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Research on Digital Cultural and Creative Product Design in the Context of Metaverse Technology

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Abstract: Starting from the development prospects of the digital cultural and creative product industry and the key applications of metaverse technology, this paper proposes innovative approaches for product design. It advocates actively integrating metaverse technology to create multi-dimensional sensory experiences; leveraging open co-creation platforms and AI assistance to enable user collaboration, thereby enhancing creative and economic value; and emphasizing dynamic interaction, reconstructed logic, and blockchain technology in brand and identity design to elevate value and influence. In the design of cultural digital collectibles, the integration of digital twin technology and immersive interactive product design creates a distinctive cultural ambiance for users.

1. Development Prospects of Cultural and Creative Products and the Importance of Metaverse Technology in Product Design

In recent years, the market scale of China's cultural and creative products has continued to expand. The rapid development of digital information technology has provided robust technical support for the integration of traditional industries and emerging technologies. For instance, under the impetus of digitalization, the deep integration of the metaverse with traditional cultural and creative industries has gradually become a mainstream trend in the sector, accompanied by a growing industry scale. As shown in Table 1, the market size of China's cultural and creative product industry has exhibited a sustained upward trajectory in recent years[1].

Table 1 Changes in the Market Size of China's Cultural and Creative Product Industry (2021–2024)

Year	Market Size (CNY 100 million)	Year-on-year growth rate
2021	785	7.0%
2022	845	7.6%
2023	880.53	6.9%
2024	950	7.8%

Note: As there is no specific data for 2024 as of now, the above data is mainly based on industry reports.

Under the technological support of the metaverse, traditional cultural and creative products can not only be better presented to audiences but also demonstrate the potential to reshape cultural content

creation, distribution, and consumption. This provides greater opportunities for the development of the digital cultural and creative industry. Therefore, traditional cultural and creative product design can and should prioritize the application of metaverse technologies. Within the metaverse framework, it is essential to strengthen the integration of blockchain technology, augmented reality (AR), virtual reality (VR), and other digital ecosystem components. Building on traditional design philosophies, designers must maximize the transcendence of physical forms and limitations of conventional display methods, forging distinctive, innovative, and technology-driven design pathways for new-era digital cultural products. Through the application and innovation of diverse technologies, the unique charm and rich cultural connotations of these products can be fully showcased, delivering more participatory and immersive experiences to audiences[2].

2. Key Points and Considerations for Metaverse-Empowered Cultural and Creative Product Design

The metaverse, constructed through digital technologies such as virtual reality (VR), augmented reality (AR), and blockchain, offers infinite possibilities for innovation in digital cultural and creative product design. Driven by the "integration" of these technologies, the traditional cultural and creative industry will gain access to entirely new creative platforms and dissemination channels, as illustrated in Figure 1.

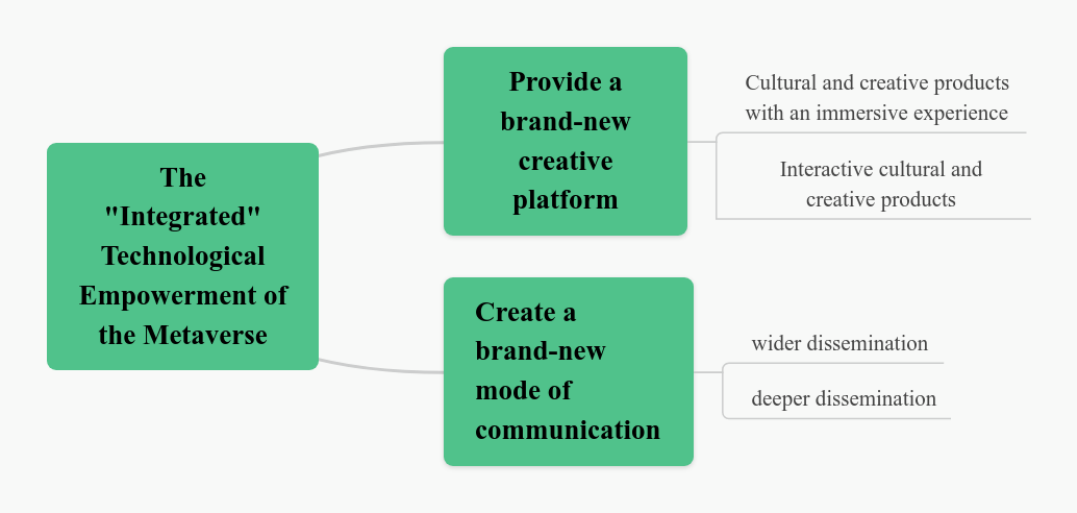

Figure 1 Metaverse-Empowered Cultural and Creative Product Design

On one hand, the metaverse enables "integrated" convergence of multiple technologies to provide traditional cultural and creative product design with entirely new creative platforms. By leveraging virtual reality (VR), mixed reality (MR), and other technologies, it achieves a deep fusion of traditional cultural elements and modern scientific advancements, creating immersive and interactive cultural products for users. For example, VR technology allows visitors to virtually experience the grandeur of the Palace Museum (Forbidden City) from centuries ago, immersing them in the allure of traditional culture. On the other hand, the metaverse facilitates novel dissemination methods for cultural products. Through diversified social media and virtual social platforms, it establishes comprehensive communication channels powered by emerging technologies. Users can become ambassadors of cultural products by sharing, liking, and commenting on digital platforms, amplifying their influence through social interactions[3].

