

Retraction

Retracted: Design of a Panoramic Virtual Dynamic Display System for Digital Museums Based on Visual Interaction Technology

Scientific Programming

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their

agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] J. Wang, "Design of a Panoramic Virtual Dynamic Display System for Digital Museums Based on Visual Interaction Technology," *Scientific Programming*, vol. 2022, Article ID 1626448, 7 pages, 2022.

Research Article

Design of a Panoramic Virtual Dynamic Display System for Digital Museums Based on Visual Interaction Technology

Jing Wang 

Shanxi Vocational University of Engineering Science and Technology, College of Art and Design, Shanxi 030012, China

Correspondence should be addressed to Jing Wang; wangjing@sxgkd.edu.cn

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To address the spatial and temporal limitations of historical museums, a panoramic virtual dynamic display system for digital museums is designed using visual interactive technology. The VM file is generated by using the Digital Museum Design module to obtain a list of available objects, and the VM file is analysed by the Digital Museum View module to stretch and change the two-dimensional flat map into a three-dimensional spatial map for viewers to browse. The system software designs the technical construction process of the digital museum, uses a linearisation algorithm to calculate the number of clicks, visualises the font according to the number of clicks reflecting the weights, and builds a tag cloud component to provide interactive services to facilitate efficient understanding of the museum information by the viewer.

1. Introduction

When browsing through museums, people are constrained by the conditions and time available to view ancient artefacts up close and for long periods of time. To address the spatial and temporal limitations of historical museums [1], digital museums have emerged. The definition of a digital museum is narrowly defined as the reproduction of museum exhibits through digital technology, and broadly defined as a virtual representation of the real world that exists only within the network [2]. As an integrated result of technological applications combined with artistic displays, the digital museum has one of the most important characteristics—interactivity [3]—which determines whether the visitor can have a high-quality visual interactive experience during the visit [4].

The rapid development of technology has led to the maturation of multimedia and VR technologies, and interaction technologies have now evolved from static two-dimensional interfaces to multidimensional information spaces [5], with the basis for this leap forward being research and design for multilevel, dynamic user behaviour in virtual environments. Therefore, the design of a panoramic virtual dynamic display system for digital museums based on visual interaction technology will facilitate visitors to

access and understand museum information more efficiently [6–10].

Virtual reality combined with architectural sketch models allows the imagination to be realised and the spatial experience to be experienced from a human perspective, changing the building form and the relationship with the site at any time according to the actual spatial experience [11]. The change in spatial perception brought about by the change of form can be experienced at any time, and the ambiguity and coherence of the design will not be interrupted, while the digital graphic representation is at the same time precise and easy to adjust later [12].

2. The Advantages of Combining Virtual Reality with Architecture

2.1. Moving Away from the Traditional Linear Design Process. Most designers today still prefer sketching in the early stages of architectural design [13, 14]. Sketching is an interactive process of visual design thinking, where the architect's design concept and imagination are clues to the meaning of the sketch, while this abstract graphic medium triggers the architect's imagination. However, the vagueness of the sketch design often makes the building shape limited by the

site a large gap from the imagination, and the pre-construction design is often we always want a “so big” building, rather than a building with precise volume. The current pre-design process is often a combination of sketching and sketching of moulds to find the most suitable solution [15].

It is a process of discussing the relationship between space and space, between building and site. This process is often a compromise between imagination and actual scale, between sensibility and rationality [16]. In this case, sketches or sketches are often inappropriate in terms of their actual size, or in other words, they are only good for looking at, but not for using [17].

2.2. Immersive Experience Architecture. In conducting architectural design often through the designer’s perspective of a bird’s eye view or master plan, few designers are able to tour the space from the user’s or visitor’s perspective, which is largely limited by the designer’s imagination and spatial perception [18]. Through virtual reality labs, designers can refine their architectural proposals through 3D visualisation, interactive controls and group discussions. This method of learning provides a vivid learning journey that allows designers to understand their knowledge better than if they were instructed or lectured individually by a teacher, who can ask designers to tour their own spaces as users and experience the differences between different design perspectives [16]. It is often easy for junior designers to design a building in such a way that the connection between the plan and the façade is severed or only one of the two is emphasised, often resulting in windows that are well designed on the façade but do not work well from an internal user perspective, or even dark room for the sake of the façade. Often the window arrangement on the façade is completely different from what was thought of in the earlier plan design. Students often prefer to follow the OMA (Figure 1) approach of a spatial structure+curtain wall, using floor-to-ceiling windows or simply not opening them on the façade, but rarely do they consider the impact of windows on the perception of space and changes in light and shade in the interior, because the existing teaching and architectural presentation is not sufficient to express the changes in light and shade that windows bring to the interior [19]. Virtual reality combined with architectural education brings more new design ideas than traditional teaching, such as design from the perspective of window openings and interior light and shade or comfort of use.

