Comparison of Design Logic Between VR and AR Games-An Analysis Based on Four Benchmark Cases

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Abstract. With the rapid iteration of Extended Reality (XR) technology, XR games have become the most promising core segment in the global digital entertainment industry. Taking four benchmark works of XR games as research objects, this paper systematically sorts out the product design logic and industrial practice paths of Virtual Reality (VR) and Augmented Reality (AR). The research covers AAA-grade native VR content, popular lightweight VR games, phenomenal AR mobile games, and innovative AR exploration products. It focuses on the core innovations and lessons of different cases in interaction design, immersive experience creation, and business model construction, and compares the design differences between VR and AR games. The study finds that native content design based on XR technical features and player experience-centered gameplay innovation are the core logic for XR games to achieve both reputation and market breakthroughs. At present, the industry still faces challenges such as high hardware thresholds, high content development costs, and immature general interaction paradigms. Finally, combined with industrial development trends, this paper proposes future research directions for XR games, providing theoretical references and practical guidance for content creation and industrial development.

Keywords: XR Games; Interaction Design; Immersive Experience; VR; AR

1 Introduction

Extended Reality (XR) is a general term for immersive technologies including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). Its core value is to break the physical boundary between virtual and real worlds and reconstruct the interaction mode and experience form of digital content. In recent years, XR hardware has been continuously upgraded in resolution, wearing comfort, and spatial positioning accuracy, and the content ecosystem has gradually evolved from early casual games to high-quality and diversified mature content. According to Newzoo's 2025 Global XR Games Market Report, the global VR game market exceeded 80 billion US dollars in 2025, with a compound annual growth rate of over 35%, showing significant industrial growth potential [1]. As the most mature consumer-level application scenario of XR technology, games have become a core focus of the global technology and digital content industries [2].

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At present, scholars at home and abroad have conducted multi-dimensional research on XR games. Some focus on the embodied interaction design of VR games and analyze the immersive experience construction logic of native VR content from the perspective of embodied cognition theory [3]. Others explore the breakout paths of lightweight VR games and summarize the design rules of mass-oriented VR content [4]. AR game research mostly concentrates on LBS technology application and business model innovation, analyzing the scenario-based implementation paths of AR games with phenomenal products as samples [5]. Some scholars also review failed AR game cases and summarize core misunderstandings in product design [6]. However, most existing studies focus on a single track or single sample, lacking a systematic summary of design logic differences between VR and AR games [7, 8]. Few studies explore the underlying laws of XR game product design through two-way comparison of successful and failed cases, and the industry lacks replicable successful design paradigms.

Therefore, this paper conducts an in-depth review and comparative analysis of four benchmark XR games from different tracks with distinct development outcomes, and systematically sorts out the development laws and core logic of XR games. It provides practical references for industrial content creation and supplementary case support for academic research in the XR game field, with strong theoretical and practical significance.

2 Review Scope and Research Methods

2.1 Case Selection Criteria

The case selection of this paper follows three core criteria: first, having industrial milestone significance and a major impact on the development direction of XR games; second, covering the two core sub-tracks of VR and AR, taking into account both heavy immersive and light social product types; third, including representative successful and failed cases for two-way comparison to ensure the comprehensiveness and objectivity of the review. Accordingly, this paper selects four benchmark cases: Half-Life: Alyx and Beat Saber in the VR track, and Pokémon GO and Minecraft Earth in the AR track.

2.2 Research Methods

This paper mainly adopts two research methods. The first is the case study method, which extracts core innovations and development experiences of each product by analyzing the core gameplay, technical highlights, business models, and operation strategies of the four cases. The second is the comparative research method, which horizontally compares the design logic, experience differences, and user thresholds of VR and AR games to summarize the development laws of different tracks, and vertically compares the core differences between successful and failed cases to explore the underlying logic of XR product design.

3 Core Content of Benchmark Cases

3.1 VR Gaming Benchmark Cases

Half Life: Alex-An Industry Milestone for 3A Level Native VR Content. Valve released Half Life: Alex in 2020. This is the official sequel to the Half Life series, developed from scratch specifically for VR platforms, and is widely recognized as a milestone in the history of VR gaming. Its biggest innovation is the development of an interactive system that is fully suited to the characteristics of VR. The revolutionary gravity glove function allows players to pick up things from a distance with natural gestures. The game also deeply integrates physics rules into puzzle solving and combat elements. The entire scene has an interactive physics engine and a manually loaded design. Players' body movements and game controls are fully integrated, providing a truly immersive experience. Technically, this game uses Valve's own Source 2 engine, which achieves realistic physics effects, intelligent enemy AI, and precise spatial sound effects, laying the foundation for a good gaming experience. It not only proves that VR platforms can produce 3A level masterpieces, but also directly drives the sales of VR devices and sets quality standards for native VR content.

"Rhythm Lightsaber" - Successful Breakthrough in Lightweight VR Games. Beat Games released "Rhythm Lightsaber" in 2018. This is a VR music game that combines music rhythm and lightsaber cutting, and is also the world's hottest lightweight VR blockbuster. Its most impressive feature is that it lowers the threshold for VR games with the simplest operations. Players only need to follow the rhythm of the music and use the corresponding colored lightsaber to cut blocks, which beginners can quickly learn. At the same time, this game breaks out of the traditional gaming circle. It is designed with movements such as swinging arms, turning around, and squatting, perfectly combining gaming and fitness. Many players use it for VR fitness, greatly expanding the product's uses. In addition, the official has been updating music DLC and many players have created their own mods, forming a complete content ecosystem that keeps the game popular. It breaks the prejudice that VR games are only played by hardcore players, proving that lightweight, easy to learn, and social VR content can also become popular among the public.

