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A Framework for the Cross-Cultural Immersive Display of Traditional Chinese Clothing Using Virtual Reality

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Article

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ABSTRACT

This study proposes a virtual reality–based cross-cultural immersive display system (VR-CCTC-IES) for the digital reconstruction and interactive presentation of traditional Chinese textile and garment heritage. The system integrates textile historical analysis, high-precision 3D modeling, fabric structure reconstruction, and real-time simulation technologies to digitally reproduce representative garments from the Han, Tang, and Ming dynasties. Within the digital reconstruction module, textile engineering considerations—including garment pattern structure, weaving organization (e.g., plain, twill, satin), embroidery techniques, fabric drape behavior, and surface optical properties—are incorporated into the modeling workflow. Physically based rendering (PBR) materials are developed to simulate yarn thickness, glossiness, transparency, and texture characteristics of historical fabrics, while physics-based cloth simulation is employed to approximate dynamic behavior during movement. The cross-cultural interaction module further translates textile craftsmanship, structural decomposition, and pattern symbolism into multi-layered visual and interactive formats, enabling users to explore garment construction, material features, and cultural context in an immersive environment. A multi-dimensional evaluation framework is proposed to assess immersion, usability, and cultural learning effectiveness. By combining textile process documentation with digital visualization and interactive technologies, the study contributes to the digital preservation of garment craftsmanship and explores new technological pathways for sustainable dissemination of textile cultural heritage.

KEYWORDS

virtual reality, garment reconstruction, textile structure, cloth simulation, cultural heritage

INTRODUCTION

As an important carrier of China's rich historical culture, traditional Chinese clothing embodies Chinese aesthetics and philosophical thought through its exquisite weaving techniques, unique structural forms, and rich symbolic connotations [1]. However, in the context of globalization, the cross-cultural dissemination of

traditional Chinese clothing continues to face many difficulties [1]. Conventional methods such as textual descriptions, video presentations, and static physical exhibitions often fail to convey the wearing effect, fabric texture, and the "living" appearance of the clothing in specific historical and cultural scenarios in a three-dimensional and dynamic way [2]. For overseas audiences who lack the relevant cultural background, this limitation often leads to a loss and misinterpretation of cultural information [3].

The development of virtual reality (VR) technology offers a novel approach to addressing these challenges. By generating three-dimensional virtual environments, VR technology provides users with immersive experiences through head-mounted displays (HMDs) and other devices, creating a convincing sense of presence in terms of vision, hearing, and even touch [4]. In recent years, VR has achieved initial success in applications such as cultural heritage preservation, museum exhibitions, and fashion design [5,6]. Research indicates that VR can not only reproduce precious cultural relics with extremely high fidelity but also significantly stimulate users' curiosity through interactive design, thereby deepening their understanding and memory of the exhibits [7].

Therefore, this study aims to explore the potential of VR technology in the cross-cultural display of traditional Chinese clothing by designing and constructing an immersive virtual exhibition hall. This exhibition hall will not only focus on the accurate digital restoration of clothing but, more importantly, will integrate cross-cultural communication theories to design interactive methods and narrative strategies aligned with the cognitive habits of overseas users. The objective is to answer the following core questions: How can the shape, materials, and craftsmanship details of traditional Chinese clothing be reconstructed in a high-fidelity virtual environment? How can effective cross-cultural interaction mechanisms be designed to eliminate cultural barriers and promote an in-depth understanding of the cultural connotations behind the clothing among overseas users? How can the effectiveness of this VR display system in enhancing user immersion, cultural learning efficiency, and cross-cultural acceptance be scientifically evaluated?

The significance of this study is twofold: it not only proposes a specific technical and design solution for the digital preservation and active inheritance of traditional Chinese clothing but also presents an innovative methodological framework for the cross-cultural communication of cultural heritage more broadly. If validated, this work would hold considerable academic value and practical significance.

