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The Future Of The Moving Image: Virtual Production Technology

Hareketli Görüntünün Geleceği: Sanal Prodüksiyon Teknolojisi

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Abstract
The moving image production process is based on the universal rules of physical science, sensitive to technological innovations, and focused on the viewer experience. The opportunities created through new technologies in the television and cinema industry transform production practices by forcing production companies to be sensitive to technology. Virtual production technology is recognised as one of the groundbreaking innovations in moving image production and is used by production companies in various ways. The technology in question includes innovative production models such as the creation of virtual universes for the realisation of productions, the use of backgrounds consisting of LED screens, and the possibility of simultaneous rendering. The fact that game engines such as Unity and Unreal Engine are involved in the moving image production process and offer the possibility of simultaneous rendering blurs the boundaries between traditional production and post-production stages. In addition to global developments in virtual production technology, production companies operating in Turkey are also focusing on the subject and realising pioneering initiatives. This study has been conducted to discuss the potential of virtual production technology in Turkey. For this purpose, The *Prince Series*, which is one of the first productions to use virtual production technology in Turkey, was analysed technically by content analysis method. It was concluded that the virtual production technology used in the series eliminates time-space dependency, is an important alternative to green screen and blue screen technologies and makes significant contributions to the production process in terms of actor management, image management and art management. It is predicted that virtual production technology will become accessible to independent producers in Turkey in time and can be integrated into all stages of moving image production.

Keywords: Virtual Production, Moving Image, Real-Time Render, Prince Series

Özet

Hareketli görüntü üretim süreci fizik biliminin evrensel kurallarına bağlı, teknolojik yeniliklere duyarlı, izleyici deneyimine odaklanan bir yapıya sahiptir. Televizyon ve sinema endüstrisinde yeni teknolojiler aracılığıyla oluşan fırsatlar, yapım şirketlerini teknolojiye duyarlı olmaya zorlayarak üretim pratiklerini dönüştürmektedir. Sanal prodüksiyon teknolojisi hareketli görüntü üretiminde önemli yeniliklerden biri olarak kabul edilmekte, yapım şirketleri tarafından çeşitli biçimlerde kullanılmaktadır. Söz konusu teknoloji, yapımların gerçekleştirilmesi için sanal evrenler oluşturulması, LED ekrandan oluşan arka planların kullanılması, eş zamanlı render olanağı sunması gibi yenilikçi üretim modellerini kapsamaktadır. Unity ve Unreal Engine gibi oyun motorlarının hareketli görüntü üretim sürecine dahil olarak eş zamanlı render imkânı sunması, geleneksel yapım ve yapım sonrası aşamaları arasındaki sınırları muğlaklaştırmaktadır. Sanal prodüksiyon teknolojisindeki küresel gelişmelere ek olarak Türkiye'de faaliyet gösteren yapım şirketleri de konuya odaklanmakta, öncü girişimler gerçekleştirmektedir. Çalışma, sanal prodüksiyon teknolojisinin Türkiye'deki potansiyelini tartışmaya açmak amacıyla gerçekleştirilmiştir. Bu amaç doğrultusunda sanal prodüksiyon teknolojisini Türkiye'de ilk kullanan yapımlardan biri olan *Prens Dizisi* içerik analizi yöntemiyle teknik açıdan incelenmiştir. Dizide kullanılan sanal prodüksiyon teknolojisinin zaman-mekân bağlılığını ortadan kaldırdığı, yeşil perde ve mavi perde teknolojilerine güçlü bir alternatif olduğu, oyuncu yönetimi, görüntü yönetimi, sanat yönetimi açısından üretim sürecine önemli katkılar sunduğu sonucuna varılmıştır. Sanal prodüksiyon teknolojisinin zamanla Türkiye'de bağımsız yapımcılar için de erişilebilir hâle geleceği, hareketli görüntü üretiminin tüm aşamalarına entegre edilebileceğine dair öngörüler sunulmuştur.

Anahtar Kelimeler: *Sanal Prodüksiyon, Hareketli Görüntü, Eş Zamanlı Render, Prens Dizisi*

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Introduction

Since the early days of moving image recording, the process of image production has been directly related to the positive sciences, especially physics. The technical stages of moving image production are undoubtedly based on technological innovations that utilise the universal rules and well-established theories of physical science. In order to comprehend the close relationship between series and film production and technological innovations, it is enough to compare the first films in the history of cinema with contemporary films. Undoubtedly, this is a comparison whose outcome is obvious, but the process of TV series and film production involves not only technical development processes, but also processes in which the narrative is reconstructed.

With the film *Avatar* (Cameron, 2009), which is accepted as an important turning point in terms of technological development in the series and film industry, the effect of technological transformations has become visible and contemporary production practices have been redefined. Undoubtedly, the team that produced the film aimed to bring the audience experience to the top by applying many innovative technologies. The film, which succeeded in this sense, has become known for its technical elements. The technological innovations in the production processes of the film have been described as far ahead of its period when compared to traditional forms of production. Following the film *Avatar*, important productions such as *The Lion King* (Favreau, 2019a) and *The Mandalorian* (Favreau, 2019b) also aimed to use new technologies by making technological breakthroughs. Virtual production technology, which is one of the innovations in question and which is predicted to replace green screen and blue screen technologies, has started to play an active role in the production processes of series and films.