3.2 Benchmark Cases of Augmented Reality (AR) Games

Pokémon GO-A Classic Case of Combining LBS and AR Technology. Niantic released Pokémon GO in 2016. This is a mobile game that utilizes location services (LBS) and augmented reality (AR) technology, with the theme of Pokémon. It is also the most successful AR game in the world. Its core innovation is to connect the virtual Pokémon IP with the real world. Through GPS positioning, the game places virtual Pokémon, Taoist temples, and Pokémon stations on a real map, guiding players to go out and capture Pokémon and engage in battles in real scenes. With the AR function of the mobile phone camera, players can see vivid Pokémon in real environments and feel

like virtual creatures have really appeared around them. In terms of business model, it has three ways of making money: in store purchases, offline merchant sponsorships, and large-scale offline events, achieving diversified commercial value. This game not only earned billions of dollars, but also sparked a global trend of offline social interaction, paving the way for the practical application and commercial development of AR games.

Minecraft: Earth - Exploration and Lessons Learned from AR Sandbox Gameplay. Mojang released "Minecraft: Earth" in 2019. It is an AR sandbox mobile game under the top IP "Minecraft". The core gameplay allows players to freely build, collect resources, and play with others on a flat surface in the real world. With the huge user base and IP influence of Minecraft, this game combines sandbox construction and AR technology for the first time, supporting multiple people to build things together in the same scene, and has strong social attributes. But due to three main issues, it was discontinued in 2021: firstly, the requirements for mobile performance and network were too high, which prevented many people from playing and limited the number of users; Secondly, the core gameplay is too single, without long-term growth goals and new content, which cannot retain players; Thirdly, the content updates slowly, the operation lacks novelty, and the market has been taken away by mature competitors such as Pok é mon GO. Although it was eventually discontinued, its attempts provided valuable experience for the commercialization and gameplay innovation of AR games in the future.

4 Analysis and Discussion

4.1 Core Differences in Design Logic Between VR and AR Games

Case comparison shows essential differences in the design logic of VR and AR games. The two are not mutually exclusive but form a complementary development pattern. In terms of core experience, VR games focus on fully virtual immersion, creating a virtual world isolated from reality, suitable for heavy gameplay with in-depth narrative and high intensity. AR games emphasize virtual-real superimposed interaction, with the real world as the core stage, more suitable for light exploration and offline social casual gameplay [2]. In terms of equipment threshold, VR games rely on dedicated headsets and controllers, with high hardware costs and indoor space requirements, resulting in a relatively high user threshold. AR games mainly use smartphones, requiring almost no additional equipment, with extremely low entry costs and stronger mass communication attributes [9]. In terms of gameplay design, VR games focus on long-term deep immersion in a single session, with advantages in core-oriented gameplay. AR games adapt to fragmented experience scenarios, focusing on offline social interaction and real-scene linkage.

4.2 Common Laws of Successful XR Game Cases

By comparing the success and failure of the four cases, three core commonalities for XR game success are extracted. First, adhere to native content design. All successful

works do not simply transplant traditional game gameplay but create exclusive interaction systems based on XR technical characteristics. The gravity gloves of Half-Life: Alyx and the LBS exploration of Pokémon GO both give full play to XR technical advantages. Second, take player experience as the core. All successful works make targeted designs to lower entry thresholds and optimize experience details. For example, Half-Life: Alyx launched a comfort mode to reduce motion sickness, and Beat Saber used minimalist rules to lower the difficulty of getting started. Third, build a complete content ecosystem. Long-term operating successful works have formed an official update plus user co-creation content system to ensure long-term product vitality [9].

4.3 Existing Problems in the Current Development of XR Game Industry

Combined with case analysis, the current XR game industry still faces four core challenges. First, the hardware threshold has not been broken through. High-end VR experience has high equipment performance requirements, and AR glasses have not achieved consumer-level popularization, limiting user scale expansion [10]. Second, high-quality content development costs are high. R&D investment in AAA-grade XR content is huge, raising the entry threshold for small and medium-sized developers, resulting in a structural gap in industrial content supply [1]. Third, the general interaction paradigm and design standards of XR games are still under exploration, and a mature interaction system like the keyboard, mouse, and controller of traditional games has not yet been formed [11]. Fourth, AR games generally face problems of insufficient gameplay depth and difficulty in user retention. Balancing lightweight experience and long-term content driving force remains an urgent industry issue [6].

4.4 Future Research Directions

Combined with industrial development trends and existing problems, this paper proposes four follow-up research directions. First, research on multimodal interaction of XR games, exploring the application of eye tracking, haptic feedback, facial expression capture and other technologies in XR games to build a more natural interaction system [11]. Secondly, investigate the deep application of artificial intelligence in XR games, analyze how generative AI empowers XR game content production, intelligent NPC design, and dynamic narrative innovation, in order to reduce content development costs. Thirdly, explore the business model innovation of XR games, investigate the feasibility of new business models such as subscription systems, virtual economies, and immersive brand marketing, in order to improve the business loop of XR games [8]. Fourthly, study the social mechanism design of LBS AR games, analyze how to enhance the offline social attributes of AR games through gameplay innovation, and solve the problem of user retention [5].

5 Conclusion

This paper systematically compares the design logic of virtual reality (VR) and augmented reality (AR) games through four benchmark cases, clarifies their respective development patterns and complementary industry positioning, and summarizes the

core success factors of extended reality (XR) games. The research results provide a theoretical framework for subsequent XR game research and practical guidance for industry content creation and product iteration.

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