RELEVANT RESEARCH REVIEW

Virtual Reality and Cultural Heritage Exhibition

The application of VR technology in the field of cultural heritage has become an international trend. Its core advantage lies in creating a "sense of presence," which allows users to transcend time and space limitations to visit inaccessible sites or "touch" fragile cultural relics. For instance, existing research has employed VR technology to virtually reconstruct Egyptian pharaohs' tombs and ancient Roman arenas [3,8]. In these environments, users can not only observe freely in 360 degrees but also trigger information points via interactive controllers to obtain relevant historical knowledge. In museum applications, researchers have developed virtual tour systems that allow users to roam through virtual spaces and interact with digital exhibits. This approach has proven more effective at stimulating users' learning interest than traditional web Browse [9].

However, most current research focuses on the reconstruction of buildings and static artifacts. The complexities and unique requirements for the digital display of cultural heritage such as clothing—which is flexible, dynamic, and intimately related to the human form—have not been fully explored.

Digital Technology for Traditional Clothing

Digital research on traditional clothing has primarily focused on 3D modeling and virtual simulation. Early studies often employed traditional computer-aided design (CAD) software, such as 3ds Max and Maya, for manual modeling. Although these tools could construct the general shape of clothing, they were insufficient for accurately reproducing complex fabric textures and fine embroidery patterns.

With technological advancements, high-precision modeling methods based on photogrammetry and 3D laser scanning have been applied, enabling the acquisition of precise 3D point cloud data of clothing. In fabric simulation, specialized software like CLO3D and Marvelous Designer, which use advanced physics engines, can simulate the drape, folding, and dynamic effects of different fabrics (e.g., silk, cotton, and linen), significantly enhancing the realism of virtual clothing [10,11]. These digital fashion technologies have also had a profound impact on the textile supply chain [12]. However, a significant technical challenge remains: integrating these high-precision digital clothing assets into VR environments, which demand high-performance real-time rendering, while ensuring the smoothness and physical authenticity of their dynamic behavior.

Cross-Cultural Communication Theory and Design Application

To ensure that VR display content is effectively received by users from diverse cultural backgrounds, cross-cultural communication theory must be integrated as a design guideline. The cultural dimensions theory proposed by Dutch scholar Geert Hofstede is particularly influential [13]. This theory presents six dimensions for measuring different cultural values: power distance, individualism vs. collectivism, masculinity vs. femininity, uncertainty avoidance, long-term vs. short-term orientation, and indulgence vs. restraint. For instance, for users from cultures with high uncertainty avoidance, the interface design should be more structured, providing clear navigation and explicit explanations. In contrast, for users from individualistic cultures, more personalized choices and freedom of exploration should be provided.

Furthermore, the high- and low-context cultural theory proposed by anthropologist Edward T. Hall is also highly instructive [14]. High-context cultures (e.g., China) tend toward implicit and indirect communication, with a large amount of information embedded in the physical environment or personal relationships. In contrast, low-context cultures (e.g., the United States, Germany) emphasize direct and clear verbal communication. When designing displays for overseas users, who are often from low-context cultures, this implies that it is necessary not only to present the clothing itself but also to use "low-context" methods—such as clear textual explanations, audio guides, and interactive diagrams—to make the implicit cultural information explicit. This includes details about materials, craftsmanship, and the meaning of patterns, thereby avoiding misunderstandings.

Overall, while existing studies have laid a foundation for this research, few have integrated high-fidelity digital clothing, an immersive VR experience, and systematic cross-cultural communication strategies. This study aims to conduct an in-depth exploration at the intersection of these fields.

DESIGN FRAMEWORK OF THE VR DISPLAY SYSTEM

The "Virtual Reality-based Cross-cultural Immersive Display System for Traditional Chinese Clothing" (VR-CCTC-IES) designed in this study comprises three interrelated modules: the Digital Reconstruction Module for Clothing (D-ARC), the Cross-cultural Interaction Design Module (C-CID), and the Multi-dimensional Evaluation Module (M-DAE). As illustrated by the 'Proposed Feedback Loop' in Figure 1, the framework is designed to be iterative. The data and feedback collected from the M-DAE are intended not as a final verdict, but as crucial input to inform subsequent revisions of the C-CID. This paper presents the initial design and

the methodological framework for this future iterative optimization process, which remains a key component of the planned research.

