

Construction of XR Musical Space based on Intelligent Technology

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Abstract: XR technology provides a broad space for the creation of musicals and gives the audience a more aesthetic and real sensory experience. Based on the design of a three-dimensional system to display the beauty of dance, This study uses sophisticated scientific and technological means such as optical motion capture technology, virtual shooting and green back matting synthesis to present the virtual space under the specific situation of musical drama from a 360 degree free perspective in the XR stage virtual scene, and realize the interaction between roles and scenes, so that the audience can be better immersed in it. Taking the local musical “Tang Xianzu” as an example this paper analyzes the free shuttle of actors between the screen, stage and theater under the XR technology, and the aesthetic artistic space construction leads the audience into the dramatic dream written by Tang Xianzu. The ingenious design transforms “emptiness” and “prosperity” into an instant, integrates virtual traditional Chinese drama elements into the real stage, and interacts with real actors to immerse the actors and audience in the extraordinary life course of Tang Xianzu, a great Chinese man.

Keywords: XR Technology, Musical Theater, Intelligent Technology, Immersive Experience

1. Introduction

Musical theater is a new comprehensive stage art that emerged in the 20th century, integrating song, dance, and drama. It extensively uses high-tech technical means to express the storyline and the emotions contained in it with great on-site appeal, so as to bring a good experience to the audience in multiple dimensions such as visual and auditory.

2. The Development of Musical Theater

The creation of musical theater reflects the “profound conceptual culture” of a country, and embodies the core values of a country and a nation, as well as the cultural nature and spiritual ideological system of the region in which it is located. [1]. In particular, it

pursues the stage effect closely integrated with sound, painting and drama, and spends a lot of money to make sophisticated productions through the ingenious ideas of the artist. At first, it was a form of realist stage art creation, and its stage installations, scenery, lighting, costumes, makeup, character modeling, folio effects, etc. mostly pursued realistic modeling, visual texture, and historical authenticity [2]. In the past ten years, high-tech has emerged in an endless stream. Musical theater has been at the forefront of stage art expressions and has been iteratively updated in the rapid development of information technology. The combination of sound, light, electricity and other new media and new technologies greatly enhances the artistic expression of musical theater and creates a better immersive experience atmosphere for the audience. In the past few years, The worldwide pandemic has affected the development of the global musical market, but the innovation of information technology has not stopped and is changing rapidly. The application of XR technology in the field of musical art is the trend, and this work is also a bold attempt.

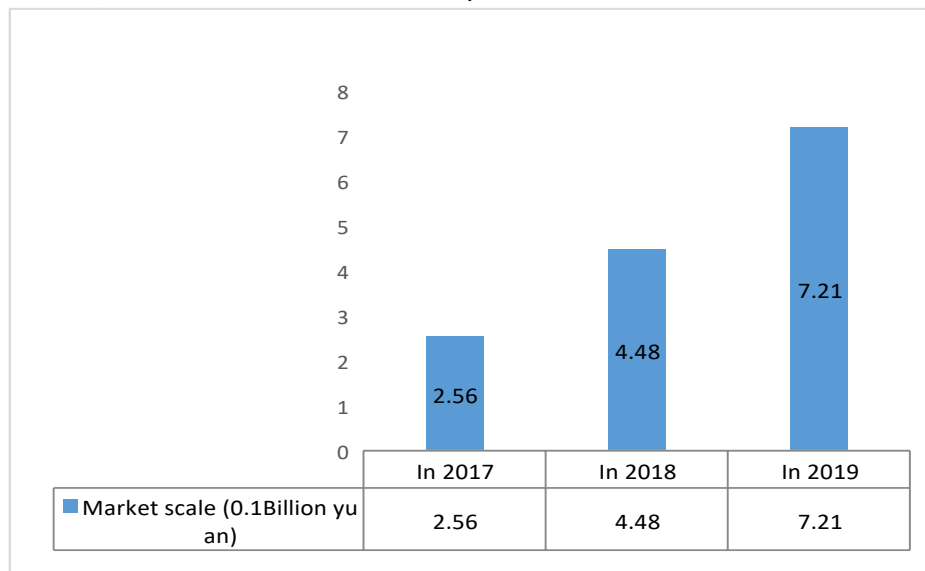


Fig.1 Analysis of Chinese musical market scale in 2019

Musical theater has gradually formed a rapid growth trend in China. According to the “Musical Theater Industry Market Analysis Report” [3] data show that since 2014, Musical Theater has entered a stage of rapid development in China. From 2014 to 2018, the market share of musical theater in mainland China maintained a steady growth at an annual growth rate of 8%. In 2018, the market size of musical theater in China was 448 million yuan. In 2019, the market size reached 721 million yuan, a year-on-year increase of 60.94%. This shows that the form of musical theater is gradually recognized by the audience. Both the attendance rate and the average ticket price have greatly increased, which is directly reflected in the substantial increase in musical theater’s box office revenue. The survey at the same time showed that, in addition to the aesthetics of the musical theater and the level of performing arts, what