The most important goal of these transformations in the series and film sectors has been to bring the audience experience to the top. The global TV series and film production process has undergone significant narrative and technical transformations. The aim of the research is to shed light on the use of virtual production technology in Turkey in relation to these technical transformations. The first trials of the technology applied in Turkey by MGX Film were successfully carried out, and the first productions were produced and met with the audience. In the research, the *Prince Series* (İşbilen & Uslu, 2023), which is one of these productions, was analysed technically by using the content analysis method.

In order to carry out the analyses, technical elements were divided into categories and subcategories and a coding table was created. As a result of these analyses, it was determined that the use of virtual production technology in cinema-television productions offers significant advantages. In the research, it was determined that virtual production technology eliminates the time and place dependency in shooting and offers convenience to the production team in many ways. It has been observed that technologies such as green screen or blue screen eliminate the high lighting costs, provide simultaneous rendering through game engines, and create realistic space depictions during the shooting process.

It has been observed that it eliminates the sharp boundaries between production and post-production processes with the possibility of simultaneous rendering. In this way, it has been determined that many of the post-production processes that take a long time can be realised during the production process. Although this situation prolongs the preliminary preparation process, it is thought to have a positive effect on stage performance for actors compared to technologies such as green screen or blue screen. It has been found that virtual production technology allows game engines such as Unity and Unreal Engine to play an active role in series and film production, leading to a sectoral expansion.

1. Virtual Production (VP) Technology Overview

Since the beginning of moving image recording, various experiments have been carried out by filmmakers such as Georges Méliès and Eadweard Muybridge, trying to create illusions and make the viewing experience more effective. Back and front projection techniques were used by leading directors of cinema such as Hitchock and Kubrick, and the technological experience was tried to be carried forward. According to Etherawe (2023), in the film *2001: A Space Odyssey* directed by Stanley Kubrick (1968), virtual production experiments were made in some scenes, and the first experiments that could be related to virtual production technology were carried out with front-back projection techniques. Director Stanley Kubrick faced logistical difficulties in shooting a scene set in a remote corner of Southwest Africa and managed to shoot the scenes by projecting the locations he wanted to show on the back wall in a studio. Although this technique, known as front projection, was not entirely new, it inspired future filmmakers.

According to Kuchelmeister (2020), especially since the 1990s, real-time computer graphics have made significant progress in narrative filmmaking, and the use of simultaneous 3D computer graphics accelerated after the 2000s. Thanks to the emergence of a computer-aided production process, directors, freed from physical and temporal limitations, are now able to produce scenes that were previously impossible or very expensive to produce. In the past, in order to create physical reality in the processes in question, the big work was left to the post-production process, but the virtual production technique has completely shaken these production models and started to combine the production and post-production process (Eschenbacher, 2018).

Virtual production is an innovative technique that seamlessly combines physical and virtual filmmaking to achieve visually stunning results. Harnessing the power of real-time game engines, the technology is characterised by shooting footage by projecting images onto large LED walls. Virtual production techniques, which make use of real-time rendering possibilities, provide a more immersive and realistic experience to the audience by ensuring the harmonious integration of virtual and physical elements (Etherawe, 2023) Virtual production is a broad concept that refers to film production methods with computer-aided production and visualisation techniques. It combines the traditional structure of the series and film production process with game engine technologies and makes a great contribution to the production process of the scene (Kadner, 2019). Unlike the green screen or blue screen production process, virtual production technology, which provides a high-level experience for both the production team and the audience, enables the film production process and visual arrangements to take place simultaneously while the scene is being shot.

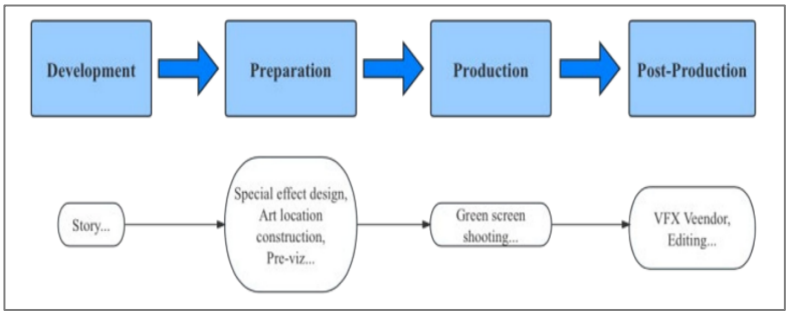
Virtual production (VP) is a computer-aided production and visualisation method, first officially implemented in 2009 in the film *Avatar*, directed by James Cameron. After a decade of development, the concept and technical level of virtual production reached a new dimension in *The Mandalorian Series* in 2019 and *The Lion King* in the same year and had a revolutionary impact on the TV series and film industry (Li et al., 2022). In recent years, virtual production technology has gained popularity in the TV series and film industry due to its various advantages. Producers' demands for faster and cheaper production, innovations in computer hardware and real-time image processing, the globalisation of virtual-enhanced reality, and the need for remote collaboration have forced the series-film production process to transform. Although virtual production technology has affected many departments in the cinema and broadcasting industry, the visual effects department has been one of the most affected (Pires et al., 2022, p. 20). Studies focusing on the spatial effects of virtual technologies in the cinema and television sectors have examined virtual production technology from various angles. In particular, it has been stated that vitual production technology, which makes it possible to blend visual effects and computer

