Decentralized Ticketing System for Concert Events

¹Surya M D Gowda, ²Ankith B Shetty, ³Mohith Aradhya, ⁴Nehal C Gadkar

¹ Department of Computer Science and Engineering, NIE, Mysore
² Department of Computer Science and Engineering, NIE, Mysore
³ Department of Computer Science and Engineering, NIE, Mysore
⁴ Department of Computer Science and Engineering, NIE, Mysore

Mrs. Poornima N, Assistant Professor, Dept. of Computer Science and Engineering, NIE, Karnataka, India

---***---

Abstract—This research introduces a transformative solution to address the pervasive challenges in the contemporary ticketing industry, including ticket fraud, scalping, and transparency deficits. The project aims to revolutionize ticketing through the development of a Decentralized Online Ticket System. The proposed system leverages cutting-edge technologies, specifically non-fungible tokens (NFTs) and smart contracts, to establish a secure and tamper-proof environment. By transforming event tickets into NFTs, the system enhances security and authenticity. Smart contracts automate key ticket-related processes, such as transfers and sales, ensuring efficiency and transparency. Furthermore, the project facilitates a secondary market for ticket trading, fostering a fair and transparent ecosystem. This research contributes to the evolving field of decentralized systems, offering a pioneering approach to mitigate the challenges inherent in the ticketing industry.

Keywords: Decentralized Online Ticket System, Ticket Fraud, Scalping, Transparency, Non-Fungible Tokens (NFTs), Smart Contracts, Tamper-Proof, Security, Authenticity, Ticket Ownership, Secondary Market, Fair Ecosystem, Contemporary Ticketing Industry, Innovative Solutions, Blockchain Technology.

1. INTRODUCTION

In today's digital age, the paradigm of booking tickets for events, concerts and entertainment shows has undergone a radical change with the emergence of online platforms. This platform offers users the convenience of browsing, selecting and purchasing tickets from the comfort of their homes, experiencing an era of unprecedented access. However, despite its convenience, the centralized nature of traditional online ticketing systems has led to persistent challenges that undermine user experience and process integrity.

Issues such as ticket fraud and scalping complicate the online ticketing space and pose a major threat to event organizers and attendees. In addition, the lack of transparency regarding fees and charges often leaves users in financial limbo, losing trust and confidence in the system. To respond to these challenges, there is a need for innovative solutions that can transform the online ticketing ecosystem, ensuring security, transparency and fairness for all stakeholders.

This research paper proposes a radical approach to online ticketing using the power of blockchain technology and non-volatile tokens (NFT). By incorporating blockchain and NFTs into the ticketing process, we aim to overcome the shortcomings of traditional systems while opening up new opportunities to improve security and efficiency.

The basic concept of the proposed system is to convert traditional tickets stored securely on a centralized blockchain into unique, verifiable NFTs. Unlike traditional tickets, which are prone to fraud and manipulation, NFTs offer the unique features of immutability and uniqueness, making them ideal for representing digital assets such as event tickets.

Smart contracts, code that can be executed on a blockchain, play an important role in automating various ticket-related processes, including issuing, transferring and reselling. By using smart contracts, we can ensure transparent and secure ticket transactions, eliminate the risk of counterfeit tickets and promote fairness and accountability.

Additionally, the introduction of a secondary market for NFT-based ticket trading opens up new ways for users to buy, sell and exchange tickets in a decentralized manner. This secondary market not only increases liquidity, but also promotes a fairer and more inclusive ecosystem where genuine fans have ample opportunity to purchase tickets at affordable prices.

In conclusion, the proposed hive-based approach to online tickets has the potential to change the way they are bought, sold and managed in the digital age. By addressing the inherent challenges of traditional systems and introducing innovative features enabled by blockchain and NFTs, we can create a more secure, transparent and user-centric ticketing ecosystem that benefits both event organizers and attendees.