is valued most by the audience is the immersive experience that the auditory senses bring to the audience. The plot presents a more realistic and three-dimensional artistic effect in the highly electronic technology integration of sound, lighting, video, and mechanical systems. These have played a positive role in promoting the development of musical theater and are an indispensable part of the success of musical theater.

3. XR (Extended Reality)

In recent years, the concept of “meta universe” has been popular in the technology and entertainment industries. Metaverse includes 5G, AI, block chain, content production and other industries, but its core is to continuously optimize users’ digital life experience through virtual experience XR (extended reality) technology and equipment. XR technology, namely extended reality, is the collective name of VR (virtual reality), AR (augmented reality) and MR (mixed reality). Through wearable devices and computer technology, XR can greatly improve the experience of movies, television and on-site activities, enhance the immersion of actors during performance, interact with CG content in real time, improve the realism of object surface light in the scene, and present the content on the stage in a very natural visual way. As XR technology becomes more and more mature, XR application scenarios such as virtual image and virtual reality performance have brought many innovative entertainment experiences to the public. At the same time, it has also expanded a new consumer market. Even the traditional musical stage has added many new highlights with the support of XR technology.

4. Perception Analysis of Traditional Musicals and Intelligent Technology Musicals

Intelligent technologies such as XR provide a broader space for musical creation, allowing audiences to have a more authentic sensory experience. The creation of musicals should respect the traditional foundation and advantages. On the basis of fully understanding their own strengths and weaknesses, the main creative team closely connects with the current information technology explosion, adjusts the development direction of musical creation, and continuously updates the concepts of time and space in the transformation of new technologies. On the premise of summarizing the experience of traditional musical creation, it is necessary to fully leverage one’s professional advantages and achieve the logical continuation of creative theory. The author conducted a perception survey on the arrangement of intelligent technology musicals and traditional musicals.

Table 1. Cognitive survey on intelligent technology musicals and traditional musicals (rating standard: 10 point scale)

Contents	Average of intelligent technology musical teams (N=30)	Average value of traditional musical teams (N=30)
Performance content	8.29	8.07
Stage space	9.58	7.48

Technical skills	8.25	7.07
Musical motion textures	9.67	8.89
Variety shows	9.56	7.49

As shown in Table 2, in the perception survey of intelligent technology musicals and traditional musicals, the highest average value of smart technology music dramas is 9.67, and the lowest average value is 8.25. The highest average value for traditional musicals is 8.89, while the lowest average value is 7.07. There are significant differences in the creative and performance styles between intelligent technology musicals and traditional musicals. The intelligent technology musical teams is about ± 3.17 higher than the traditional musical teams.

From the above analysis, it can be seen that the emergence of intelligent technology musicals means that on the basis of traditional musicals, technological progress has given people a higher artistic taste, which can meet the higher artistic pursuits and aesthetics of modern people. There are significant differences between intelligent technology musicals and traditional musicals in terms of stage space and overall comprehensive performance. Intelligent technology musicals outperform traditional musicals in terms of motion texture, technical skills, performance actions, and stage performance. Thus, it can be seen that while respecting tradition, intelligent technology in musicals can help improve the stage scheduling and pioneering and innovative level of stage performances of musical creators.

5. Application of Intelligent Technology in Musical Theater

In the prelude scene, the MO Sys camera tracking system is used to firmly lock in the musical theater scene, automatically present depth of field and adaptive environmental perspective, and continuously feedback tracking data to the control room, making the originally two-dimensional image present impeccable 4D visual perfection. The camera tracking system and real-time rendering technology have broken the physical boundary between the real world and the virtual world.

