level. As a result, it has become inevitable to create the infrastructure of games by programming games and adding design elements for mobile games that are in demand. With the use of the developing three-dimensional technology in game production, the increase in visual effect significantly affects the game experience.

Undoubtedly, the appearance of the character is of great importance in games. The uniqueness of the character and the identification of the actor with the character representing him/her strengthens the bond between the play and the actor. (Rogers, 2014). Research on mobile gaming habits in Turkey has generally indicated that the visuals and genre of the game are influential in game preference. Users also claimed that the first two factors that influenced their choice of games were the fact that the game was offered for free and that the in-game design and graphics were remarkable (Turkey Game Market Report, 2023 p. 40).

The findings of the research are the character design produced for mobile games within the discipline of digital game design, the technical and aesthetic production processes of three-dimensional character design, the developments in the design steps used for three-dimensional characters, and the contributions of character design production as a visual effect to the consumption process of the game.

In the light of all these data, the aim of this research is to emphasise the value of visual impact in mobile games, to give information about the three-dimensional character design and modeling process and to reveal the effects of the game development process. The impact of three-dimensional character design on mobile games, mobile games and the characters designed for them in terms of design and modeling is the main subject of this article. As mentioned in the introduction, mobile games are frequently played by users via smartphones and tablets. These games are available on multiple platforms (iOS, Android) and in various genres (puzzle, strategy, role-playing, action games, etc.).

The beginning of the research article started with a literature review and articles, theses, books and



digital resources on the subject were accessed. The stages of the development process of three-dimensional character design and modeling were taken as a sample for mobile games that constitute the research universe. The research aims to make it possible to examine the stages of the development of three-dimensional character design and modeling in detail. The research also aims to contribute to the limited literature on three-dimensional character modeling for mobile games.

At the beginning of the study, the concept of game was mentioned and the history of games was briefly mentioned and examined specifically for mobile games. With the title of Three-Dimensional Character Design and Modeling for Mobile Game, the construction stages of a three-dimensional character designed for a mobile game were elaborated and these stages were detailed. In the conclusion section, an evaluation of the determinations reached at the end of these examinations was made.

WHAT IS A GAME

Play, which is introduced to human beings from an early age, is among the methods mostly used to contribute to the perception and learning processes of the world we live in. It has a physically and mentally stimulating effect. At this point, it is seen that the dictionary meaning of the game is "*Entertainment that develops talent and intelligence, has certain rules, and serves to have a good time*" (TDK, 2023). With the generalisation made here, it is understood that the game also has talent and intelligence developing aspects. The game develops a person's intelligence and abilities by forcing him/her to develop various strategies in line with a goal and by using his/her ability to solve problems.

According to Johan Huizinga: "*Play, even in its simplest forms and in animal life, is something more than a purely physiological phenomenon or a physiologically determined psychic response*", he states that play does not depend on a single situation and puts forward a definition as "As play, it goes beyond the limits of a purely biological or at least purely physical activity." (Huizinga, 1993 p. 17).

Again according to Huizinga, the game: "*Within the limits of its field, a specific and absolute order prevails. Here is a new, more positive line of play: Play creates order, play is order itself*" (Huizinga, 1993: 28). Huizinga also mentions that the negative and imperfect aspects of real life are presented in a perfect and attractive way in the game.

The game must be really perfectly organised. When this absolute order is combined with beauty, the attractiveness of the game increases even more. The game, which contains many facts and emotions, contains order against the disorder of the real world, beauty against the ugly aspects, and in some cases tension and excitement.

According to Ernest Adams

"Games arise from the human desire to play and our capacity for role-playing. Play is a broad category of non-essential and often recreational human activities. It is often also socially significant. Role-playing is the mental ability to construct a conceptual reality that the aspirant knows is different from the real world and that the aspirant knows he or she can create, abandon, or change at will" (Adams, 2010 p. 2).

The desire and desire of human beings to play a role shapes the game and the other world created allows people to enter a new world where they can move freely. In a way, the digital game creates a new world where people realise themselves.