Of course, the innovative application of any technology comes with challenges, and the integration of the metaverse with digital cultural and creative product design is no exception. First, metaverse-driven cultural product design must demonstrate high levels of innovation and uniqueness to

genuinely attract audiences through technological novelty. Thus, digital cultural product design must be rooted in traditional cultural elements, requiring a deep exploration of their underlying cultural narratives to achieve meaningful integration with modern technology. Second, such designs must adapt to the inherent characteristics of virtual worlds. For instance, designers must address how to deliver interactive and immersive experiences through digital cultural products, offering audiences diverse and enriched cultural engagements—key considerations for innovation in this field.

3. Innovative Pathways for Digital Cultural and Creative Product Design in the Metaverse

3.1. Actively Creating Multi-Dimensional Sensory Experiences for Cultural Products

The integration of digital cultural product design with metaverse technologies should prioritize delivering multi-dimensional sensory experiences to users. This entails harnessing the strengths of metaverse technologies—such as visual, auditory, tactile, and olfactory dimensions—to craft distinctive cultural products and unique sensory engagements, as illustrated in Figure 2.

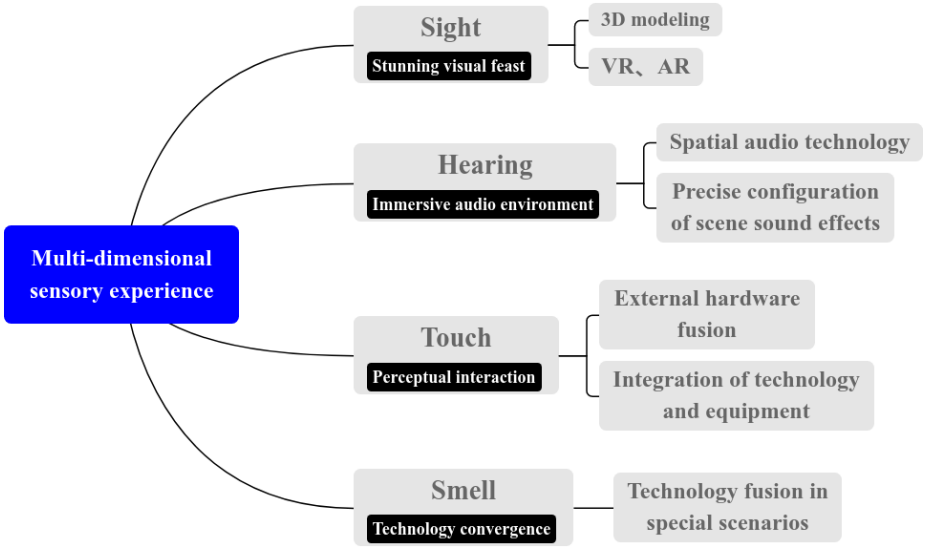

Figure 2 Multi-Dimensional Sensory Experiences Enabled by Metaverse Technologies for Digital Cultural and Creative Products

Specifically, metaverse technologies can first deliver awe-inspiring visual experiences for digital cultural products. Through 3D modeling, real-time rendering, VR, and AR, users are immersed in lifelike visual environments. For example, the Palace Museum's "The Forbidden City: Pocket Palace" leverages augmented reality (AR) technology, allowing users to project 3D models of palaces and artifacts into real-world settings via mobile device cameras. Visitors can examine intricate details of the Hall of Supreme Harmony from any angle without physically entering the site. Thus, VR and AR technologies can innovate digital cultural products by creating immersive "time-travel" experiences, enhanced by dynamic lighting and color effects to simulate realistic atmospheres, enabling users to virtually engage with traditional history and culture[4].

Second, spatial audio technologies provide immersive auditory experiences tailored to different cultural products. For example, in a martial arts-themed game empowered by the metaverse, players in a bustling tavern might hear clinking glasses and lively chatter, while distant erhu melodies drift in. Conversely, entering a tranquil valley immerses them in sounds of wind, birdsong, and flowing streams. Similarly, spatial audio can precisely map soundscapes to cultural product scenarios,

allowing users to perceive directionality, distance, and layering of sounds, deepening immersion.

Third, integrating external hardware and devices enables users to experience tactile engagement. For instance, ceramic-themed cultural products could employ haptic feedback gloves, simulating the soft texture of clay, resistance during shaping, and subtle vibrations from tools in a virtual pottery-making environment.

Finally, emerging technologies are beginning to incorporate olfactory experiences. Some theme parks now blend scent diffusion systems with metaverse interactions. Olfactory design must align with product characteristics to deepen users' multi-sensory perception, enriching realism.

In summary, metaverse-driven digital cultural product design should strategically combine technologies to create multi-dimensional sensory experiences. By aligning with cultural narratives and historical contexts, innovations in visual, auditory, tactile, and olfactory dimensions can enhance user engagement and authenticity.

