

Research on Quantitative Interaction Technology and Cross-media Experience Design

Zhao Zhehan

Zhuo Fan (corresponding author)

Central Academy of Fine Arts

No.8, Huajiadi South Street, Chaoyang District, Beijing, China

Abstract: In today's era of interdisciplinary integration, cross-media technology and disciplinary research have become emerging research ranks, and the combination with experience design has opened up innovative exploration. Meanwhile, quantitative interaction technology has emerged under the influence of various technologies, bringing new opportunities for multidisciplinary and cross-media experience design. Through qualitative and quantitative research and case studies, this paper explores how quantitative interaction techniques can help cross-media experience design. It analyzes the concepts of quantitative interaction technology and cross-media experience design, describes the innovative effects of the integration of the two, and empirically analyzes "2933 Synthetic Pig Farm Rhapsody" as an example. Finally, it is proposed that quantitative interaction technology can help cross-media and cross-disciplinary innovative practice experience design to develop new interaction methods, enhance the emotional resonance of the masses and public understanding, improve the efficiency of experience, and promote the development of multidisciplinary integration and innovation.

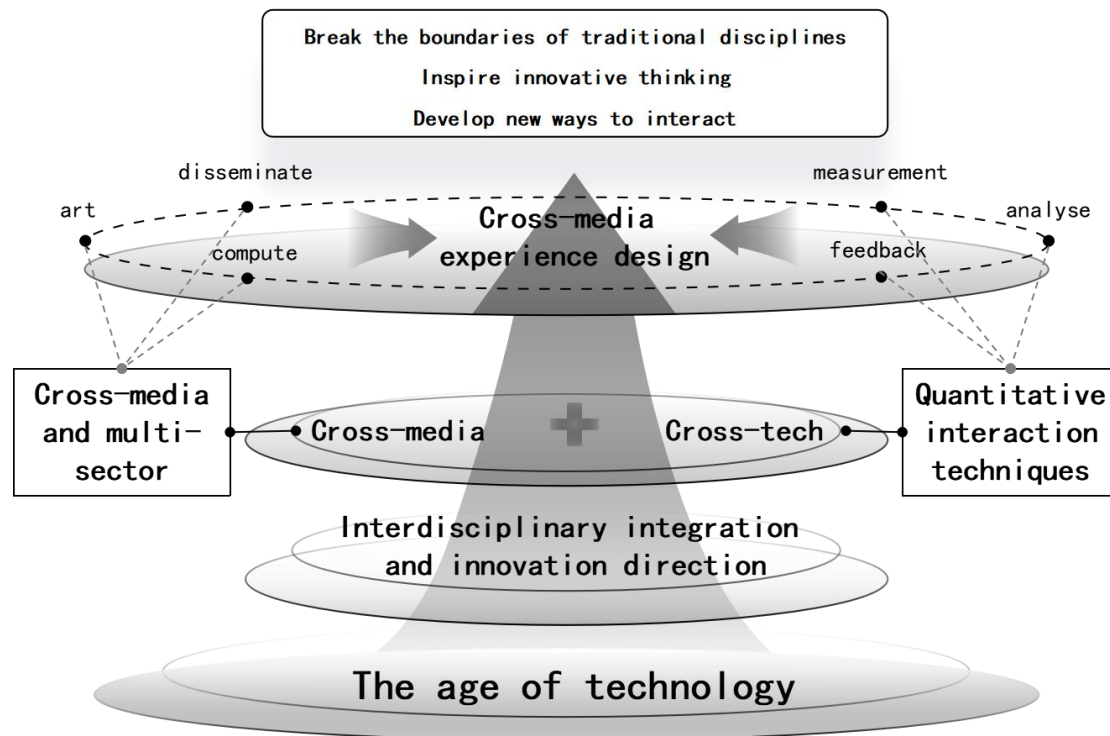
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1. Introduction

Under the background of the current era of rapidly changing science and technology, the innovative research work of interdisciplinary integration is presenting a brand new development trend, possessing a more novel pioneering direction, but also facing many unprecedented challenges. As an emerging cross-discipline in this trend, cross-media skillfully integrates the knowledge and technology of communication, art, computer science and other fields, and closely connects the essence of different disciplines. Cross-media experience design is a bold and innovative exploration between the fields of communication and art. It tries to break down the barriers between traditional disciplines, combining the communication characteristics of media and the charm of art in a unique perspective and way, and bringing people an unprecedented experience. When the two are organically combined, innovative and unique experiences, products and services can be created, injecting new vitality into the market and meeting the increasingly diversified needs of people.

