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บทความวิจัย

การออกแบบและสำรวจห้องเรียนเสมือนจริงที่มีฉากหลากหลายบนฐานเทคโนโลยีเสมือนจริงแบบ XR

Design and Exploration of Virtual Multi-Scene Classroom Based on XR Technology

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บทคัดย่อ

หลังการระบาดของโรคทั่วโลก การผสมผสานระหว่างการเรียนรู้แบบออนไลน์และออฟไลน์และสภาพแวดล้อมการเรียนรู้เสมือนจริงกลายเป็นแนวโน้มการพัฒนาของหลักสูตรการเรียนการสอน และเป็นพื้นที่สำหรับการเรียนรู้สำหรับอนาคต มีการใช้งานเทคโนโลยีโลกเสมือนจริงมากมายทั้งในสาขาการออกแบบและธุรกิจ แสดงให้เห็นว่า การใช้ฉากที่หลายหลายบนฐานเทคโนโลยีเสมือนจริงแบบ XR (XR virtual technology) ได้รับการพัฒนาอย่างสมบูรณ์และมีความเป็นไปได้ในการนำมาใช้ในการเรียนการสอน งานวิจัยนี้จึงออกแบบการทดลองพื้นที่การสอนแบบตรงจุด (on-spot) ที่บูรณาการความเสมือนจริงกับสภาพที่แท้จริงโดยจำลองฉากหลากหลายโดยใช้ซอฟต์แวร์แบบ 3D ร่วมกับการใช้โครงสร้างสภาพแวดล้อมทางกายภาพ และการบันทึกและติดตามกิจกรรมการเรียนรู้แบบออฟไลน์ ผลการวิจัยพบว่า เนื้อหาการเรียนรู้ที่บูรณาการการเรียนรู้แบบออนไลน์และออฟไลน์แบบเรียลไทม์ เพื่อบรรลุเป้าหมายการออกแบบพื้นที่การเรียนรู้เสมือนจริงที่มีฉากหลากหลาย การบูรณาการระหว่างความเสมือนจริงกับสภาพที่แท้จริง ภายใต้การผสมผสานของเทคโนโลยีระหว่างโลกแห่งความจริงกับโลกเสมือนจริง (XR immersion technology) และพื้นที่การสอนแบบออนไลน์ในอนาคต แก้ปัญหาการเรียนรู้ที่ทำได้เฉพาะพื้นที่ทางกายภาพ ทำให้ประหยัดเวลา กำลังคน และค่าวัสดุได้มากขึ้น อีกทั้งยังเปิดโอกาสให้นักเรียนมีประสบการณ์กับการเรียนรู้เฉพาะที่แบบเสมือนจริงอีกด้วย

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Abstract

With the advent of the global post-epidemic era, the online and offline hybrid teaching mode and virtual learning environment will become the development trend of curriculum teaching and future teaching space. This virtual reality technology has many application cases in the design and business fields, which shows that the multi-scene application based on XR virtual technology is relatively mature and feasible. This study designs experiments for the on-spot teaching space that integrates virtual and reality. The author conducts multi-scene design simulation through the 3D multi-scene software, with the construction of the physical environment, and the recording and tracking of offline teaching activities. This study finally renders and outputs online and offline teaching content in real-time, to achieve the design purpose of a virtual multi-scene teaching space. The effects of virtual and real integration under the integration of XR immersive technology and an online teaching platform and the conversion of physical space can be saved, saving a lot of time, manpower, and material costs and allowing students to have an immersive on-spot learning experience.

Keywords: XR virtual technology, embodied learning, immersive multi-scene, on-spot experience

Introduction

Under the background of the transformation of science and technology and industry, and the transformation of global governance, digital transformation is becoming a “new strategy” for the development of all countries in the world. Digital literacy driven by digital teaching is becoming a “new requirement” for talents in enterprises. Digital teaching refers to the teaching activities of teachers and learners in the digital teaching environment, using digital teaching resources, and cultivating composite talents with innovative consciousness and innovative ability that meet the needs of the new century in a digital teaching mode (Hao, 2004).

