Classical Culture VR Game Design Method

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Abstract: Virtual (augmented) reality is a strategic emerging industry based on the new generation of information technology, with the characteristics of large application space, great industrial potential, and large technological span. The virtual (augmented) reality industry chain mainly includes hardware, software, content production and distribution, applications, and services, as shown in the following figure. In this paper, we propose a classical culture VR game design method. The key quality attributes of the poetry VR challenge game include:1) Using PicoVR all-in-one machine as a hardware carrier for operation, it is compact, lightweight, easy to operate, and can be experienced anytime, anywhere.2) High quality UI design, diverse experience in crossing levels, including poetry, ancient Chinese, and ancient objects, restoring authentic ancient scene architecture, making the experience as if traveling through the ancient world of the Tang Dynasty.3) The game has an upgraded system with randomly appearing poems, Chinese characters, item resources, and levels of novelty, making the game more challenging.

1. Introduction

Virtual Reality (VR) technology, also known as spiritual realm technology, is a new practical technology developed in the 20th century. Its core is to use computers to simulate virtual environments, giving people a sense of environmental immersion. Augmented Reality (AR) is a technology that cleverly integrates virtual information with the real world, applying computer-generated text, images, 3D models, music, videos, etc. to the real world. The two types of information complement each other, thereby achieving "enhancement" of the real world. Virtual (augmented) reality is a strategic emerging industry based on the new generation of information technology, with the characteristics of large application space, great industrial potential, and large technological span. The virtual (augmented) reality industry chain mainly includes hardware, software, content production and distribution, applications, and services, as shown in the following figure [1-5].

The hardware link includes three parts: core devices, terminal equipment and peripherals, and supporting equipment. Among them, core devices include chips (CPU, GPU, MCU, SOC, etc.), sensors (IMU, mechanics, thermodynamics, optics, electronics, chemistry, biology, five senses, etc.), display screens (LCD, OLED, AMOLED, micro displays, and their driver modules), optical devices (optical lenses, diffractive optical elements, image modules, 3D modeling modules, etc.), communication modules (RF chips, WIFI, Bluetooth, NFC, etc.). Terminal devices and peripherals are divided into output devices and input devices. Output devices include head displays (eyeglass boxes, PC devices, all-in-one machines), desk displays (holographic tables, etc.), large screens (circular screens, CADWall, multi fold screens, variable form CAVE, etc.), body sensations (seats, flight simulations, etc.), and input devices include motion control devices (handles, data gloves, universal treadmills, data jackets, etc.) Motion capture equipment (optical, inertial, mechanical, acoustic, electromagnetic, etc.), sound input equipment (Ambisonics microphones, Binaural microphones, etc.). Supporting equipment includes panoramic shooting equipment (panoramic

camera, pan tilt, etc.) [6-10].

The software link includes support software and software development kit. Among them, support software includes OS operating system (Windows, Android, etc.), middleware (Conduit, VRWorks, etc.), and software development tool package includes SDK and engine (Unity3D, UE4, CryEngine3, VRPlatform, etc.) [10-15].

The content production and distribution process includes virtual (augmented) reality content representation, content generation and production, content encoding, real-time interaction, content storage, and content distribution. Among them, content production includes VR film and television, VR games, and VR industry solutions, while content distribution includes online distribution (application stores, websites, players, etc.) and offline distribution (theme parks, experience stores, etc.) [16-20].

Application and service links include government level (military, smart city, science popularization, etc.), enterprise level (aerospace, industry, construction, real estate, conference and exhibition, etc.) and consumer level (education, medical care, training, cultural tourism, audio-visual media, games and entertainment, etc.) [21-25].

