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Research on the Application of Computer Graphics and Image Processing Technology in Graphic Design

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Abstract

Computer graphics and image processing software, as an auxiliary technology widely used in graphic design, can provide creativity and color display for graphic design. At the same time, image processing software can also improve the aesthetics and connotation of graphic design. This paper innovatively proposes a computer graphics and image processing reconstruction method for dynamic object model based on point cloud model. The method adopts the principle of watershed segmentation to segment the image and extract the contour of the watershed; and then uses the silhouette contour sequence modeling method to reconstruct the sparse point cloud model of the object. Finally, the experimental research proves that the image processing algorithm model proposed in this paper can quickly generate a flat model with compact description and appearance.

Keywords

Computer; Image Processing Technology; Graphic Design; Modeling; Visual Shell; Point Cloud Model.

1. Introduction

Graphic design is essentially a combination of art and technology, and the application of computer image processing software can express the designer's ideas in visual form. The relevant software provides a platform for designers and enhances the appeal of graphic works. Graphic design plays a role in beautifying the image, which is in line with the purpose of computer graphics and image processing software. The use of computer graphics and image processing software in graphic design can meet the aesthetic needs of users and design graphic design works that have both beauty and ideas. Graphics processing unit (GPU) is a key component for graphics rendering, image and video processing and display, and it generally exists in various systems that need to accelerate window systems, graphical interfaces, game scenes, image applications, and video playback. The image processing unit is an important component in the GPU responsible for pixel, texture and bitmap loading and reading, and can perform color transformation and processing during the loading and reading process. It is responsible for providing GPU support for image pipeline and image processing subset functions [1]. Aiming at the problem that grid processing and texture mapping increase modeling time in graphic design, this paper proposes a method of reconstructing dynamic object model, which can solve this problem to a certain extent. The method in this paper is based on the fact that plane-space color local consistency can quickly generate a plane model with full-view, compact description and appearance representation through a silhouette contour sequence modeling method, and reconstruct the object geometry while reconstructing the object.

2. Key Computer Technology in Graphics and Image Processing

In essence, the application of computer technology in graphic image processing is to convert graphic images into digital information, then store the digital information in the computer, and use related

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algorithms to reasonably process graphic images, so graphic image processing can be regarded as an editing process [2]. With the development of social times and science and technology, the application of graphics and image processing technology in various industries has become more and more extensive, and the application of computer technology for graphics and image processing has become the norm, which can be basically divided into image coding, image enhancement, image restoration and Image digitization and other types.

2.1 Computer Graphics

The most effective way to attract customers' print advertisements is to create visual impact, which can deepen customers' memory points. Computer graphics converts product effects into visual pictures or videos to increase audiences by technical means; in the field of entertainment, computer graphics can be used to design plane characters, animated characters, game interfaces, movie special effects, etc.; in art design, commercial advertising and other industries, Graphics also plays an important foundational role. Richard Hamming has proposed that the purpose of computation is to gain insight into the nature of things rather than to obtain a numerical point of view. This also shows the importance of computer graphics in print advertisements [3]. The form of graphic images is more attractive than numbers, which greatly promotes the presentation of the effect and also provides help for the design of print advertisements. For example, if a company wants to design a print advertisement, the traditional design scheme is to create the entire print advertisement by hand-painting, but once there is a deviation in the design process, the designer needs to repeatedly modify and create to achieve the best effect, using computer graphics Designing a print ad can reduce many of the modification processes and make print ads more accurate.

2.2 Computer Image Processing

The development of informatization has made the development of many industries more and more colorful. Computer image processing is based on the development of ordinary iconography. The original use of iconography is to explore the history of art and the symbolic meaning of works of art. Through years of in-depth research, relevant experts have introduced basic imagery concepts into computer systems, and have made them widely and deeply diffused and developed. Computer image processing technology has a wide range of applications. The speed of image processing is improved by applying digital means, and it provides practitioners with a simple and operable platform. Through computer image processing, the following functions can be achieved: First, the visual effect and visual quality of the image are improved, and the visual quality of the image can be improved by adjusting the brightness and chromaticity of the image. Secondly, it is the information extraction of images and the functions of image data transformation, compression and automatic coding [4]. The target image is input, processed and output by using computer image processing techniques. Image extraction includes feature extraction, texture extraction, information extraction, text extraction, domain extraction, etc. Finally, the functions of image restoration, enhancement, segmentation and description are realized. The image enhancement and restoration function can improve the quality of the image and enhance the details of the image. The image segmentation function is one of the key technologies to calculate the image processing function, which refers to the application of computer image processing tools, and the use of segmentation, extraction and other methods to separate effective image information. Image description function is the precondition to realize image recognition.

