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Research on Three Dimensional Animation Production Combined with Virtual Reality Technology

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Abstract: The research investigates and researches the three-dimensional animation production combined with virtual reality technology, in order to provide a reference and help for the underlying business. Traditional three-dimensional animation technique mainly dues to the role of animation production and special post-production effects, etc. and as the three-dimensional animation gradually entering into the vision of the crowd in these years, its application is increasingly widespread in the world. In order to break through the bottleneck of traditional three-dimensional animation' backward, the relevant personnel has made some achievements in constant exploration and research, especially in three-dimensional animation production combined with virtual reality technology. The research will discuss the following aspects: the overview of virtual reality and three-dimensional animation production, the current status of the three-dimensional animation production, three-dimensional animation production and virtual reality technologies, as well as the application of the combination technology in the animation practice. Through research, It is the truth that using imaging technology, three-dimensional computer graphics technology-CG (Computer Graphics) and the motion capture system can achieve higher quality and efficiency of three-dimensional animation production and the effect is very significant, so it should be widely applied.

Key words: Three-dimensional animation, animation production, virtual reality, imaging technology, computer graphics, motion capture

INTRODUCTION

At the present, although the animation production has made some achievements in China, on the whole the production of small and medium-sized animation technology is still relatively scarce which is largely related to the education needs. Of course, these small and medium-sized animation companies present the state of high cost and low efficiency on the production of anime which also seriously affected the anime popularity of teaching. After the emergence of three-dimensional (3-D) animation production and virtual reality combined with technology, the small and medium-sized animation production to a new method of exploring appears a new turn. Even if the turning point coming but the 3-D animation production technology has many flaws and shortcomings which is the gap between China and the foreign advanced animation countries. Therefore, it is necessary to continue to learn advanced technology from abroad for the future development, at the same time, combing with China's own advanced and innovative technologies to form unique 3-D animation production (Ascaso *et al.*, 2013).

The 3-D animation production technologies are emerging creative process which is a combination of a lot of technology, especially computer graphics, one of the core technologies. Although most of them are treated as the computer graphics applications, based on its own characteristics, a distinct field of research is formed. For example, some well-known films,"Kung Fu Panda", "Shrek", "Avatar" and "Resident Evil" all use the 3-D animation production technology, its effect undoubtedly impresses millions of viewers and become the most successful animation or movies. With the 3-D animation becoming one of the major industries of the related industries, China's government also has issued the related industrial policies to make the strong support and many enterprises have also developed some certain development strategies and plans to make 3-D animation present a fast growing state. Of course, getting the continuous development and improvement of the 3-D animation, it should depend on the advanced technology and talented people which cannot be separated from education and personnel training in animation and building of the animation industry bases. The advancing of 3-D animation technology and virtual reality

technology not only bring the new opportunities and challenge for China's animation education but also put forward higher requirements for personnel training. This article expands the discussion and research on 3-D animation production combined with virtual reality technology. Firstly, the following section will make a brief introduction of virtual reality and 3-D animation production overview and analyze the current status of 3-D animation production. Secondly, three-dimensional animation production and virtual reality technology will be explored. Finally, it is essential that teaching animation environment (animation lab) should be established for achieving the improvement of teaching and maturity of the 3D animation production combined with virtual reality technology constantly.

RESEARCH METHOD, RESULT AND CONCLUSION

Research method of the research: The main use method of this research is inductive reasoning which is the overview of the concept, current situation of generalization. At the same time, summary and analysis the related technology and reason its application effect in technology. Then use experimentation to prove its effect.

Result of the research: The three-dimensional animation combined with virtual reality can obtain ideal effect. Its application in lab shows that the centre of room appears a kind of open virtual interactive environment. It can use motion capture technology and human-computer interaction technology. Build a true, clear and the experience environment interact with cartoon characters.

Conclusion of the research: Strengthen the imaging techniques, three-dimensional computer graphics techniques CG(Computer Graphics)and motion capture system with the combination of virtual display technology application. It can achieve higher quality and efficiency of the three-dimensional animation production.

