Discussion on the Construction of Computer Image Scene Based on Virtual Reality Technology

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Abstract: Compared with the traditional graphic method to construct virtual scene, the image-based rendering technology in recent years has the rendering quality of the real scene. The algorithm complexity is only related to the image resolution, and it has become a research focus. In this paper, through the study of the principle of stereoscopic vision, a panoramic stitching algorithm based on vertical edge processing is proposed. The matching features of the samples are highlighted by the main vertical edges to avoid local optimum. A uniform circular trajectory image sequence method is proposed, which makes image acquisition easy. The fixed acceleration is rotated around the fixed center in the horizontal plane to take photos, and the light information of the points in the horizontal plane is collected, which has a three-dimensional effect.

1. Introduction

With the development of computer graphics, realistic virtual environments can be built through traditional geometric methods. Usually, a three-dimensional geometric model is created to describe features such as illumination in the scene and texture of the surface. It requires high computing power to generate an image observed by the viewpoint by calculating the light intensity, and the resulting effects are difficult to reproduce the complex textures of nature presented in photographs. In recent years, the image-based rendering technique has been proposed, which has the rendering quality of real scenes, and the algorithm is only related to the image resolution. This paper discusses the significance of image-based virtual scene rendering technology, discusses the photography geometry principle of stereoscopic vision and discusses the method of constructing virtual scenes with 3-dimensional plenoptic function to reduce the possibility of traditional methods falling into local optimum in corresponding point matching.

2. Photography geometry principle of stereoscopic vision

Virtual reality technology is a focus in the field of science and technology both at home and abroad in recent years, involving research fields such as computer graphics, dynamics and artificial intelligence. With the development of related disciplines, virtual reality technology has developed rapidly and is used in the fields of aerospace, medical rehabilitation, building and manufacturing. With the help of computers, VR technology realizes the virtual illusion that people can feel through visual and audio means. Virtual reality technology has the characteristics of immersion and interactivity. It uses a variety of information channels for the simulation of advanced user interfaces in a timely manner. The information received by human beings through visual perception accounts for 80% of the total amount of information received. Building virtual reality is an important part of virtual reality and has been widely used in many fields[1].

2.1. Principle of imaging geometry

Virtual reality technology requires users to have a strong sense of immersion in the virtual environment. Building a virtual scene is a way for users to experience realistic visual effects. The imaging systems usually turn a three-dimensional scene into a two-dimensional grayscale image. Perspective projection is a commonly used imaging model. It is characterized in that the light of the scene passes through the center of the projection, and the straight line perpendicular to the image

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plane is the projection axis.

Orthogonal projection is a special case of perspective projection, which projects a scene onto an image plane using the light parallel to the optical axis. Obtaining the distance between each point and the camera is an important task of the vision system. Each pixel value in the depth map represents the distance between a point in the scene and the camera. Passive ranging sensor is the optical energy emitted by the vision system. The depth information of the scene is restored on the basis of the image. Depth information can be estimated indirectly by using gray image shading features and motion features. Radar ranging system and triangulation ranging system are commonly used active ranging sensor systems. Active vision mainly studies the combination of vision and behavior to obtain stable perception by actively controlling camera position and aperture parameters.

2.2. The principle of stereoscopic imaging

It is the most difficult step of stereoscopic vision that the stereoscopic imaging system can find the conjugate pair in the stereoscopic image pair to the actual stereoscopic image pair. Many constraints have been established to reduce the corresponding point mismatch. The traditional feature point search is to select feature points on one image, and one image feature point is located on the epipolar line corresponding to the other image. If the distance between the target and the camera is known to be within a certain interval, the search range can be limited to a small interval, which can greatly narrow down the search space for finding the corresponding point and can reduce the number of mismatched points. Due to the camera position measurement error, the matching points may not appear exactly on the corresponding epipolar line in the image plane.

Stereoscopic vision usually consists of more than two cameras. The light intensity of the corresponding points in the scene may vary greatly, and the image needs to be normalized before matching. Each feature point of one image can only correspond to a unique point of another image. The projection of each point on the surface of the object on the image is continuous, and the continuity constraint at the boundary of the object does not hold.