graphics interactively, eliminates the clear boundaries of pre-production, production and post-production stages (Bodini et al., 2024; Ewis et al., 2024, p. 147; Helzle, 2023, p. 575; Brillhart, 2023, p. 33; Ilmaranta, 2020, p. 321; Silva et al., 2024, p. 2530; Shan & Chung, 2022, p. 64; An, 2022; Grau et al., 2017, p. 29)

Although virtual production technology is closely related to many departments in the industry, undoubtedly, one of the fields that has been most affected and has to adapt itself to the technology in question has been the field of director of photography and another one has been the field of visual effects.

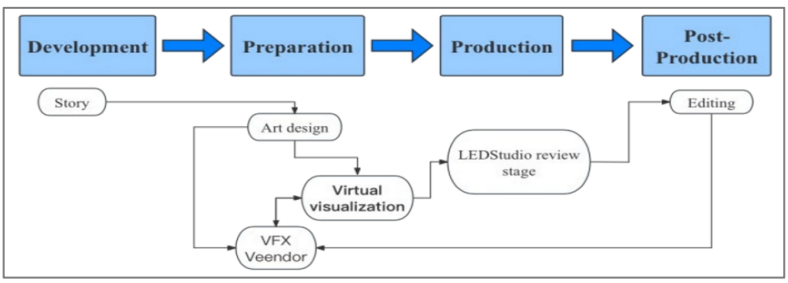
According to Etherawe (2023), virtual production technology moves the costly post-production editing and visual effects processes, which are performed using huge green screens, into the shooting process. This undoubtedly affects the preparation process of cinema-television productions. There is also the advantage of real-time visualisation, allowing producers to imagine with greater accuracy what the final shot will look like before post-production begins. At the same time, the fact that it allows instant background changes without the need to physically relocate the shooting crews, provides logistical convenience thanks to the movement of the ground, and eliminates the concept of time dependent on physical conditions during shooting by providing access to the desired lighting conditions at any time has made virtual production preferable. The differences between virtual production and traditional production processes are explained by Wan (2024) by utilising various studies and presented in the following images.

Figure 1: *Traditional Production Process*



Source: Wan (2024)

Figure 2: *Virtual Production Process*



Source: Wan (2024)

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According to Chanpum (2023, p. 9), in recent years, virtual production technology has been used in many quality series, films and video games, forcing these industries to accept innovations. Thanks to virtual production technology, producers can produce quality productions quickly and cost-effectively. Virtual designs replace real props and costly locations. Although virtual production technology has some technical challenges, research has shown that virtual production has radically changed the traditional production format and process. Virtual production technology undoubtedly has a significant advantage in the production cost and efficiency of productions. Virtual production is a technology with great development potential, and in the future, virtual production will gradually be applied to other fields. This will inspire more and more industries to adopt and develop virtual production.

The ability of productions to reach viewers quickly through video streaming services and to be consumed faster by them has been an important transformation point in the viewing experience. Many practices of traditional broadcasting and viewing experience have changed and a digital cultural transformation has begun. This situation has pushed companies to innovate and respond quickly to the demands of consumers. In the world and in Turkey, studies on topics such as the transformation of the viewing experience, new technologies in moving image production are being carried out, and the scientific literature on the subject is expanding (Božek, 2019, p. 109; Hallaçoğlu, 2021, p. 73; Oakden & Kavakli, 2022, p. 61; Söğütlüler & Aday, 2023, p. 44; Başer & Söğütlüler, 2023).

2. Productions That Stand Out with the Use of Virtual Production Technique

Virtual production technology is a model that aims to carry out the production process by utilising the power of game engines for purposes such as creating unique locations, offering more flexibility to producers, and reducing the use of time and resources. According to information compiled by Swords and Willment from various sources (2024), there are various approaches to virtual production, but three basic production mechanisms stand out among the techniques. The first of these is virtual production with the green screen-blue screen used in *The Jungle Book* (Favreau, 2016) the second is to design and shoot completely virtual universes as in *The Lion King*, and the third is the use of LED screens combined with physical sets and props for actors to perform as in *The Mandalorian*. Important productions such as *The Mandalorian*, *The Lion King* and *The Jungle Book* have laid the foundations of today's virtual production technology by utilising this technology. The film *Avatar* is seen as an important turning point of these technological innovations in the series and film sector.