OVERVIEW OF VIRTUAL REALITY

Virtual Reality (VR) refers to treat computer technology as the core and combine a variety of related science and technology to form a certain range of digital environment which is extremely similar to the real environment in terms of visual, auditory and tactile. Depending on the appropriate equipment and digitized environment object, interaction will be implemented and users will have an immersive sense. Virtual reality belongs to a kind of science technology and method for understanding and analogizing the natural, then better

adapting to and taking advantage of the natural which is formed in the process of constantly exploring the natural by human beings. As the world of science and technology growing rapidly, social productive force has made an unprecedented development during these year, so all walks of life have a greater demand on virtual reality technology. Meanwhile, human research on virtual technology is also gradually wide and deep which leads to the virtual reality technology has made tremendous progress and has become a new field of science and technology which makes great influence on people.

OVERVIEW AND STATUES OF 3-D ANIMATION PRODUCTION

Overview: The 3-D animation production is an huge integrated technology which refers to combine the theory and method of computer graphics and robotics, physics, artificial intelligence and artistic. The CG is ranging from the image processing technology, realistic graphics generation technology, video display technology to the principle of motion control, even including the visual biology, biology and other fields (Pham and Luo, 2012).

The characteristics of 3-D animation production technology is shown as Fig. 1.

- **Compact design of 3-d animation has a superb ability:** The design and production of 3-D animation relies on computer and mathematical methods to finish. It will not be limited by the objective constraints. On one hand, the existence in reality (objects and landscape) can be simulated, on the other hand, it can fraud out something that does not exist in real life (objects and landscape) which cannot be done by hand-painting and shooting. Specifically, the 3-D animation can usually generate the following formation: (1) The objective nature scene. The formation of a variety of natural landscapes become a reality resulting from the advancing development of computer graphics, for example, water, clouds, fog and fire has good fake. (2) Artificial geometrical objects. 3-D animation production has its own software. These software can get a variety of flat, curve and surface generation tool, so that constructing many vivid bodies becomes come true, such as a variety of furniture, utensils and so on. (3) Articular animal. The joint animal (such as man and beast and so on)can get the realistic simulation through 3-D computer animation techniques, for example, in the famous movie named "Jurassic Park", the dinosaur as shown in Fig. 2 is production of the 3-D animation

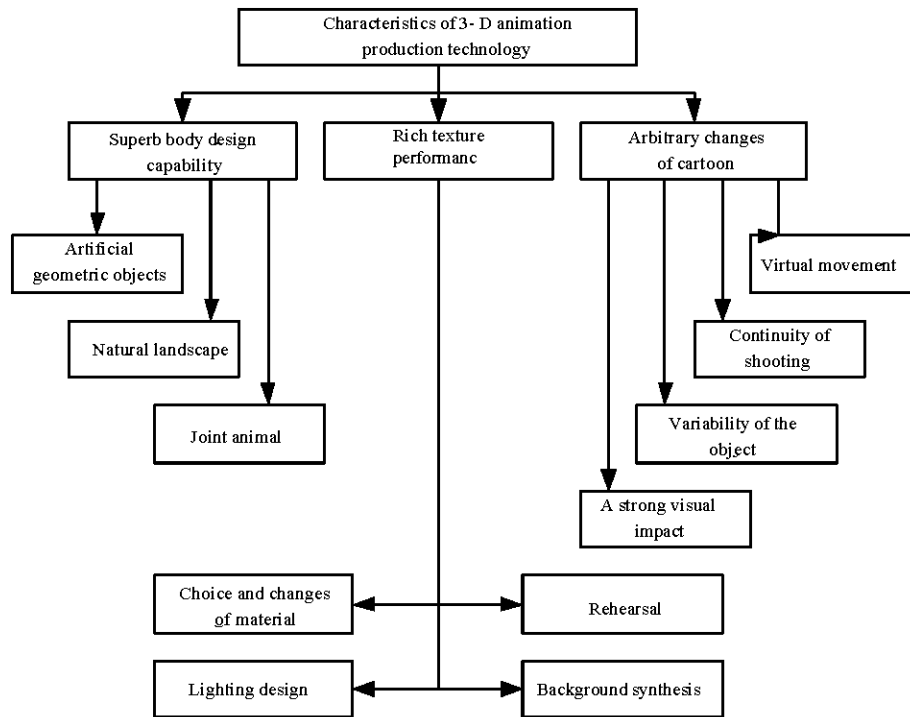


Fig. 1: Technical characteristics of the 3-D animation production



Fig. 2: Dinosaurs of “Jurassic Park” in the 3-D animation production

- 3-D animation can be arbitrary change:** The 3-D animation can produce any change in accordance with any of the specified object direction of motion trajectory, with arbitrary changes. As evidenced in the following aspects: (1) The continuity of the shooting. Computer animation can achieve the continuous shooting from the macro world to the micro world and vice versa. (2) Sports fiction. A complex action can be constructed by more than one single action gradually flying into the screen, eventually to form the whole one. (3) The visual