With the advent of the global post-epidemic era, the online and offline hybrid teaching mode and virtual learning environment will become the development trend of curriculum teaching and future teaching space. In the development of metaverses and virtual reality technologies, Extended Reality (XR) technology integrates physical environments with virtual environments A comprehensive term that provides a fully immersive virtual experience environment (Li & Shi, 2021).

So far, the XR industry has gone through five stages of technological infancy (1968-2012), development recovery (2012-2019 first half) and rapid growth (2021 to present). In the late 1960s, the first computer graphics-driven helmet display and head tracking system were born, marking the emergence of XR as a tangible commodity, and XR entered its technological infancy. In the second half of 2021, as the meta-universe concept set off a new industrial wave, it drove the XR industry into its formative years, with domestic and international headline manufacturers such as Meta, Apple, Byte Dance and Huawei rapidly

accelerating the XR business layout. The meta-universe catalyzes the layout of the XR industry, and XR terminals create a key entrance to the meta-universe. XR is the collective name for a variety of new immersive technologies such as VR and AR, as well as mixed reality.

Extended Reality (XR) embodies the latest development of virtual reality technology, which can create a fully immersive virtual world, which has broad application prospects and practical significance in the development of immersive education and teaching in the digital age.

At the same time, cognitive science influences the theory and practice of learning design, especially the discussion of the relationship between mind and body. From the perspective of learning methods and "audience" students, this immersive presence and online and offline interaction brought by XR technology can meet the needs of concrete learning activities, the need for physical perception and structured reflection enhances students' learning experience and learning ability. "Embodied Learning Design" is based on the concept of physical and mental integration, regards learning as the emergence of individual experience, and focuses on "on-the-spot experience" and "learning" that improves learners' physical participation. Dynamic generation with "with". Embodied cognition theory holds that there are two basic modes of cognition: immediacy based on bodily perception and structured reflection with the help of technological tools. (Zheng et al., 2019) For example, in recent years, the work carried out by the Multimedia Situational Art Learning Lab (SMALLab) in Arizona, USA has been represented in the design of concrete learning activities based on immersive virtual-real fusion environments.

