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Three-dimension design analysis of interior decoration based on construction information modeling

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Abstract. A kind of three-dimension design analysis method of interior decoration for construction information modeling based on wavelet algorithm was proposed to increase the effectiveness of three-dimension design analysis of interior decoration. Firstly, modeling and visualization method of interior decoration of construction information modeling was offered and the house side is mainly composed of a quadrangle, which can be indicated with facets composed of triangles; secondly, a kind of improved finite difference algorithm based on wavelet noise filter was proposed to realize effective analysis on three-dimension design of interior decoration for construction information modeling; finally, effectiveness of the proposed method was verified through experimental research.

Key words. Construction information, Interior decoration, Three-dimension design, Visualization.

1. Introduction

The world is manifested as various figure and data. People have always tried to describe, handle and display as many as objects in the world through computers since they were invented. Graphics technology was generated with development of computer technology and interactive image display equipment and methods to define free-form surface appeared in the early 1960s; geometric modeling technology appeared in the 1970s and graphic workstation appeared in the 1980s and graphics technology went through several phases such as forming, development and improvement, etc until present graphics network technology appears. Today graphic technology goes deep into various fields to be an indispensable part of computer science and technology field. Realization method and means of graphics system has

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been more and more advanced so far to further increase and strengthen operation efficiency of the overall system.

Information quantity in the three-dimension world is far more than that of a two-dimension world, thus description difficulty of the three-dimension world is very huge. A need is clearly reflected by the huge quantity of information needing to be described and handled, namely there shall be a technology to perfectly present the three-dimension world. Computer graphics has developed rapidly and three-dimension presentation technology has been more and more perfect in recent years; graphics system has been gradually developed to three-dimension plotting from two-dimension plotting and it has been gradually penetrated to development and research of graphics system with object-oriented approaches to make design thought of graphics system conform to natural thinking way of humans more; function and exploitability of the graphics system itself are further increased through application of human-computer interaction technology.

Three-dimension graphics technology is mainly applied to three aspects: scientific visualization, computer animation and virtual reality technology. Three-dimension graphics system of comprehensive application of object-oriented technology and human-computer interaction technology is the most competitive and influential with wide development prospect from the perspective of market share and technology in current fierce graphics system competition. A comprehensive application of object-oriented technology and human-computer interaction technology of virtual reality is described in this thesis.

2. Research background, purpose and meaning of the system

2.1. Purpose and meaning

Primary decoration upon purchasing a new house and once more decoration of the old house are very frequent with increase of people's livelihood in current society. There is usually the problem that routing and layout of interior decoration are not clear due to absence of interior decoration drawing, causing interior decoration damage and necessary troubles to decoration during current house decoration, especially during redecoration of a second-house house. So, it becomes a problem to be solved to provide accurate and reliable interior decoration information for the construction organization.

Some domestic companies are also devoted to interior decoration management and construction software development, but most systems are 2D or 2.5D. Interior decoration on the wall is criss-cross and it is insufficient to present it with a surface; overall 3D state cannot be embodied upon wiring in the house and there is no intuitive effect. Common wiring design software in current domestic market are Hongye software and Tianzheng software, etc and Tianzheng software is widely used because its design is close to habits of project personnel. Set Tianzheng software as an example, it is constructed based on AUTOCAD software and dominant in planar wiring diagram, thus it is close to reality of project design personnel and has good application value. But the developer is not oriented from the perspective of house users because it is hard for house users to understand drawings and software installation is not easy and it is not 3D. The software cannot give people a stereo feeling of 3D wiring and there are usually the problems that 2D design is not intuitive and design drawings are not coordinative and comprehensive drawing review is difficult in construction drawing design phase, etc in project installation. Hidden interior decoration is clearly and intuitively presented in front of the users from the perspective of 3D with Virtual Reality and Delphi object-oriented programming technology; interior decoration drawing is kept at the time of decoration so that it can be opened, edited and stored at the time of decoration each time. Software of such functions is applicable to decoration companies, construction personnel and house owners to provide great convenience for them, thus it has huge market potential.