The global virtual (augmented) reality industry has shown a rapid development trend since its outbreak in 2016, with products featuring more user-friendly pricing, stronger content experience and interaction methods, as well as strong capital support and market promotion. In 2017, the market size reached 66.75 billion yuan, a year-on-year increase of 120.8%; The problems of lack of content, poor experience, and difficulty in monetization caused the virtual (augmented) reality industry to encounter a "double cold" in the capital market and hardware equipment market in 2018, with a market size of 111.63 billion yuan, a year-on-year increase of 67.2%. The industry's growth rate slowed down compared to the previous two years, and since then, it has entered a mature market period; Since 2020, with the acceleration of 5G commercialization and the COVID-19, the new demand of the "non-contact" economy has brought new opportunities for the development of virtual (augmented) reality industries. It is estimated that the global market size will exceed 450 billion yuan in 2023, with an annual compound growth rate of more than 30% [26-30].

In this paper, we propose a classical culture VR game design method. Poetry VR Challenge Game is a small VR game to learn our ancient Chinese literature through an interesting game. It builds scenes with ancient buildings, and the operator can take a VR helmet to roam in it. It aims to integrate a series of ancient Chinese, poetry, etc. into the game through virtual reality technology, promote our traditional Chinese culture through "recognizing Chinese characters, reading poetry, learning Chinese", and immersive VR interaction, It can walk around the scene randomly, with a wealth of interactive objects, the origin of hieroglyph, poetry, song and fu reading dialogue, and collection of items, so that the operators can learn Chinese ancient literature in the interesting game, recognize the characters of the ancients through virtual reality technology, read the poems of the ancients, and understand the thoughts of the ancients, so as to better and more comprehensively understand Chinese traditional culture.

2. Design Principle

This system uses the MVC game framework design principles:

Model: Responsible for storing the central data of the system.

View: Display information to users (multiple views can be defined).

Controller: Process user input information. Responsible for reading data from the view, controlling user input, and sending data to the model, it is the part of the application that handles user interaction. Responsible for managing and controlling user interaction.

The model component contains the functional kernel of the application, which encapsulates the corresponding data and outputs the process of executing specific application processing; The model also provides functions for accessing data, which are used by view components to obtain the data to be displayed. The controller calls all these procedures on behalf of the user.

Separation of views and data models: using different views to present the same data; Separate visible and invisible components, enabling independent testing of the model. Because the separation

of visual components reduces external dependencies, it is beneficial for testing. (Database is also an external component)

Separation of View and Presentation Logic (Controller): Controller is a component of presentation logic, not a business logic component. MVC can serve as both a presentation pattern and a construction pattern, meaning that the Controller can also be a business logic. Separate logic and specific presentation, enabling independent testing of logic.

MVC has further divided the UI layer in the three-layer architecture into three parts: controller, view, and entity. The controller completes page logic and communicates with the interface layer through entities; The C layer directly communicates with the business logic layer in the three layers. Three layers and MVC can coexist. The three layers are divided based on business logic, while MVC is divided based on pages.

The hierarchical pattern of a three-layer architecture is a typical top-down relationship, with the upper layer relying on the lower layer. However, as a representation mode, MVC does not have a hierarchical relationship, but rather a collaborative relationship. Even if MVC is considered an architectural pattern, it is not a hierarchical pattern. MVC and three-layer architecture have little comparability and are technologies applied in different fields.

3. Sysytem Design

The poetry VR challenge game can be divided into the following parts by function:
1) Level data storage, visualization system,
2) The luggage system is responsible for mobilizing data storage and visual display instructions for ancient Chinese, ancient script, and ancient poetry,
3) Interactive interaction system, including teleportation interaction, UI interaction,
4) Personal cultivation upgrade system.

3.1. Level Data Storage and Visualization System

1) Level Data Static Class: Level data stores various items in the game, including ancient texts, ancient items, ancient poetry upgrade settlements, score display, whether to pass, experience points, item values, level names, etc.

2) Reading and writing level data: Based on the player's gameplay process, read the breakthrough data of this level. After meeting the upgrade settlement requirements, the upgrade command can be triggered to clear the level and update the upgrade data in real-time.

3) UGUI level data visualization: level information displays the level of the current level, the total level, and whether the level is cleared.

4) VR ray interaction mechanism: mainly aimed at UI interaction, self-developed ray triggering system, including triggering of UGUI.

3.2. Luggage System, Interactive Instructions

Random generation of items: read the customs clearance data, and randomly generate hieroglyph ancient Chinese, ancient poetry and ancient items in the scene.