2.3. Assisting Designers with a Sense of Scale. By combining virtual reality software with modeling software such as Sketch up and Rhino to create virtual reality scenes, designers can experience the spatial layout, flow and building materials of an architectural design in an ‘immersion’ way, changing the traditional situation of using only photographic materials and drawings to describe the interior and exterior of a building. It facilitates the designer’s understanding of the architectural space [20]. The difficulty of translating the physical dimensions of a building space into a physical perception is

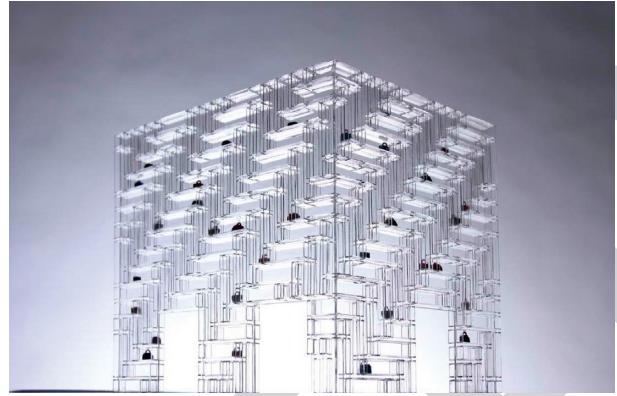


FIGURE 1: Spatialised structure of the OMA Shenzhen Stock Exchange Building headquarters+curtain wall design approach.

addressed. Virtual reality can be an alternative when site visits are costly and difficult to arrange due to health and safety issues. The combination of virtual reality experience of different architectural space and lectures by teachers can better assist designers in understanding space and scale. Building setbacks, safe evacuation distances and other codes are no longer cold numbers for designers, and virtual reality can be used to simulate space that does not meet the code requirements in order to experience their shortcomings and reinforce designers’ knowledge of the code requirements [20].

2.4. Emphasis on Building Structure and Construction Techniques. Currently many designers do not consider their designs from a construction point of view, nor from a practical use point of view, and the building design is often just an empty box, with sections only looking for the simplest and best drawn sections, symbolically expressing the position of beams, slabs and columns [21]. The traditional teaching system allows designers to understand the construction of buildings only through classroom lectures and pictures. The combination of virtual reality software and BIM models allows for a realistic teaching model, showing designers the animation of the building assembly process and combining theory with practice. Most designers only consider which materials or colours to use in general, but few consider the size or modulus of the specific materials to be used. Virtual reality allows designers to experience the texture and effect of the material from a human point of view, improving the details of the building [22].

3. Digital Museum Dynamic Panoramic Virtual Display System

3.1. Overall Structural Design. The Digital Museum Dynamic Panorama virtual display system consists of a viewer and object database management module, a digital museum design module and a digital museum viewing module, see Figure 2.

In Figure 2, the main function of the viewer and the object database management module is to correct, add and delete objects in the MySQL database and FTP server; the main function of the digital museum design module is to

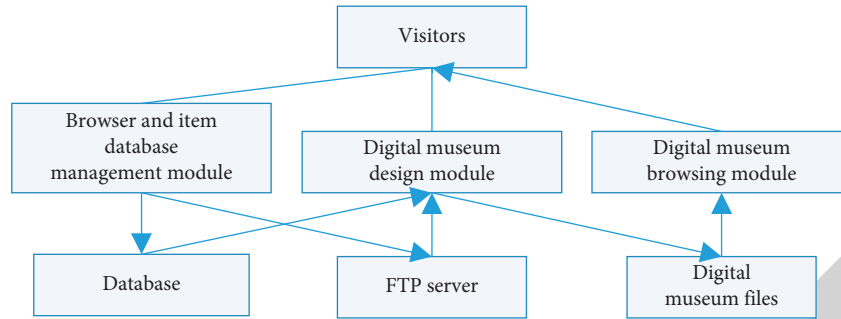


FIGURE 2: Architectural framework of the digital museum dynamic panoramic virtual display system.

access the information of the objects for viewing, download the information from the MySQL database and FTP server to the local area, and the viewer sets up the two-dimensional floor plan of the digital museum according to their needs. The viewer sets up a 2D floor plan of the digital museum according to their needs and then builds a VM model file [23]; the digital museum viewer module analyses the VM model file and displays a dynamic panorama of the digital museum that has been built.