2. RELATED WORK

In [1], Li Ji and Tingting Zhou from Shanghai Film Academy and Shanghai University proposed a ticket system based on Non-Fungible Token (NFT) to solve the problem of fraud and shrinkage in traditional tickets. They have innovatively introduced NFTs to connect tickets and buyers through blockchain technology, increasing authenticity, control and

transparency in ticketing transactions. Their system not only uses blockchain for ticket management, but also manages the secondary market, ensuring fair prices and consumer protection.

In [2], Patcharaporn Sombat and Paruj Ratanaworachan from Kasetsart University developed a honeycomb-based ticketing platform using Ethereum Virtual Machine (EVM) based smart contracts on the Ethereum blockchain and Avalanche. The platform uses the ERC-721 standard to increase transparency and decentralization. When they offer open source code on GitHub, they show the efficiency and effectiveness of the platform, especially in Power Blockchain.

In [3], David Carmelo Calderone explores the potential of Non-Fungible Tokens (NFT) using blockchain technology for unique digital assets in managing sports events. Through a comparative analysis, the paper explores the challenges of NFT adoption, the emergence of blockchain solutions, and the use of NFT tickets with POAPs and smart contracts for fan engagement. Despite its shortcomings, NFT offers a unique opportunity to improve the fan experience and revenue stream in the management of sporting events.

In [4], Tralyn Le, Yoohwan Kim, and Ju-onon Jo proposed a blockchain-based event trading system using Ethereum and smart contracts to ensure ownership and prevent fraud. Sellers verify their identity through MetaMask, pay a registration fee, and use mutual guarantees to reduce fraudulent activity and create a safe recycling environment.

In [5], Nguyen, Huu-Quang, Huynh Tuong Nguyen, and Thi-Thiet Pham proposed a honeycomb-based ticketing and tracking system to solve the problem of counterfeit tickets in Ho Chi Minh City University of Technology. Their work builds on previous research such as Doan's digital currency system for e-book transactions, blocking solutions for email security, and research on non-traceable tokens (NFT) in event tickets by Ferdinand et al.

In [6], Lin, Keng-Pei, Yi-Wei Chang, and Zhi-Hong Wei present a multi-signature blockchain-based mobile ticketing system for implementing and validating smart contracts and transactions. His work uses blockchain technology for efficient and secure ticket transactions based on previous research such as TYM Doan's digital currency system and the use of blockchain in email security by Le et al.

In [7], Rafati Niya et al. Introducing DeTi, a decentralized ticket management platform using blockchain and smart contracts to address issues related to ticket counterfeiting and the black market. Their work builds on previous research on decentralized ticketing solutions, such as those that use blockchain-based service management functions to ensure ticket authenticity and manage subsequent transactions.

In [8] Konstantinidis et al. Presents a systematic literature review that examines the various business sectors where blockchain technology finds application. Their work explores current implementations and future applications, while addressing challenges and barriers to blockchain expansion. By analyzing various preliminary studies, it provides insight into the disruptive impact and problems associated with the adoption of blockchain technology in various industries.

In [9], Toyoda et al. proposes a blockchain-based Product Ownership Management System (POMS) to combat fraud in the supply chain. Using immutable blocking records, POMS verifies product ownership, allowing customers to reject counterfeits even with authentic RFID tag information. The system implementation of the concept on Ethereum demonstrates cost-effective ownership management for six transfers.

In [10], Ompal et al. Propose a new blockchain-based Non-Fungible Token (NFT) ticketing system to solve ticket fraud and environmental sanitation issues on traditional paper and QR code tickets. By using NFTs, the system creates a chain of ownership that can be traced and verified, increasing control over ticket sales and secondary market transactions. This study fills an important knowledge gap by demonstrating the impact of NFTs on tickets through rigorous evaluation and design science methodology.