In the 2000s, when the digital game market was on the rise, Nintendo, one of the leading companies of famous console games, used an advertising campaign slogan as "*Man is born to play*" (Kaliroff, 2021). So much so that at this point, it can be said that this saying confirms what is happening in the sector in a sense. As the game has become an indispensable part of our lives, people of almost every age have definitely played a game on a mobile phone once. Thanks to the developing technology, games that create visually perfect and realistic worlds have made this action more attractive and even indispensable.



A BRIEF HISTORY OF DIGITAL GAMING

The first known games date back to the early 1950s. Alexander Douglas created one of the earliest computer games, Tic-Tac-Toe (OXO) (Computer History Museum, 2023), which he designed in 1952 while studying in a PhD programme at Cambridge University (Figure 1).



Figure 1. OXO Screenshot (Computer History Museum, 2023).

Six years later, American physicist William Higinbotham develops a game called "*Tennis for Two*", which has a significant impact on the computer and gaming industry (Figure 2). The highly acclaimed game was developed using an oscilloscope (a graphic display device that draws a graph of an electrical signal) and an analogue computer (Museum of Electronic Games & Art, 2021). In this way, it stands out as the first game to display graphical and visual elements completely in real time (Wolf, 2008 p. xvii).



Figure 2. Screenshot of Tennis-for-Two (Saucier, 2018).

Tennis for Two was recognised as the first sports game. It was also "*The first computer game to fully display game graphics in real time, to have two controllers for two players and thus fulfil long-term interaction requirements, and to be developed specifically to entertain the public*" (Museum of Electronic Games & Art, 2021).

In the following years, the game *Spacewar!* programmed by Steve Russell and a group of students at the Massachusetts Institute of Technology (MIT), was released in 1961 (Wolf, 2008 p. 33). The game took its place in history as the first widely accessed game (Figure 3).

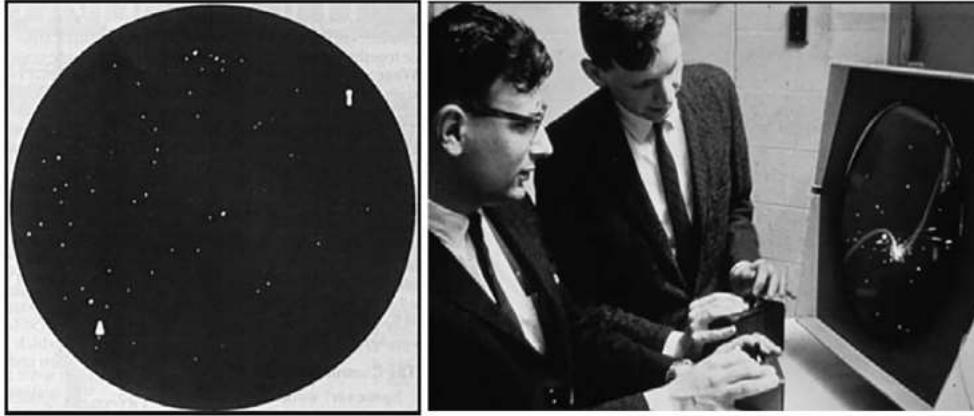


Figure 3. Spacewar! Screenshot (Saucier, 2018).

It would not be wrong to say that the foundations of video and computer games were laid in the 70s thanks to rapidly developing technology. Released in 1971, Galaxy Game comes to an important place as the first coin-operated game with vector graphics (Dyson & Saucier, 2018 p. 80). In the same year, the game Spacewar! appeared as a coin-operated version under the name Computer Space. (Image 3) Although the game did not achieve a significant success, it takes its place in history as the first mass-produced game in the history of computer games (Hansen, 2016 p. 11). The gaming giant Atari company was founded in 1972 and signed important games. Again, the foundation of the console games that will emerge in the 70s is laid. These games, which are considered the basis of today's digital games, have rapidly developed and multiplied.

In the 1980s, the Nintendo Console Game Company (1985) was founded (Wolf, 2008 p. 107). The Game Boy and Tetris game made a big impact, and millions of copies were sold. The following year, Pixar Animation Studios, which had been established under a different name the year before (1979- Graphics Group, Lucasfilm), was re-established by Steve Jobs in 1986 (Timeline of Computer History, 2023). Pixar still draws attention as the producer company of important animated films today.

