Blockchain-Powered Gaming

Subjects: Computer Science, Software Engineering

Contributor: Dimitrios Stamatakis , Dimitrios G. Kogias , Pericles Papadopoulos , Panagiotis A. Karkazis , Helen C. Leligou

In the rapidly evolving domain of digital gaming, blockchain technology emerges as a transformative force, offering novel paradigms for player interaction and game design. At its core, blockchain serves as a decentralized digital ledger, recording transactions in a secure, transparent, and immutable manner. This technology, foundational to the new wave of web3 games, redefines the traditional boundaries of gaming, introducing concepts of true digital ownership, trustless environments, and decentralized governance. As the gaming industry grapples with challenges around security, transparency, and player agency, blockchain presents itself as a compelling solution, heralding a new era of gaming experiences.

blockchain blockchain game gaming serious game smart contract Dapp NFT

meta transaction

1. Introduction

In the rapidly evolving domain of digital gaming, blockchain technology emerges as a transformative force, offering novel paradigms for player interaction and game design [1]. At its core, blockchain serves as a decentralized digital ledger, recording transactions in a secure, transparent, and immutable manner [2][3]. This technology, foundational to the new wave of web3 games, redefines the traditional boundaries of gaming, introducing concepts of true digital ownership, trustless environments, and decentralized governance [4]. As the gaming industry grapples with challenges around security, transparency, and player agency, blockchain presents itself as a compelling solution, heralding a new era of gaming experiences [5][6].

Blockchain's efficacy in gaming is rooted in its unique technological underpinnings. Central to this are consensus mechanisms like Proof of Work (PoW), Proof of Stake (PoS), and Delegated Proof of Stake (DPoS), each playing a crucial role in transaction validation and network security [7]. PoW, known for its robust security but high energy cost [7], contrasts with PoS and DPoS, which offer more energy-efficient alternatives [8]. Moreover, the advent of smart contracts—self-executing contracts with the terms of the agreement directly written into code—revolutionizes game mechanics [9]. These contracts autonomously manage and enforce game rules, in-game asset ownership, and player interactions, ensuring a trustable, automated gaming environment [2]. In addition, the peer-to-peer nature of blockchain networks enhances the resilience and security of games by distributing data storage, thus mitigating risks associated with centralized servers [9]. This inherent features allow blockchain to be used efficiently in many different use-cases [10][11].

2. Blockchain Games

The rapid evolution of blockchain technology has sparked a multisided exploration into its applications in various domains, one of them being the gaming industry [12]. As blockchain games expand in popularity and diversify in form and function, several pioneering studies have emerged to unpack the intricacies and potentials of this synergy [13]. These studies delve into the categorical variations [14], player perceptions [15], technical functionalities [16], and educational aspects of blockchain games [17].

A few studies have been conducted to investigate the landscape of blockchain games, categorizing them based on their characteristics and user interactions. For example, Tian Min, Hanyi Wang et al. [16] executed a comprehensive survey that focused on identifying the unique categorizations within the realm of blockchain games. They examined the market trends and classified the games into four categories: Rule Transparency, Asset Ownership, Asset Reusability, and User-Generated Content (UGC). Their observations revealed that while the Ethereum network sees a higher number of average active users in general, when it comes to blockchain games, the EOS network is more popular due to its ability to offer higher transaction volume at a significantly lower cost.

On another note, Iikka Paajala et al. [15] sought to investigate the factors that contribute to player retention and engagement in blockchain games. Their focus was on understanding the player's perceptions and how they are influenced by blockchain's inherent characteristics. They concluded that the nature and quality of the game significantly impact player retention. Additionally, the study raised concerns about the transparency and potential misuse of data in blockchain games. Despite these concerns, participants were enthusiastic about user-generated content and the concept of true asset ownership.

Venturing into the territory of Serious Blockchain Games, Yunifa Miftachul Arif et al. [18] came up with a unique approach by devising a tourism-based serious game powered by blockchain technology. Their focus was on how blockchain could handle transactions, providing a more immersive and educational experience for users. They conducted a series of experiments to evaluate the speed, efficacy, and precision of transactions in a blockchain environment, observing how factors such as gas price, gas limit, and data size impact these attributes. The velocity of transactions is affected by gas price, chain length, and data weight, with gas price being the primary adjustable factor for transaction speed [18]. When studying transaction success rate, the gas limit emerged as the most impactful factor. An increase in the gas limit from 40,000 to 50,000 units doubled the success rate from 40% to 80%. Regarding transaction accuracy, a series of thirty assessments were conducted, comparing estimated expenses against actual costs, and the estimations were found to be accurate 80% of the time.