Visualization of 2 items: The data of clearance, cultivation, and breakthrough is updated in real-time to the data storage, and then displayed in the backpack by the central command program.

3.3. Ray Mechanism Triggering System

1) VR ray ground interaction mechanism: by acquiring ground coordinate information, the position of the person can be moved teleportation.

2) VR ray object interaction mechanism: Based on ray settings, objects can be grabbed, changed color, highlighted, and thrown.

3) VR ray UI interaction mechanism: VR rays are constructed using the UnityRay class, requiring low-level logical changes to the UGUI EventSystem before obtaining Canvas layer information. This involves studying OpenGL low-level logic and then interacting with Canvas layer information.

3.4. Personal Cultivation Upgrade System

1) Personal information display: Display an individual's current name, level, experience value, item value, and so on.

2) Cultivation data reading: Pass levels to read static data allocation and obtain relevant information.

3.) Upgrade command: Read the current level information to determine whether it meets the upgrade criteria.

4. Sytem Implement

4.1. How to Use VR Software

After entering the software, you can clear the helmet and observe the scene, holding one handle in each hand. The handle triggering event is shown in the following figure:

Left handle push pull button: Push forward to display the left handle UI interface, push back to hide the left handle UI interface.

Left/Right Handle Home Key: Exit the software and run in the background.

Right handle trigger button: Point to the ground, trigger teleportation, point to objects, pick up objects, point to UI, trigger button.

4.2. UI Interface

After entering the software, the VR helmet will be directly cleared to enter the scene. The left hand handle is the UI tablet interface, and the right hand handle is the handle that triggers the event.

1) Personal information interface: includes personal information, level, experience value, and item progress value.

2) Backpack interface: including poetry page, ancient Chinese character page, and item page.

3) level information interface, including display of all levels, level names, and more.

4.3. Detailed Instructions for Use

4.3.1. Ancient Chinese Character Pickup Interface

Ancient Chinese characters will randomly appear and be distributed on site, and clicking on the stone will bring up the interface. Based on the shape of the stone's text, the correct modern text will be selected. After selecting the correct text, you will receive it as a proof of promotion.

4.3.2. Collection Methods of Ancient Poetry

Ancient poetry will appear randomly in the scene. Players can only pick up poetry by searching for it on site and clicking on it. However, poetry may lack text, so it is necessary to search for it on site and read it aloud as a proof of upgrading experience.

4.3.3. Method of picking up items

Various items randomly appear in the scene, and by clicking to pick up the specified items, promotion conditions are obtained.

5. System Result

5.1. Implementation of Backpack System

When importing antique scenes, items, and other resource files, in the scene view, call using UnityEngine. UI.

5.2. Implementation of Three Major Functional Modules

We use a 3D scene roaming system as a bridge to achieve the operator's roaming control. By

selecting scene positions through rays, we can achieve a single roaming of the scene. At the same time, by picking up, we can pull poetry, text, items, etc. into the backpack system.

5.3. Implementation of Personal Upgrade System

Here, it is necessary to determine several data points for personal upgrade system: reading static data of levels through clearance, reading current level information, and determining whether the upgrade conditions are met. Here, we call the relevant data from the previous game process, and write the corresponding judgment logic.

5.4. Unity Software and VS Functional Development

Unity is a game engine that can create 3D interactive games, with a rich variety of systems available for us to use, such as animation systems, ray systems, UGUI systems, Effects special effects systems, etc. Through C # code, we can create high-quality 3D interactive games.

Unity's animation system features include redirectable animation, complete control of animation weights at runtime, event calls during animation playback, complex state machine hierarchical views and transitions, mixed shapes for facial animation, and more.

The ray system can be combined with LineRender and Ray class mechanisms to render the display of Ray. At the same time, the Ray mechanism needs to control the length of LineRender events to achieve mutual coordination of the mechanisms.

The UGUI system is extremely powerful, achieving high-quality image visualization effects through graphical algorithms. It is easy to operate, easy to use, and has various convenient and easy-to-use interfaces.