3.2. Empowering User Co-Creation and Economic Value

In the metaverse era, digital cultural products can foster user co-creation, transforming users into designers, creators, and consumers. For example, a metaverse game based on folklore or mythology could allow users to design quests, scenes, and characters using their imagination and cultural knowledge. Blockchain technology can authenticate ownership of these user-generated assets, turning them into tradable digital commodities. Other players may purchase or rent these creations, generating revenue for creators and incentivizing participation. To enable co-creation, two key strategies are essential:

First, build open co-creation platforms using metaverse virtual spaces. Users can craft personalized virtual worlds based on their interpretations of cultural themes, enriching the product ecosystem.

Second, integrate AI-assisted creation. In literary metaverse projects, users input themes, plot outlines, or character frameworks, and AI generates subsequent content for refinement. This "user-guided" approach accelerates creative workflows while preserving originality.

3.3. Enhancing Brand and Identity Design

Dynamic and Interactive Branding: Metaverse-era digital cultural products should transcend static logos. For example, music-themed brands could incorporate dynamic elements triggered by user interaction—clicking a logo might activate melodies, instruments, or animated notes, conveying core values through playfulness.

Reconstructing Design Logic with Metaverse Technologies: Leverage tools like Unreal Engine 5's Nanite virtualized geometry system to create interactive 3D logos with real-time rendering and spatial adaptability. Baidu's Metaverse Concert, for instance, employed dynamic particle systems where logos morph based on user interactions, blending physical and virtual brand experiences.

Blockchain-Based Digital Identity: Use blockchain to create unique digital identifiers for cultural assets. For digital artworks, blockchain records creation and transaction histories, ensuring security while enhancing value and brand authority.

3.4. Building Metaverse-Architected Cultural Digital Collectibles through Technological Advancement

Since the 2023 Spring Festival, the surge of interest in the metaverse has provided robust technical support for the explosive growth of digital collectibles, while also reflecting how traditional culture is gradually achieving "breakthrough development" through digital technologies. For instance, museums in regions such as Xi'an, Gansu, Sichuan, Anhui, and Henan have launched multiple digital

cultural collectibles centered on their most treasured collections during the recent Spring Festival period. These collectibles have even attracted large numbers of young consumers to engage with traditional culture and purchase digital cultural products. Digital collectibles effectively address the scarcity demands of cultural product collection and, compared to physical counterparts, exhibit stronger social connectivity, particularly in meeting the social needs of younger demographics. Therefore, under the metaverse's technological framework, digital cultural product design must leverage cultural digital collectibles to capture public preferences and promote traditional culture.

3.4.1. Digital Twin Reconstruction Drives Innovation in Cultural Digital Collectible Design

Taking museum collections as an example, multimodal data fusion technologies can be employed to construct 3D digital twins of cultural artifacts. This approach not only mitigates information loss inherent in traditional 2D digital cultural design but also enhances preservation efficiency. For instance, the Dunhuang Academy's Digital Flying Apsaras project achieved 0.01mm-precision texture mapping to digitally preserve the mineral pigment layers of Dunhuang murals. This digital modeling system provides an accurate foundation for derivative cultural product design. Additionally, dynamic data encapsulation technology can integrate multidimensional information—such as creative provenance, cultural context, and interactive behaviors—into digital collectibles. This enables users to automatically generate personalized appreciation logs while engaging with the collectibles, offering a more comprehensive and diversified understanding of their cultural narratives.

3.4.2. Interactive and Immersive Digital Cultural Product Design

For diverse types of cultural products, multisensory synesthetic systems should be developed by integrating tactile feedback, olfactory simulation, and biosensing technologies. These systems build cognitive loops that align with the cultural artifacts themselves, allowing users to engage more holistically. For example, the British Museum's Egyptian digital collectible Secrets of the Pharaohs uses electrodermal conduction to simulate the tactile sensation of breezes from the Nile River Valley, paired with olfactory simulations of frankincense and biosensing technologies, creating a cross-modal cultural immersion. Similarly, the ALIGHT team collaborated with the Shanghai Museum to explore exhibition concepts, spatial narratives, and artifact storytelling. Leveraging cutting-edge digital technologies and unique curatorial language, they orchestrated a cross-temporal dialogue between multimedia content and ancient Egyptian artifacts. Through ultra-wide visual screens and immersive audio blending, audiences experienced the cultural allure of ancient Egyptian civilization as if physically present.

4. Conclusion

In conclusion, the emergence and application of metaverse technologies have unlocked boundless possibilities for innovation in cultural product design. When crafting digital cultural products, it is imperative to strategically leverage metaverse platforms to develop more unique and creatively compelling cultural creations. The design and innovation of digital cultural products must harness the metaverse's technical strengths while aligning with cultural characteristics, industry trends, and technological advancements. By optimizing sensory experiences, enabling user co-creation, and reimagining branding strategies, designers can elevate interactivity and appeal. Prioritizing immersive engagement, collaborative creativity, and adaptive identity systems will define the future of digital cultural and creative industries.

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