At the same time, with the rapid development of science and technology, a variety of cutting-edge technologies have emerged, which have had a profound impact on various fields. In the field of cross-media experience design, there are also many innovative combined technologies. One of them is quantitative interaction technology, which realizes precise and efficient personalized human-computer interaction through meticulous digital measurement, thorough analysis and timely and accurate feedback of the interaction between users and systems, bringing users a more intelligent, convenient and tailored experience. It can be seen

that on the road of continuous expansion of multidisciplinary integration, despite the various challenges and unknowns, quantitative interaction technology is like a powerful force that can provide strong support for cross-media experience design research, help it realize more accurate and efficient interaction, and further promote the development of the field.



This paper will make comprehensive use of qualitative and quantitative research as well as case studies to explore in depth and comprehensively how to skillfully use quantitative interaction technology to help cross-media experience design develop more innovative interaction methods, give full play to its greater experiential effects, break down the boundaries between traditional disciplines, and stimulate unlimited innovative thinking. In this way, it provides a more unique and novel perspective for the integration of multiple disciplines, thus enhancing the emotional resonance of the masses and public understanding, and ultimately promoting the dissemination and development of related disciplines in a wider scope.

2. Research on the application of quantitative interaction techniques in interdisciplinary experience design

In the field of interdisciplinary experience design, quantitative interaction technology is emerging as a key bridge connecting cross-media and user experience. From a theoretical perspective, this technology leverages digital measurement, analysis, and feedback of user-system interactions to enable precise and efficient personalized human-computer interaction. This, in turn, fosters interdisciplinary integration and stimulates innovative thinking. To further explore the feasibility and effectiveness of applying quantitative interaction technology in interdisciplinary experience design and to gain a comprehensive and accurate understanding, we employ both qualitative and quantitative research to investigate

how various fields are experimenting with and experiencing this technology.

2.1 Qualitative research

In the complex ecosystem of interdisciplinary experience design, to understand how quantitative interaction technologies are integrated into and influence the design of intermedia experiences, we need to use qualitative research to help us delve into the essence of things and dig out the intrinsic meaning. Take the “MediaVerse” project as an example, it is an immersive experience product that combines cross-media and virtual reality (VR) technologies. It utilizes quantitative interaction technology to adjust the content and form of the media presentation in real time according to the user's movements and gaze points in the virtual environment. For example, when the user approaches a key element in the virtual scene, the content will be expanded accordingly; when the user makes a specific gesture, the display form will change its style or layout. The key to the project's success was the high degree of integration between technology and design. The development team fully understood the user's demand for immersive experience at the early stage of design, and skillfully integrated quantitative interaction technology into the storyline and interactive links. Through accurate motion capture and real-time feedback, users feel as if they are in a multi-dimensional world full of creativity, which greatly enhances their sense of participation and experience. Once the product was launched, it was widely praised in various cultural exhibitions and new media activities, attracting a large number of audiences and effectively spreading the concept of multi-disciplinary and multi-media cooperation.

Through qualitative research, we gained an in-depth understanding of the practical effects in multiple fields, and distilled valuable information from the rich details, providing a multi-dimensional and deep perspective for a comprehensive understanding of the application of quantitative interactive technology.

2.2 Quantitative research

In this digital era, data has become an important basis for insight into the nature of things. Through quantitative research, we are able to transform the interaction behaviors between users and cross-media experience design products into quantifiable data indicators, reflecting the performance, laws and relationships of quantitative interaction techniques in practical applications. In this way, we can prove that quantitative interaction techniques have great potentials and roles in interdisciplinary experience design.