In initial period of decoration, construction personnel establish house 3D model, select all walls of specific construction, input interior decoration installation drawing to the computer and store it into the database. Related personnel can obtain drawings from the database and display it in house 3D state so that layout and wiring of interior decoration are intuitive at the time of decoration for a second time; then needed wall information can be obtained and corresponding original construction drawing can be modified and edited before storing it into the database once more according to specific situation of this decoration. It can not only help construction personnel to arrange interior decoration and the trend reasonably, but also provide referential basis for decoration once more, thus interior decoration layout will be mastered when the house is decorated for a second time.

2.2. Modeling and visualization of houses

The house is geometric object of interior decoration at the time of decoration and the basis of buildings. It can be found from data structure of house model that complex houses are actually composed of many simple parts and each part occupies a space scope of certain size; each surface of the house may be equipped with different interior decoration colors or texture attribution features. Secondly, a house model exists in monomer state in most cases; for example, a room is composed of several walls and a roof. So, Geometric data capacity can be reduced and 3D display speed can be increased through simplifying house models at the time of 3D plotting. Scene tree structure of a house model can be decomposed into texture data of roof, wall and all surfaces according to data structure of 3D target model, as shown in Fig. 1.

House visualization is mainly composed of house side visualization and complex roof visualization. House sides are mainly composed of several quadrangles and they can be indicated with facets composed of triangles. While the house roof is commonly a complex polygon structure and polygon on the house roof is segmented into triangles for visualization in consideration that the triangle is the most basic figure to be applicable to figure display; a complex house roof should be realized through designing algorithms. There are wide researches at home and abroad for model construction methods of geometric objects of buildings and structures and the main research is focused on automatic or semi-automatic 3D reconstruction of building model; the main research content is automatic extraction and 3D reconstruction of building roof model. These researches are mainly focused on stereo reconstruction of a single room model and there are some defects of research on aspects of editing and interactive operation of 3D model such as model shape change and analysis function development, etc.

Geometric object on the house surface is stored in the computer in digital form upon modeling and virtual houses can only be seen through visualization of the model. Computer graphics knowledge shall be adopted to display all house models through the computer and certain algorithms; meanwhile, the house 3D model system can be optimized through effective data processing, LOD algorithm, data processing of multi-resolution and vivid texture mapping.

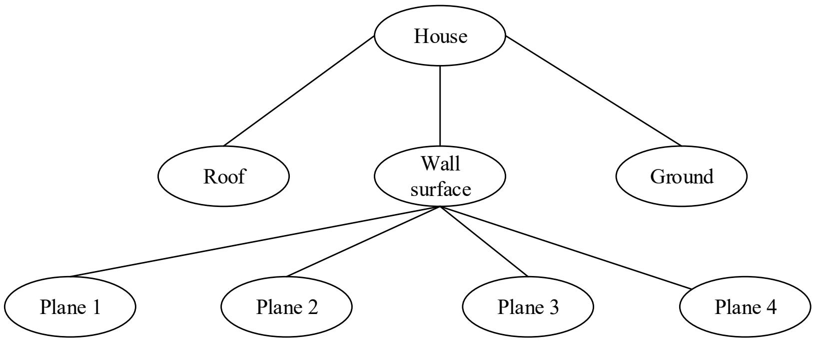


Fig. 1. Structure diagram of 3D scene tree of a house

3. 3D design of interior decoration based on wavelet

3.1. Pick method of the system in human-computer interaction

The house model is 3D and interior decoration on all surfaces is conducted on 2D surface; interior decoration drawings are pasted to corresponding surfaces of the house 3D model, so the problems of human-computer interaction and wall pick shall be solved for the system. Pick operation refers to that the user can return to a mark and certain related information of the drawing element when certain application of drawing element is clicked on the screen with the mouse. General thought of pick algorithm is: screen coordinate on the mouse clicking is obtained and then converted to client area coordinate to realize inverse transformation of the visual area; then the coordinate is converted to a ray shooting into the scene passing through viewpoint and mouse clicking point through projection matrix and observation matrix and the intersected drawing element information can be obtained if the ray is intersected with drawing element of scene model. So the ray equation is determined upon obtaining direction vector and the eye point of the ray from the perspective of mathematics and finally whether it is intersected with a drawing element in the space can be judged through the ray so as to realize selection of drawing element.

It can be roughly divided into the following several steps according to handling order of pick operation.

Step 1: converting coordinates

Screen coordinate on mouse clicking is obtained and then converted to client area coordinate to realize inverse transformation of the visual area.