impact. The 3-D computer animation allows the objects to finish the far to near or the near to far movement according to the settings on computer wide-angle lens curve which would causes a strong visual impact. (4) The object can be denatured. The 3-D computer animation can provide two variants, one is the 3-D shape deformation, the other is the image level change (Sivitskaya *et al.*, 2013)

- 3-D animation has a rich texture performance:** 3-D animation production technology enable the body texture vivid and lifelike by the choice of materials and lighting design, specifically, in the following aspects: (1) The choice of material. 3-D animation technology software has extensive material library where you can find all necessary materials, such as metal, glass, fabric and wood. (2) The lighting design. 3-D animation software can determine the light intensity and color, even design a shadow effect freely, according to the specific requirements. (3) Background synthetic. During the 3-D animation design, you can design the foreground and background, at the same time, you can process the synthetic background to meet the actually needed at any time. (4) Rehearsal. The effect of 3-D animation design can be rehearsed for the necessary improvements and achieving the best results (Watanabe and Ujike, 2012)

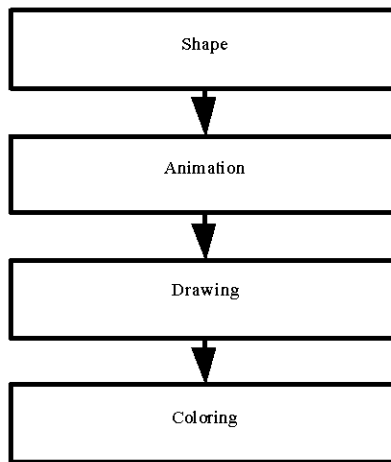


Fig. 3: 3-D animation production steps

Principle: Overall, 3-D animation production has four steps (as shown in Fig. 3) that is shape→animation→drawing→coloring.

Shape: The model of 3-D animation production is 3-D modeling which refers to use software to draw a 3-D object. It has two main steps: Firstly, basic physical drawing and thus to make the necessary combination, then forming complex shapes; secondly, after the 3-D shape produced, it should be placed in a suitable location, then forming a complete scene.

Animation: 3-D animation refers to the movement of a variety of shapes which make these images play in a certain order and ensure the continuity and coherence of the play, giving a very real sense of and make the effect of reality have a high degree of consistency (Kim, 2012).

Drawing: 3-D animation drawing is a very important step, because the key of the 3-D animation lies in the non-interactive aesthetics and visual effects while the drawing is executed to make sure the 3-D animation vivid and lifelike, including light control and mapping (Zarlin *et al.*, 2012).

Coloring: The coloring of the 3-D animation production is the last step. The current animation production software are provided directly generation process, that is directly connecting the number of continuous animation screen, shortly, video animation.

Current situation: The Current Situation in the Foreign Country. European and American countries are the most mature and advanced countries in 3-D animation



Fig. 4: Effect of 3-D animation production technology in “The Moon of Qin dynasty”

production, these years, Japan, South Korea and other countries show a rapid development state and have make great progress in 3-D animation production technology. In Foreign animation, 3D animation production technology requirements often less than a large-scale investment in the film, therefore it is widely used in the foreign country.