In the 2009 film *Avatar*, directed by James Cameron, various techniques such as performance capture, real-time rendering, and the use of game engines were used, and a computer-aided cinematographic narrative was created. The production team, who designed a fictional universe hosting various life forms on a planet named Pandora, made the film memorable with its impressive visual effects. Undoubtedly, the film *Avatar* attracted attention with its realistic effects as much as its narrative and took its place in the history of cinema. The film, which brought a new dimension to visual effects and computer-aided moving image production in the history of cinema, has come to represent the modern technological transformation processes in cinema with its innovative structure.

The film *Avatar*, which is considered to be one of the early examples of virtual production techniques, has taken the usual viewing experience in the cinema industry to a different dimension. In the film *Avatar*, a new method called performance capture, which allows actors to

capture their facial expressions and body movements and transfer them to virtual characters, was also used, so that fictional characters could present expressions close to human facial expressions. In this way, the facial expressions of fictional characters were made quite similar to human facial expressions, and it was possible to produce a realistic image. Performance capture, which allows the transfer of human anatomy to digital through motion recognition systems placed at important points on the face and body, has provided a realistic animated film viewing experience (Hurwitz, 2023, p. 43).

According to Prince (2011), the locations of the film *Avatar*, which is one of the important examples of motion and performance capture, also offered a realistic experience to the audience. In Pandora, where the plot of the film takes place, vegetation and objects related to the environments are presented with a high level of realism, and an extremely detailed depiction of space is made. Stating that digital visual effects have become realistic in a way that cannot be separated from real life over time, Prince stated that visual effects challenge realistic film production through the films *Avatar*, *Inception* (Nolan, 2010), *Jurassic Park* (Spielberg, 1993), *Lord of the Rings* (Jackson, 2001), *Ratatouille* (Bird & Pinkava, 2007).

Referring to the 3D structure of the film *Avatar*, Brown (2012, p. 269) stated that although the fact that there is an extra tool between the image and the audience is a negative, it increases the immersion and underlined that the purpose of some scenes in the film is to make the audience admire the technology in which the film is produced. In the cinema and TV series industry, it has been stated by many experts in the field that viewers attach importance to the impressiveness of visuality and thus the viewing experience is carried to a higher level, and academic studies have also been carried out on the subject.

In the history of cinema, various audiovisual approaches have tried to enhance the audience experience, and realistic images with high visual quality have been obtained thanks to the development of narrative elements as well as the developing processing capacity of computers. Innovations such as 3D technology, green screen or blue screen attracted the attention of the audience and encouraged them to watch the productions (Pires et al., 2022, p. 22). In the study conducted by Sun (2022), impressions of 3D animation special effects and ordinary animation special effects, which were considered new for the period, were analysed and two sample groups were compared. As a result of the comparison, statistical significance was found at the level of $t<10.000$, $p< 0.05$, and it was determined that the display of 3D animation special effects was more impressive. The table below shows the results of the comparisons between the animation effect formats performed by Sun (2022, p. 4) on the visual effects of the film.

Table 1: *Expression form and comprehensive analysis wo groups of animation effects*

Expression form analysis of two groups of animation effects (%)			
Group	*Sense of form design*	*Give consideration to scenes and details*	*The layout of all elements*
Ordinary animation special effects	73.45	70.38	70.19
3D animation effects	92.34	93.78	93.27

Comprehensive analysis of two groups of animation effects (%)			
Group	*Preview results of special effects production*	*Visual and auditory effects*	*Audience satisfaction*
Ordinary animation special effects	69.34	74.39	73.67
3D animation effects	93.45	97.23	95.54

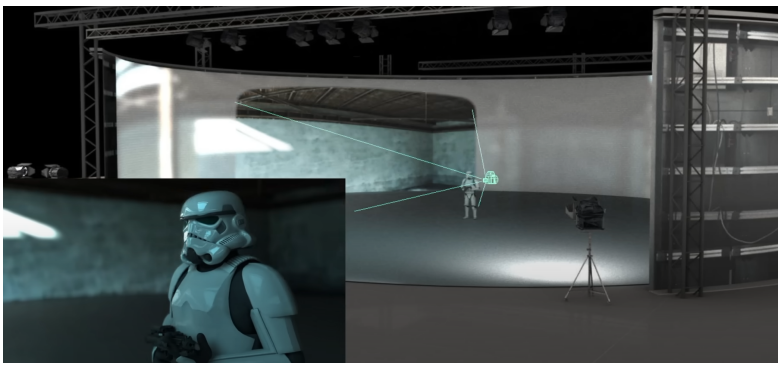
Source: Sun (2022, p. 4)

According to Wan (2024), after the extensive use of virtual production technology in the film *Avatar* in 2009, LED screens were used in *The Mandalorian* series in 2019. Following these productions, the film and television industry has paid more and more attention to virtual forms of production in special effects processes. In this way, it has been realised that new techniques can be boldly experimented with and can be successful. Since *Avatar*, various productions have adapted to virtual production processes based on special effects production and have gained a different structure from the traditional production process. According to Unit (2023), in addition to film and television production, virtual production LED screens has been widely used in commercial shoots, TV stations, studios, live broadcasts, online conferences and other fields.