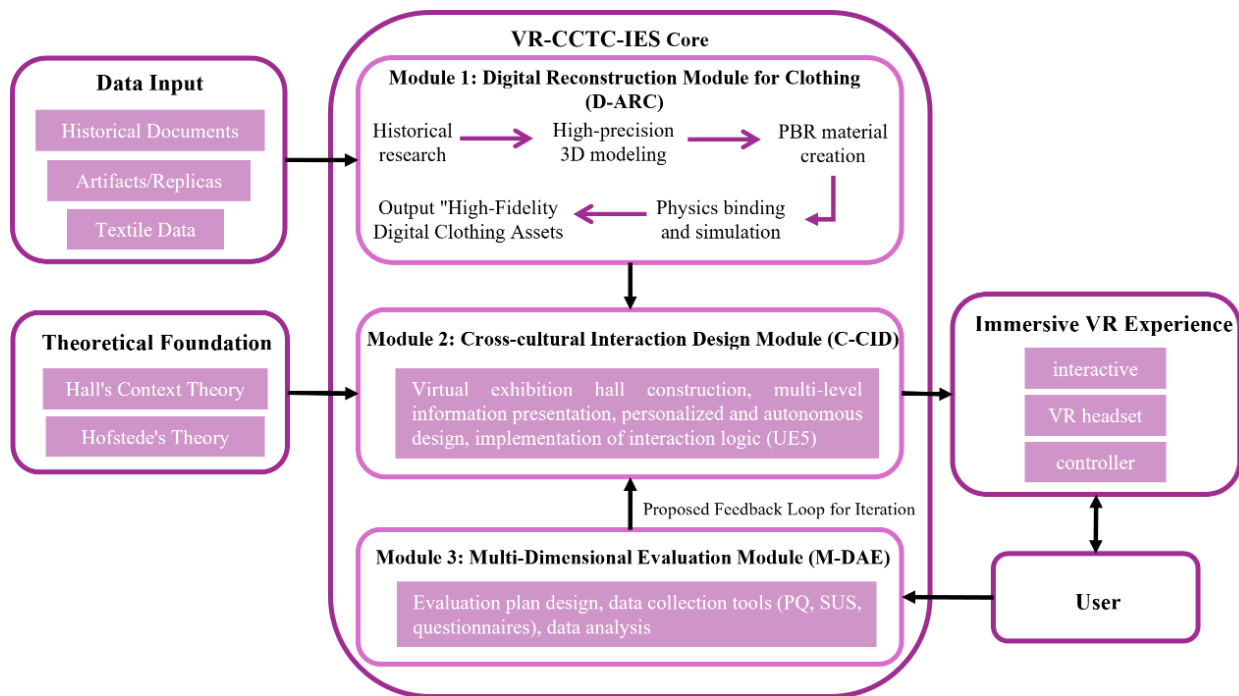


Figure 1. Design framework diagram of the VR-CCTC-IES system

Digital Reconstruction Module for Clothing (D-ARC)

This module forms the core data foundation of the entire system, with the objective of accurately and scientifically reproducing traditional Chinese clothing. The entire process follows rigorous textile engineering and digital archaeology methodologies.

Primary Source Triangulation and Analysis

Representative ancient Chinese clothing styles (such as those of the Han, Tang, and Ming dynasties) were selected as the display objects. The research team conducted in-depth studies on the forms, structures, fabrics, colors, and patterns of clothing in each period by consulting historical documents, analyzing ancient paintings, and examining unearthed artifacts and replicas. Our methodology relies on data triangulation, where information from visual (paintings), textual (documents), and physical sources is systematically cross-

referenced to validate the garment's form, structure, and material. Any discrepancies are noted and resolved through further focused research before proceeding.

High-Precision 3D Modeling

Base Model Creation: 3D scanning technology is used to obtain the overall shape data of existing clothing or replicas. For garments that cannot be physically obtained and for which complete physical evidence is lacking, 2D pattern diagrams are first reconstructed through a rigorous synthesis of period illustrations and detailed textual descriptions of tailoring. These reconstructed patterns, along with their source justifications, are then submitted for verification by historical clothing experts. Only after expert approval are they used in professional software like CLO3D to conduct precise 2D drafting and 3D sewing to generate the base digital model.