Given these insights, the integration of blockchain technology into serious games, like the one developed in this research, represents an innovative leap in gaming. The current game, leveraging blockchain technology, offers a distinctive educational experience by allowing players to use renewable energy sources to power their towns. The online, multiplayer aspect of the game, developed using web technologies, makes it widely accessible and presents a unique opportunity for scientific exploration. Its educational focus is further enhanced by future updates that will introduce more features to engage players and deepen their understanding of renewable energy

transitions. The game also promotes collaboration through a marketplace feature, and its research component includes a questionnaire to capture player perceptions, contributing to broader research efforts in the field like the one Iikka Paajala et al. [15] sought to investigate. The use of DappRadar for obtaining fresh data about blockchain games provides an updated perspective, adding to the research initiated by Tian Min, Hanyi Wang, and others. This game stands as a promising example of the educational and collaborative potential of serious games powered by blockchain technology.

In a similar way, Ansh Mittal et al. [19] developed an innovative online blockchain-focused serious game, known as CEBT, intending to educate the public about the fundamentals and benefits of blockchain technology. Rather than being hosted on a typical blockchain network, this game was hosted on Firebase, a cloud service offered by Google. This game served as an effective pedagogical tool, providing interactive blockchain training through an adversarial sandbox-based serious game, encouraging the widespread adoption and understanding of blockchain technology.

In summary, the fusion of blockchain and gaming is a growing field, exhibiting vast potential in diversifying gameplay, enhancing player experience, and expanding educational horizons. Critical studies, as reflected above, have underscored the variations of blockchain games, shedding light on the categorizations, the pivotal role of networks like EOS, the significance of player perceptions, and the technologically driven challenges and triumphs within transactional mechanisms. Furthermore, the development of educational blockchain games highlights the potential for this technology to transcend mere entertainment, forging pathways for enhanced public understanding and appreciation.

Building upon the exploration of educational blockchain games, it is essential to delve into the domain of serious games, which represent a significant evolution in the gaming industry. Serious games, defined as games designed primarily for purposes other than entertainment [20], represent a significant discipline within the gaming industry. They are distinguished by their objectives that extend beyond mere entertainment, focusing on areas such as education, training, or information dissemination. They are designed not only to engage but also to impart knowledge or induce behavioral changes in players, making them a perfect match for the capabilities offered by blockchain technology. The principles of serious games revolve around the integration of educational strategies within the game design, ensuring that the gameplay mechanics and narrative support and enhance the learning experience. This approach aligns with the broader vision of the fusion of blockchain and gaming, wherein the technology not only diversifies gameplay but also amplifies the educational potential of games.

Research in this field highlights the importance of aligning game design with educational goals, ensuring that gameplay mechanics and narrative elements support the intended learning outcomes. For instance, the work of Michael and Chen [21] and the 'Game-Based Learning' theory of Prensky [22] provide foundational insights into how games can be structured to enhance learning and engagement. These studies emphasize the need for a balance between entertainment and educational content, ensuring that the game is both enjoyable and informative.

In the context of researchers' project, the GENERA Web3 Game is developed with these principles in mind. The game integrates educational content about renewable energy and sustainable practices into its core gameplay mechanics. By doing so, it not only provides an engaging gaming experience but also educates players on important environmental topics. The game's design reflects the principles of serious games by incorporating interactive learning scenarios, where players make decisions that have real-world parallels, such as managing resources and developing sustainable energy solutions.

Furthermore, the inclusion of blockchain technology in the GENERA Web3 Game adds an innovative layer to the serious game genre. It allows for transparent and secure tracking of players' progress and achievements, aligning with the educational aspect of the game. This integration demonstrates how emerging technologies can be utilized to enhance the efficacy and appeal of serious games, paving the way for future research and development in this field.

As blockchain games continue to evolve, these foundational studies provide invaluable insights, guiding the direction for future research and development in this multifaceted intersection of technology and recreation.

References

1. Fowler, A.; Pirker, J. Tokenfication—The potential of non-fungible tokens (NFT) for game development. In Proceedings of the Extended Abstracts of the 2021 Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '21), Virtual Event, Austria, 18–21 October 2021.

2. Xevgenis, M.; Kogias, D.G.; Karkazis, P.A.; Leligou, H.C. Addressing ZSM Security Issues with Blockchain Technology. Future Internet 2023, 15, 129.

3. Kogias, D.; Leligou, H.C.; Xevgenis, M.; Polychronaki, M.; Katsadouros, E.; Loukas, G.; Heartfield, R.; Patrikakis, C.Z. Towards a Blockchain-enabled Crowdsourcing platform. Int. J. Hum. Comput. Interact. 2019, 21, 18–25.