In 1989, Nintendo launches the GameBoy game console. It has an important place among the best-selling and indispensable console games of the 90s (Dyson & Saucier, 2018). In 1994, Sony makes a breakthrough and launches the PlayStation game console. Consoles are devices for playing games electronically. In this way, the home gaming market will gradually strengthen. Game systems produced in co-operation with Sony and Nintendo will be a great breakthrough for the gaming industry. The gaming industry, which gained great momentum in the 90s, continues its rapid development in the 2000s. Although console games remain popular today, it would not be wrong to say that they are not in demand due to their ease of use and budget. Digital games played through portable devices are preferred by a wide audience due to their ease of access and uncomplicated features.

Mobile Games

In the 20th century, with the widespread use of mobile phones, users generally started to play games through this platform. These games can also be played with smart mobile phones, tablets, game consoles and some portable media players (Noyons, and others, 2011).

It is seen that the beginning of such games dates back to the early 1990s. With the rapid development of mobile devices and technology, games became widespread in the 2000s and turned into a large sector. According to the 2023 Turkey Game Sector Report, the distribution of players according to platforms is estimated as 44 million players on mobile, 20 million players on PC and 11 million players on console (Turkey Game Market Report, 2023 p. 116). It is observed that mobile games reach a high number of users due to their easy access and relatively low prices compared to other platforms.

Today, there are various types of mobile games. Examples of these games include three-dimensional games, action games, mass online games, platform games, first-person action games, real-time strategy

games and adventure games (Demirbaş, 2015 p. 364).

THREE-DIMENSIONAL CHARACTER DESIGN AND MODELING FOR MOBILE GAME

Character design is an important aspect of storytelling, both in stories and in evoking an emotional response in games. Whether based on the visual appearance of the character or the emotional depth of the backstory, the character we play and the people we interact with make the game world believable to us.

Many factors need to come together for a character to appeal to the user. A character does not have to be beautiful or attractive from a conventional point of view, but it has to be well designed, drawn and competently realised (Noyons, and others, 2011).

Generally, a story is necessary for us to talk about the existence of a character in games. The visualisation of the character is directly related to the story. At this stage, it is necessary to mention certain elements that are vital for the visualisation phase of the character to be created. Initially, the characters should be well-designed original characters to be adopted by the users. For this purpose, sketches are created based on the audience and story that the character to be created will address. Then, the process is continued by using 2D or 3D modeling techniques to be applied depending on the character of the game. With the developing technology, it has become more possible to provide a realistic image to the character. These visuals greatly increase the effectiveness of the games. However, although phones and tablets with highly developed processors suitable for mobile games are becoming widespread, mobile game producers aim to ensure that the visuals used and the content of the game are low in size, free from unnecessary details and have a simple design in order to work compatible with most phones and tablets. In this way, games are more optimised, in other words, they are brought to the final form that can work comfortably on portable devices. For example, if the character to be used in the game is designed in a very large size, the optimisation process is inevitable since the game will have difficulty in running on the mobile device.