Step 2: coordinate of corresponding point to the ray in observation coordinate space is obtained.

Coordinate of corresponding point to the ray in observation coordinate space is obtained. 3D conversion refers to observing objects in current scene through a camera placed in a 3D world. Visual size scope covered by the camera can be set through a projection matrix. Solving method to the selection problem of overlapped objects in the same position is: intersection points can be obtained through intersecting overlapped objects and the ray respectively upon obtaining the ray from screen coordinates; then selected objects can be determined according to their distances to viewpoints so that the objects temporarily covered by other objects can be selected. Screen coordinates can be converted to projection conversion space with inverse transformation of view-port and coordinates near clip plane is obtained for simplicity and corresponding Z coordinate is zero; then this point coordinate is converted from projection space to observation space and corresponding converted coordinate is $P = P \times M^{-1}$ upon assuming point P according to perspective projection definition and graphics principle.

$$P = \begin{bmatrix} \frac{2n}{r-l} & 0 & \frac{r+1}{r-1} & 0 \\ 0 & \frac{2n}{t-b} & \frac{t+b}{t-b} & 0 \\ 0 & 0 & -\frac{(f+n)}{f-n} & -\frac{2fn}{f-n} \\ 0 & 0 & -1 & 0 \end{bmatrix}. \tag{1}$$

Where $(l, b, -n)$ and $(r, t, -n)$ are coordinate values of top left corer and lower right corner for near and far clip planes; n, f respectively indicate the distances from the viewpoint to near and far clip planes. Another intersection point Q between it and far clip plane in the ray direction can be obtained so as to determine the ray equation and the presentation of the direction vector of the ray in observation space can be determined as $(P - Q)$.

Step 3: final operation should be conducted in world coordinate space, so the used points P and Q by vectors should be converted to points in the world coordinate space from the observation space.

$$P = P \times inverse - ViewMatrix\,. \tag{2}$$

Where, inverse-ViewMatrix is observation matrix. Coordinate of observation point in the observation coordinate system is OriginView(0,0,1), so its coordinate in world coordinate system can also be inversely converted to the world coordinate system through ViewMatrix matrix.

3.2. Function of Gaussian noise and the original signal

It is assumed that the original data is polluted by Gaussian noise and the signal model is like

$$g(x,y) = f(x,y) + n(x,y), \quad x,y = 1......N-1\,. \tag{3}$$

Where $g(x,y)$ indicates noised data and $f(x,y)$ indicates the original data; $n(x,y)$ indicates Gaussian noise signal of variance σ^2 and noised data $g(x,y)$ is obtained through addition function of original signal and noised signal; $w_g = w_f + w_n$ is established upon wavelet transformation of $g(x,y)$, where w_g is wavelet coefficient of noised data and w_f is the wavelet coefficient of the original data and w_n is wavelet coefficient of the noise. Then Gaussian noise function can be indicated as:

$$n(x,y) = \frac{1}{\sqrt{2\pi} \times \sigma^2} e^{\sum\limits_{k=0}^{N} \cdot \sum\limits_{L=0}^{n} \frac{(X_{i+k},_{j+l}^{2} - \mu^2)^2}{\sigma^4}}\,. \tag{4}$$

3.3. Adaptive fuzzy wavelet threshold de-noising

(1) Pretreatment on noised data with median filtering method

Data of bad smooth effect is obtained through median filtering treatment on noised figure $g(x,y)$ based on the fact that impulse noise can be well removed and data details and the edge features can be ensured through median filtering method.

Firstly the noise in the data is detected. The signal amplitude will be equipped with high fidelity and introduction of quantizing noise is avoided upon median filtering of the signal; impulse signal can also be effectively filtered and partial Gaussian noise can also be inhibited.

(2) Conducting wavelet transformation on pretreated data to filter Gaussian noise in the data

Data noise is mostly Gaussian noise upon median filtering treatment and wavelet transformation coefficient is obtained through wavelet transformation on the data; estimated value of reconstructed wavelet coefficient is obtained after the data is processed with adaptive fuzzy wavelet threshold for high-frequency coefficients and it is indicated that it is edge detail if wavelet coefficient increases with increase of the scale, so the wavelet coefficient is kept constant; estimated value is obtained from adaptive fuzzy wavelet threshold function in 1-2 equations for other wavelet coefficients and adaptive fuzzy wavelet threshold function is obtained through improvement of soft threshold function.