Current situation in China: At present, Digital animation design has become an emerging industry and has a very broad market prospects. Based on the temptation of commercialization interests, China has achieved unprecedented trends of the development in digitization. As the development of the digital media, in China, some areas have gradually entered into the age of “map reading”. The development of 3-D animation has a splitting speed. For example, some TV, ads, cartoons and games, all of them have relationship with the 3-D animation production technology. Undoubtedly, China’s first large-scale martial arts 3-D animated series is “the moon of Qin dynasty” (as shown in Fig. 4). It is very popular and has brought high attention since the launch. It’s said that the total investment of this animation was expected to exceed the fifty million yuan. The first part (only 20 episodes) named “hundred flying sword” on the investment over ten million yuan. As the technology becomes more mature, the film has to overcome all kind of challenges and difficulties, break through the barrier in technology and and control the cost strongly. Further analysis of “the moon of Qin dynasty” shows that the film has broken the traditional 2-D situation and made the characters, scenes and special effects achieve full 3-D CG images and 2-D advantage which make the animation style

is no longer a single and realism and make it have the property both beautifully delicate hand-drawing animation and strong dynamic performance effects of 3-D animation. It makes the audience more fresh and perfect viewing experience. In addition, in the martial arts, “the moon of Qin dynasty” utilizes the most advanced and mainstream high-tech motion capture technology in order to capture the actor’s action scenes. Overall, there is no doubt that this film is the first 3-D cartoon which was produced by hand motion capture technology in China. Because of 3-D animation production technology making the actual movement of the object be recorded, the produced action is more precise and the effect is also very high. Thus, the 3-D animation production technology steps into a landmark situation (Fon *et al.*, 2012).

ANALYSIS OF THE 3-D ANIMATION PRODUCTION COMBINED WITH VIRTUAL REALITY TECHNOLOGY

Along with the continuous development of the CG (Computer Graphics), 3-D animation technology and virtual reality have been a great deal of development, all kinds of software and hardware and with excellent performance and powerful new products have been developed by related industries at home and abroad. In the practical application, the results are satisfactory. Earlier, some discussions about virtual reality and 3-D animation production have been made, the following part will analyze the 3-D animation production combined with virtual reality technology, namely 3D animation virtual system, its design can be expressed by Fig. 5.

In Fig. 5, the 3-D virtual animation system can quickly implement production system by using organic integrated 3-D modeling, VR equipment, animation technology and network technology, so as to achieve the interactive animation virtual environment effect. Analysis of this figure, the main parts of this system are motion capture system, stereoscopic projection system, interactive input devices and distributed network virtual platform.

3-D modeling System. Generally speaking, in the practical modeling, using a combination of methods to form the model data is feasible. It can be simulated by real-world objects and the realistic simulation desired degree. The method used in the modeling process should be related to the simulated object class but also it has a close relationship with the field of application. Based on the different aspects of the simulated object, the mainstream modeling method can be divided into three kinds: Physical modeling, scene appearance modeling and virtual fusion modeling. Physical modeling reflects the physical characteristics of the object which makes the anime more realistic in terms of the combination of statics and movement. The kind of physical characteristics include collision between objects, dynamics, deformation and so on; scene appearance modeling is that the simulation of the scene appearance, including the scene geometry, materials, lighting and image information; virtual fusion modeling is a very important method of modeling, it mainly lies in integrating the computer generated virtual scene and the real world of the real environment naturally, thus it appears lifelike and vivid. Of course, during the 3-D animation modeling, scanning

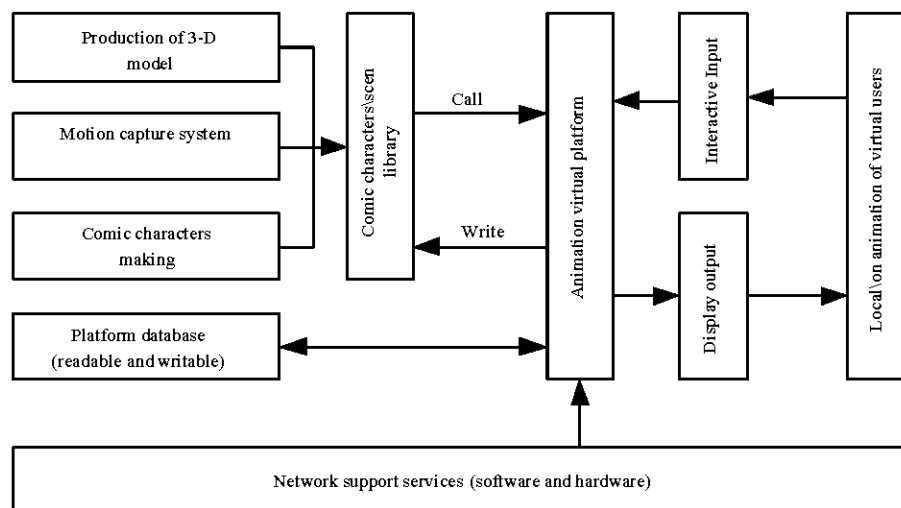


Fig. 5: 3-D animation virtual system design diagram

the object by 3-D scanner in order to create the surface 3-D data is the first step. These data is a set of 3-D coordinates of points which are the data of the physical surface. In this process, a large number of coordinate points set became point cloud. By this way, the 3-D model will achieve high precision, speed and very realistic (Sas-Nowosielska *et al.*, 2012).

