Image 3D Reconstruction System for Indoor Environment Based on JAVA 3D

Li Qian

College of fine arts
Xi'an university of technology
Xi'an 710048,China
li0q0an@yahoo.cn

Abstract—**The reconstruction of virtual indoor environment with sense of reality has a great important significance for consumer to select and purchase a house. JAVA 3D has the characteristics of security and platform independent. It is a strong tool, which help user realize three dimensions stream in network age. With the advantages of JAVA 3D's three-dimensional modeling, we established the image 3D reconstruction system for the indoor environment. The system reconstructed the indoor virtual space through some images, and it can import various formats of three-dimensional objects for interactive operating, which to attain the goal of decorating the indoor space virtually. In addition, the system can solve independence of platform and transportability of the system is added. Finally, the proposed method in the paper is testified by the experiment.**

Keywords- JAVA 3D; virtual; image; 3D reconstruction; interactive

I.INTRODUCTION

In order to avoid structure break and waste due to two times repairing, housing and the city country construction department continuously descend the notice to request raising the proportion of hardback building to gradually instead semi-finished product building on the market. It is clear that the ages of heavy adornment has been already come, what we need do is to rebuild the virtual indoor environment with photograph class true feeling. On the foundation of this virtual indoor environment, the consumer can decorate a choosing of thing and create the characteristic space of having the unified art style, and purchase all adornment products with indoor environment on the market. The virtual environment is to study a topic on picture processing, artificial intelligence,etc. The important research achievement in many directions is developed, such as medical science, aviation, military and number. In the paper, with the advantages of JAVA 3D's three-dimensional modeling[1-3], we established the image 3D reconstruction system for the indoor environment[4,5]. The system reconstructed the indoor virtual space through some images, and it can import various formats of three-dimensional objects for interactive operating, which to attain the goal of decorating the indoor space virtually.

II. THE INTRODUCTION OF SYSTEM FUNCTION

In the paper, JAVA 3 Ds/JAVA is used as development tool to build up virtual indoor picture 3D reconstruction system[6-9]. The whole system is composed of photograph model, light model, 3D model database, network publication, which is shown as Fig.2.The user can rebuild an indoor virtual space by inputting a few photographs, and can duct into complicated 3D object to carry on adornment from the model database.

A. Photograph Model

The preparation work of photograph model includes taking photograph, recovering camera parameter, extracting outline line, picture partition. The light heart O is taken as origin, and the directions which parallel with row are the x-axis and the y-axis,and light stalk direction is z stalk, coordinate is built up. Then

$$\frac{f}{z} = \frac{(u-u_0)}{x} dx = \frac{(v-v_0)}{y} dy \qquad (1)$$

where (u, v) is the shadow point of the point(x, y, z), (u_0 ,v_0) is a handing over of light stalk and picture flat surface; dx,dy means respectively the pixel of x direction and y direction, f is the focal distance of camera.

$f_x = f / dx$, $f_y = f / dy$, Eq(1) is transformed into followings:

$$u - u_0 = \frac{f_x}{z} x, v - v_0 = \frac{f_y}{z} y \qquad (2)$$

Establish arbitrarily order(x, y, z), then the relation between (u, v) and (X, Y, Z) is:

$$z \begin{pmatrix} u \\ v \\ 1 \end{pmatrix} = \begin{pmatrix} f_x & 0 & u_0 & 0 \\ 0 & f_y & v_0 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} R & t \\ 0 & 1 \end{pmatrix} \begin{pmatrix} X \\ Y \\ Z \\ 1 \end{pmatrix} \qquad (3)$$