Soft threshold function:

$$w_{j,k} = \begin{cases} sign(w_{j,k}) \cdot (|w_{j,k-\lambda}|) & |w_{j,k}| \geq \lambda \\ 0 & |w_{j,k}| < \lambda \end{cases} \tag{5}$$

Adaptive fuzzy wavelet threshold function:

$$w_{j,k} = \begin{cases} sign(w_{j,k}) \cdot (|w_{j,k}| - \mu\lambda)) & |w_{j,k}| \geq \lambda \\ 0 & |w_{j,k}| < \lambda \end{cases} \tag{6}$$

Where, $\lambda = \sigma\sqrt{2\log(N)}/\log(j+1)$. λ will reduce with increase of j and μ is a membership function. $\mu = \frac{1}{(w_{j,k}-\lambda)^2+1}$.

Overall continuity of $\hat{w}_{j,k}$ is ensured and $\hat{w}_{j,k}$ approaches $-\lambda$ so as to avoid signal oscillation when $w_{j,k}$ is close to λ; deviation between $\hat{w}_{j,k}$ and $w_{j,k}$ is smaller and smaller when $|w_{j,k}| > \lambda$, thus reconstruction signal will be closer to the real signal. In soft threshold algorithm, λ is reduced by $\hat{w}_{j,k}$, so the deviation should be reduced; estimated wavelet coefficient $\hat{w}_{j,k}$ is closer to $\mu_{j,k}$ when value of $\hat{w}_{j,k}$ is between $|w_{j,k}| - \lambda$ and $|w_{j,k}|$. Then a membership function μ is added to threshold estimation and value of $|w_{j,k}| - \mu\lambda$ is between $|w_{j,k}| - \lambda$ and $|w_{j,k}|$ so as to obtain better de-noising effect. Where, σ^2 is noise variance and N is the length of discrete sampling signal and j is decomposition scale.

Noised function is obtained through wavelet decomposition of $g(x,y)$ in j scale:

$$g(x,y) = \sum_j c_{j,k} n_{j,k}(x,y) + \sum_j d_{j,k} w_{j,k}(x,y)\,. \tag{7}$$

Where, $c_{j,k}$ and $d_{j,k}$ re respectively remaining coefficient and wavelet coefficient of j scale space and function figure is shown in Fig. 2 through adding Gaussian noise to the data after interaction between the noise and adaptive fuzzy wavelet threshold function.

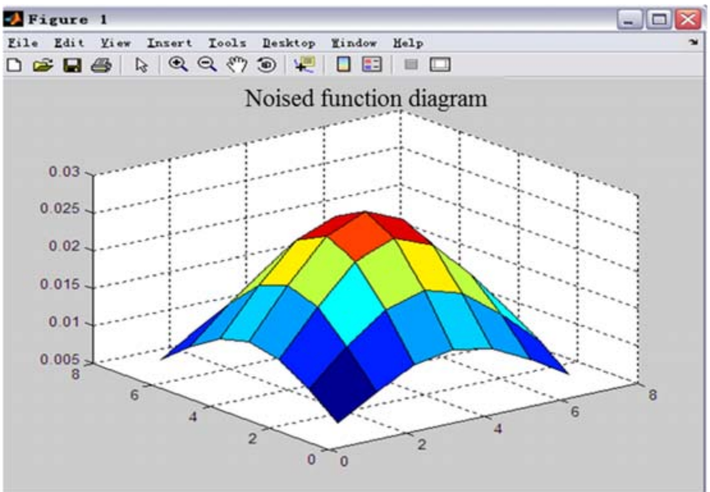


Fig. 2. Function diagram upon interaction of signal and noise

Specific steps for adaptive fuzzy wavelet threshold de-noising method:

1) Input noise data and pre-treat the data with median filtering method.2) Conduct wavelet transformation on pretreated data and adaptive handling way can be adopted for wavelet coefficient; wavelet coefficient of edge details will keep constant and other wavelet coefficients can be handled with fuzzy threshold function.

3) Enhancing processing is conducted on wavelet coefficient after step 2.

4) Invert wavelet transform is conducted on treated wavelet coefficient to reconstruct data.