3. The Algorithm Design of this Paper

The meaning of the target map and reference map is shown in Figure 1 (the picture is quoted from Incremental digital volume correlation method with nearest sub volume offset: An accurate and simple approach for large deformation measurement), where $m_i(i=1,2,\cdots)$ represents the pixel and C represents the target image camera optical center , e' represents the pole of the camera center of

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the target image in the reference image, and $l_i^{'}(i=1,2,\cdots)$ represents the corresponding epipolar line of m_i in the reference image.

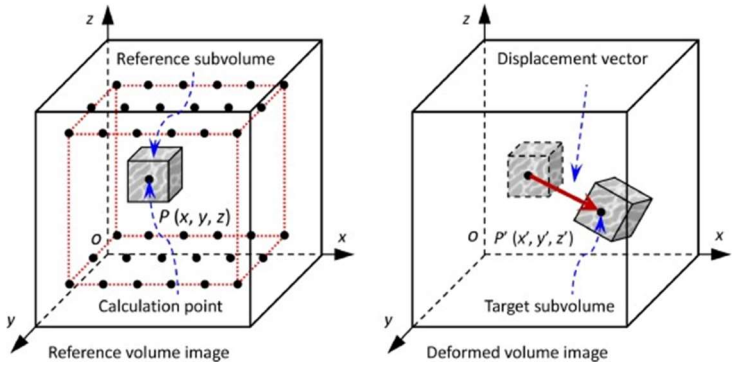

Figure 1. Schematic diagram of target image and reference image

In principle, the projected point of the point cloud model to each reference image should be located within the silhouette outline of each reference image. However, due to the instability of numerical calculation, noise points that do not meet this conclusion are often generated [5]. Therefore, the noise points of the intermediate point cloud model are eliminated according to whether the projected points are within the silhouette outline. The principle of plane-space color local consistency is shown in Figure 2 (the picture is quoted in Quantitative super-resolution solid immersion microscopy via refractive index profile reconstruction). It has two meanings:

Pixels in the same area of the image have the same or similar color values. In this paper, the fractional ridge area segmentation method is used to obtain the local area of the image with similar colors. It is assumed that a local area $A, p(x_i, y_i)$ of the two-dimensional image is the pixel point $i=1,2,3,\cdots,N,N$ in the area (indicates the number of pixels in the area), that is, $p(x_i, y_i) \in A$. The pixel value of the point in this area is $I(x_i, y_i)$, then $I(x_i, y_i)I(x_1, y_1) \approx I(x_2, y_2) \approx \ldots \approx I(x_N, y_N)$. 2)

The local color consistency on the image plane is reflected in the corresponding plane model surface area in space. From the perspective of projection, the perspective projection model can be used to illustrate the principle of plane-space color local consistency.

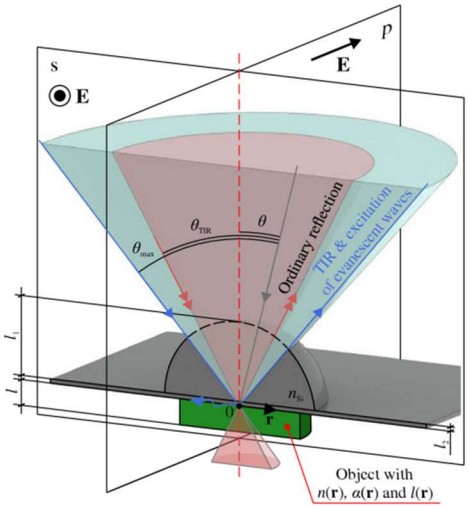

Figure 2. Schematic diagram of plane-space color local consistency

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Assume that the space point $P(X_i, Y_i, Z_i, l)^T, i = 1, 2, 3, \cdots, N, N$ where the line of sight l intersects with the geometric shape of the space object represents the number of intersecting space points; its projection point on the image plane is $p(x, y, l)^T$; the corresponding projection matrix is M , which is a 3×4 order matrix; Q is the camera lens parameters. Then the projection relation is:

$$\lambda p = MP \tag{1}$$

The color value of the image plane pixel to the corresponding point in space is mapped as:

$$I(X_i, Y_i, Z_i, M, Q) = I(x, y) \tag{2}$$

In formula (2), in order to reduce the error of pixel value mapping, the pixel value of the plane pixel is formed by superimposing the pixel value of the pixel point and the neighboring pixels according to a certain weight, and then mapped to the corresponding spatial point. Using the principle of the closest point of view to obtain the point $(FMP)P(X_{FMP}, Y_{FMP}, Z_{FMP}, l)^T$ where the line of sight intersects with the geometric shape of the object and is the closest to the point of view, then:

$$I(X_{FMP}, Y_{FMP}, Z_{FMP}, M, Q) = I(x, y) \tag{3}$$

All FMP constitute a sparse point cloud model. The algorithm flow of the point cloud model is shown in Figure 3 (the picture is quoted from Correlation scan matching algorithm based on multi-resolution auxiliary historical point cloud and lidar simultaneous localization and mapping positioning application).

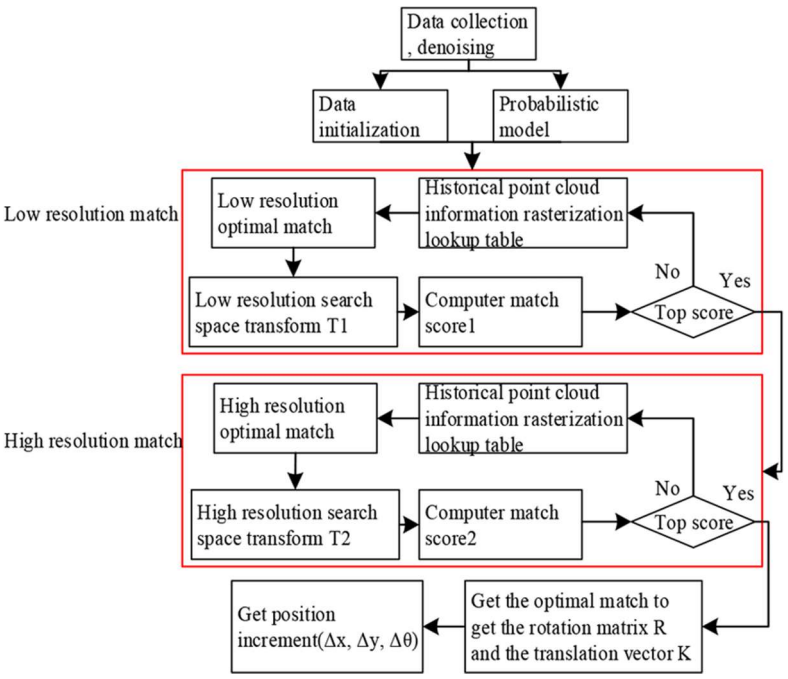

Figure 3. Flowchart of the algorithm in this paper

In this paper, four recursive expansions are carried out, and the point color values of the expanded point cloud model space are taken from the corresponding target image. Because in the process of

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forming a space point, the data structure of the space point saves the coordinate position information of the pixel point corresponding to the space point, so the process of mapping the pixel color value of the image plane to the space point is not complicated [6]. Assume that the illumination model of the object satisfies the *Lambert* model, P_A, P_B are two high-confidence points, and P_C is the middle point of P_A, P_B; project P_A, P_B, P_C into the corresponding target map, and obtain the color values of P_A, P_B and P_C according to the principle of plane-space color local consistency . Assign the color value of P_C to the extended space points between P_A, P_B. Assuming an expanded spatial point $P(X_j, Y_j, Z_j, I)^T, j = 1, 2, 3, \cdots, N$, where N represents the number of expanded spatial points between P_A, P_B, then:

$$I(X_j, Y_j, Z_j) = I(X_{pc}, Y_{pc}, Z_{pc}) \tag{4}$$

By checking whether the projection of each expansion point is outside or inside the silhouette contour line of the corresponding target image, it is judged whether to keep the expanded space point. This step reflects the main idea of the algorithm.

4. System Check

Functional simulation is divided into module-level functional simulation and system-level functional simulation. First, a single module is simulated and verified at the module level. After the function and performance of each module meet the design requirements, each module is interconnected and system integrated, and then the system level is performed [7]. Virtual simulation verification. This section focuses on the system-level functional simulation verification after the integration of the entire image processing unit. For system-level simulation verification, a virtual simulation verification platform for the image processing unit shown in Figure 4 is constructed (the picture is quoted in Powertrain development without additional hardware).