Detailing and Topology Optimization: In software such as ZBrush, the model is refined by adding handcrafted details like clasps, straps, and embroidery. Topology optimization is then performed to meet the requirements of real-time VR rendering.

Physically Based Rendering (PBR) Material Creation

Material Analysis: The physical properties of the fabrics used in the target garment—such as yarn thickness, weaving structure (plain weave, twill, satin, etc.), glossiness, and transparency—are analyzed.

Material Production: Using software such as Substance Painter, texture maps that conform to the PBR process are created. These include base color (Albedo), metallicness, roughness, normal, and ambient occlusion maps, which realistically reproduce the visual textures of different fabrics, such as the smoothness of silk and the rustic quality of cotton and linen, in the virtual environment.

Physics Binding and Fabric Simulation

The completed clothing model is bound to the skeleton of a virtual human avatar. Within a VR engine (such as Unreal Engine or Unity), its built-in physics system (e.g., Chaos Physics or NVIDIA Flex) is utilized. Appropriate physical parameters (such as mass, damping, and stretching/bending stiffness) are set for different parts of the clothing to achieve natural dynamic effects, such as fluttering sleeves and swaying skirts when the avatar performs actions like walking, turning, or bowing.

Historical Accuracy Verification Protocol

The verification of historical accuracy is an iterative process integrated throughout the digital reconstruction module. It involves a panel of consulting experts, including textile historians and museum curators, who provide feedback at three key milestones:

Pre-production Review: Approval of the triangulated source data and any reconstructed 2D patterns.

Asset Review: Assessment of the untextured 3D model for correct silhouette, structure, and proportions.

Final Review: Evaluation of the final textured model, PBR material representation, and dynamic simulation for overall authenticity.

All expert feedback and subsequent revisions are documented in an 'Accuracy Verification Log' for each digital garment to ensure a transparent and rigorous validation trail.

To provide a concrete focus for the initial phase of this project, three representative garments have been selected, each chosen for its distinct historical significance and technical reconstruction challenges:

Han Dynasty Shenyi: As a foundational one-piece robe in the Chinese clothing system, the *Shenyi* was chosen for its embodiment of Confucian ritual concepts. The primary challenge lies in accurately modeling its unique tailoring pattern and the philosophical symbolism embedded within its structure.

Tang Dynasty Qixiong Ruqun: This high-waisted ensemble for women was selected to represent the opulent and open aesthetic of the Tang era. Its reconstruction will focus on simulating the dynamic flow of the long skirt and the delicate textures of silk fabrics commonly depicted in period art.

Ming Dynasty Feiyufu: A ceremonial robe granted to elite guards and officials, the *Feiyufu* was selected for its intricate and symbolic brocade patterns. This garment will test our PBR texturing pipeline's capability to reproduce complex, historically accurate textile designs.

Cross-Cultural Interaction Design Module (C-CID)

This module is crucial for achieving effective cross-cultural communication, and its design deeply integrates the theories of Hofstede and Hall. The typical user interaction process in this module is shown in Figure 2.

Virtual Exhibition Hall Design: The virtual exhibition hall is designed with the aesthetic of a classical Chinese garden or palace but features a clear spatial layout and navigational flow conforming to modern exhibition logic. This approach not only creates a cultural atmosphere but also meets the need for clarity desired by users from low-context cultures.

Multi-level Information Presentation:

Macro-narrative Layer: Upon entering the exhibition hall, users are presented with a brief opening animation or audio introduction to establish a broad context of Chinese clothing history and a preliminary cognitive framework.

Exhibition Interaction Layer: Users can "approach" any virtual garment. When their gaze focuses on or the controller points at the clothing, a concise core information label (e.g., name and era) appears.