where u_0,v_0,f_x,f_y are called parameter inside the camera; R and t are revolve matrix of 3 ×3, 3 ×1respectively.
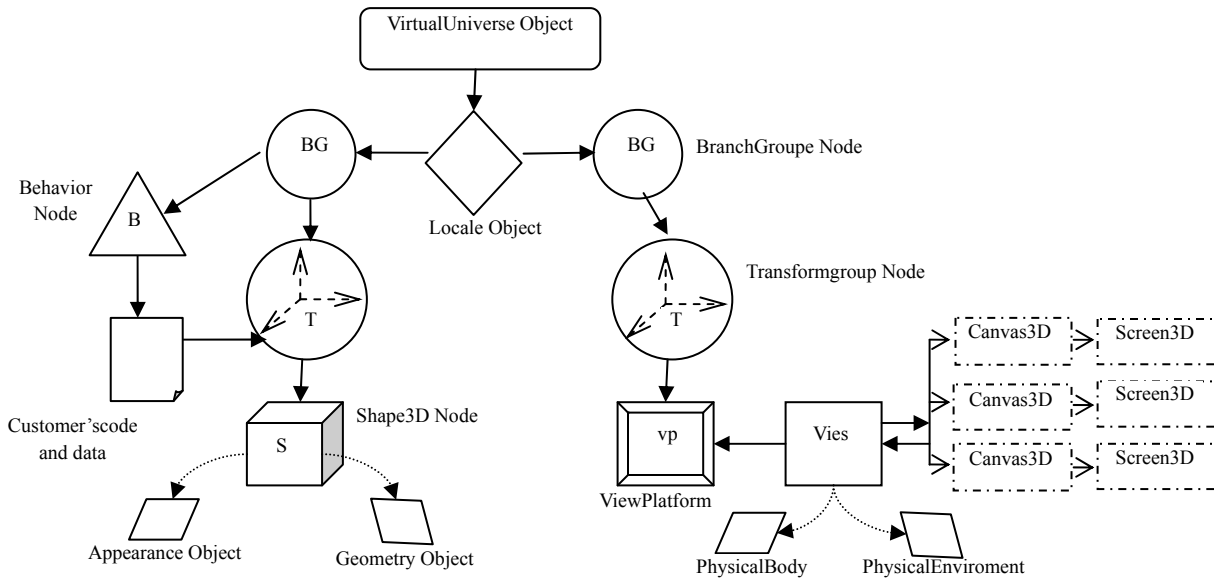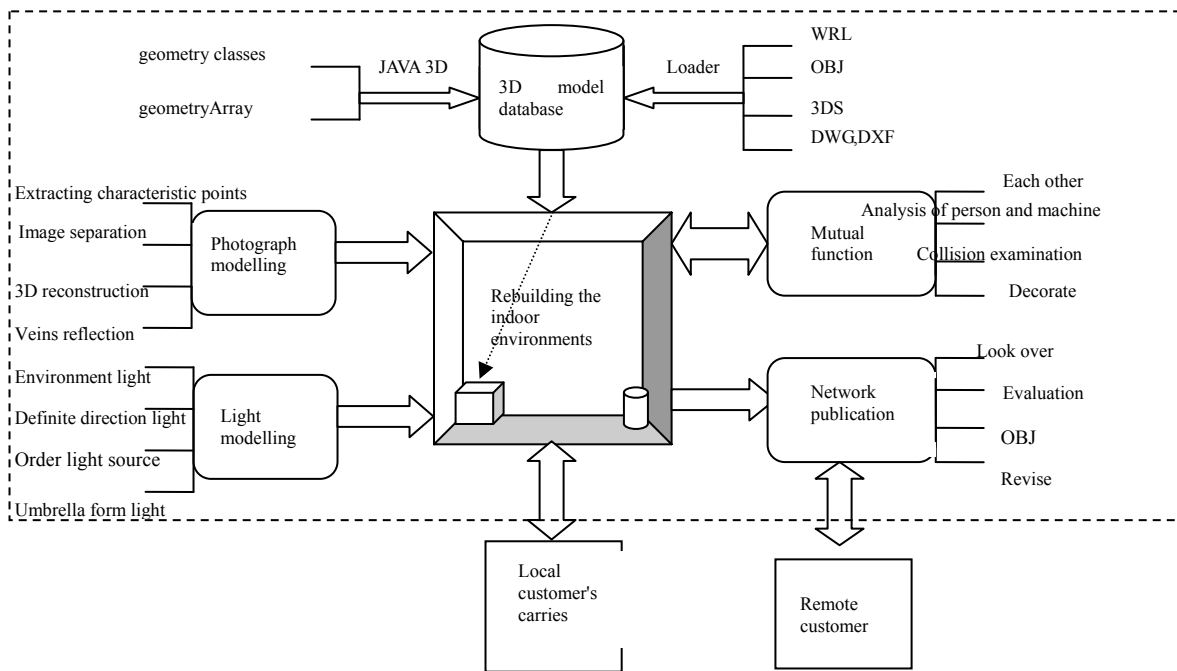
Figure 1. JAVA 3D scene diagram