Following important experiments in the field of moving image production, it is possible to see the virtual production method based on LED screens in *The Mandalorian* series. Released in 2019 by Disney+, the series was realised by showrunner Jon Favreau, executive producer and director Dave Filoni, visual effects supervisor Richard Bluff, cinematographers Greig Fraser and Barry 'Baz' Idoine. The series utilised StageCraft technology, LED walls and virtual production methods. A 20-foot-high, 75-foot-wide, 270-degree LED video wall provided the actors with a performance space approximately 23 metres in diameter (Unit, 2023; ILM, 2020). According to Pires et al. (2022), virtual production technology has been used with various techniques in productions such as *Harry Potter* (Columbus, 2001), *Jurassic World* (Trevorrow, 2015), *Transformers* (Bay, 2007), *Star Wars* (Lucas et al., 1977), *Life of Pi* (Lee, 2012), *Pirates of the Caribbean* (Verbinski, 2003), *Bohemian Rhapsody* (Singer, 2018).

The virtual production technology used in *The Mandalorian* refers to a process designed through Epic Games' Unreal Engine 4, a game engine, in which the background of the action taking place on location is projected onto LED walls. More than 50 per cent of the first season of *The Mandalorian* was shot using virtual production, virtually eliminating the need for outdoor filming. Digital 3D environments created by ILM were played interactively on LED screens surrounding the action, simultaneously organising the visual structure during the shoot. The technology enabled high-resolution pixel precision through computerised systems powered by NVIDIA GPUs, enabling the creation of perspective-accurate 3D images. The image below is important in terms of showing the simultaneous rendering process by Industrial Light & Magic (ILM, 2023).

Figure 3: *Real-Time Rendering and Virtual Production Studio*



Source: ILM (2023)

Virtual production technology, which uses real-time 3D computer graphics, virtual camera systems and motion capture technologies, has had a major impact on the traditional production models of the cinema industry over time (Bennett & Carter, 2014). This technology was developed and used in *The Lion King*, which was shot by Jon Favreau again in 2019. According to Bédard (2022, p. 226), *The Lion King* is a special production in which the virtual production technique and the changes in the use of camera in the context of this technique will be seen.

Virtual production technology enabled *The Lion King* to achieve the desired cinematic realism by making the film similar to nature documentaries. The virtual camera presented the realistic landscape to the audience and built in the minds of the audience the pleasure of observing animals in their natural habitat. Virtual production technology enabled the audience to interact with realistic-looking characters and contributed to the creation of immersive spaces. Through realistic landscapes, animals and camera movements, the director successfully applied the technique in question, transforming the film into a nature documentary (Golotov, 2022, p. 159).

According to Cofer et al. (2018), in the film *Ready Player One* directed by Steven Spielberg, virtual production technology was used by Industrial Light & Magic and Digital Domain teams, and a large virtual universe known as OASIS was designed. The technology in question has been described as a revolution in the cinema and TV series industry, and the use of virtual production continued rapidly after the this productions that laid the foundations of the technology.

3. Methodology

According to Bordwell, Thompson & Smith (2010), films and TV series are works of art presented with a unique language and aesthetic structure. It consists of a combination of various elements and is considered as an advanced form of art due to this structure. According to Nelmes (2012), the unique narrative forms of films require examination from various aspects, film interpretation and analysis methods examine how a text can be understood in different ways. In terms of narrative and technical aspects, cinema and television productions are examined within the framework of the concept of genre, it is stated that the narrative language of each genre should be emphasised in the analysis.

According to Villarejo (2013), the narrative presented on screen is structured like a language. Sequences or films, which are composed of basic units called shots, aim to combine scenes obtained in larger sequences through a fictional process, just as words become sentences. As

cinema enters its second century, film studies faces two questions. The first question is whether film studies should be studied through the methods of visual arts, media studies, social sciences and humanities; the second question is whether it should be studied through disciplines such as anthropology, sociology and psychology, which offer a broader perspective. The answer to these questions lies in understanding the uniqueness and social role of films that are presented to audiences through the increasingly digitalised field and different platforms. Although it is difficult to find a clear answer to these questions, each field focuses on films through its own perspective. At this point, while methodological differences are encountered, it is seen that analyses focusing on productions in the field of communication sciences frequently use the content analysis method.

Content analyses are divided into two different forms, qualitative and quantitative. These two methods differ in the way they create categories, apply them to the data and analyse the data obtained. Qualitative content analysis is one of the many qualitative methods used to analyse textual data and uses a hermeneutic perspective, including techniques such as narrative analysis, interpretation, and contextualisation (Sandelowski, 1991, p. 162; Sandelowski & Barroso, 2023; Forman & Damschroder, 2007). According to Krippendorf (2018), content analysis has a history of over seventy years and is an empirically grounded method. The method, which is exploratory, predictive and inferential as a process, is similar to the structural features of language. Although it is similar to empirical research in various aspects, the materials used by the qualitative content analysis method are different. Unlike researchers using empirical techniques, qualitative content analysts analyse data, printed materials, images or sounds, what they mean to people, and how the messages conveyed are constructed. These are questions that naturalistic researchers cannot answer directly and are generally insensitive to quantitative research methods. For this reason, contemporary content analysis focuses on the elements such as symbols, content and messages presented by the mass media and the relationship between these elements and society.