Case 1: For example, take the interactive 3D heart in Apple VisionPro as an example. In the interactive 3D heart application of Apple VisionPro, with its powerful hardware and visionOS system, the knowledge of the heart in the medical field is integrated with advanced mixed reality technology. In a learning effect test for medical students, students who used this interactive 3D heart application for learning scored 30% higher on average in the assessment of heart-related knowledge than those who studied in the traditional way. A survey of user experience found that more than 90% of users said that through the application, they have a deeper understanding of the structure and function of the heart, and are able to observe the internal structure and physiological function of the heart more intuitively, such as the heart's beating rate, the speed of blood flow and other quantitative information can be clearly displayed. This not only provides a more efficient learning tool for medical education, but

also proves that quantitative interaction technology can present complex scientific knowledge to users in a more intuitive and vivid way in cross-disciplinary experience design, thus improving learning efficiency and effectiveness, and enhancing users' understanding and mastery of knowledge.

Case 2: Let's take the example of the music and media fusion interactive project utilizing big data and artificial intelligence again. In the field of music and media convergence and interaction, the use of big data and artificial intelligence technology realizes an innovative interdisciplinary fusion. By collecting a large amount of data on music works and music preferences of the audience, as well as media communication data, artificial intelligence algorithms analyze and learn. For example, a music platform uses big data to analyze data such as users' listening history, collection lists, and playing hours, and combines them with the characteristics of media communication channels to provide users with personalized music recommendations, whose recommendation accuracy rate is up to 80% or more, which greatly improves the efficiency of users in discovering their favorite music. In the performance of music-media integration, based on the real-time feedback data of the audience during the performance, such as the frequency of applause, the size of cheers, and the interactive data of the online media platform, the AI system can quickly adjust the style and rhythm of the music, as well as the way of the media display, in order to better satisfy the audience's preferences, which has resulted in the audience's satisfaction reaching more than 90%. This fully demonstrates that quantitative interaction technology can accurately meet user needs and enhance user participation and experience in the interdisciplinary experience design of music-media fusion, providing strong support for the interaction and resonance between music art and media communication, as well as the audience.

Through the qualitative research and quantitative research mentioned above, we understand the application of quantitative interaction technology in interdisciplinary experience design from multiple dimensions. Quantitative interaction technology shows certain potential in cross-media experience design, and this advantage of cooperation between multiple technologies and multiple disciplines, combined with user needs and design concepts, opens up new paths for experience design under the integration of multiple disciplines. This approach can stimulate more innovative possibilities and promote the widespread dissemination and application of cross-media communication concepts.

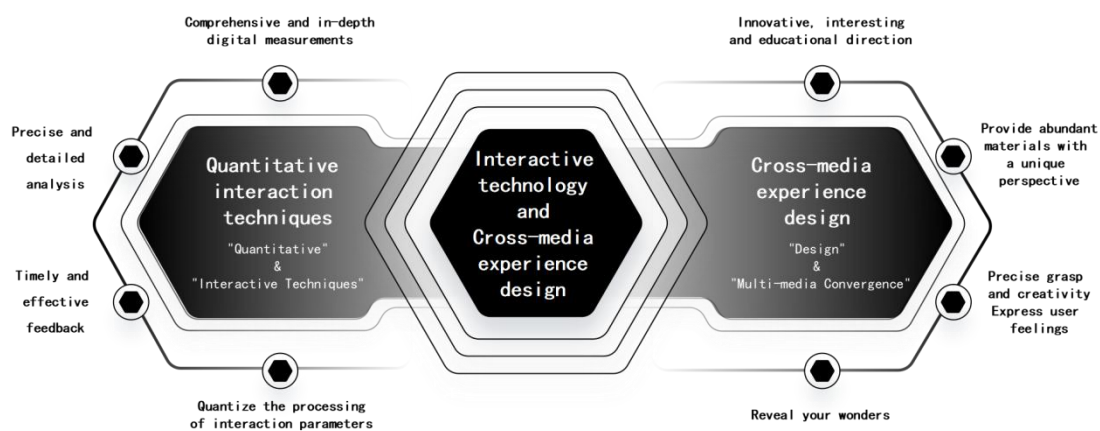
3. Quantitative Interaction Technology and Cross-Media Experience Design

In today's era of rapid technological advancement, the integration of interaction technology with interdisciplinary experience design has led to numerous innovations and explorations. At the same time, the concepts of "quantitative interaction technology" and "cross-media experience design" have gradually emerged, attracting widespread attention across various fields.