Deep Exploration Layer: By pressing a controller button, users can trigger a deeper interactive menu. The design of this menu fully considers cross-cultural factors:

"X-Ray View" Mode: With a single click, the outer garment can be hidden to reveal the structure of the undergarments, helping users understand the characteristic "layered" style of dress.

"Structural Decomposition" Mode (Exploded View): The clothing is deconstructed into individual pattern pieces, and the sewing process is shown in an animated form to visually demonstrate its ingenious design.

"Pattern Decoder": By selecting a specific pattern (e.g., a dragon, phoenix, or peony), a richly illustrated card appears, explaining its symbolic meaning, application scenarios, and related cultural stories in concise, direct language (low-context communication).

"Fabric Magnifier": This feature enables users to zoom in on the fabric surface to observe its intricate weaving structure. It is supplemented with short videos about the manufacturing process of the fabric (such as *Yunjin* brocade or *Kesi* silk tapestry).

Personalization and Autonomy Design:

Virtual Avatar Try-on: The system offers virtual avatars of different races and genders. Users can select an avatar and "try on" various traditional costumes in front of a virtual mirror. This feature caters to the demand for personalized experiences from users of individualistic cultures and deepens their emotional connection through an embodied experience.

Free Navigation and Guided Tour Modes: Users can either explore freely or choose a "themed tour" mode led by a virtual curator (a friendly virtual character), such as a "Wedding Attire Tour" or "Clothing of Scholars." This flexibility meets the needs of users with different levels of uncertainty avoidance.