3.2. Digital Museum Design Module. The digital museum design module ensures that the viewer is provided with a list of objects available in the database according to the viewer level after successfully logging into system. A 2D plan of the digital museum is generated in the drawing board and images are selected from the local plan as textures for the different areas of the digital museum. The objects listed in the object information list are placed in the 2D plane of the digital museum display system and a VM file is generated, as shown in Figure 3.

The information stored in the VM file includes: the number of vertices and the location of the different vertices in the 2D plan of the digitised museum; the number of objects, their IDs and their locations in the digitised museum; and the initial position of the viewer set in this module.

3.3. Digital Museum Navigation Module. The main function of the digital museum viewer module is to analyse the VM file in the digital museum design module, stretch and change the 2D plan view in the digital museum design module into a 3D spatial view [24], and provide the viewer with the viewer, as shown in Figure 4.

The VM file containing information about the digital museum is accessed through the Digital Museum Design module, and the VM file is opened through the Digital Museum Browser module to access the information contained in the digital museum. Within the digital museum display system, the viewer is able to roam through the VM file using the keyboard [25].

3.4. Software Design

3.4.1. Digital Museum Technology Building Process Design. The need of the viewer is fundamental to a digital museum display system. In order to meet the needs of the viewer, the

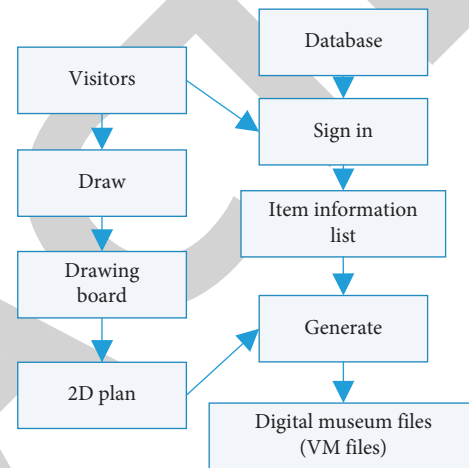


FIGURE 3: Digital museum design module.

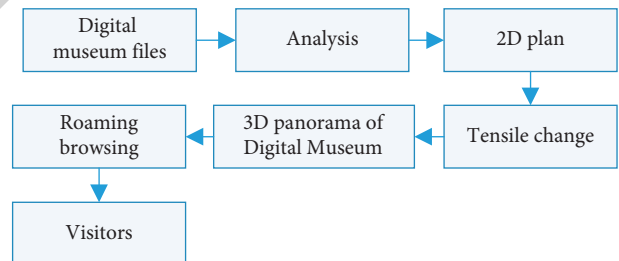


FIGURE 4: Design of the digital museum browsing module.

technical construction process of the digital museum is based on display design, human interaction theory and visualisation techniques, as shown in Figure 5.

Theme identification and requirements analysis phase focuses on a comprehensive analysis of the theme of the digital museum display system. The need and feasibility of the theme is studied, and the system structure is comprehensively planned based on the theme, while the ultimate functions and objectives of the digital museum are defined. The overall architecture design phase is based on the results of the previous analysis and defines the overall framework for the scenarios, presentation methods and functional objectives of the digital museum. The 3D modeling software is used to construct the planned museum scene and the required models, set the lighting and materials and other performance effects, and obtain a realistic browsing experience. The

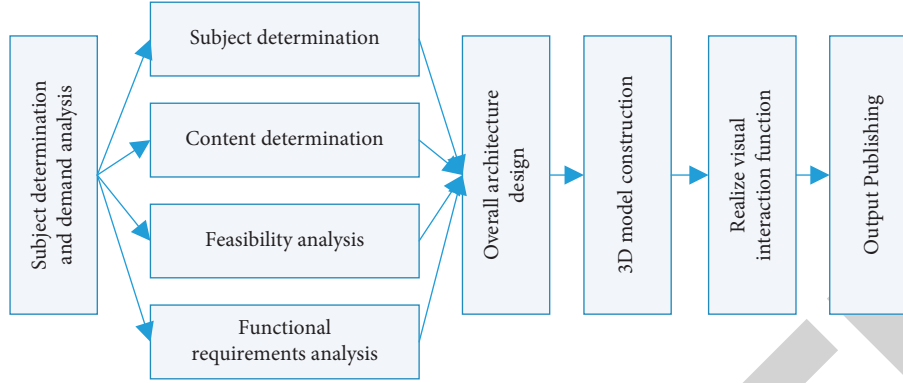


FIGURE 5: Digital museum technology building process.

interactive visualisation phase imports the completed museum scene and model into the interactive visualisation software and optimises it for high-quality interactive visualisation. Once the visualisation has been implemented, the museum visualisation is exported as a web page or an executable file and published on the corresponding website [1].