Content analysis is a highly flexible research method widely used in social sciences with different research goals and objectives. The research method is applied with qualitative, quantitative and sometimes mixed methods and uses various analytical techniques to create and contextualise the findings (Weber, 1990; Sandelowski, 1991, p. 162; Krippendorff, 2018; Collier, 2001). Visual materials have an important place among the data that can be used for content analysis studies, and these materials are very important research objects for anthropology, sociology, psychology and communication sciences, which are the leading fields of social sciences (White et al., 2006; Bell, 2001; Collier, 2001). Content analyses on cinema and TV series also benefit from the visual-based part of content analysis as a methodological basis. Based on these views, the thematic content analysis method was used in the research.

The study aims to analyse the use of virtual production technology in Turkey through the *Prince Series*, one of the first productions. The secondary aim of the study is to discuss the potential of this technology to shape the process of TV series and film production in Turkey. In the study, The Prince Series, which has been broadcasted on BluTV and TV+ and has been popular especially among young generations recently, has been selected as a sample. The aim of the study is to analyse the series from a technical point of view by using content analysis, focusing on the virtual production process based on the use of LED screen. Since the series depicts a historical period and art direction processes are challenging, virtual production technology was utilised and successfully applied to the field. Categories were created in the content analysis of the series. These categories are cinematography, production design, visual effects, editing, and sound-music. The table containing the main categories and sub-categories is presented below. This classification is based on similar studies in the literature (Khoury at al., 2019; Neuendorf et al.,

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2010; Bullerjahn & Güldenring, 1994; Johnson & Holmes, 2009; Walker et al., 2013; Söğütlüler, 2024).

Table 2: *Coding Table for Technical Content Analysis*

Cinematography	Production Design	Visual Effects	Editing	Sound and Music
Camera Angle and Movement	Arts Management	Digital Structure	Editing Rhythm	Sound Design
Framing	Set Design	Camera Tracking Systems	Types of Transition	Music
Lighting	Space	Real-Time Rendering	Manipulation of Time and	Sound Effects
Colour	Costume	Reality and Immersion	Space Continuum	Sound Usage Patterns

The number of productions shot with virtual production method, which is an important technology in the recent cinema and broadcasting sector, is increasing rapidly. In this study, virtual production technology is discussed in the context of shooting the backgrounds of scenes that are difficult or impossible to shoot by transferring them to LED screens with the help of visual effects based on computers. This technology has been applied by MGX Film Company in Turkey and various productions have been produced. Since this innovation is a pioneer in the Turkish cinema and TV series sector, it was thought that it should be the subject of research in the academic field and in this respect, the study was deemed important. In writing the Findings and Comments section, both the *Prince Series* (2023) broadcast by BluTV and the *Making of Prince* (2024) documentary on how the production was realised were used. The research was limited to the *Prince Series* and explained the assumptions that virtual production technology makes important contributions to the production processes and will play an important role in the moving image production process.

4. Findings and Discussion

BluTV, a subsidiary of Doğan Holding, is an SVOD (Subscription Video On Demand) platform that offers video streaming services to its subscribers whenever they wish. The platform is important in terms of being Turkey's local SVOD platform and shapes viewing trends in the social sphere. According to JustWatch (2024), BluTV, which offers original and purchased content to its subscribers, is one of the platforms with high viewership rates in Turkey along with global video streaming services. TV+, on the other hand, is a video streaming platform offered by Turkcell. The *Prince Series*, which constitutes the sample of the study, was broadcasted in Turkey by these two platforms and reached a wide audience, especially among young generations.

Set in the fictitious Kingdom of Bongomia in medieval Europe, The *Prince* is a comedy series that presents a period narrative. The series tells the events that develop in the kingdom under the threat of the Hungarian Empire, with the decision of war by King Thun. In this process, Giray Altınok, who plays the leading role of the series as the *Prince* character, is both the author of the series and the character who applies the comedy element to the series. In the series, criticisms against the social class and hierarchical order are presented together with the comedy element, while the characters other than the *Prince* character are presented as individuals who maintain the order. *The Prince* character, who also constitutes a point of opposition to the system, reinforces the comedy element by criticising the hierarchical and social class system from various aspects.

The *Prince* is an important series in terms of presenting a period narrative and experimenting with new techniques in the Turkish cinema and broadcasting industry. In the first season, Giray Altınok (Prince), Ceyda Düvenci (Queen Sion), Aslı Tandoğan (Anarkhia), Serdar Orçin (Kalesh), Çağdaş Onur Öztürk (Thenio) took part in the series as the main characters. The series was directed by Gökdeniz Uzlu.