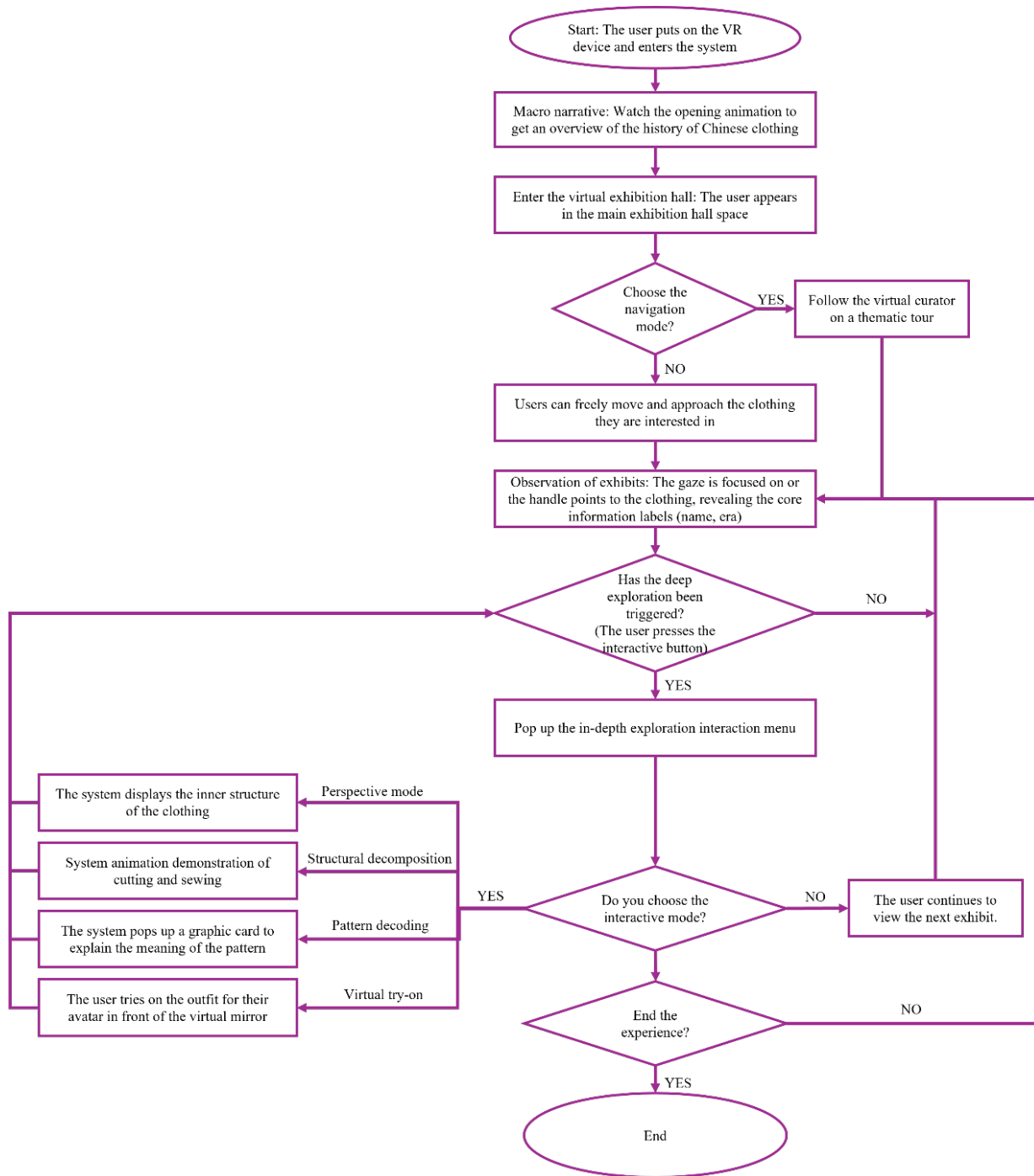


Figure 2. User Flowchart for Cross-cultural Interactive Design

Multi-Dimensional Evaluation Module (M-DAE)

To scientifically evaluate the effectiveness of the VR-CCTC-IES, this study proposes a mixed-method assessment plan that combines quantitative and qualitative approaches. The specific details are presented in Table 1.

Participant Recruitment: The evaluation plan involves recruiting 30 overseas individuals without a Chinese cultural background to form an experimental group. Another 30 participants, who will learn the same content through a traditional website format, will be recruited as a control group.

Evaluation Tools and Methods:

Presence Questionnaire (PQ): Developed by Witmer and Singer [15], the PQ is used to quantify the sense of presence, realism, and engagement experienced by users in virtual environments.

System Usability Scale (SUS): A quick and effective industry-standard questionnaire used to evaluate the usability of a system [16].

Cultural Learning Effectiveness Test: Pre- and post-experience tests, consisting of multiple-choice and short-answer questions about Chinese clothing, will be administered to measure the amount of knowledge acquired.

Semi-structured Interviews: After the experience, in-depth interviews will be conducted with users in the experimental group to collect qualitative data regarding their experience, cultural understanding, emotional resonance, and suggestions for design improvements. From this qualitative data, we expect to find evidence of deeper cross-cultural understanding. Theoretically, this is because features like the 'virtual avatar try-on' are designed to leverage the psychological mechanism of 'perspective-taking.' By embodying an avatar and seeing the world from a new perspective, users may move beyond viewing the clothing as an exotic object and begin to understand it as part of a lived, human experience.

Table 1. Multi-dimensional Evaluation Scheme

Evaluation Dimension	Evaluation Objective	Tools/Methods	Participants	Data Type Collected
Immersive experience	To measure the levels of immersion, presence, and realism provided by the system.	Presence Questionnaire (PQ); Semi-structured interview	Experimental Group	Quantitative (questionnaire scores); Qualitative (interview descriptions)
System Usability	To evaluate the usability, ease of learning, and user satisfaction of the system.	System Usability Scale (SUS); Task completion time; Error rate records	Experimental Group	Quantitative (SUS score, time, error count)

Cultural Learning Effectiveness	To evaluate the efficiency with which users acquire and comprehend cultural knowledge.	Pre-test and post-test knowledge questionnaire (multiple-choice, short-answer); Semi-structured interviews	Experimental and Control Group	Quantitative (pre/post-test score difference); Qualitative (recounting and understanding of cultural points in interviews)
Cross-cultural Acceptance and Emotional Resonance	To explore the system's effectiveness in evoking users' emotional resonance and enhancing cross-cultural identification.	Semi-structured interview	Experimental Group	Qualitative (descriptions of emotional responses to the design, content, and experience)

PROPOSED IMPLEMENTATION AND HYPOTHESIZED OUTCOMES

Technical Implementation Pathway

This section outlines the proposed technical pathway for the development of the VR-CCTC-IES system. The following plan details the specific software and hardware selected for the project, as well as the intended sequence of development steps. It is important to note that this describes the planned implementation phase; therefore, tangible artifacts from this process—such as screenshots of reconstructed models, performance benchmarks, and a discussion of challenges encountered—will be generated and reported in future publications upon the project's execution.