They are in line with the script, integrated with the performance, and jointly convey its content and spirit. To the audience. Mr. Hu Miaosheng wrote in “A Dramatic Space Full of Symbols” that “stage design accomplishes its own function by maintaining material and information connections with the drama. It is above all an organized space, a place where specific dramatic actions can be unfolded. [6]”

5.1. Three-Dimensional Animation Scene Rehearsal to Create an Immersive Experience of Creation

By using 3ds Max to draw a three-dimensional stage beauty scene and importing it into Unity3D to generate a multimedia presentation system for the demonstration of the musical theater stage beauty program, it is faster and more efficient to fit the director’s creative intent. This pair of drama space is full of reflected era, history and time and other rich information in a visual way and intuitively presented to the main creators. This technology has changed the work order and method of the preliminary creation. Screenwriters, directors, actors, costume design, music and sound design, stage supervision, prop production, and relocation work teams have all carried out their work in an immersive creative state. This not only improves efficiency, but also enhances the

interactive state of various departments in the creative stage, and enhances the power of musical theater in terms of ideology [7]. This technology is extremely effective in the country music version of musical theater “Tang Xianzu”. This musical theater is carefully built for the urban theme of “A Place with Dreams” in Fuzhou, Jiangxi. [8] The director asked the choreography staff to use 3ds Max software to draw a three-dimensional choreography scene: rendering the scene with a two-story antique small building; using creative tools in the software to achieve interactive lighting mixing, color correction, etc. to enrich the wedding, farewell, examination room, south capital and other performance situations; then carry on the multimedia demonstration through Unity3D. This process allows actors and staff without musical theater performance experience to see the stage performance scene that will be realized later through three-dimensional imaging at the beginning of the creation and arrangement. The audience can have a comprehensive and clear understanding of the setting, lighting, and prop placement. The presentation of virtual audio-visual effects allows the cast and crew to have an intuitive experience, and is easy to be immersed in the later stage of creation, which greatly enhances the inner perception of the actors and comprehensively enhances the expressive power of musical theater. This laid the foundation for the successful performance of this musical theater at the International Theatre Festival. Compared with traditional stage design, not only does using this virtual collaboration save a lot of work travel expenses, but it also reduces material and labor costs. The operation of 3ds Max and Unity3D technology has provided early reference for the overall process of setting and drama with the immersive model brought by XR tools in an extremely efficient manner.

5.2. Intelligent Technology Creates an Immersive Musical Theater Experience

Learning advanced Intelligent Technology design concepts and technologies, and exploring the production concepts and methods of musical theater with Chinese characteristics, creating an immersive experience of Chinese original musical theater is the direction of the prosperity and development of this industry.[9]

(1) Combination of Light and Shadow in XR Space

In the prelude scene, the cinematic shooting technique breaks the physical boundary between the real world and the virtual world through optical motion capture technology. In the musical monologue “I don’t know when I fell in love with him, but now I firmly know I really love him (her)”, Tang Xianzu’s Du Liniang and Liu Mengmei meet in the Chinese garden with butterflies flying in the virtual space. Flowers bloom dynamically around them to produce novel visual effects, creating an instant visual sense of actors integrating into the space. With rich colors and high saturation, the XR virtual scene of Chinese courtyard is built. The realistic virtual performance space and interactive technology carrier realize the interactive connection between the stages, shorten the distance between the actors and the audience, make the audience have a real sense of participation, and break the “fourth wall” on the drama stage. In the three-dimensional pictures with narrative and story, the audience began to have an immersive experience.

The immersive XR musical space, with its unique imaging diversity and its own light source characteristics, can not only imitate the realistic performance space, but also show the abstract picture, so that the actors and the audience have an immersive feeling, and thus creating an illusory atmosphere of “people in the picture” and

realizing the perfect combination between the scene and the actor's reality. In an instant, the audience will be introduced into the palace of beauty.

(2) Construction of XR Musical Space based on Intelligent Technology

Musical is an art that breaks up and reorganizes all kinds of subject knowledge and skills directly or indirectly involved. It enriches vision and hearing through modern multimedia technology, and sets off the plot with dazzling and colorful elements through sound and light films. Due to the limitation of space, the traditional musical stage is mainly in the form of large screen background and lighting. There are certain limitations in the viewing and creative presentation of the program. However, the addition of XR technology can not only break through this limitation, but also integrate more creative scenes, enrich the performance level of the program stage and realize the wonderful interaction across spaces. The play is divided into Tang Xianzu's life stages. In the early stage, a lot of virtual shooting and green back matting synthesis work are carried out to make the clues of the work clearer. The construction of XR stage virtual scene makes the construction of the whole visual space go along the time axis. With the synchronization of music, lighting, plot and performance, it changes nodes more accurately, and strives to make the integrity and rhythm of the whole play more accurate. CG design and production and optical motion capture technology cooperate with the plot and actor performance to make it more perfect. A series of external factors that force the division of plays, such as "pulling the curtain", "grabbing the scene" and "positioning target" in traditional drama performance, have been handled more properly. [11] Fast and accurate transformation ensures the effect of any live performance, reduces the waiting time of the audience, and makes the whole performance process more compact and coherent.

