STUDY ON SMOOTHING BROWSER IN MULTI-VIEW VIRTUAL SPACE BASED ON PANORAMA

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ABSTRACT:

In a scene which is not open, people cann't watch the scene behind the barrier through the single-viewpoint. And the cross-cutting in the multi-viewpoints space can make up for its shortcomings. The Panoramic technology of single perspective is mature, but the study on muti-perspective is comparatively lack. In this paper a multi-view virtual scene was builted which can be developed the number of viewpoints by cylindrical single-viewpoints space and bidirectional transitional-chain between perspectives. The author designed a smooth roaming approach in the virtual space based on multi-viewpoints by using the image-matching and the line-extraction method, and implemented a single-view panoramic and transitional-image between viewpoints generation platform, as well as the multiple-viewpoints scene browser platform, and got a good visual effects in the smooth transition between the viewpoints.

1. INTRODUCTION

Constructing panoramic images of IBR is an important research topic in computer vision, image processing, and other areas. This technology constructing a virtual scene by real images, provides people with visual experience. Constructing panoramic images already enter into more and more industries because of its advantages such as drawing fast, easy modeling, photorealistic and so on. These industries include Site construction, real estate exhibition, virtual tour, Hotels exhibitions.

The panoramic images may express complete surroundings information of a scene from one fixed viewpoint. It reflect a three-dimensional perspective of space. It is the basic unit of a virtual scene. But in many cases, there are often some objects which make people unable to watch the scene behind them in a real scene. So people should complete all parts of the scene's browser by several perspective space. Bacause the cross-cutting in the multi-viewpoints space can make user browse every corner of the entire scene.

The effective organizations of these viewpoints space which could make users have a smoothing view in the virtual scene is an important issues. So the key of this problem is the structure among all of these viewpoints space. Currently, all panorama manufacture software only complete smoothly browse on a single-perspective, but between these viewpoints space, most of them use hotkey switching means. And the user clicks a button, the software automatically jump from one viewpoint to another viewpoint space. This way can achieve faster, but lose smooth transition between two perspective space, so make user lack of realism and sense of direction.

In this paper, an effective construction approach of multi-perspective of the virtual scene is proposed. The virtual scene was builted by cylindrical single-viewpoints space and bidirectional transition-chain between perspectives.The repalcement texture mapping of cylindrical scene can describe different virtual space,as well as the transitional-images'changing on transitional-chain can simulate the visual effects that a person could see when he roam from a perspective to another one. In order to achieve the effect of smooth roaming, the experiment use of the line extraction and matching, and other image processing methods.

2. THE CONSTRUCTION APPROACH OF MUTI-VIEWPOINTS VIRTUAL SCENE

In order to browse every corner , a scene which has several obstructions offen needs not only one perspactive:each perspective space map corresponding panoramic image,users can look around in the space. Moreover, in order to achieve a smooth roaming in the whole scene, bidirectional transitional-chain need to be constructed between two adjacent viewpoints.Several trasitional-nodes are distributed on these chains.When user browse along the chain to these nodes,the virtual scene will change corresponding trasitional-images to make he feel more closer to the next perspective.And on the nodes user can only be allowed to watch the direction of the advance.

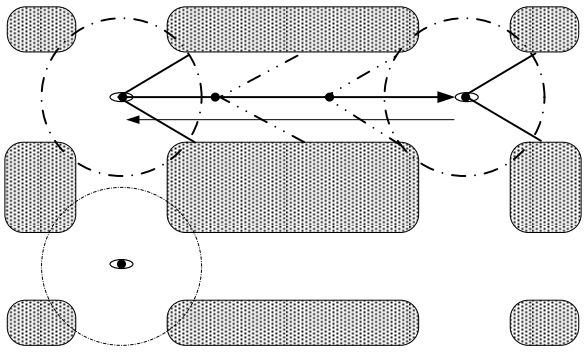

Figure.1. The transitional chain construction between two view spaces

When user go forward from perspective1 to perspective2,the scene he saw will not change as long as he doesn't change the direction he watched.But the changing thing is the distance from scene on perspective2,which looks like the change of image's scale.Therefore,the important things on browse between perspectives are user's advancement and the trasitional image's replacement and the relationship between these images is the distance from the scene when they are collected.

The reason that interpolating transitional-nodes on the chain is: ①the distance between two scene is so long that trasitional-image's resolution is not high enough after magnification. Accordingly,when user advance from one viewpoint to another without any transitional-images, will hard to be smoothly because of the significant differences on image quality. ②the scene user faced has more than one object which are not in the same plane.This phenomenon result in different distortion of images after center projection,and these images have different distance from the scene when they are collected.The farther distance between two collecting place,the greater image distortion after projection is.Therefore,if the distance between two scene is long,the transitional-nodes should be interpolated on the chain to shorten the distance of collecting place, improve the image quality ,reduce the image distortion and make the roaming smoothly.