This research project will utilize Unreal Engine 5 (UE5) as the primary development platform, chosen for its powerful real-time rendering capabilities (particularly its Lumen global illumination and Nanite virtualized micropolygon geometry technologies) and its mature physics simulation system. The specific technical process is as follows:

- (1) Obtain physical clothing data using an Artec 3D scanner.
- (2) Complete garment drafting and initial dynamic simulation in CLO3D.
- (3) Perform model optimization and UV unwrapping in Blender or Maya.
- (4) Create PBR textures in Substance Painter.
- (5) Import all assets into UE5 and implement interaction logic using Blueprints or C++ programming.
- (6) Conduct performance optimization for the Meta Quest 3 or similar mainstream VR headsets to ensure a stable frame rate of 72 FPS or higher to prevent motion sickness.

Expected Results and Discussion

This study hypothesizes that, compared to traditional display methods, the proposed immersive VR display will offer notable advantages in the following areas:

Immersion and Engagement: We hypothesize that the experimental group will report significantly higher presence scores on the PQ. This expectation is grounded in the media psychology concept of 'presence,' where VR's technical affordances (e.g., stereoscopic 3D, 360-degree view) diminish the user's awareness of the medium itself, fostering a stronger sense of 'being there.' We anticipate a deeper experience resulting from high engagement as users shift from being passive viewers to active explorers. If validated, this finding would underscore the intrinsic value of VR for heritage display, suggesting the medium itself is crucial for capturing audience attention in a saturated digital landscape.

Acquisition of Cultural Knowledge: We hypothesize that the experimental group will demonstrate significantly higher mastery of cultural knowledge. This hypothesis is attributed not only to the multi-sensory nature of VR but is more deeply grounded in constructivist learning theory and the principle of embodied cognition. These theories posit that allowing users to actively construct knowledge (e.g., by manipulating 3D models in the 'Structural Decomposition' mode) leads to deeper cognitive encoding than passively receiving information. Validating this would provide strong empirical support for the efficacy of VR as a pedagogical tool within the digital humanities, offering a transferable model for teaching other forms of complex, intangible cultural heritage.

Cross-cultural Understanding and Empathy: From qualitative data, we expect to find evidence of deeper cross-cultural understanding. Theoretically, this is because features like the 'virtual avatar try-on' are designed to leverage the psychological mechanism of 'perspective-taking.' By embodying an avatar and seeing the world from a new perspective, users may move beyond viewing the clothing as an exotic object and begin to understand it as part of a lived, human experience. Such a finding would be significant for the field of cross-cultural communication, providing a practical demonstration of how immersive technologies can serve as a powerful tool for cultivating cultural empathy.

System Usability: A key goal is to test the hypothesis that applying cross-cultural theories (Hofstede, Hall) leads to improved usability. This is based on the premise that designing an interface to match a user's cultural communication patterns (e.g., providing explicit, low-context information) reduces cognitive load and increases perceived ease of use. A high SUS score would provide evidence supporting this assumption. If

validated, this would offer a valuable contribution to Human-Computer Interaction (HCI) and cross-cultural design literature, presenting a clear case study of how established communication theories can be practically applied to improve the usability of digital heritage platforms for a global audience.

During the interviews, some potential issues might also be revealed. For instance, some users might still be confused by certain cultural symbols or may have higher expectations for the expressiveness of the virtual avatars. This feedback will provide a valuable basis for the further iteration and optimization of the system. It is important to note that since this paper presents a design framework, the aforementioned claims are necessarily speculative at this stage. A crucial next phase of this research will involve the full implementation of the described technical pathway. This will allow for the gathering of concrete performance metrics—such as final polygon counts, texture sizes, rendering times, and actual frame rates achieved on the target hardware (e.g., Meta Quest 3)—and the collection of empirical results from the proposed user evaluation scheme. These quantitative and qualitative data are essential to rigorously validate the system's real-world feasibility and effectiveness.