3. PROBLEM STATEMENT

The current state of online sales systems faces serious challenges that hinder their effectiveness and reliability. The traditional ticketing system, characterized by a hierarchical system in which ticket distribution and control is centralized, has many problems. The most important of these difficulties is the problem of ticket fraud. In an integrated system, malicious actors exploit vulnerabilities to create fake tickets, leading to financial loss and frustration for event organizers and ticket buyers. This type of fraud not only undermines the ticketing process, but also undermines the trust of event visitors. In addition to ticket fraud, ticketing incidents also increase the fragility of ticketing systems. Scalpers take advantage of market demand by buying large numbers of tickets and selling them at high prices, disrupting the supply-demand balance. This practice not only disrespects true fans, but also creates injustice and inequality in the ticketing environment. Additionally, the lack of transparency and accountability in ticket sales models exacerbates existing problems. Opaque rates and uncertainties often overwhelm ticket buyers, leading to dissatisfaction and distrust. Additionally, ticket buyers' limited control over the possession and transfer of tickets perpetuates vulnerability and a sense of disenfranchisement among users. To solve these many problems, it is necessary to change the way decentralized ticketing is done. By leveraging emerging technologies such as blockchain and abstract tokens (NFTs), decentralized ticketing systems provide an effective solution to the most fundamental problems facing the environment. However, implementing and validating a decentralized

ticketing system requires extensive research, analysis and evaluation for it to be effective, efficient and effective in the ticketing industry.

4. EXISTING SYSTEM

The traditional approach to online ticketing revolves around centralized systems, wherein the distribution and management of tickets are primarily controlled by a select group of entities. This centralized model encompasses various stakeholders, including event organizers, ticketing platforms, and sometimes third-party resellers.

In the existing system, tickets are typically issued in either digital or physical formats. Upon purchase, tickets are either delivered electronically via email or mobile apps or physically dispatched to the buyer's address. During the event, attendees present their tickets for validation, either in printed form or digitally via smartphones or other electronic devices. However, despite its widespread adoption, the existing centralized ticketing system is plagued by several challenges:

1) Ticket Fraud: Fraudulent activities are prevalent within the centralized ticketing ecosystem, with counterfeit tickets being circulated in the market. Fraudsters exploit vulnerabilities in ticketing platforms to produce fake tickets, resulting in financial losses for both event organizers and unsuspecting ticket buyers.

2) Scalping: Ticket scalping, whereby tickets are purchased in bulk and resold at inflated prices, is a pervasive issue in the existing system. Scalpers leverage market demand to capitalize on ticket shortages, often leaving genuine fans unable to attend events due to exorbitant prices set by resellers.

3) Lack of Transparency: The centralized ticketing model often lacks transparency, with hidden fees and undisclosed charges catching ticket buyers off guard. Attendees may find themselves unaware of the actual costs involved, leading to dissatisfaction and mistrust in the ticketing process.

4) Limited Ownership Control: Once a ticket is sold, the original purchaser typically loses control over its subsequent transfers or resale. This lack of ownership control leaves tickets susceptible to unauthorized resale or transfer, further complicating the ticketing landscape.

5. PROPOSED SYSTEM

The proposed decentralized ticketing system presents a novel approach to online ticketing, integrating blockchain technology and non-fungible tokens (NFTs) to overcome the limitations of the centralized ticketing model. This innovative system aims to provide a secure, transparent, and equitable ticketing experience for both event organizers and attendees.

Key components of the proposed decentralized ticketing system include:

1) Utilization of Blockchain and NFTs: Event tickets are converted into unique NFTs and securely stored on a blockchain platform. Each ticket is assigned a distinct token ID, ensuring its authenticity and immutability. Through blockchain technology, the system maintains a transparent and tamper-proof record of ticket ownership and transaction history.

2) Integration of Smart Contracts: Smart contracts are employed to automate various ticket-related processes such as issuance, transfer, and resale. These self-executing contracts enforce predefined rules and conditions, eliminating the need for intermediaries and ensuring transparency and fairness in ticket transactions. Smart contracts facilitate secure and efficient ticket transfers while minimizing the risk of fraud and unauthorized resale.

3) Introduction of a Decentralized Secondary Market: The proposed system introduces a decentralized secondary market for ticket trading, enabling users to buy and sell tickets directly on the blockchain platform. By eliminating intermediaries, the secondary market promotes transparency and fairness in ticket pricing. Prices are determined by market dynamics, preventing scalping practices and ensuring equitable access to tickets.