3.4. Finite difference solution of improved algorithm

It is assumed that $\beta_D = \{\beta_{j,k} \,|j, k \in D\}$ is wavelet coefficient to be restored in abnormal chain area and then adopted finite difference solution is as follows:

$$\begin{aligned}\frac{\partial F(\beta_D)}{\partial \beta_{j,k}} &= \int_{\mathrm{R}^2} \tau \frac{\nabla u}{|\nabla u|} \cdot \frac{\partial \nabla u(\beta, x)}{\partial \beta_{j,k}} + (1-\tau)\nabla u \cdot \\ &\quad \frac{\partial \nabla u(\beta, x)}{\partial \beta_{j,k}} dx + \lambda_{j,k}(\beta_{j,k} - \alpha_{j,k}) \\ &= \int_{\mathrm{R}^2} \tau \frac{\nabla u}{|\nabla u|} \cdot \nabla \phi_{j,k} + (1-\tau)\nabla u \cdot \\ &\quad \nabla \phi_{j,k} dx + \lambda_{j,k}(\beta_{j,k} - \alpha_{j,k})\end{aligned} \tag{8}$$

The above equation can be obtained through integration by parts if mother wavelet ϕ satisfies the condition:

$$\begin{aligned}\frac{\partial F(\beta_D)}{\partial \beta_{j,k}} &= \int_{\mathrm{R}^2} \tau \nabla \cdot \frac{\nabla u}{|\nabla u|} \cdot \phi_{j,k} + (1-\tau)\nabla \cdot \nabla u \cdot \\ &\quad \phi_{j,k} dx + \lambda_{j,k}(\beta_{j,k} - \alpha_{j,k})\end{aligned} \tag{9}$$

The following equation is set to simplify the equation:

$$\begin{cases} D_1^+ = u_{k+1,l} - u_{k,l},\ D_2^+ = u_{k,l+1} - u_{k,l} \\ D_1^- = u_{k,l} - u_{k-1,l},\ D_2^- = u_{k,l} - u_{k,l-1} \end{cases} \tag{10}$$

The calculation process needs to be transformed between wavelet domain and pixel domain and firstly calculation is conducted in pixel domain for all points (i, j) in abnormal chain area:

$$\begin{aligned} cl_{i,j} =& \tau[D_1^- \left(\frac{D_1^+ u_{i,j}}{\sqrt{\left|D_1^+ u_{i,j}\right|^2 + \left|D_2^+ u_{i,j}\right|^2 + \varepsilon}} \right) + \\ & D_2^- \left(\frac{D_2^+ u_{i,j}}{\sqrt{\left|D_1^+ u_{i,j}\right|^2 + \left|D_2^+ u_{i,j}\right|^2 + \varepsilon}} \right) + \\ & (1-\tau)\left[D_1^- D_1^+ u_{i,j} + D_2^- D_2^+ u_{i,j}\right] \end{aligned} \tag{11}$$

Then the pixel domain is transformed to wavelet basis projection:

$$W_{cl} = FWT(cl)\ . \tag{12}$$

Finite difference solution step of the improved algorithm is as follows:

Step1: initialize algorithm parameter, set $\beta_{j,k}^{old} = 0$ and calculation parameter$i = 1$, set algorithm termination step number N and initialization$\beta_{j,k}^{new} = \alpha_{j,k}\chi_{j,k}$, then initial deviation $E = \left\|\beta^{new} - \beta^{old}\right\|_2$ of the algorithm can be obtained.

Step2: If $i < N$ or $E \leq \delta$, turn to Step3, or turn to Step6.

Step3: Set $\beta^{old} = \beta^{new}$ and calculate the projection of pixel domain to wavelet basis in abnormal chain area according to Equations (10)∼(22).

Step4: Wavelet coefficient is changed for each pixel point(j, k):

$$\beta_{j,k}^{new} = \beta_{j,k}^{old} + \frac{\Delta t}{\Delta x}\gamma_{j,k}\,. \tag{13}$$

Where,

$$\gamma_{j,k} = \beta_{j,k}^{TV} - 2\lambda\left(\beta_{j,k} - \alpha_{j,k}\right)\left(1 - \chi_{j,k}\right)\,. \tag{14}$$

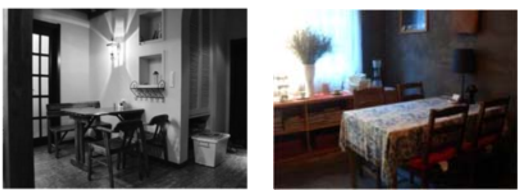
Step5: Change algorithm deviation $E = \left\|\beta^{new} - \beta^{old}\right\|_2$, set $i = i + 1$ and turn to Step2.