3.4.2. Tag Cloud Component Design. A collection of weighted tags, known as a tag cloud, reflects the differences in tag weight based on differential fonts and other visualisation, and viewers use tags to connect to relevant information. The tag cloud component is used in the display system, where tags are constructed by viewers and experts, and the topics and categories of information are presented through tags, which are used by viewers to obtain information related to the topic. The font size in the tag cloud component is based on tag weight. The number of tag visits describes the tag weight and the difference in font size reflects the information that is more frequently viewed.

The Tag Bean Java class, which stores information such as tag name, builds time and tag link, stores the tag topics and their corresponding Tag Bean objects in a HashMap, data type included in Java. The core of the Tag Cloud component is how to scientifically map the number of tag clicks to the differences in tag fonts. The number of clicks on all tags in the database is unevenly distributed, similar to a normal distribution. The system uses a linearisation algorithm to calculate the number of clicks in order to distribute the number of user clicks evenly across the font variance interval, as follows :

$$E = \sqrt{\sum_{i=1,2,\dots,m} \frac{(\text{hitNum}_i - \text{meanNum})^2}{m}}, \quad (1)$$

$$W = \frac{\text{maxSize} - \text{minSize}}{4E}, \quad (2)$$

$$\text{FontSize}_i = W (\text{hitNum}_i - \text{meanNum}) + \text{midSize}, \quad (3)$$

where: E , W and FontSize_i are the average difference in label clicks, linear slope and label i font variance, respectively, and meanNum are the number of clicks on label i , the total

number of labels in the database and the average of all label clicks, respectively; maxSize , minSize and midSize are the maximum value of the label font variance interval, the minimum value of the label font variance interval and the middle value of the font variance, respectively and the middle value of the font difference.

The first step in the calculation process is to determine the E of the total number of tag clicks; the deviation error of the total number of tag clicks is obtained by aggregation from $-2E$ to $2E$, and W is determined by equation (3); on this basis, the font difference value of tag i is determined using the values of meanNum and midSize , etc.

4. Experimental Analysis

4.1. Virtual Display Effects. The results of the virtual display of the digital museum in Figure 6 show that the system is able to effectively display the digital museum exhibition hall and the exterior of the digital museum.

4.2. Practicality. The results of the questionnaire survey were analysed in Figures 7 and 8 to verify the practicality of the system. The results of the questionnaire survey are shown in Figures 7 and 8. Based on these advantages, designers and science, education, culture and health stakeholders are more likely to use the digital museum display system to browse and learn about museums, while institutions and enterprises are less likely to prefer digital museums to physical museums due to the constraints. The above findings suggest that the digital museum virtual display system designed in this paper has a high degree of practicality [26, 27].

4.3. VR Technology Combined with Architectural Design. The virtual reality facility is designed to be used by groups of 30 participants and allows teachers and designers to view designs from multiple perspectives in a three-dimensional format and to navigate through the virtual space in real time. The semi-immersive virtual reality lab includes several workstations for designers and teachers dedicated to 3D modeling and visualisation. 2–3 sets of virtual roaming headsets, screen for display and projection equipment. The designers work in groups to experience the virtual roaming



FIGURE 6: Results of the dynamic panoramic virtual presentation of the digital museum.

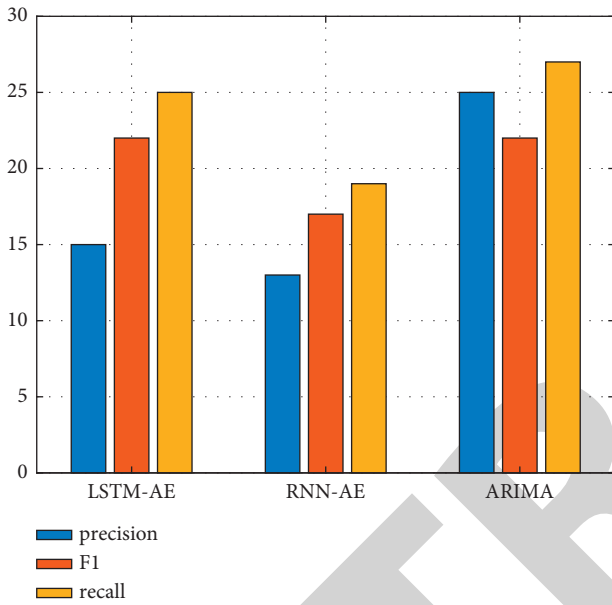


FIGURE 7: Points of interest for visiting the virtual display system of the digital museum in this paper.

experience with each other, discussing the advantages and disadvantages of each other’s solutions, and the teachers provide guidance in relation to the virtual roaming experience, as showed in Figure 9.