Motion capture system: In the process of 3D animation production, it is obvious that the use of hand-tune animation is time consuming. Once mass production, you have to take a lot of funds and many character animation professionals. In addition, a long production cycle and the hand-tune animation has a certain degree of difficulty in achieving real style. However, utilizing the motion capture system in virtual reality, a true style animation will be created in very little time and little money, moreover, adopting 3-D animation combined with virtual reality technology can make it be obviously superior to hand-tune animation in action authenticity, shortening the production cycle and saving money.

Adjustable motion data technology: For researching on motion capture, it has haven a long history so far, especially human beings have very mature technologies in human skeleton movement. So you can get a perfect solution to whole process ranging from the track, capture, identification and skeleton to skeleton adjustment. However, since its own features, it still exists a certain degree of deficiencies in practical operation. For the shortfall, some software, such as Film Box can be used to solve these problems effectively. But for now, most of the animators have disadvantage in the use of such software and it is difficult to use different software to finish mutually importing and exporting. Therefore, further exploration and research is necessary.

Character animation usually adopts two control techniques (kinematics and dynamics) to form a human animation, especially for the inverse kinematics; it is widely used in the 3-D animation software. In terms of these two control technologies, both of them are trying to achieve the human animation by using the physical laws of human. But due to the laws of human motion has a very high complexity, especially, simulation in the coordination mechanisms of human motion is extremely difficult which make the generated animation is often not vivid, even lack of the rich detail of the actual human motion. Of course, these problems exist in traditional 3D animation. Once the motion capture system is added, the shortcomings in the movement control technology will be overcome perfectly, meanwhile, it can achieve good results. Currently, it has become an integral part of China's virtual 3-D animation

system and one of the best promising technologies. Overall, motion capture technology integrates many aspects of technology, for example, computer graphics, mechanical, electronic, optical, computer animation and computer vision. Its specific operation is following: The tracker installs in the key parts of the moving object and capture system capture the corresponding position of the tracking device, then the computer can provide users with the required data in the animation after high intelligent processing. Followed by computer identification, animators can take advantage of these data to driven 3-D model to generate the required animation which make the computer generated lens easier to adjust and control the movement of objects. Aforementioned data acquisition which adopts motion capture technology can be directly transferred into the 3-D animation to drive the 3-D model and can also be edited by the third party software (middleman), finally matching the data with corresponding software.

In order to make 3-D virtual animation technology achieve better performance, it is necessary to continue to strengthen the ability of motion capture system in data acquisition. The technology applications of these obtained data in the 3-D software mainly depend on the data characteristic and utilize plug-in unit that is programmed by Mel which is transplanted from Maya, meanwhile, this plug-in unit can act as a "middleman", so that to achieve the corresponding effect. For now, the superposition, insertion and other different ways to modify the dynamic data can be used, in addition, free conversion between forward dynamics and inversed dynamics algorithm is also the good choice. It can be said to have a very distinct advantage in developing more friendly use interface (Ajala and Okoro, 2012).

In addition, if large and complex regulation is needed in dynamic role capturing, it is necessary to provide a widely adjusted skeleton system which can achieve adjustment to the forward dynamics and inversed dynamics and cannot select between different skeleton. In short, it can design four same sets of skeleton which is forward dynamic skeleton, inversed dynamic skeleton, data skeleton of motion capture and skin skeleton of role. With these sets of skeleton, achieving mutual association and completing the related work is not impossible.