Application and the prospect of virtual reality technology

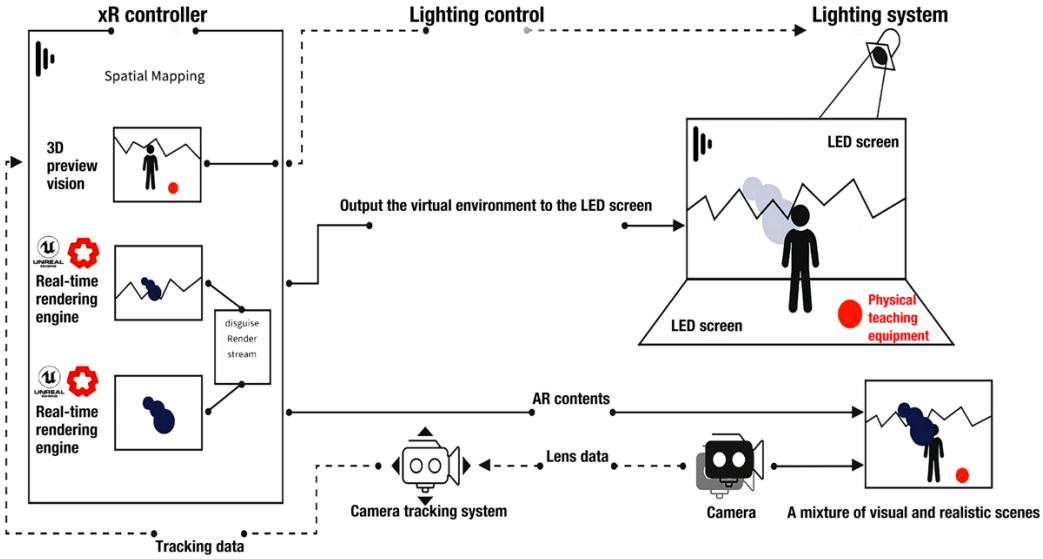
1. Technical analysis

XR technology as a fusion of immersive technology, not only breaks the limitations of traditional VR and AR technology dependent on the presentation of equipment, its important feature is that it can be infinitely extended by extending the LED screen to build a "virtual environment" as the imaging of XR scenes, the real world LED screen seamlessly extended to the virtual world environment, to complement and expand the effect of the scene. Complement and expand the effect of the scene.

By superimposing virtual space in real space, XR technology can create the dual experience of "real objects + virtual scenes". In a limited space such as a classroom or laboratory, unlimited scenes can be switched and extended, allowing a perfect combination of virtual and real images.

Figure 1

Technology path and method of xR (by Starparkmedia)



XR is now specifically defined as a workflow that includes LED displays, camera tracking systems and a powerful graphics engine for real-time rendering, a virtual production method that integrates performers into the virtual world in real time without the need for green screens and post-production processes, and outputs the final image in real time.

2. Application in the design and commercial field

XR technology is now rapidly making case applications in the commercial sector, especially in advertising scenarios. Its multi-scene switching feature helps advertising scenery to respond quickly to conceptual art design.

With the normalization of the epidemic, XR virtual technology not only is used for scene transitions in commercials, but also uses new technologies to promote content innovation and build new application scenarios and communication channels.

At the same time, the post-epidemic era has brought the most intuitive challenges and opportunities, the suspension of offline activities has led to the cancellation of live show viewing, and major brands have begun to use digital forms to produce launches or fashion catwalks The Balenciaga brand released a series of advertising films for the spring of 2022, using virtual simulation technology to show models starting from the Oriental Pearl TV Tower in Shanghai, traveling through scenes such as islands, snow-capped mountains, moons, and high-rise buildings, and the changing scenes convey the theme of the series “Here Is Anywhere”.

Figure 2

Campaign application based on XR, “Here Is Anywhere" (2021)

In the case of design and business, we can find that the integration of XR virtual technology and show will become a new trend in the development of the fashion industry, and the multi-scene design application based on XR virtual technology has become more mature and feasible, many of these technologies and experimental methods are worth learning and learning, the content of which is mainly: to build a systematic XR virtual technology, through the multi-sensor capture system + volume video + engine real-time rendering, to achieve real model and digital virtual model show synchronous interaction, real model and digital clothing model changes and replacement, Significant time and space savings are also enhanced for design and commercial innovation.

3. Prospects for development in the field of educational teaching

Because the training programs and curriculum settings of many disciplines have a strong practical nature, especially the design disciplines in which the author is engaged, it is necessary to guide students to draw reasonable conclusions through a variety of analytical means such as classroom teaching and internship, data analysis, user demand analysis, combined with scientific methods, and continuous innovation from a multi-dimensional perspective. So as to create a design product that meets the needs of the market and the needs of users.

As mentioned earlier, this immersive presence and online and offline interactivity brought about by XR technology are able to meet the needs of physical perception and structured reflection in embodied learning activities, whether from the integration of theoretical and practical teaching. Whether it is a concrete way of learning, it is necessary to “communicate and interact” and “learn and use”.

Figure 3

Students interact in the teaching space of SMALLab

Learners engage in the dynamic blending of the physical body, mental memory, and environmental interaction in the teaching space, and in this dynamic blending learning experience Learners can enhance the memory points of this multi-sensory learning experience through physical contact and immersive on-the-spot experience of virtual scenes, making the interaction between learners and the classroom environment more realistic Rich, on-spot experience construction will also be more profound and vivid, so as to achieve better learning results.