The term "quantitative interaction technology" has surfaced alongside the continuous and rapid evolution of technology. As human factors engineering has undergone a long process of development and reached maturity, its research focus has increasingly shifted toward the field of human-computer interaction. Meanwhile, the digital and intelligent era has surged forward like an unstoppable tide, profoundly transforming all aspects of people's lives and work. Driven by the demand for efficiency and high-quality experiences in this fast-paced era, the

combination of "quantitative" and "interaction technology" has given rise to the new concept of "quantitative interaction technology."

Quantitative interaction technology aims to achieve precise, efficient, and personalized human-computer interaction by comprehensively measuring, analyzing, and providing feedback on user-system interactions. Specifically, this technology places great emphasis on quantifying various parameters throughout the interaction process. This means that aspects such as the frequency and duration of user operations, as well as the speed and manner of system responses, are all incorporated into a quantitative framework. By leveraging this data-driven approach, a deeper understanding of user needs and behavioral patterns can be achieved, allowing for targeted optimization of interaction experiences. As a result, users are provided with more convenient, comfortable, and personalized interaction experiences.



In the broader context of interdisciplinary integration and the growing demand for personalized and human-centered experiences, cross-media innovation has emerged as a groundbreaking, engaging, and educational approach to experience creation. It breaks away from the limitations of traditional single-medium experiences, seamlessly integrating multiple media formats to construct a rich, diverse, and interconnected experiential space.

In cross-media experience design, text, images, audio, video, virtual reality (VR), and augmented reality (AR) no longer exist in isolation. Instead, they work together, strategically arranging content and interaction logic based on the unique characteristics and strengths of each medium. This synergy crafts immersive and personalized user experiences. Cross-media experience design greatly enhances user engagement, catering to the increasingly diverse needs of modern audiences. While single-medium communication has traditionally been limited, cross-media experiences fully activate multiple senses—vision, hearing, and touch—delivering a more multi-dimensional and profound impact.

For example, in a cross-media theatrical performance that combines live acting, on-site projections, and mobile interaction, the audience not only enjoys the actors' performances but also engages with the storyline through their mobile devices, interacting with characters in real-time. This deep level of participation fosters emotional resonance, creating memorable experiences that allow audiences to better appreciate cultural nuances.

The unique advantage of cross-media experiences lies in their ability to integrate and utilize multiple media formats, offering designers a wealth of creative resources and fresh

perspectives. Experience design, with its precise understanding of user engagement and creative expression, translates cross-media knowledge into compelling and accessible experiences for the public. The fusion of quantitative interaction technology with cross-media experience design injects new energy into the field of experience design, introducing novel approaches and methodologies that enhance engagement, interactivity, and personalization.

4. Integration of Multiple Technologies with Cross-Media Experience Design

In the practical application of quantitative interaction technology, accurately collecting user interaction behavior data is crucial, as it forms the foundation for achieving a more precise interactive experience. This level of precision is made possible by specialized user behavior analysis tools such as Mixpanel and Amplitude. Known for their powerful data collection capabilities, these tools comprehensively track user interactions on websites and mobile applications. Like keen observers, they precisely capture and record details such as user clicks, scrolling patterns, operational sequences, and dwell time within an application.

Once these detailed datasets are obtained, the process of interaction design begins. To optimize design based on quantitative interaction technology, designers utilize various interactive software tools to create, edit, and test user interfaces and interaction flows. These tools offer a wide range of visual design functions and extensive libraries of interactive components, serving as a creative repository for designers. Leveraging these resources, designers can rapidly develop design prototypes and conduct realistic simulations and comprehensive testing of their interaction effects.