The *Prince Series* is undoubtedly of particular technical importance for the Turkish broadcasting and cinema sector. The technical importance of the series stems from the fact that it utilises a technology called virtual production, which is explained in the theoretical section. MGX Film, which introduces itself as Turkey's first virtual production studio, has implemented a film and a series project using this technology. MGX, an Istanbul-based production company, aims to bridge the gap between the real world and the LED screen, combining traditional and innovative cinematographic techniques. MGX is a leading production company in Turkey with its high-tech equipment and production systems. The company works in coordination with important companies such as Unilumin, Brompton Technology, Disguise, Mo-Sys, OptiTrack, Unreal Engine and Nvidia to carry out virtual production processes (MGX, 2024). In the study, the series is analysed under the main title of technical structure. In order to carry out the analyses, the content analysis method described in the theoretical section was used and a coding table was created. The table was presented in the methodology section and the analyses were made from this perspective.

4.1. Cinematographic Elements

The *Prince Series* uses the virtual production technique in an important part of the film and this technology has various advantages compared to green screen or blue screen technology. In chroma key processes, it is difficult for filmmakers to establish the relationship between the object and the ground and to carry out shooting processes with multiple moving cameras. The virtual production system is a system built on a large LED screen that extends from the top to the ground and has a certain ovality and a movable floor. In order to realise the shots with general scales in the series, the ground must also have a decoration in harmony with the theme on the LED screen. For this reason, it is seen that Medium Close-Up (MCU), Medium Shot (MS), Long Shot (LS), Wide Shot (WS) scales are widely used, especially in the first episodes of the *Prince Series*.
The camera avoids sudden movements that may disturb the audience and disrupt their concentration, in line with traditional narrative patterns. Fixed shots or panning movements are predominantly seen. In terms of lighting, virtual production technology was utilised and lighting suitable for the narrative structure was applied. The visuals below are important for showing the set environment during the production process of the series.

Figure 4: *Behind the scenes of the Prince Series*

Source: BluTV (2024)

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LED screens used in virtual production technology reflect the light conditions of the environment spontaneously during the shooting process of the scene and thus provide convenience to the cinematographer. This method was used in the series, and in addition to the light and colour tone of the LED screen, conventional lighting and colouring techniques were applied through modern lighting systems such as Kino Flo Diva-Lite 21. Cold and warm colour tones were used appropriately according to the structure of the scenes. In the scenes where candle flame is used in lighting, warm tones are dominant in addition to dim lighting in order to depict a natural environment, while cold colour tones dominate in the general structure.

4.2. Production Design

The *Prince Series* is a period narrative set in the Middle Ages. The art management of the series, which reflects medieval Europe, undoubtedly undertakes a very challenging task. Objects and decoration elements in the spaces used must be related to the period. It is seen that the art management team of the series attaches importance to the preparation phase, including a historical analysis process. In the series, which was undertaken by Reza Himmeti as the general art director and Seher Dut as the art director, set designs related to the period narrative were created, and a significant time and financial loss was prevented by using virtual production technology in the backgrounds.

Details and objects are undoubtedly of great importance in the stage atmosphere, which is organised to reflect medieval Europe. In all the space arrangements designed to increase the realism of the production and to distract the audience from an artificial perception of reality, the art management has gone through long preparation stages. Objects reflecting the period conditions were produced in the spaces, and the art management realised new spatial designs from time to time with a meticulous preparation process. 3D printer technology was also used in various stages of the series' costumes and jewellery, and various new technologies were used instead of producing cinematic reality only with virtual production technology (BluTV, 2024).

Figure 5: *LED screen and platform*

Source: BluTV (2024)

Thanks to the virtual production technology, which offers real-time rendering, the cinematographer was also provided with great convenience, and the idea of how the scenes would

be before entering the post-production process of the production was presented through the technology in question. This situation also enabled the actors to understand and play the dynamics of the story more effectively. The actors, who had to perform in front of walls coloured with only two colours in green screen or blue screen technology, had a wider knowledge about the structure of the spaces. In this way, both the acting experience was enhanced, and the production process was carried out with an immersive reality environment offered by high quality LED technology. The image above is important to show the LED screen and platform.

4.3. Visual Effects

One of the prominent elements of the series was undoubtedly the way visual effects were applied. Most of the series was produced with the virtual projection technology that offers simultaneous rendering. For this reason, it was possible to see that the visual effects and the shooting process were synchronised from time to time. The green or blue screen technology, which is used to reduce costs and time spent in big budget productions in the cinema and TV series sector, was realised through virtual production technology in the *Prince* series. In this way, it is often not necessary to build costly backgrounds. The *Prince Series* is an example of the answer to the question 'is virtual production replacing green screen or blue screen technology?' in Turkey in terms of visual effects.

The integration of long post-production processes in green screen or blue screen technology into the production phase has brought many advantages. The burden of traditional computer-aided post-production processes has been reduced in the virtual production process, which allows the design of both a real and a digital cinematic universe. The *Prince Series*, in which CGI technologies were used effectively, also included the scaling and incorporation of scenes into the series through the Unreal Engine game engine.