As an interactive medium between learners and the teaching environment, XR technology can transform traditional classrooms, innovate contextual classroom teaching, build smart classrooms and virtual simulation laboratories, and so on. In the multi-sensory experience such as sight, hearing, and touch, a digital environment similar to a certain range of real environments is generated, so that teaching finally presents the effect of virtual and real integration. In the future, under the integration of XR immersive technology and an online teaching platform, the conversion of physical space can be eliminated, saving a lot of time, manpower, and material costs, and allowing students to have an immersive on-spot learning experience.

Imagine the construction of a digital multi-scene teaching space

An immersive teaching space where virtual and reality blend

SMALLab is built as a virtual-real fusion environment supplemented by computer network technology, Internet of Things technology, and infrared sensing technology (SMALLLAB Learning, nd). The physical space at SMALLab is relatively open, and students have no restrictions on entering and exiting interactive areas. Learners inside and outside the interactive area can directly observe the learning scene naked and participate in communication and collaboration (Yang & Zhang, 2011). SMALLab has a constantly updated library of scenes with different scenarios, and teachers can provide different activity scenarios for multiple disciplines as needed in teaching practice.

Figure 4

Schematic diagram of SMALLab's virtual space construction

However, it exists based on real classrooms and multimedia equipment, which is a kind of media-oriented interactive teaching space facing offline, and the author's experience in fashion activities through XR technology is based on this media-integrated interactive teaching space, trying to build a digital multi-scene teaching space.

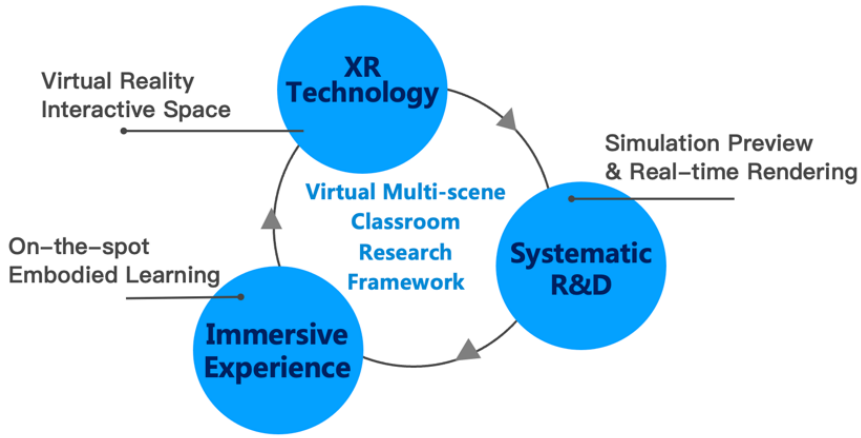
Findings

In the research framework of this study, it includes the following two aspects:

1. Imagine building an information fusion, immersive interactive space through XR virtual technology, and allowing the experimental audience to have a visual, auditory, and tactile sense through sensors, and interact with each other to feel the real environment effect.

Figure 5

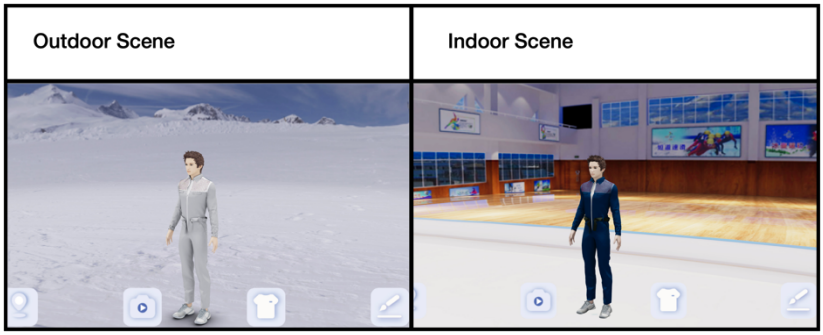
Research framework



2. Pre-simulation through the “3D Multi-scene Virtual Simulation Rehearsal Platform” (Figure 6), combined with the construction of the physical environment, the recording and tracking of offline teaching activities, and finally the real-time rendering output of online + offline teaching content, to achieve virtually. The purpose of the design of the multi-scene teaching space.