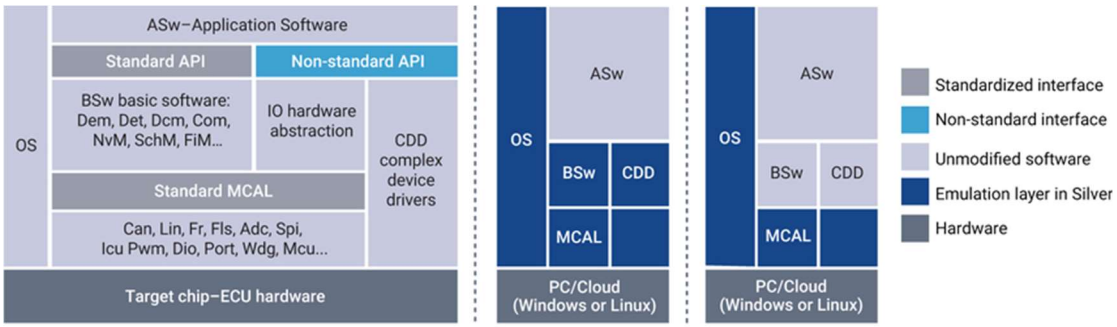

Figure 4. Virtual simulation verification platform of the image processing unit

Testcase and data transmission bus functional model (BFM) are used to apply test stimulus to the design; image processing unit model is the functional model used for comparison with the image processing unit RTL. Testcase, as the excitation of the whole platform, is responsible for sending BFM to the image through data transmission The processing unit RTL and the image processing unit model send image data, and the register configuration of the image processing unit RTL and the image processing unit model can produce different image processing effects. The data processed by the image processing unit RTL in the platform has two Output direction, DDR model and data comparison BFM. Data comparison BFM selects one of the image processing unit RTL and DDR models according to the current output direction and compares it with the results of the image processing unit model. In the watershed contour extraction algorithm, the parameter λ1, the size of

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λ2 has a great influence on the image quality, the small threshold is used to control the edge connection, and the large threshold is used to control the initial segmentation of strong edges. In this paper, the influence of different typical thresholds on the extraction of watershed contours is analyzed as follows: As shown in Figure 5, when λ2 increases while λ1 remains unchanged, the quality of watershed contour extraction tends to deteriorate, and some contours are lost (the picture is quoted from https. //theailearner.com/tag/watershed-OpenCV/). Under the condition that λ2 remains unchanged, when λ1 decreases, the extraction quality of watershed contour tends to be better, but false edges may appear. The largest outer contour in Fig. 5 is obtained by the contour extraction algorithm, not by the watershed contour extraction algorithm.

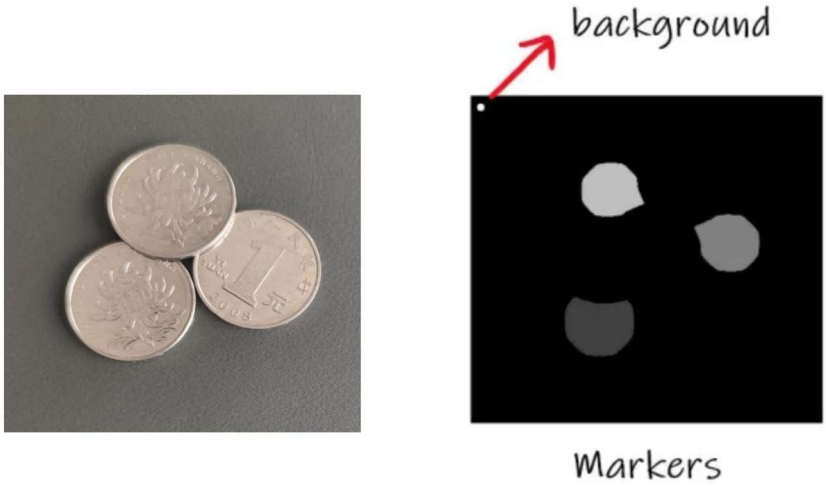

Figure 5. The watershed contour extraction result of the image

5. Conclusion

The application of computer technology in graphics and image processing has strong professionalism, and it is widely used in various industries in today's society, and plays an important role in the application of key computer technologies such as CAD technology and digital technology. The method in this paper does not guarantee the complete correspondence of the color values of the plane pixels mapped to the corresponding positions of the spatial points, but it does not affect the browsing and use in general. The work in this paper promotes the further use of reconstruction technology based on the principle of silhouette contour sequence in dynamic scene applications where fast reconstruction is required and the plane model should have appearance.

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