LIMITATIONS AND FUTURE WORK

It is essential to acknowledge the limitations of the current study, which primarily presents a detailed design framework rather than a completed empirical investigation.

Primary Limitation: Lack of Empirical Validation: The most significant limitation is that the system has not yet been implemented and evaluated with users. Consequently, all discussions regarding the system's effectiveness in enhancing user engagement, cultural learning, and cross-cultural acceptance are well-founded hypotheses that require rigorous empirical testing.

Scope of the Proposal: The technical pathway and evaluation scheme are detailed plans. Unforeseen challenges may arise during the actual development and user study phases. Therefore, this paper should be interpreted as a comprehensive proposal that lays the groundwork for future empirical research.

Generalizability of a Future Study: The proposed evaluation targets a specific user group ("overseas individuals without a Chinese background"). The findings from this initial study may not be generalizable to all non-Chinese cultures or demographic groups. Future research will need to engage a more diverse participant pool to more broadly assess the system's cross-cultural effectiveness.

Technical Constraints: While current VR technology offers high-fidelity visual displays, accurately simulating the complex tactile sensations of different fabrics (e.g., the smoothness of silk) remains a significant technical

challenge. The current design's reliance on visual representation without advanced haptic feedback is a known constraint on the potential level of immersion.

These limitations directly inform our agenda for future work. The immediate next steps will be to execute the implementation plan, conduct the proposed multi-dimensional user evaluation, and analyze the resulting data to validate our hypotheses. Subsequently, we aim to address the current limitations by expanding the participant demographics and exploring the integration of emerging haptic feedback technologies.

CONCLUSION

This study addresses the practical challenges in the cross-cultural dissemination of traditional Chinese clothing by proposing a systematic, immersive display solution based on virtual reality. The core contribution of this paper is the establishment of a comprehensive design framework that: (1) outlines a complete technical process from high-fidelity digital reconstruction to real-time VR presentation; (2) innovatively integrates cross-cultural communication theories (Hofstede & Hall) into the interaction design, proposing specific strategies aimed at eliminating cultural barriers; and (3) details a scientific, multi-dimensional evaluation system to ultimately verify the effectiveness of this solution.

It is hypothesized that this approach will demonstrate that VR technology can function not only as an innovative display tool but also as a more immersive and effective method for cultural dissemination. The system is designed to create a "presence-based" and "embodied" experience, intended to transform traditional Chinese clothing from a static 'object' into a dynamic 'cultural event,' thereby engaging audiences from different cultural backgrounds on a deeper cognitive and emotional level.

Looking ahead, this system has several clear avenues for future expansion. Technically, more advanced haptic feedback technologies could be integrated to simulate the smoothness of silk or the texture of brocade, further enhancing the sense of reality. In terms of content, the clothing library can be continuously expanded to cover more eras, ethnic groups, and occasions, creating a comprehensive "Virtual Museum of Chinese Clothing." In terms of application, this system could be deployed in overseas Chinese cultural centers, Confucius Institutes, international museums, and online education platforms, serving as a novel cultural diplomacy and educational tool. Ultimately, this research aims to provide a foundation for further interdisciplinary work combining technology and cultural heritage studies, contributing to methods for the creative transformation and innovative development of traditional culture.

Availability of Data and Materials

The datasets used and/or analysed during the current study were available from the corresponding author on reasonable request.

Author Contributions

Xiaoyi Duan designed, collected and analyzed the data, and drafted the manuscript. Xiaoyi Duan conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Xiaoyi Duan participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This survey was conducted in compliance with Ethics Committee of Xinxiang University. Participants were informed of the study's purpose and data usage prior to participation, and responses were collected anonymously. No personally identifiable information was stored.

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Conflict of Interest

The author declares no conflict of interest.

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