4) Enhanced Security Measures: Leveraging blockchain technology and NFTs enhances the security of the ticketing system, reducing the risk of ticket fraud and counterfeiting. Each ticket is uniquely associated with its owner's blockchain address, making it virtually impossible to duplicate or tamper with. The transparent nature of the blockchain allows users to verify the authenticity of tickets and track their ownership history.

5) Transparency and Ownership Control: The decentralized nature of the proposed system grants users greater transparency and control over their tickets. Ticket holders have full ownership control, allowing them to transfer and resell tickets with confidence. The transparent and auditable nature of the blockchain ensures visibility into ticket transactions and ownership changes, fostering trust and accountability within the ticketing ecosystem.

6. SYSTEM DESIGN

The design of the proposed decentralized ticketing system is meticulously crafted to ensure a seamless user experience while leveraging the security and efficiency of blockchain technology.

A. Architecture Design

1) Blockchain Integration: The system is built upon a blockchain platform, like Ethereum, serving as the foundation for storing and managing ticket data securely. Smart contracts are deployed on the blockchain to automate ticket-related processes and enforce predefined rules.

2) Smart Contracts: These contracts execute predefined logic autonomously, governing ticket issuance, transfer, and resale. They interact with the blockchain to facilitate transparent and fair ticket transactions.

3) Decentralized Storage: Ticket data, including NFTs and transaction records, are securely stored in a decentralized manner on the blockchain. This ensures data integrity and prevents tampering.

B. User Interface Design

1) Registration and Authentication: Users can register and log in securely using their blockchain wallet addresses or other authentication methods like MetaMask.

2) Ticket Purchase: The purchasing process is user-friendly, allowing users to browse events, select tickets, and complete transactions seamlessly.

3) Ticket Management: Users can manage their tickets, including viewing details, transferring ownership, and listing tickets for resale. Ownership history and transaction activity are easily accessible.

4) Secondary Market: A dedicated section allows users to buy and sell tickets directly on the platform. Real-time pricing and transaction data are provided for informed decision-making.

5) Transaction History: Users can access their transaction history, providing transparency and accountability.

C. Security Measures

1) Encryption and Authentication: Sensitive data is encrypted, and robust authentication mechanisms are implemented to protect user information.

2) Access Control: Role-based access control ensures that only authorized users can access specific features and data.

3) Immutable Ledger: The blockchain acts as an immutable ledger, recording all ticket transactions transparently.

D. Scalability and Performance

1) Optimized Smart Contracts: Smart contracts are optimized for efficiency and scalability to minimize transaction costs.

2) Load Balancing: Mechanisms for load balancing and resource optimization are implemented to maintain optimal performance.

In summary, the design of the proposed decentralized ticketing system prioritizes user experience, security, and scalability while harnessing the power of blockchain technology to revolutionize the ticketing industry.
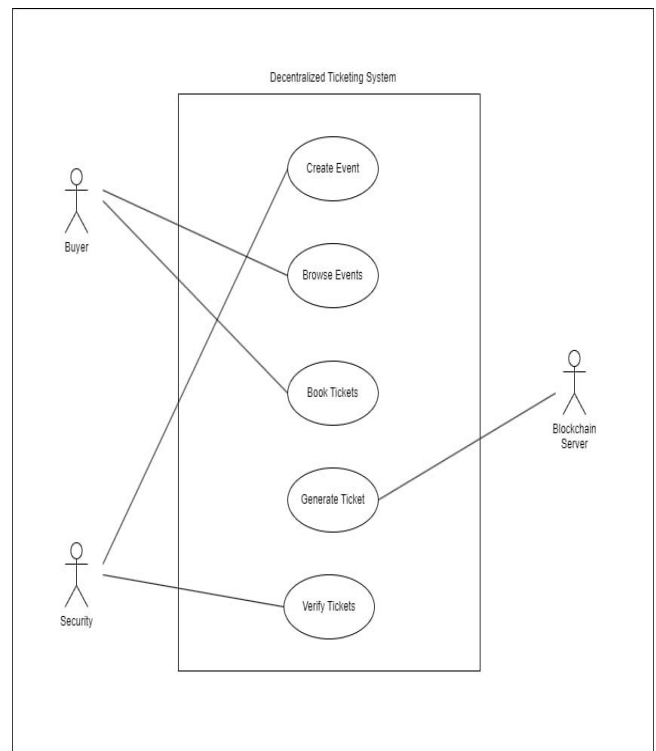
Fig.1. Use Case Diagram