PRACTICE AND APPLIED RESEARCH ON 3-D ANIMATION VIRTUAL ENVIRONMENT CONSTRUCTION

For now, some colleges and universities that open course and gradually build up 3-D animation virtual laboratory mainly consider from both research and

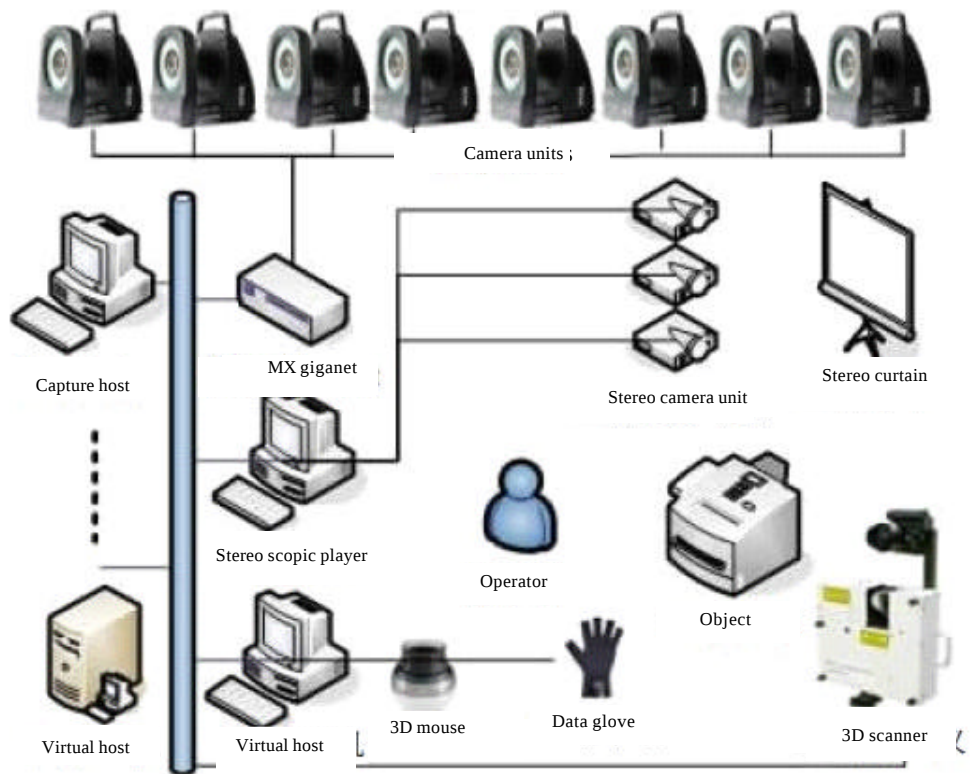


Fig. 6: Virtual environment diagram of the 3-d animation

teaching. Changing the traditional mode of virtual reality lab or traditional CG lab is first when this laboratory is constructed, in addition, network virtual experiments or 3D animation product development and professional teaching experiment should also be considered. The college builds 3-D animation virtual laboratory, On one hand, the students can learn animation from animation, on the other hand, the experiment in virtual becomes realistic. For example, in Figure 6, it shows the hardware layout of a 3-D animation virtual laboratory in the university.

In Fig. 6, it presents the motion capture system contains eight camera units which distributes around the top of each room in the virtual environment of the present 3-D animation; 3-D scanner can be disposed in the two corners of the room; projector of stereoscopic projection system can be installed at the top of the center of the room and the projection screen should be placed close to the wall; for other types of devices, such as the system equipment, network, should be placed along the wall edge, opposite the screen. Thus, the center of the whole room shows a sense of an open virtual interactive environment and adopting the motion capture technology

and human-computer interaction techniques can build an experience environment which is real, clear and where people can interact with cartoon characters (Soltzberg *et al.*, 2012).

CONCLUSION

Totally speaking, 3-D animation has a very broad application prospects in China, after all, China is a great country and the population of China exceeds to 1.3 billion. Therefore, it is necessary to strengthen the exploration and development of 3-D animation in China. In other words, in order to improve the quality of China's 3-D animation, it is very important to improve the technical and artistic effect, after all, 3D animation is the crystalline of the art and technology and both technology and art are dispensable. Of course, there are many deficiencies in 3D animation production in China which requires to learn the advanced and mature technology from the foreign country. In addition, the most important thing is China should strengthen the exploration and study on the 3-D animation production combined with virtual reality technology to create more exciting and touching anime.

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