Figure 6

3D multi-scene virtual simulation rehearsal platform designed by the author



The 3D multi-scene virtual simulation rehearsal platform is designed for learners to perform interactive rehearsals in different learning spaces. The software needs to be used in conjunction with the 3D digital model, and relevant parameters can be adjusted directly through the graphical operation interface. Its adjustable and pre-rehearsed parameters include basic environment scene switching (between indoor and outdoor, etc.), simulating the change of light in the learning environment. It responds to the interactive environment of teaching, so that light and dark, cool and warm, tones can be performed, which simulates different effects in a real environment (Figure 7).

Figure 7

3D model is designed to switch between multiple scenes

In addition, even the learner's clothing color switching can be presented through the simulation of this software, which is composed of modules such as modifying and viewing the character's clothing model. After the design and simulation of the multi-scene learning space in the first step through this software, the second step needs to build a real physical environment. In the construction of the physical environment based on XR technology, the LED display is used, including 3D dynamic digital scenes

in the Unreal Engine, as well as real environmental objects (such as tables and chairs, etc.), a camera system, and monitors.

In this step, it is the virtual reality presentation of the scene of the first step “3D multi-scene virtual simulation rehearsal platform”. Moreover, thirdly, it needs to use light sensors, camera tracking, and positioning devices to track and record multiple scenes (locations), learning contents (events), and learners (characters) in the Unreal Engine in real-time. Finally, the digital output of video and images is carried out through the real-time rendering system (Figure 9).

Figure 8

The research steps

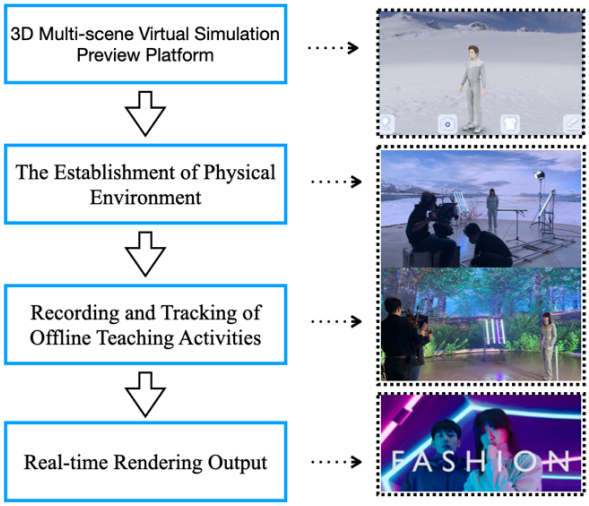


Figure 9

Teaching experiment in XR Virtual multi-scene by author

The final design and experimental results of the XR virtual multi-scenes teaching space were released in the form of video (Figure 9), which covered four scenarios: outdoor, indoor, natural, and fashion. Two test students participated in this experiment.

Discussion

Based on the above research ideas and contents, this project explores the influence of different modeling methods and presentation forms on the display effect by constructing a virtual environment platform and a field show site, and optimizes the construction of the overall system. At the same time, by using interdisciplinary research methods, and integrating multidisciplinary characteristics such as computer vision, fashion activities, artificial intelligence, and design, the author hopes to digitize the multi-scene teaching space. In future-oriented educational activities, experiments and imaginations are carried out.

Recommendations

XR virtual technology can transform traditional classrooms, build smart classrooms and virtual simulation laboratories, and create virtual contextual teaching environments (Yu et al., 2011). In terms of sight, hearing, and touch, a digital environment similar to a certain range of real environments is generated to interact so that the picture finally presents the effect of virtual and real fusion. From the perspective of educational practice, multi-scene simulation and immersive learning experience can help students improve their learning enthusiasm in the classroom, can effectively improve learner participation, knowledge and memory level, and self-efficacy, and even simulate the environment such as competitions and maker roadshows in advance, helping students improve self-confidence and transform learning results, which is the development prospect of digital learning in the future.

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