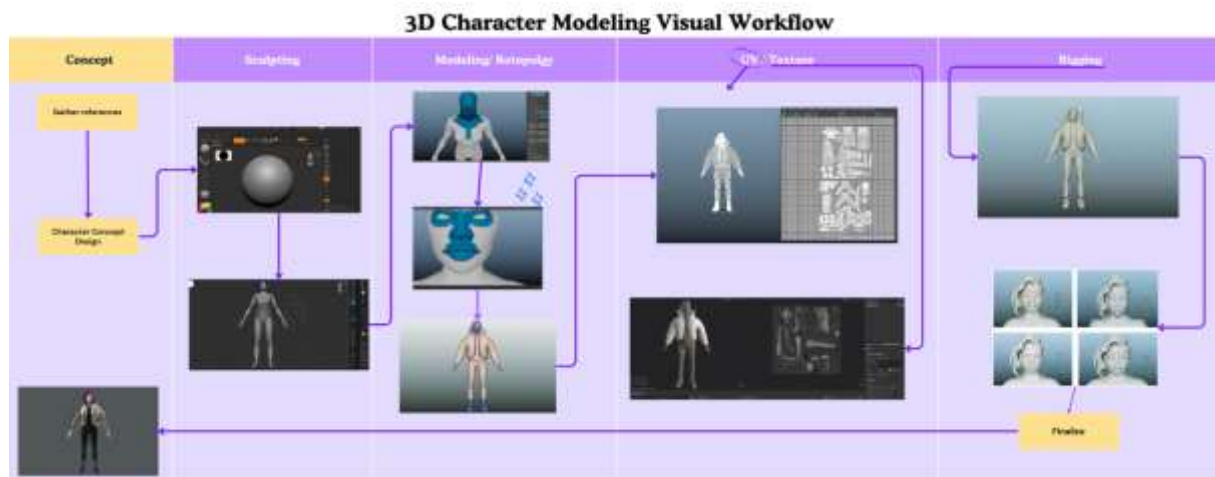


Figure 4. 3D Character Modeling Visual Workflow.

In a good game design document, the story, body structure, personality and psychological characteristics of each character in the game, accessories, if any, and the references required for the description of each of these are available. In this way, the character design phase progresses smoothly. These stages are generally categorised under the title of research.

Linda Seger says "*Research is the first step in the character design process*" (Seger, 2015 p. 2). Thus, the importance of character-specific research is emphasised once again. What will this character be designed for? A cartoon, a game, an advertisement. Gathering reference visuals on the subject as much as possible constitutes the critical stage of the study. Afterwards, the concept is created and the sketch stage is realised (Figure 5). The more detailed a model is required, the more detailed a two-dimensional

concept drawing is required. If possible, the drawing is drawn from different angles such as front, side and back to contribute to the modeling process. In order to talk about an original character design, graphic design elements and principles should be utilised. The design elements used at this point; elements such as colour, texture and line diversity will make the character stronger and more remarkable. The stronger the form in the drawing phase of the character, the stronger and more unique the modeling to be made by the artist/designer in the three-dimensional design phase will be, and it will affect the character or its being more interesting and memorable by the users. Using graphic elements that are compatible with the theme and atmosphere of the game will also make the design stronger.



Figure 5. 2D Concept character design (Escachx, 2018).

In addition to all these, it is necessary to have a good knowledge of anatomy in order to make an accurate and trouble-free three-dimensional character modeling. The concept drawing may contain details, but when modeling, the artist / designer can interpret their own knowledge and point of view on the model. Thanks to this experience, the model emerges both with a correct anatomy and in a faster time. Because the concept design and modeling stages of a game should progress as quickly but smoothly as possible. This approach can only be carried out by experienced people without any problems (Rogers, 2014).

The process of turning an object's three-dimensional shape into a mathematical representation is known as digital modeling. What the industry refers to as a 3D mesh or model is the end product of this process (Vaughan, 2012 p. 4).

There are many different 3D modeling programmes. Leading those generally used are 3ds Max, LightWave 3D, Maya, Modo, Silo, XSI, ZBrush. Several open-source 3D programs are also quite powerful and completely free, including Blender (Vaughan, 2012).

The building blocks of three-dimensional design programmes are *mesh* and *polygon*. Mesh can be defined as a network and polygon as polygons on it. Polygon structure is used during modeling. Polygons consist of quadrilaterals, squares and triangles (Figure 6-7).