3. TECNOLOGY IN SYSTEM IMPLEMENTATION

3.1 Panorama Coalition

Panorama representation has four formats plane, sphere, cube and cylinder. Cylindrical panorama among them is used widely which is the approach this experimental used.One of the reason is that this kind of panorana's images are easy to collected and storaged in computer because of the easily spreading from cylinder to plane.And the first step of virture scene's construction is the production of cylindrical panorama.

① Image collection
Image collection is mainly completed in a single spot with 360-degree omnidirectional superposition sequential images collection and single image collection along transition direction at several transition nodes.
② Image projection
Bcause the images on one perspective are collected by circumrotating camera,so they have differernt central projection plane and the same object on different images have different projection distortion(Fig.2). If merging those sequential images directly, there will be local contorted phenomena, it will wreck the coherence of the objects in the practical scenes.

Figure.2. The adjacent original images and the images after cylindrical projection

In order to avoid the distortion and keep the spacial restiction relationship of images,we have to project these images which have their own projection plane to a standard projection surface which is cylinder(Fig2).

③ Image matching,stitching,smooth
The leading assignment of this part are the template matching base on feature points,finding Stitching Line by homonymy point.If we overlap two images together without any process,there will have obvious borderline of stitching.So we should eliminate the borderline by smoothing.The smoothing method we choose is gradual mean of weighted.It is the effect of smoothing.

Through the above several steps of work,the original collected sequence images can be made into panoramic image,Fig3 reflects the single viewpoint of spacial scene before the WuHan university of Engineering's Library.

Figure 3. A panorama about a library of WuHan University

3.2 Obtaining of transitional images

The transitional-images collecting is not restricted to equidistant shooting, the shooting point just along the tansitional-direction without lining and the distance between any two shooting point is unkown.So the position of an object on different images have changed,and the scale of different images is unkown..These problem will hinder the smoothing effect when viewer go forward on the transitional-chain,so the important assignment is finding the relationship of scale and position between any two images by Image Processing.

1） Scale relationship between transitional-images
Trasitional-nodes distributed on the chain should follow two principle,the collecting order and scale of transitional-images. When user go forword along the chain in browse system,the image he faced could magnify.When the image is magnified to the scale of the next transitional-image, browse system will interpolate a tansitional-node on the chain and use the next image instead of the former one.

The shooting scene isn't change on the transitional-chain and the spatial geometry relationships are consistent,so the scale relationship between transitional-images can be obtained by the ratio of distance between two pairs of homonymy line(Fig.4).

Suppose that there are two pictures,one is reference diagram(first node)Image1(widthL×heightL), another is diagram needed to process(second node)Image2(widthR×heightR). The scale of the two pictures can be calculated by formula (1)

$$scale = (\sum_{i=2}^{n} \frac{l_{2[i]} - l_{2[i-1]}}{l_{1[i]} - l_{1[i-1]}}) / (n-1) \quad (n \geqslant 2) \qquad (1)$$

where l_1,l_2= the abscissa of the lengthways homonymy line that found on the two pictures
i= the number of the line

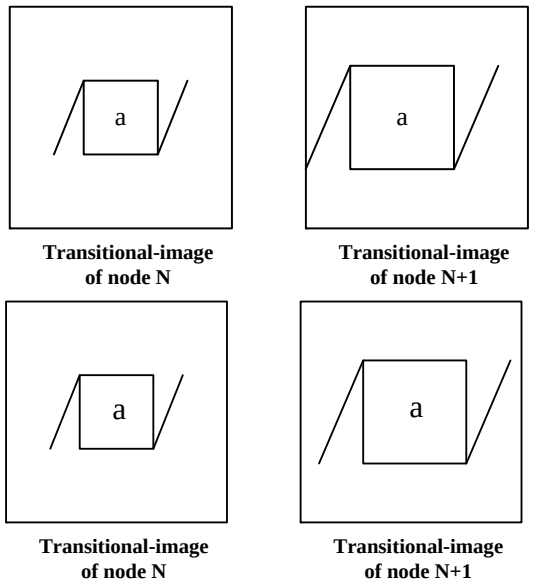

Figure 4. Radio and Position relation between two adjacent transitional images

2） Position relationship between transitional-images
The shooting point go along the tansitional-direction without lining,that makes the position of an object on different images have changed(Fig.4).When system use the second transitional-image instead of the first one,user will generate visual saltus.So it is difficult to realize smoothly roaming.The solution of this problem is cutting or filling pels to change the display borderline,that is in order to make the watching object hasn't position change on different images.And the important thing of this solution is to calculate the extension of image's display by the coordinate of homonymy lines.And this part is called positioning of transitional-images.
The horizontal or vertical homonymy lines are selected when positioning,because it is easy to caculated. The extention of image2's display is caculated vertical and horizontal cutting pels by formula(2). This equation suits the condition only when Left and Top value is bigger than zero "0", and Left+widthL<widthR and Top + hightL < heightR. If neither of them suits, it should to fill in pixels into Image2 properly, to insure the new image is the same size as reference image.