Figure 2. The system function diagram

The reconstruction work includes geometry reconstruction and veins reconstruction, the flow diagram of geometry reconstruction is shown in Fig.3. The steps are: carry on a picture according to the photograph, and the characteristic point is exacted. Make use of the room in the picture scene, and in order to get of camera parameter to resume room of 3D information, geometry model is built up. Secondly, veins reconstruction is processed, compute sex matrix of each vein ,then the veins are transformed into face veins image. Finally, veins are completed after veins reflecting.
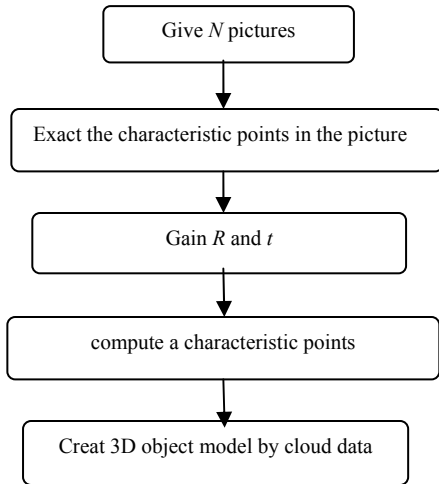
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┌─────────────────────────────┐
│      Give N pictures        │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────────────┐
│ Exact the characteristic points     │
│ in the picture                      │
└─────────────────────────────────────┘
              │
              ▼
┌─────────────────────────────────────┐
│         Gain R and t                │
└─────────────────────────────────────┘
              │
              ▼
┌─────────────────────────────────────┐
│   compute a characteristic points   │
└─────────────────────────────────────┘
              │
              ▼
┌─────────────────────────────────────┐
│ Creat 3D object model by cloud data │
└─────────────────────────────────────┘
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Figure 3. The flow diagram of geometry reconstruction

B. 3D Model Database

The indoor 3D object model database is the foundation that carries on virtual indoor adornment. The system exploitation connects the conjunction database by making use of interface and develop an indoor 3D entity model database mold piece. The indoor 3D entity model resources of stock keep and management includes: ①Geometry data of 3D entity model and its key parameter; ②The text file of related model attribute information; ③veins data and a sketch plan data of model.

C. Light Model

The system imitates indoor space to exaggerate indoor virtual environment in irradiation of light. Make use of light source to organize the appearance of point, line and noodles to constitute, or make use of light source and enhance these spaces to reach stereoscopic feeling and sense of vision of piece. The light reconstruction of the indoor environment is completed by the constitution of AmbientLight (environment light); DirectionalLight(definite direction light);PointLight (point light source) . The environment light is only called diffusion light or spreads to cast light. After giving various characteristic parameter of the type of settling the light source, light source, color and object surface, other objects are taken no account of in the scene.Color and strength will be called this kind of part light photograph calculation model. The different light source position, light color and amounts can create different environment atmosphere, the design of light environment should well combine physiology, appreciate beauty and sense of vision ,etc.

D. Mutual Function Mold Piece

Mutual function mold piece is mainly used for controlling object's revolving, the light exaggerating, distance measure, 360 degrees looking into and collision examination, etc. Moreover, this function mold piece can also introduce a virtual person to carry on a person machine analysis and valuation. Mutual function is the technique guarantee that carries on virtual adornment each other. The virtual person can imitate geometry size of a person, and analyze and examine the surrounding environment, even can also use a furniture product, such as switch electric light, curtain doors and windows and wardrobe refrigerator, broadcast television music, etc.

Figure 4. Reconstruction image of photo

III.CONCLUSION

The virtual indoor picture 3D reconstruction system is an effective method that the common consumer carries on oneself adornment and valuation. This text uses JAVA 3 D technique to check against a slice of 3D model and hand over with each other. In the paper, with the advantages of JAVA 3D's three-dimensional modeling, we established the image 3D reconstruction system for the indoor environment. The system reconstructed the indoor virtual space through some images, and it can import various formats of three-dimensional objects for interactive operating, which to attain the goal of decorating the indoor space virtually. The experimental results have proved the usefulness and effectiveness of this method.

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