7. IMPLEMENTATION

The decentralized ticketing system is implemented through the use of NFTs (Non-Fungible Tokens). The NFTs represent each individual tickets issued by storing all the information present in them digitally. These NFTs are an extension of a smart contract which means they each of these tokens carry a code that allows to automatically perform necessary conditional checks and run specified code for different actions performed with these tokens.
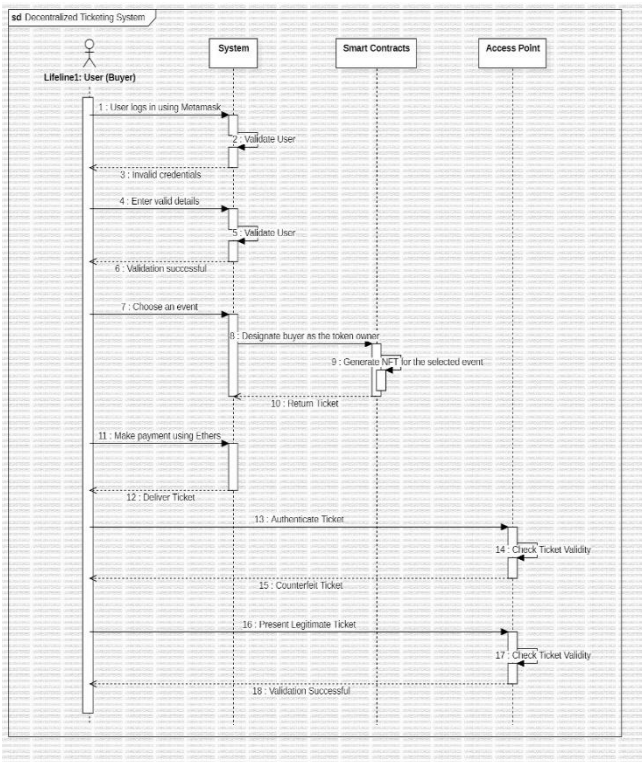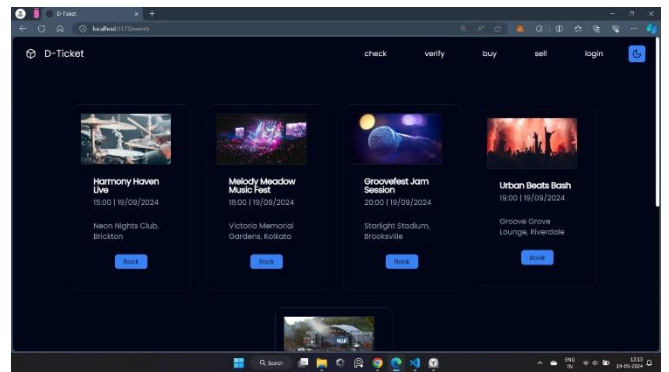
Fig.2. Sequence Diagram