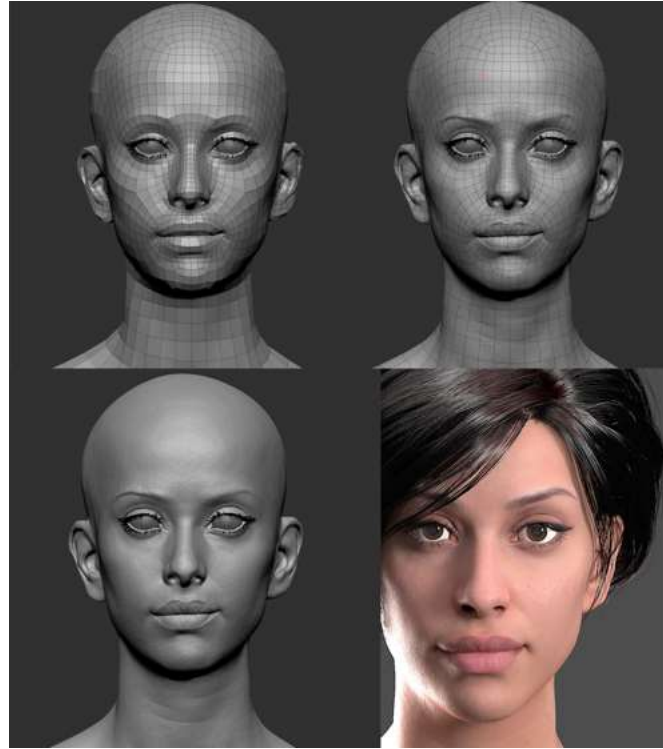


Figure 6. A realistic 3D Model with polygonal structure (Fokin, 2016).



Figure 7. 3D Model with polygonal structure (Erdoğan, Art Station, 2022)

The number of polygons on a three-dimensional modeling made for Mobile Games should be as low as possible (*Low poly*) (Figure 8). As the number of polygons used increases, the detail ratio of the character also increases. This increases the rendering time and is not preferred in mobile games because it requires a high processor.

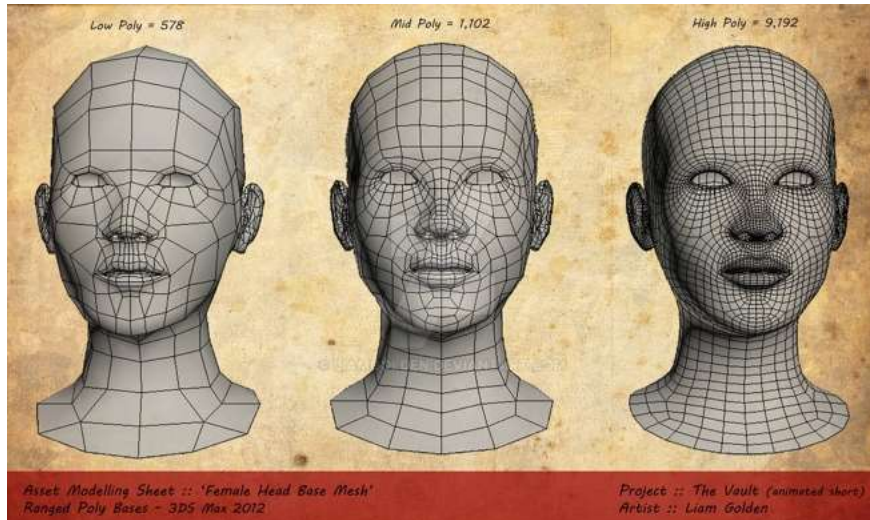


Figure 8. Low and high polygons from left to right (Golden, 2012).

For production work, character modeling is usually carried out using higher polygon (high poly) numbers.

Characters modelled in detail using high polygon numbers are processed by reducing the polygon numbers while preparing them for use in game engines. The UV map (UV Mapping) is created in order to perform the texture operations of the character whose modeling is completed. (Figure 9-10)



Figure 9. Left UV Map & Right Texture of the 3D Character, (Erdoğan, Art Station, 2022).