2.3. Regional correlation

Edge features often correspond to the boundaries of objects. The depth value of the boundary can be any value between the depth distances of the closed edge of the object. The edge of the contour image observed in the two image planes does not correspond to the edge of the object, and the edge of the image plane can only be detected along the closed edge. The basic problem of restoring depth is to identify more feature points distributed in the image.

Matching points in the two images should be as easy to identify as possible. The interest operator should look for areas with large changes in the image. It can be selected at where the interest measure function has a local maximum value. After the features are identified in the two images, many different methods can be used for matching[2]. Only points that meet the epipolar constraint can be the matching points.

3. Methods for constructing virtual scene of plenoptic function

IBR technology has changed people's understanding of traditional computer graphics. The IBR technique for constructing a virtual environment is based on the theory of plenoptic functions. The panorama method constructing a virtual scene has broken through the matching features of image samples. The virtual scene construction method of the uniform circular trajectory image sequence is a three-dimensional plenoptic function. It can produce visual effects with horizontal stereo and is easy to be obtained. The rendering process is independent of the internal parameters such as the focal length of the camera, and has a high operational efficiency.

3.1. Plenoptic function

The plenoptic function describes all the information seen from any point in space, describes the possible environmental mapping geometry in a given scene, reconstructs a continuous plenoptic function from some directed discrete samples and draws a new view through the resampling function. As long as the incident light is collected at any viewpoint, the scene can be constructed in some way. Images are also information that passes through a certain point in space at a certain time.

The five-dimensional plenoptic function is difficult to capture. The dimension of plenoptic function can continue to decrease. The plenoptic function constructs a virtual scene by reconstructing a continuous plenoptic function from the light information sampled in space in a certain way according to the Nyquist's law. The plenoptic function is sampled according to the viewpoint parameters, and the image observed through the viewpoint is obtained.

3.2. Methods for constructing plenoptic function virtual scene

The two-dimensional panoramic view is fixed. The plenoptic function reduced to two dimensions is to fix points of sight and collect only the information of a fixed point of light in space. The points of sight cannot be moved in the reconstructed virtual scene, and there is no parallax to produce stereoscopic sense. If a panoramic camera is used, the panorama can be easily obtained. Photographs taken in different directions can be stitched into a panorama by a normal camera.

The main process of constructing virtual scene by panorama method is to stitch panorama. The panorama reflecting a specific scene will be obtained by seamlessly stitching the images with overlapping boundaries collected by the camera, such as stitching a straight line into a broken line.

The current image stitching algorithm generally uses the stitching algorithm and the suturing algorithm. The matching is performed by searching for local correspondence. The sample sequence acquisition process for stitching the panoramic image is that the center of light is fixed at the fixed center, and a certain angle is taken to take a photo and make it rotate in a fixed plane. It can be considered that there is a translation relationship between adjacent image samples in the same image space. The vertical edges of the image become an important feature in the match.Based on the vertical edge processing method, the overlap region of adjacent image samples is found by the image difference method.

Image samples are often rich in detail. Digital image capture is not exactly the same due to the presence of random noise. Edges in detail textures often introduce additional errors into the processing. The smooth image samples are sharpened by vertical edges, and the image sample convolution gradient operator method is used to highlight the sharpened edge features without causing the edges to be widened to introduce errors[3].

3.3. Methods for constructing virtual scene with uniform circular trajectory image sequence

Plenoptic functions and panoramas with two-dimension can not provide stereoscopic sense of vision. An appropriate form of the plenoptic function should be found to create a virtual scene. When a person moves in a horizontal plane and there is no parallax in the vertical direction, he can still feel a strong sense of stereo vision. The image virtual scene construction method based on the uniform circular trajectory image sequence is to place the camera around the center of rotation O, and the captured image sequence is used as an input to construct a three-dimensional plenoptic function. The image observed at different points of sight within a certain range of the horizontal plane can be obtained through the processing of the obtained image sequence, and the acquisition of the image sequence is simple.

For example, by shooting light with a radius of R in some horizontal direction on a circle, the light in the horizontal direction of all points in the plane can be obtained. The camera has a certain horizon in the horizontal direction. Photography can not get all the horizontal light of the shooting point, but can only reconstruct and draw views with in a certain range of visual points.