Step6: termination condition is satisfied, so the algorithm is terminated and restored wavelet parameter $\beta_D = \{\beta_{j,k}\,|j, k \in D\}$ is output.

4. Experimental analyses

Two different cases are researched in the same group of design so as to evaluate 3D design analysis method performance of interior decoration for construction information modeling based on wavelet algorithm. Interior decoration color of five combinations is set for the table lamp in each case and interior decoration color combination suitable for the user to define specified background is selected. There are two groups of component combination of different interior decoration colors.

Besides, there is a different target user intending to select the opposite style in each case research. One is male target user (case 1) and the other is female target user (case 2). The two target users are both college students of 22 years old. The background of the male target user is subject to cool tone and the shape usually tends to be linear at the element background; warm interior decoration color background is used at the opposite background of female target user. The details are shown in Fig. 3.



(a) Cool tone background (b) Warm tone background

Fig. 3. Two different design environments

All target users participate in the selection process of the four interior decoration colors, as shown in the Table 1; different combinations are made and they are arranged in the options to select the favorite combination.

Table 1. Experimental color symbol

Case 1 (male)		Case 2 (female)	
Code	RGB	Code	RGB
n	0,0,0	n	0,0,0
b	255,255,255	b	255,255,255
a	0,71,255	r	197,0,11
v	92,133,38	c	76,25,0

Besides, description of the target user is printed out and submitted to all cases for design. Personal data of the user, the favorite interior decoration color, film, place, hobby, brand and the lamp background in the picture are all included. Three different kinds of users are considered in the experiment:

(1) Target user is the buyer and user of the product without 3D modeling experience. (2) The design team is composed of product design engineers. Each designer is required to determine five interior decoration color combinations to better describe specific users. (3) The panel is composed of professors in different technological fields.

18 designers record and interact with the software to analyze the interaction of the two interfaces. Meanwhile, emotional state and design skill of all designers are not controlled without time limit. 100% users can completely interact with the interface in an easy way for interaction with NUI, while 55% users think that this interface is more disperse so that operation is hard for the classical interface interaction, as shown in Fig. 4.

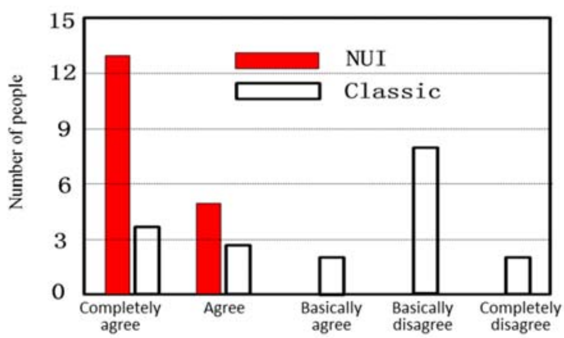


Fig. 4. Difficulty comparison of interface interaction

94% designers think that NUI is advantageous to make interior decoration color selection easier in decision activities, but interior decoration color selection can be simplified by both the classical interface and NUI generally. The details are shown in Fig. 5.

It can be found from the experimental results in Fig. 4∼5 that the interior decoration color selection scheme according to 3D design analysis method of inte-

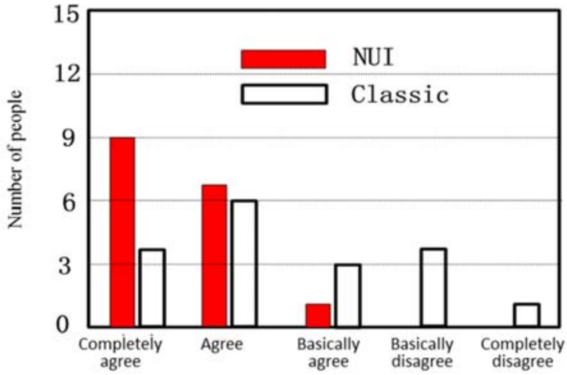


Fig. 5. Selective difficulty comparison of interior decoration color

rior decoration for construction information modeling based on wavelet algorithm adopted in the thesis is recognized by the evaluation team better composed by three different kinds of users compared with traditional classical interior interface color selection scheme, thus effectiveness of the proposed method is embodied.