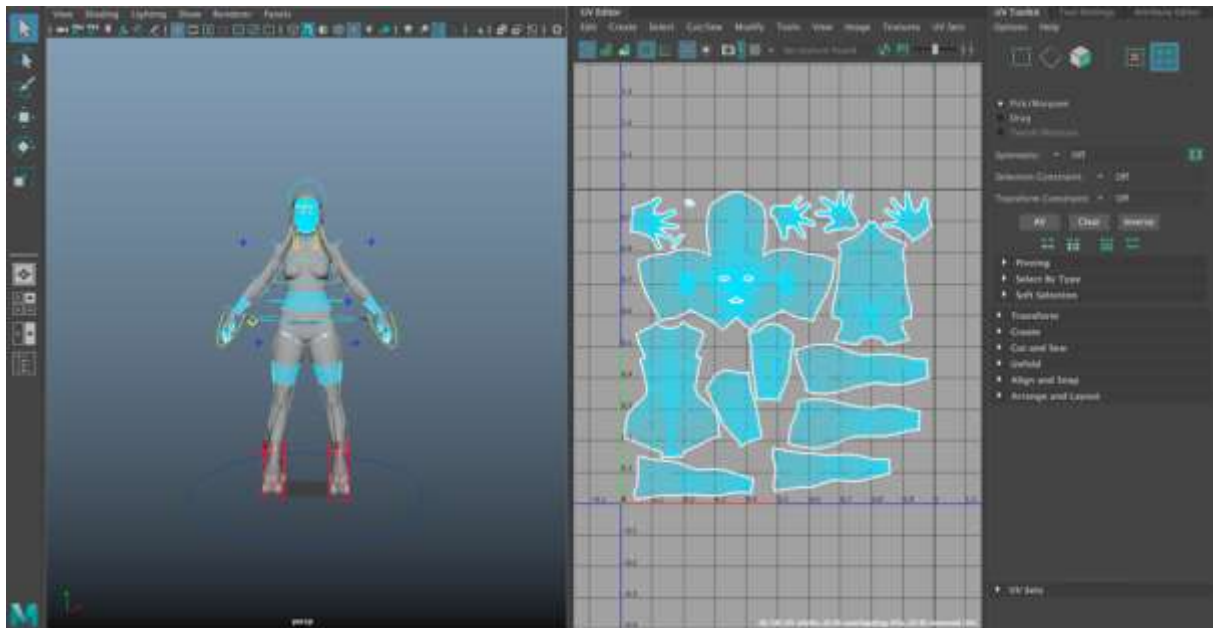


Figure 10. UV Unwrapping, (Erdoğan, Art Station, 2022)

Basic 3D Character Modeling Process for Games

3D character modeling is continued sculpting process after the concept design is created. At this stage, the details of the character are created, usually starting from a sphere, the character is modelled. Again, the character's garment, hair and other accessories, if any, are created. After the sculpting process is finished, the retopology process is started to recreate the topology of the character (Figure 12). In this way, the character is provided with a clean topology for future rig and animation processes. If necessary, skin details can be made on the character. In addition, if more details are to be added to the character, this process can be done from high poly texture resolution to low poly texture resolution (Figure 13). This process is called High to Low Poly Texture Baking.

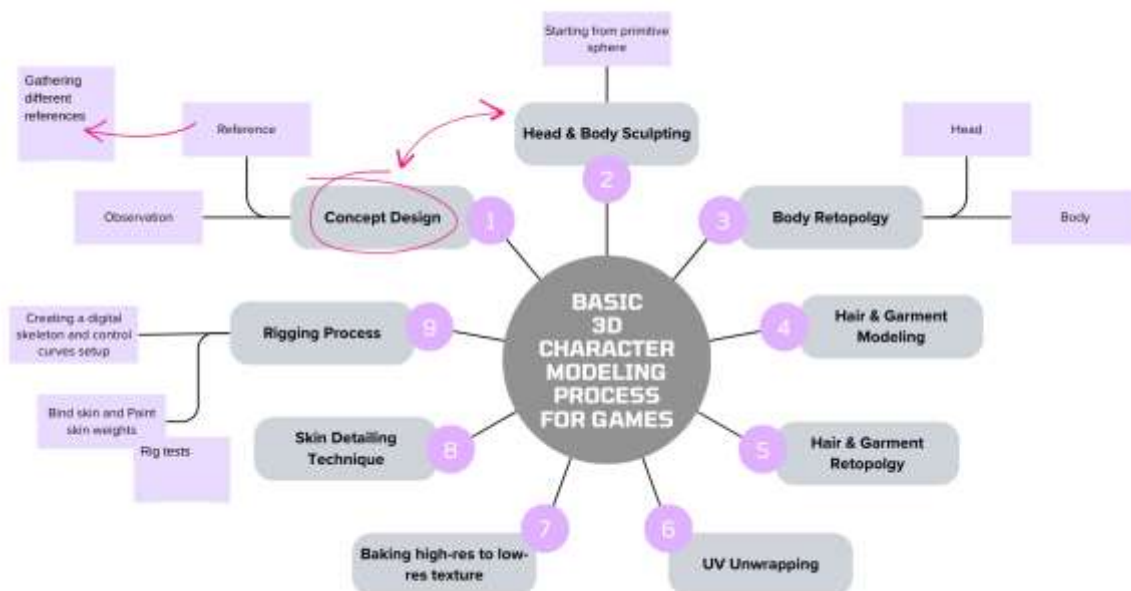


Figure 11. Basic 3D Character Modeling Process for Games.