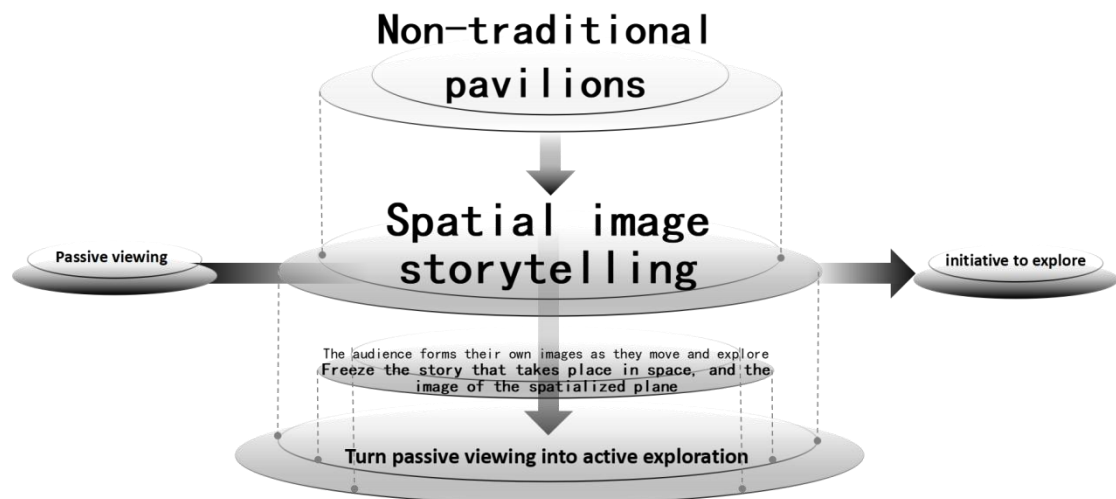
Additionally, quantitative interaction technology facilitates interdisciplinary collaboration in interactive expression, thanks to powerful design software such as Sketch, Adobe XD, Figma, and Axure RP. Sketch, for instance, is specifically tailored for interface design, featuring an intuitive and user-friendly interface along with robust vector graphic editing capabilities, making it highly favored among UI designers. Meanwhile, Axure RP stands out as a professional prototyping tool that provides diverse interactive effects and dynamic panel functionalities, enabling designers to create high-fidelity interactive prototypes. These high-fidelity prototypes play a crucial role in communication and collaboration among product managers, interaction designers, and development teams, ensuring a shared and clear understanding of interaction logic and final design outcomes throughout the project.

This interdisciplinary integration serves as a bridge, organically connecting software and achievements from different fields, paving an engaging and innovative path for cross-media experience design.

For example, in the field of smart environments, rigorous quantitative analysis and well-constructed interaction technology can bring cross-media experience concepts to life through virtual reality (VR) or augmented reality (AR). In VR and AR applications, quantitative interaction technology demonstrates outstanding performance, enabling natural and precise interactions between users and virtual or augmented environments. Hand-tracking technology, for instance, utilizes advanced sensors and algorithms to capture users' hand movements and gestures in real time, swiftly and accurately translating them into corresponding actions within the virtual environment. A user can effortlessly swipe their fingers to switch between different media contents in a virtual cross-media exhibition space or interact with virtual media elements using specific gestures.

This interaction method significantly enhances the sense of immersion and engagement within virtual or augmented environments, making users feel as though they are truly navigating a multidimensional world of creativity. Through this highly immersive experience, users can gain a deeper and more intuitive understanding of cross-media innovations, transforming abstract and complex cross-media communication concepts into vivid, engaging, and easily comprehensible experiences.

5. Case Study – 2933 Synthetic Pig Farm Rhapsody



In exploring the practical application scenarios of the integration of quantitative interaction technology with cross-media experience design, we use the work 2933 Synthetic Pig Farm Rhapsody as an example to demonstrate the key role and profound significance of quantitative interaction technology in the interdisciplinary experience design field.

This work uses quantitative interaction technology, among other methods, to design, construct, and improve biological systems and components, creating an entirely new functional gaming exhibition space. It expands the scope of its application, sparking numerous reflections on ethical issues and the future direction of development. At its core, the project addresses synthetic biology, employing cross-media experience design techniques. Through this specific practice, it reveals the urgency of addressing potential ethical and moral crises in an increasingly expanding interdisciplinary field.