The design drawings should be carefully drawn, accurately expressing the design intention, and drawn in AutoCAD or Tianzheng, with the depth of drawing meeting the requirements of the national architectural scheme design depth, minimising errors and expressing the scheme correctly and vividly according to the requirements of the assignment. The colour and composition of the drawings and the methods of expression should be finalised. Stage 5: Finishing stage: Production of results, modeling of the results, submission of all results, an evaluation of drawings, selection of outstanding design works through software to create virtual reality scenes, evaluation of architectural design from a three-dimensional perspective. Designers team up to roam around each other to experience the architectural scheme, and the teacher gives comments or modifications in conjunction with the roaming experience, the effect of which is shown in Figure 10.

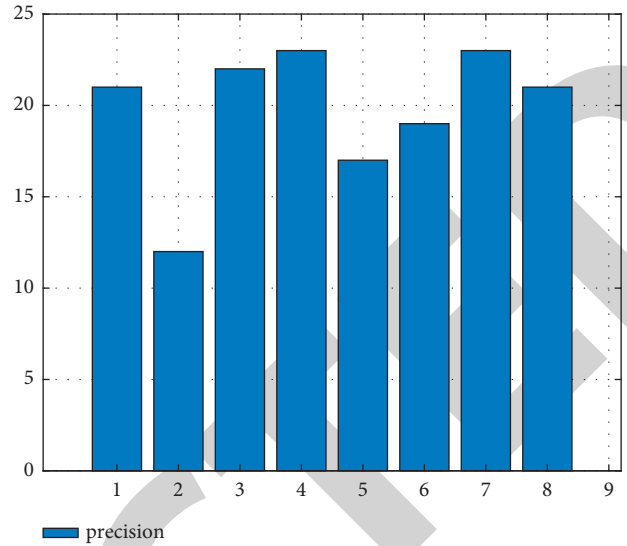


FIGURE 8: Changes in museum staff turnover.

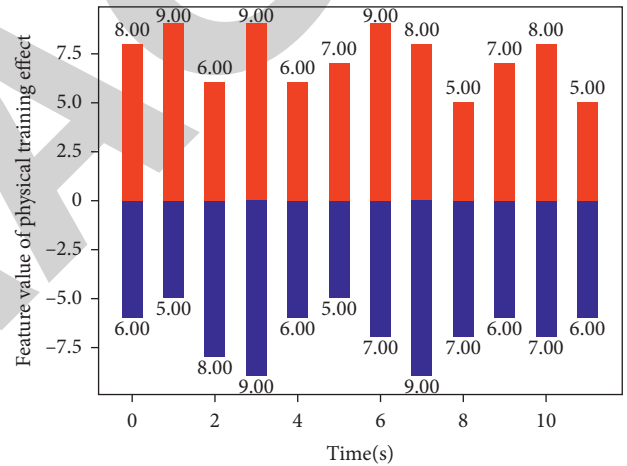


FIGURE 9: Different experience effects.

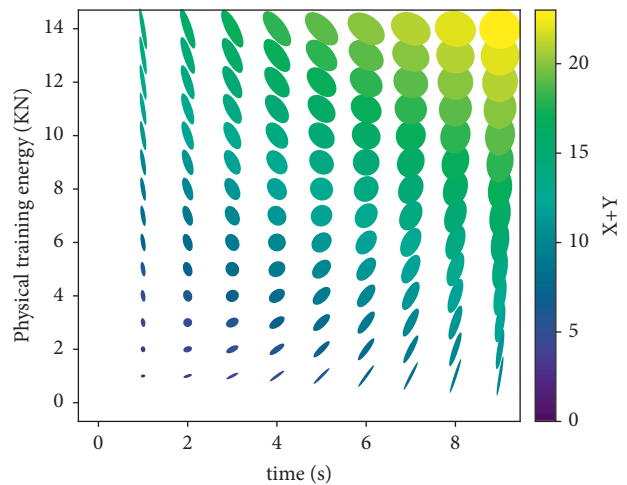


FIGURE 10: Effect of different roaming designs.

5. Conclusions

This paper builds a panoramic virtual dynamic display system for digital museums based on visual interaction technology, which is implemented through the viewer and object database management module, the digital museum design module and the digital museum browsing module. The results show that the system can not only effectively display the museum panorama, but also has the advantages of comprehensive object information, technological innovation, autonomous operation, time saving and animation display compared to the physical museum, and can achieve a full-scale, efficient and high-precision virtual display.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

Acknowledgments

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