Figure 12. Head and Body Retopology (Erdoğan, Art Station, 2022).

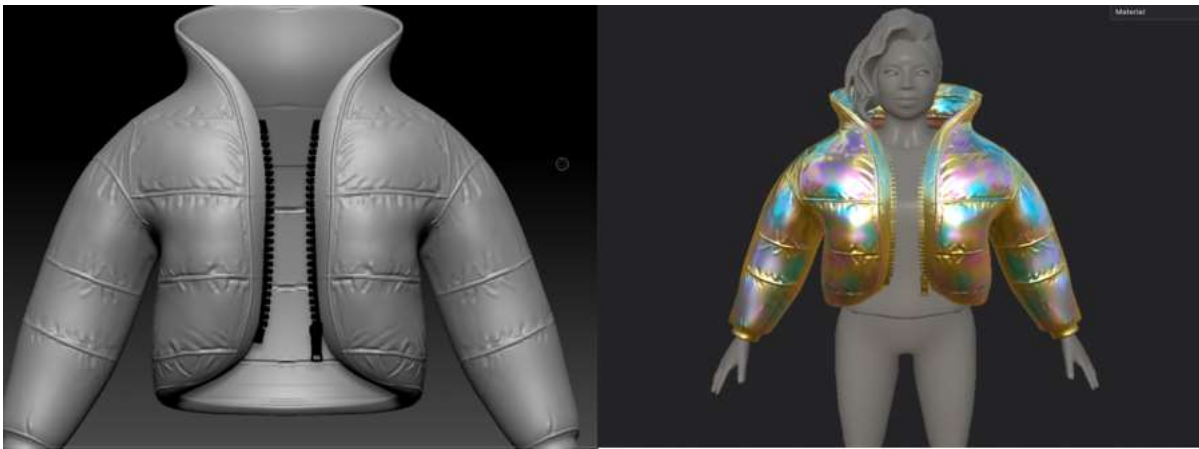


Figure 13. 3D Character Puffer Coat, adding details and baking high resolution texture to low resolution texture (Erdoğan, Art Station, 2022).

The completed character is sent to the person who builds the skeleton system *rigger* in order to create the skeleton system and control curves required for the character to move (Figure 13).

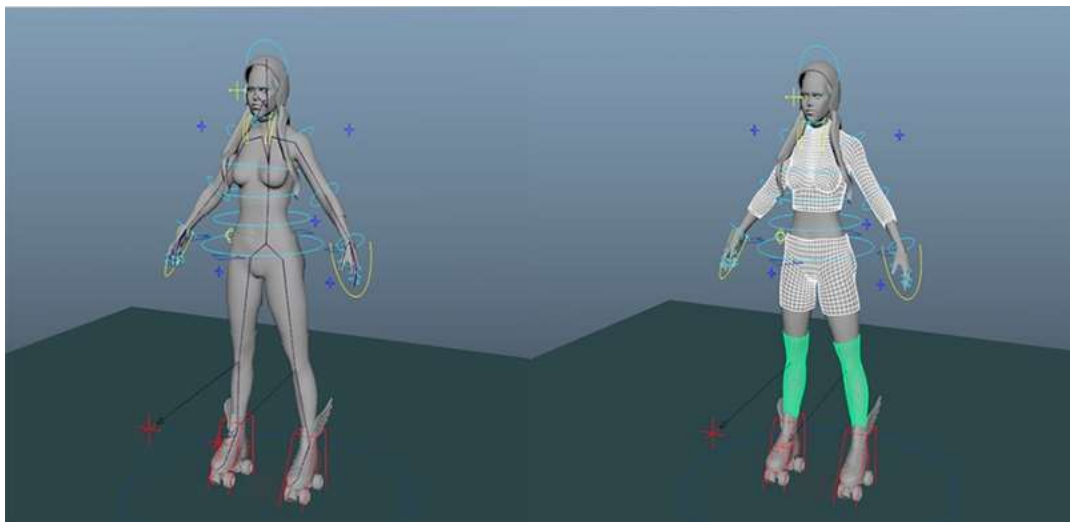


Figure 14. 3D Character Rig, (Erdoğan, Art Station, 2022).