The Effects special effects system, the Unity engine, in order to simply restore real-world scenes, has built-in fog effects and added various water effects to the standard resource package. Developers can easily add them to the scene.

5.5. How to Build Pico Helmets

Pico helmet is a VR head display all-in-one machine that can interact anytime and anywhere. Its characteristics are stable, lightweight, and strong rendering ability, achieving a good interactive experience. In Unity, the software package needs to be built as. apk to run in the Pico helmet, because Pico's processor core is an Android processor, paired with the Android system, to render it into a spherical VR effect, thereby presenting a realistic interactive experience of panoramic VR.

Pico itself is a borderless head display, and in principle, its space can be expanded to infinity because the VR title adopts SLAM technology, which renders the superimposed virtual objects based on the map obtained from SLAM and the current perspective. This can make the superimposed virtual objects appear more realistic without any sense of dimensionality.

When the. apk software package is successfully built and installed in the Pico helmet through digital transmission, you can experience it.

6. Conclusion

In this paper, we propose a classical culture VR game design method.1) Actively inheriting and developing Chinese language culture through effective channels,2) Realize diversified teaching, integrating teaching with entertainment, integrating teaching and playing, and bringing a more authentic interactive teaching experience into the learning experience,3) Create a truly fun interactive game that can be used for teaching.

References

[1] Lohman J, Turchet L. Evaluating Cybersickness of Walking on an Omnidirectional Treadmill in Virtual Reality. IEEE transactions on human-machine systems, 2022 (4): 52.

[2] Wang Y H, Zhang G H, Xiang Y Q, et al. Virtual Reality Assisted General Education of Nuclear Chemistry and Radiochemistry. Journal of Chemical Education, 2022, 99 (2): 777-786.

[3] Harknett J, Whitworth M, Rust D, et al. The use of immersive virtual reality for teaching fieldwork skills in complex structural terrains. Journal of Structural Geology, 2022, 163.

[4] Mueller J H, Neff T, Voglreiter P, et al. Temporally Adaptive Shading Reuse for Real-Time Rendering and Virtual Reality. ACM Transactions on Graphics (TOG), 2021.

[5] Simonetti V, Tomietto M, Comparcini D, et al. Effectiveness of virtual reality in the management of paediatric anxiety during the perioperative period: A systematic review and meta-analysis. International Journal of Nursing Studies, 2022, 125: 104115.

[6] Kwok A, Yan M, Deng X H, et al. Exploring the facilitating and obstructing factors of using virtual reality for 5S training: An exploratory qualitative study from students' perspectives in an industrial engineering undergraduate course. Computer applications in engineering education, 2022 (4): 30.

[7] Jaud M, Geoffroy L, Chauvet F, et al. Potential of a virtual reality environment based on very-high-resolution satellite imagery for structural geology measurements of lava flows. Journal of structural geology, 2022 (May): 158.

[8] Shirk J D, Reiter R, Wallen E M, et al. Effect of 3-Dimensional, Virtual Reality Models for Surgical Planning of Robotic Prostatectomy on Trifecta Outcomes: A Randomized Clinical Trial. The Journal of urology, 2022, 208 (3): 618-625.

[9] Ifdil I, Biondi S, Firman F, et al. Virtual reality in Metaverse for future mental health-helping profession: an alternative solution to the mental health challenges of the COVID-19 pandemic. Journal of Public Health, 2022 (1): 1.

[10] Koyagasioglu O, Ozgurbuz C. The Effects of Virtual Reality Nonphysical Mental Training on Coordination and Skill Transfer in Healthy Adults. Journal of sport rehabilitation, 2022 (4): 31.

[11] Sanford D I, Ma R, Ghoreifi A, et al. Association of Suturing Technical Skill Assessment Scores Between Virtual Reality Simulation and Live Surgery. Journal of endourology, 2022, 36 (10): 1388-1394.

[12] Huang Y, Richter E, Kleickmann T, et al. Class size affects preservice teachers' physiological and psychological stress reactions: An experiment in a virtual reality classroom. Computers & education, 2022 (Jul.): 184.