The designer employed quantitative interaction technology to create a dual-mode exhibition (online and offline), innovatively incorporating spatial imaging narrative techniques to allow visitors to engage in the exhibition as active participants. This innovation completely redefines the traditional passive viewing model of exhibitions, transforming visitors into active explorers. As they move through the exhibition, their actions and interactions generate unique images, almost making them the creators of the exhibition's story, deeply immersed in the environment being constructed.

The layout of the exhibition space includes six distinct areas: the product display room, publicity hall, R&D workshop, production workshop, conference room, and control room. In each area, interactive segments based on the "synthetic pig" story data, scripts, and other

elements are designed to engage visitors. For example, in the product display room, interactive sessions powered by quantitative interaction technology allow visitors to gain a more intuitive understanding of the characteristics and applications of synthetic biological products. In the R&D workshop, simulated interactive experiences of the research and development process let visitors feel the challenges and hardships of scientific exploration.

Each exhibit uses quantitative interaction technology to provide visitors with a rich and in-depth educational experience, encouraging deep reflection and engagement with the ethical and scientific concepts underlying the exhibit. Through this, 2933 Synthetic Pig Farm Rhapsody exemplifies how the integration of quantitative interaction technology with cross-media design can foster both intellectual engagement and ethical consideration, pushing the boundaries of traditional exhibitions and enhancing the user experience.



Through the analysis of the case *2933 Synthetic Pig Farm Rhapsody*, we can clearly see the multifaceted and significant role of quantitative interaction technology in cross-disciplinary experience design. On one hand, it significantly enhances audience engagement and immersion, allowing visitors to delve deeper into the thematic atmosphere conveyed by the exhibition. It also improves the efficiency of the visit, helping audiences acquire richer and more valuable information within a limited timeframe.

On the other hand, quantitative interaction technology provides precise and reliable foundational technology for creative work across various fields, offering new ideas and methods to address the challenges of interdisciplinary collaboration. It facilitates smoother integration between different disciplines, promoting the development of cross-disciplinary fields. Moreover, this innovative design approach greatly enhances the dissemination effect of the project, drawing more attention to the scientific value and intellectual considerations embedded in the cutting-edge cross-media approach. In doing so, it achieves a dual success: the effective transmission of knowledge and a superior audience experience.

Ultimately, this case exemplifies how the integration of quantitative interaction technology with cross-media experience design not only fosters deeper user engagement but

also drives forward interdisciplinary collaboration and innovation, benefiting both the creators and the audience.

6. Conclusion

Through detailed exploration and analysis of various aspects, we have come to a clearer understanding that, within the current era, quantitative interaction technology has become an inevitable product, as well as an essential method for driving the development of multiple fields.

Quantitative interaction technology, with its unique advantages and innovative features, has organically integrated with various fields, such as cross-media experience design, bringing significant positive impacts on improving the efficiency of user experience. In today's rapidly advancing technological age, the convergence of different fields has become an unstoppable and inevitable trend. The intersection and integration of different disciplines and fields not only give rise to new knowledge systems and technical approaches but also provide new perspectives and solutions to complex real-world problems.

In the face of this inevitable trend, what we must do is not merely adapt passively but actively and quickly respond. Each field should leverage its unique characteristics and strengths to explore effective pathways for collaboration with other disciplines. For example, by taking full advantage of quantitative interaction technology, we can proactively address the various challenges encountered in the process of multi-disciplinary integration. By precisely digitizing, analyzing, and providing timely feedback on user-system interaction behaviors, we can achieve more efficient, personalized human-computer interaction, significantly improving the overall efficiency of cross-media experience design and other interdisciplinary collaborations.

This enhancement of efficiency is not only reflected in daily workflows and project progression but, more importantly, injects powerful momentum into the entire innovation process. With the support of quantitative interaction technology, various fields can collaborate more smoothly, breaking traditional disciplinary boundaries and sparking creative collisions. As professional knowledge and technical means from different fields merge, they give rise to more novel ideas and solutions, advancing the overall progress of projects and promoting innovation in all directions. This, in turn, brings continuous vitality and momentum to societal progress and development.

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