4. Pfeiffer, A.; Kriglstein, S.; Wernbacker, T. Blockchain Technologies and Games: A Proper Match? In Proceedings of the International Conference on the Foundations of Digital Games (FDG '20), Bugibba, Malta, 15–18 September 2020.

5. Naavik. CoinMarketCap and Naavik: 2022 Blockchain Gaming Report—New Frontiers and the Path Forward. CMC Res. November 2022. Available online: https://coinmarketcap.com/alexandria/article/coinmarketcap-and-naavik-2022-blockchain-gaming-report-new-frontiers-and-the-path-forward (accessed on 18 July 2023).

6. Agrawal, G. Examples of Blockchain Games (and How They Work). Medium 8 January 2019. Available online: https://medium.com/crowdbotics/examples-of-blockchain-games-and-how-they-work-7fb0a1e76e2e (accessed on 18 July 2023).

7. Yao, W.; Ye, J.; Murimi, R.; Wang, G. A Survey on Consortium Blockchain Consensus Mechanisms. arXiv 2021, arXiv:2102.12058.

8. Ismail, L.; Materwala, H. A Review of Blockchain Architecture and Consensus Protocols: Use Cases, Challenges, and Solutions. Symmetry 2019, 11, 1198.

9. Khan, S.; Loukil, F.; Ghedira, C.; Benkhelifa, E.; Bani-Hani, A. Blockchain Smart Contracts: Applications, Challenges, and Future Trends. Peer-Peer Netw. Appl. 2021, 14, 2901–2925.

10. Liapis, A.; Katsanos, C.; Karousos, N.; Xenos, M.; Orphanoudakis, T. User Experience Evaluation: A Validation Study of a Tool-based Approach for Automatic Stress Detection Using Physiological Signals. Int. J. Hum. Comput. Interact. 2021, 37, 470–483.

11. Xevgenis, M.; Kogias, D.G.; Karkazis, P.; Leligou, H.C.; Patrikakis, C. Application of blockchain technology in dynamic resource management of next generation networks. Information 2020, 11, 570.

12. Gao, Y. An empirical study on the adoption of blockchain-based games from users' perspectives. Electron. Libr. 2021, 39, 596–614.

13. Jiang, Y.; Min, T.; Fan, S.; Tao, R.; Cai, W. Towards Understanding Player Behavior in Blockchain Games: A Case Study of Aavegotchi. In Proceedings of the 17th International Conference on the Foundations of Digital Games, Athens, Greece, 5–8 September 2022.

14. Averin, A.; Samartsev, A. Review of blockchain in computer games. AIP Conf. Proc. 2023, 2910, 020033.

15. Paajala, I.; Nyyssola, J.; Mattila, J.; Karppinen, P. Users' Perceptions of Key Blockchain Features in Games. Future Internet 2022, 14, 321.

16. Min, T.; Wand, H.; Guo, Y.; Cai, W. Blockchain games: A survey. In Proceedings of the IEEE Conference on Games (CoG), London, UK, 20–23 August 2019.

17. Prawiyogi, A.G.; Aini, Q.; Santoso, N.P.L.; Lutfiani, N.; Juniar, H.L.J. Blockchain Education Concept 4.0: Student-Centered iLearning Blockchain Framework. J. Teknol. Pendidik. 2021, 23, 129–145.

18. Arif, Y.M.; Pradana, R.P.; Nurhayati, H.; Nugroho, S.M.S.; Hariadi, M. A Blockchain-Based Multiplayer Transaction for Tourism Serious Game. In Proceedings of the International Conference on Computer Engineering, Network, and Intelligent Multimedia (CENIM), Surabaya, Indonesia, 17–18 November 2020.

19. Mittal, A.; Gupta, M.P.; Chaturvedi, M.; Chansarkar, S.R.; Gupta, S. Cybersecurity Enhancement through Blockchain Training (CEBT)—A serious game approach. Int. J. Inf. Manag. Data Insights 2021, 1, 100001.

20. Djaouti, D.; Alvarez, J.; Jessel, J. Classifying serious games: The G/P/S model. In Handbook of Research on Improving Learning and Motivation through Educational Games: Multi-Disciplinary Approaches; France, T., Ed.; IGI Global: Hershey, PA, USA, 2011.

21. Michael, D.; Chen, S. Serious Games: Games That Educate, Train, and Inform; Thomson Course Technology: Boston, MA, USA, 2005.

22. Prensky, M. Digital Game-Based Learning; Paragon House: St. Paul, MN, USA, 2007.

Retrieved from https://encyclopedia.pub/entry/history/show/121179