[13] Field J, Dixon J, Martin R, et al. Combining virtual reality and 3D-printed models to simulate patient-specific dental operative procedures—A study exploring student perceptions. European Journal of Dental Education, 2022, 26 (2): 393-403.

[14] Kesava Kovanur Sampath a i Person Envelope, Aabcg H, Ey A, et al. The role of virtual reality (VR) with haptic feedback in enhancing physical examination skills of health care students – A systematic review protocol. International Journal of Osteopathic Medicine, 2022.

[15] Wang Y, Chang F, Wu Y, et al. Multi-Kinects fusion for full-body tracking in virtual reality-aided assembly simulation: International Journal of Distributed Sensor Networks, 2022, 18 (5): 625-636.

[16] Gao C, Li X, Peng J, et al. Application of Virtual Reality with Positive Psychology in Adjusting Methods of College Students' Mental Health. Mathematical Problems in Engineering, 2022, 2022.

[17] Moeinzadeh A M, Calder A, Petersen C, et al. Comparing virtual reality exergaming with conventional exercise in rehabilitation of people with multiple sclerosis: A systematic review. Neuropsychological rehabilitation, 2022: 1-26.

[18] Tastan H, Tong T, Tuker C. Using handheld user interface and direct manipulation for architectural modeling in immersive virtual reality: An exploratory study. Computer Applications in Engineering Education, 2022, 30 (2): 415-434.

[19] Tai K H, Hong J C, Tsai C R, et al. Virtual reality for car-detailing skill development: Learning outcomes of procedural accuracy and performance quality predicted by VR self-efficacy, VR using anxiety, VR learning interest and flow experience. Computers & education, 2022 (Jun.): 182.

[20] Fuchs M, Beckert F, Biedermann J, et al. A collaborative knowledge-based method for the interactive development of cabin systems in virtual reality. Computers in Industry, 2022, 136: 103590-.

[21] Kane D, Ryan G, Mangina E, et al. A randomized control trial of a virtual reality learning environment in obstetric medical student teaching. International journal of medical informatics, 2022, 168: 104899.

[22] Dong H P, Sang S H, Han M, et al. A clinical trial of a patient-customized virtual reality intervention for tinnitus. Scientific reports, 2022, 12 (1): 12441.

[23] Thorn J T, Chenais N, Hinrichs S, et al. Virtual reality validation of naturalistic modulation strategies to counteract fading in retinal stimulation. Journal of neural engineering, 2022 (2): 19.

[24] Ida H, Mohapatra S, Aruin A S. Perceptual distortion in virtual reality and its impact on dynamic postural control. Gait & posture, 2022, 92: 123-128.

[25] Arnfred B, Bang P, Hjorthj C, et al. Group cognitive behavioural therapy with virtual reality exposure versus group cognitive behavioural therapy with in vivo exposure for social anxiety disorder and agoraphobia: a protocol for a randomised clinical trial. BMJ open, 2022, 12 (2): e051147.

[26] Sara V, Ausias C, Jorge L, et al. The benchmark framework and exploratory study to investigate the feasibility of 360-degree video-based virtual reality to induce a full body illusion. Virtual reality, 2022 (1): 26.

[27] Lin Y, Wang S, Lan Y. The study of virtual reality adaptive learning method based on learning style model. Computer Applications in Engineering Education, 2022, 30 (2): 396-414.

[28] Envelope K. Virtual reality simulation for learning wound dressing: Acceptance and usability. Clinical Simulation in Nursing, 2022, 68: 49-57.

[29] Berges A J, Vedula S S, Malpani A, et al. Virtual Reality Simulation Has Weak Correlation with Overall Trainee Robot-Assisted Laparoscopic Hysterectomy Performance. Journal of minimally invasive gynecology, 2022, 29 (4): 507-518.

[30] Brunfeldt A T, Dromerick A W, Bregman B S, et al. A trade-off between kinematic and dynamic control of bimanual reaching in virtual reality. Journal of neurophysiology, 2022, 127 (5): 1279-1288.