5. Conclusions

3D modeling and graphic data processing are combined together in a proper way, thus interior decoration is well embodied in 3D presentation through system design with wavelet algorithm; and the wiring of a single wall can be well used, edited, modified and stored to solve the problems of picking, mapping and storage of 3D modeling and 2D graph on 3D objects.

But 3D visualization theory and application research of interior house decoration are still in phases of research and exploration currently and some practical problems need to be solved; specific problems are as follows.

(1) Further theoretical exploration is needed for 3D data model research on 3D visualization of interior decoration. 3D data model is the basis of interior decoration and effective presentation of geometric objects and optimization of 3D data model are the future research directions.

(2) Great advancement and development are obtained on 3D visualization, virtual reality and 3D data obtaining technology currently, but effective integration on PC needs further research.

(3) The aspects of 3D modeling and visualization of pipelines need further research in consideration of universality of round columnar pipelines.

References

[1] R. Hamza, K. Muhammad, N. Arunkumar, G. R. González: *Hash based Encryption for Keyframes of Diagnostic Hysteroscopy*, IEEE Access (2017),

https://doi.org/10.1109/ACCESS.2017.2762405

[2] S. L. Fernandes, V. P. Gurupur, N. R. Sunder, N. Arunkumar, S. Kadry: *A novel nonintrusive decision support approach for heart rate measurement* Pattern Recognition Letters (2017). https://doi.org/10.1016/j.patrec.2017.07.002

[3] N. Arunkumar, K. Ramkumar, V. Venkatraman, E. Abdulhay, S. L. Fernandes, S. Kadry, & S. Segal: *Classification of focal and non focal EEG using entropies.* Pattern Recognition Letters, *94* (2017), 112–117.

[4] Arunkumar N., Kumar K.R., Venkataraman V.: *Automatic detection of epileptic seizures using new entropy measures*, Journal of Medical Imaging and Health Informatics, *6* (2016), No. 3, 724–730.

[5] N. Arunkumar, K. Ram Kumar, V. Venkataraman V.: *Automatic detection of epileptic seizures using permutation entropy, Tsallis entropy and Kolmogorov complexity*, Journal of Medical Imaging and Health Informatics, *6* (2016), No. 2, 526–531.

[6] L. R. Stephygraph, N. Arunkumar: *Brain-actuated wireless mobile robot control through an adaptive human-machine interface*, Advances in Intelligent Systems and Computing, *397* (2016), 537–549.

[7] W. S. Pan, S. Z. Chen, Z. Y. Feng: *Automatic Clustering of Social Tag using Community Detection.* Applied Mathematics & Information Sciences, *7* (2013), No. 2, 675-681.

[8] Y. Y. Zhang, Q. Li, W. J. Welsh, P. V. Moghe, and K. E. Uhrich: *Micellar and Structural Stability of Nanoscale Amphiphilic Polymers: Implications for Anti-atherosclerotic Bioactivity*, Biomaterials, *84* (2016), 230–240.

[9] J. W. Chan, Y. Y. Zhang, and K. E. Uhrich: *Amphiphilic Macromolecule Self-Assembled Monolayers Suppress Smooth Muscle Cell Proliferation*, Bioconjugate Chemistry, *26* (2015), No. 7, 1359–1369.

[10] D. S. Abdelhamid, Y. Y. Zhang, D. R. Lewis, P. V. Moghe, W. J. Welsh, and K. E. Uhrich: *Tartaric Acid-based Amphiphilic Macromolecules with Ether Linkages Exhibit Enhanced Repression of Oxidized Low Density Lipoprotein Uptake*, Biomaterials, *53* (2015), 32–39.

[11] Y. Y. Zhang, A. Algburi, N. Wang, V. Kholodovych, D. O. Oh, M. Chikindas, and K. E. Uhrich: *Self-assembled Cationic Amphiphiles as Antimicrobial Peptides Mimics: Role of Hydrophobicity, Linkage Type, and Assembly State*, Nanomedicine: Nanotechnology, Biology and Medicine, *13* (2017), No. 2, 343–352.

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