In practice, the image captured by the camera consists of pixels. Assuming that each column in the image represents light in a certain direction in the horizontal plane captured by the camera, the light taken is not continuous and the shooting position of the circumferential camera is discontinuous, then the points between adjacent positions can be estimated by interpolation.

3.4. Scene depth computing

The construction of the virtual scene enables the user to move within a certain range of scenes.

The traditional method of calculating depth first uses two calibrated pinhole cameras to capture images of the same object at different positions. It is preferred to search for matching points in the second image to calculate the three-dimensional position of the points in the first image. People have done a lot of work on depth calculations. The multi-baseline stereoscopic imaging algorithm eliminates the effects of noise through multiple images and is superior to traditional correlation-based algorithms.

Each feature point of an image can only correspond to a unique feature point of the image. Since most feature points are not very obvious, it often produces corresponding ambiguities. One point may be the real corresponding point, and the other points are false corresponding points. The use of multi-baseline stereoscopic imaging is an effective way to eliminate the ambiguity of corresponding points.

In practice, it is not necessary to calculate the depth of each image in the input image sequence, and the depth information of all scene points can be obtained by calculating depths of one panorama.

4. Experiment of constructing virtual scene

Using the sharpening image method to highlight the matching features of the sample, in most cases, the automatic stitching of the panoramic image can be completed, which effectively avoids the latter search process from falling into local limits, and the stitching result is basically seamless. The method of minimum similarity distance is insensitive to the change of image brightness and has a certain anti-noise ability[4].

The experiment was carried out in a computer-synthesized simulation environment. The simulation environment is a synthetic indoor scene, including geometric objects such as tables and cylinders placed indoors. The testing on the method of using uniform circular trajectory image sequence to construct a virtual scene produces stereoscopic visual effects, and experiments for obtaining depth information of virtual scenes are better implemented.

Take a video uniformly around the horizontal circle to obtain the desired image sequence. When the parameters of the points of sight are changed, the view of the new points of sight is redrawn according to the principle of the uniform circular trajectory image sequence. When the points of sight changes within a predetermined range, the correspondence relationship between the image sequences corresponding to the points of sight is calculated. When drawing light is not at the sampling point, replace it with an adjacent point.

The simulation environment is an indoor scene, and the vertical depth approximation can be used to mitigate vertical distortion. Assuming that the depth of the scene is a constant, the vertical distortion is reduced, and the width of the image is reduced to varying degrees. Due to the change of the points of sight, the relative depth is changed, and no more information is taken in the vertical direction. The depth of the scene point actually is not s constant. The observed distortion is the difference between the assumed depth and the design. The vertical distortion mitigation method has a small amount of calculation, and it is highly efficient to draw a new point of sight in the construction scene with a uniform circular trajectory image sequence under the condition that the view requirement is not particularly accurate.

Using multi-baseline stereoscopic imaging algorithm to estimate the depth of the virtual scene constructed by the image sequence should first splice the same sequence of each frame to form a panoramic image. Each panorama is 300x240 in size. Cutting the 320x240 image from the L=160 column stitching panorama. Setting the window size for calculating the SSSD function to 9x9. Searching according to the parallax variation of a panoramic column spliced from the longest baseline L=260. Calculating the corresponding depth value. Calculating the SSD for each baseline. The purpose of the search is to find the SSSD minimum depth value. The search range starts from the parallax d=0 to the direction of pixels in panorama is the same as that of reference points in reference image search.

The effect is the best by using the estimated scene depth to correct vertical distortion, but it should be based on estimated scene depth. If the view drawing requirements of scene and points of sight are required to be real-time, and the requirements for image quality is not harsh, the steady depth approximation method is faster.

5. Conclusion

In this paper, the construction technology based on image virtual scene is studied. It is based on the theory of plenoptic function. The continuous plenoptic function is reconstructed using the light information sampled in space in a certain way according to the Nyquist's law. Sampling is performed according to the parameters of points of sight when the parameters of points of sight changed. Firstly, the geometric theory of visual photography for constructing virtual scene is discussed. The plenoptic function is studied according to the related method, and the vertical edge processing stitching algorithm for panorama is proposed. The estimation method on scene depth information is studied.

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