In order for the character to be rigged, the model must be in A (*relaxed*) or T pose. Thanks to these poses, creating the skeletal system of the character gives more accurate and practical results. In the modeling and animation phase, the A-pose is especially used to emphasise the joint movements and

anatomical structure of the character (Figure 14). The character designer usually decides which pose to choose. Since the character's arms are extended to the sides and the joint movements can be used more realistically and naturally, the A-pose sometimes gives better results than the T-pose.



Figure 15. 3D Sculpting Character A-pose (Relaxed pose), (Erdoğan, Art Station, 2022).

CONCLUSION

In this research, in which three-dimensional character design in mobile games is examined, the development of three-dimensional character design in mobile games is explained and the technology of these designs made with today's technology is tried to be given.

Today, the number of resources related to three-dimensional character design for games is limited. Digital tools that can be used thanks to rapidly developing technology have paved the way for a wide variety of productions today. Character design, which is one of the most important elements that ensure the success of a digital game, goes through a long and challenging production phase. All qualities of the character should work together harmoniously; body, clothes, voice, animations, facial expressions and other features should all be suitable for each other. In addition to all these technical details, character design in games is developed by designing models with different features for different users and models that they can identify with themselves.

The rapid development of the game market in Turkey has led to the establishment of game companies and even the support and acquisition of these companies by important foreign game companies. For mobile games that are in demand, it is necessary to create the infrastructure of the games by programming the games and adding design elements.

With the use of the developing three-dimensional technology in game production, the increase in visual effect has taken the game experience to a completely different dimension.

Undoubtedly, the importance of visuality in games is very important in terms of increasing the demand for them and the pleasure they will give to the player. For this reason, especially three-dimensional character design is in an important position. Three-dimensional character modeling is finalized by going through many stages. In order for the created model to function correctly, it is imperative to use detailed and accurate techniques in the modeling part. At the slightest error, the model cannot move, the labour and budget spent are wasted.

If an effective character is to be designed, graphic design elements and principles must be utilised. In this way, the character will be original and compatible with the story.

Among the most frequently used basic design elements; colour, texture, form, ratio-proportion, movement etc. are the most common. In the designed character, these principles and elements allow the character and story to be told more effectively and remarkably.

Digital game and graphic design disciplines integrate in the field of design and modeling. Three-dimensional character design is often used in the general framework to tell stories, convey emotions or create a certain atmosphere, while graphic design is among the methods used to express information effectively. In this way, both disciplines are used as visual tools to influence the audience and convey a specific message.

Mobile games usually have low hardware specifications. For this reason, performance is affected by three-dimensional character design and other graphical elements. At this point, it is very important to provide optimum design quality without compromising the required visual fidelity.

When evaluated through the consumption process, players discovering and downloading the game are important steps for the survival, marketing and promotion of a game. Designing three-dimensional, original, attractive and unique characters contributes to the marketing phase of the game and provides significant benefits in reaching more users. In addition, if the characters are compatible with the corporate identity, the game appears more recognisable to the masses. However, it is not enough for the characters to reflect the brand. The quality, playability, enjoyment and budget of the game are other factors that greatly affect players' choices. As a result, even if character design is important for the success of a game, it will give more accurate results to be evaluated together with various other factors such as budget, playability, etc. that affect the overall game experience.

As a result, mobile games touch all areas of life and reveal their power in terms of reaching people of all ages. Thanks to its easy access, it has been experienced more frequently by large masses. This demand creates the ground for the emergence of new and more advanced character designs and shows that its contribution to the field will increase even more.

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