Figure 6: *The harbour image in the series where 3D modelling processes were carried out*

Source: BluTV (2024)

Although virtual production technology provides convenience to producers in many areas, it requires a long preparation process and expertise, which is considered as a disadvantage. In the series, virtual camera and real camera were paired through virtual production technology, and the parallax effect could be applied by transferring the camera movements to the digital environment. In this respect, the series became a pioneer in Turkey and proved that a new production process is possible. In some scenes, photogrammetry method was used to carry out modelling processes through photographs, and sometimes 3D models were designed from scratch.

4.4. Editing

When the fictional techniques of the *Prince Series* were analysed, it was observed that the cutting transition type was the predominant transition type. It was seen that the fictional structure of the series was related to narrative patterns, and fictional transition types other than cutting were not preferred in dialogues and scene transitions.

It was observed that the editing process was carried out in a way to support the rhythm and narrative structure of the series, and at the same time, rhythmic fictional transitions were made in scenes where music was at the forefront. The use of virtual production technology in a significant part of the production process had a positive effect on the post-production stages. The fictional process technically coincides with the narrative structure, and in some parts of the series, rhythm is organised through transitions.

4.5. Sound and Music

When the *Prince Series* is analysed in terms of sound and music, it is seen that ambient sounds and music suitable for the scenes are used. From time to time, rhythms known by the audience are presented through new covers in the series and it is aimed to create a musical effect by increasing the dynamism of the scenes.

In most of the series, it is seen that dialogues and sound effects are related to the environment and attention is paid to synchronization and rhythmic transitions during the editing process. In scenes where it is desired to increase the tension element and attract the viewer's attention, harmonious sound effects are used and music is brought to the forefront from time to time. It was observed that a sound and music process related to traditional narrative patterns was carried out throughout the series.

Conclusion

Moving image production has been closely related to positive sciences since the first image recording was achieved and has found expression as an impressive harmony of art and technology. Narrative and technical transformations in film and TV series production have made a place in history as elements that increase the viewing experience. The narrative and technical innovations in the field of film and TV series, especially after the 2000s, have necessitated a change in the face of scientific research on the subject.

The new moving image production industry, which replaces conventional forms of production and consumption and interacts with the concept of digitalisation, has entered a new technological transformation process since the first quarter of the 2000s. The film *Avatar*, which met with the audience in 2009, had an impact on these transformation processes, and many innovations were tried and brought the film to the forefront. Computer interaction processes in the film and TV series industry paved the way for the emergence of technologies such as green screen and blue screen technologies and eliminated the spatial and temporal limitations of conventional production forms. Technologies that allow the actors to be placed in the desired areas

independently of space and time, thus making the time-space element, which is important in terms of moving image production, independent, have left their mark on the production process.

Technological developments such as green screen and blue screen technologies, which provide convenience to producers in terms of time and cost, have continued unabated, and virtual production technology, which is frequently mentioned today, has been introduced as an important innovation in the moving image production sector. Virtual production technology, which is used for technical processes such as the creation of backgrounds through LED screens placed to cover the back of the stage, as in the form discussed in this study, has required co-operation with technologies used in various fields. Virtual production technology, for example, has enabled game engines such as Unreal Engine to collaborate with the film and TV series industry.

In the past, the boundaries between the main production stages of TV series and film production have disappeared and especially the production process and the post-production stage have become very close to each other. Through virtual production technology, the large cost items involved in the production and post-production stages have been minimised, and at the same time, the viewing experience has been taken to the highest level. Although it undoubtedly involves discussions on realistic cinema and series production, virtual production technology will serve the moving image production process by covering an important area of use in the future.

In this study, the *Prince Series*, which is one of the first examples of virtual production technology in Turkey, was analysed in terms of technical structure using content analysis method. In the examination of the series shot by MGX Film, technical elements were divided into main categories and subcategories by considering the scientific literature. In the study, the form of virtual production technology based on LED screens, which combines real and virtual environment, is discussed. It has been concluded that the virtual production technology used in a significant part of the *Prince Series* provides advantages to the producers and actors in many ways.

One of these advantages was that, unlike green screen or blue screen technology, the actors of the series could predict what kind of background the scene in which the play took place would have. In this way, various technical elements that are sometimes technically difficult to implement, such as the actors' ability to determine the direction of gaze, could be easily determined. At the same time, the need for careful application of background lighting in green screen and blue screen technologies has been eliminated.

In green screen and blue screen technologies production, the shadows of actors or various objects in the background cause a tonal difference. This makes it difficult to perform the chroma key process and requires time-consuming design of the production process and post-production phase. In the virtual production technology applied in the *Prince Series*, the background does not need high illumination, and the light beams reflected from the LED panels, reflecting the environment in which the series and film will be staged, fall on the stage. Therefore, this situation also benefited the lighting and enabled the light of LED screens to be used as a production element.

It has been observed that the virtual production technology used in the *Prince Series* also saves producers from time-consuming and costly tasks such as building large sets or producing objects to be used in the background. In the research, it was concluded that the virtual production technology used in the series, which is one of the first experiments in Turkey, makes significant contributions to the production and post-production process. It is predicted that virtual production technology, especially in terms of actor management, visual effects and audience experience,

makes important contributions to the field of series and film production and will become accessible to independent film producers in time.

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