The play combines traditional Chinese music, drama, dance and other art forms to tell moving stories. Beautiful music is supplemented by classical clothing and headwear. Chinese props such as furniture, bookcase and brush are displayed under the two-story setting of Chinese gardens. The calligraphy and painting works in the real scene echo with the overall XR stage virtual scene and the Chinese landscape to create a strong repertoire tone of Chinese classical culture. This paper arranges Tang Xianzu's life and his stories imaginatively, creating a series at the same time. The characters walk through the three-dimensional space of the original plane traditional Chinese painting. The three-dimensional scene combines modern dance beauty, lighting, sound effects and other technologies to show pictures with the beauty of Chinese artistic conception. From two-dimensional to three-dimensional, four-dimensional and five-dimensional, the plot develops in a new dimension of Chinese painting. The reconstruction of time and space has brought aesthetic and perceptual changes to the story narrative and scene style.

The dance beauty scheme provides common signals through intelligent technology and transmits the data such as XR stage virtual scene, lighting and sound effects to the control system. The ultra-high definition picture captured by the information acquisition equipment get the best display. The built-in image correction function and image color processing function make the image outline of the virtual display clearer, the picture smoother and the color expression ability stronger. It can support multi-channel different signal input, and realize the functions of multi-channel signal window display, window arbitrary roaming and scaling, video and computing signal arbitrary superposition and so on. Through the imitation and reproduction of the real

world and the media expression of the imaginary world, in the XR stage virtual scene space, it presents the image of “making the past serve the present and bringing forth the new”, and creates the image of a cultural great man who is proud of the Chinese people. [12]

(3) The Integration of Intelligent Technologies Creates a Sense of Space-time Crisscross

Makes full use of holographic scanning technology, XR virtual vision technology and 8K naked eye 3D presentation technology to break through the limitation of time and space, bring lifelike three-dimensional images to the audience, and integrate the sound effect, light, video and mechanical systems with intelligent technology. The flexible artistic treatment of time and space is another very prominent feature of this musical. Tang Xianzu failed in the imperial exam, and his wife Wu died of illness soon. The plot developed here and began to borrow Tang Xianzu’s creative technique of “dream” to keep the husband and wife separated from each other forever. Here, the sound reinforcement system is designed by using the regional multi-point sound reinforcement method to accurately regulate the volume and delay of speakers in each area, realize the sense of space in hearing, create the sense of hearing that the living and the dead can talk to each other, and add the technique of film montage to break the limitation of time and space, which also reflects the freedom of time and space. AI multi-modal dynamic capture system is used to collect the movement track and body of actors. Through the comprehensive technical means of sound effect, lighting and mechanical systems, it breaks the virtual technique and aesthetic principle of Chinese traditional opera, creates a sense of space-time crisscross, and extends the stage space to any place in people’s mind, or the courtyard or winding pool where people drink alone under the moon. The AI algorithm is used to calculate the three-dimensional coordinates of the actor’s body image in real time, so that the digital model and the actor can complete the action performance synchronously, efficiently and accurately. The actor can shuttle freely between the virtual and the stage, which greatly expands the time and space of the performance and creates a magical visual effect of virtual and real interaction. This has played a unique role in showing the psychological changes of the characters, showing the fierce contradictions and conflicts, depicting the characters’ personality, highlighting emotions and so on. Under the sound effect light, the implementation and transformation of XR virtual scene realizes the passage, jump and overlap of time and space, highlights the romantic color of this musical, greatly mobilizes the audience’s vision and hearing, makes it concentrate on entering the pre-designed situation, stimulates people’s curiosity and imagination, makes the actors and the audience constantly collide and communicate with each other in spiritual experience, and get the feeling of entering alternative space and time together. It more deeply shows the emotional waves of two life parting love and the contradiction and conflict of the limitation of not being able to die, arouses the audience’s endless pity and pain, and makes the audience enjoy and sublimate their feelings in an immersive environment.

6. Conclusion

This study uses sophisticated scientific and technological means such as CG design and production, optical motion capture technology, virtual shooting and green back matting synthesis to present the virtual space under the specific situation of musical drama from a 360 degree free perspective in the XR stage virtual scene, and realize the interaction between roles and scenes. It combines ancient Chinese rhyme and modern style in a concrete and impressive form to show the extraordinary life of Tang Xianzu, a great Chinese man. In the Chinese-style musical theater “Tang Xianzu”, the immersive experience combines technological connotation and humanistic value.

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