The main steps of transitional-images'obtain are Line-extraction and homonymy lines matching.fig5 is the flow chart of transitional-images'obtain.

$$\text{Left:}\quad l_2 - (l_1 - \frac{widthL - \frac{widthL}{scale}}{2}) \times scale$$

$$\text{Right:}\quad l_2 - (l_1 - \frac{widthL - \frac{widthL}{scale}}{2}) \times scale + widthL$$

$$\text{Top:}\quad h_2 - (h_1 - \frac{heightL - \frac{heightL}{scale}}{2}) \times scale$$

$$\text{Bottom:}\quad h_2 - (h_1 - \frac{heightL - \frac{heightL}{scale}}{2}) \times scale + heightL \qquad (2)$$

where l= the horizontal axis of the longitudinal straight line
h= the vertical axis of transverse straight line
widthL=the first image's width
heightL=the first image's height

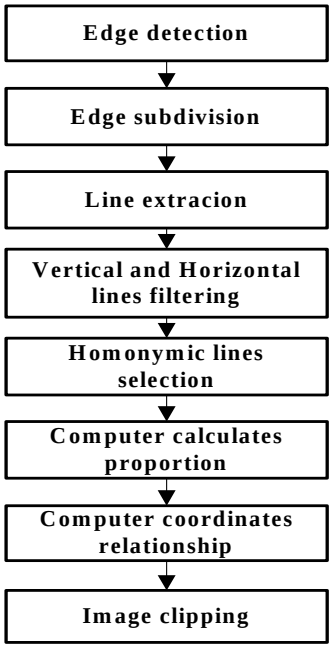

Figure.5. Flow chart of transitional images'acquisition

4. REALIZATION OF SYSTEM

The rendering and view of the virtual scene were respectively accomplished by the panoramic view generation platform and the browser platform.The generation platform can finish image projection,image matching and stitching, positioning of transitional-images,image cutting and filling and so on. Browser platform has been constructed by VC+OPENGL.A single perspective space as a virtual scene has been built to a polyhedral, and different scene can display by changing the texture(panorama) mapping on column.User in a virtual scene can watch the space for surveying, forward and back. There are two transitional chains between any two neighboring perspective space,and there were several transitional-images distributed on these chains. User also can browse on these chains smoothly.

Figure 7 is the panorama and the entrance of the transition. Figure 8 is the impact image of view one from eight directions in the browse.Figure9 is the intercepted image movably from the view point one to view point two.

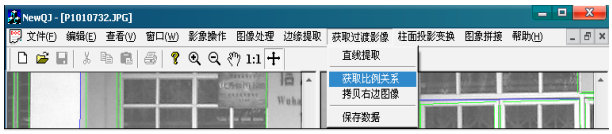

Figure 6. The panoramic generation platform

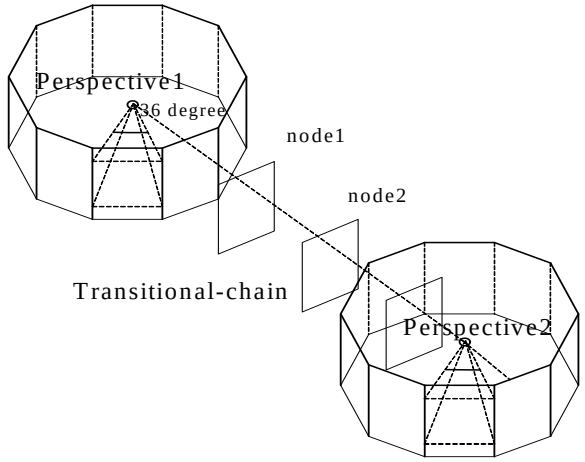

Figure 7. The construction between two perspective

Figure 8. Two panoramas and transitional path

Figeure 9. The transition from perspective two to perspective one(From top to bottom, from left to right)

5. CONCLUSIONS

This research is based on panoramic technique,proposed a construction mind of multi-perspective of the virtual scene,and designed and implemented the panorama generation and the browser platform..The research processed transitional-images and constructed the tansitional-chain by image processing,and the effect of smoothly browsing in any single or two perspectives is good.

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