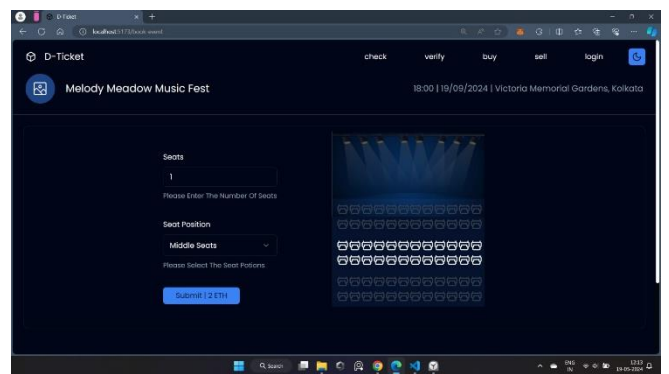So, when action of transferring a token from one user to another or buying a token from another user is performed the code associated with those actions is executed which performs a conditional check whether the current time exceeds the token deadline which is the time after which the user cannot transfer their ticket/token.
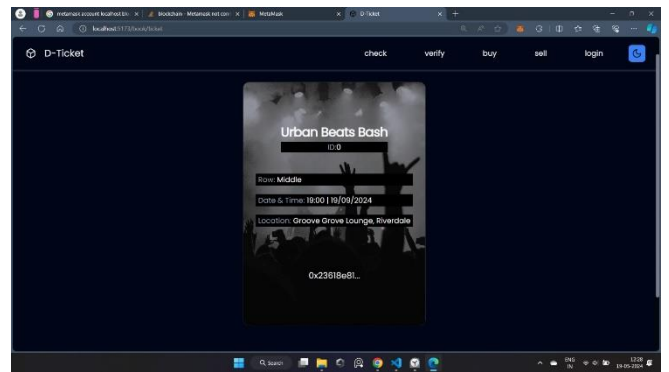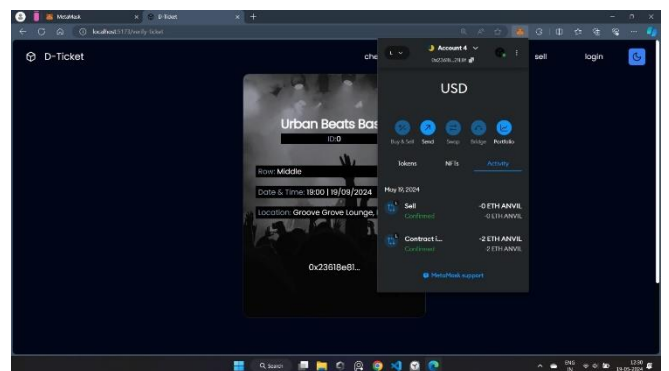
8. RESULTS

Fig.3. Home Page

Fig.4. Page to select event to book

Fig.5. Page to select seat count and section

Fig.6. Check Ticket Page

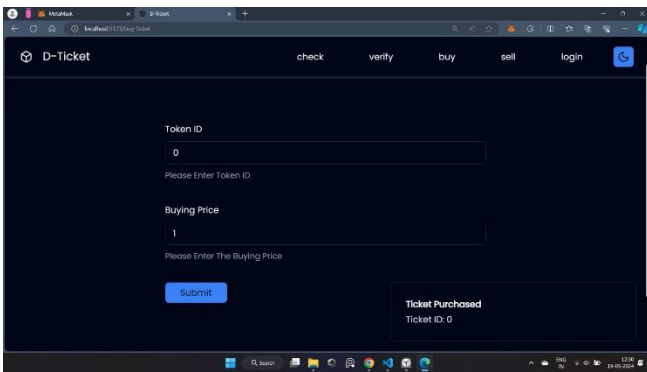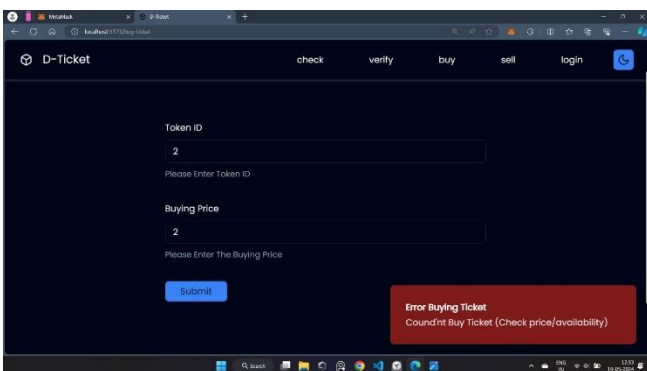**Fig.7.** Metamask Transactions Window

Fig.8. Buy Page

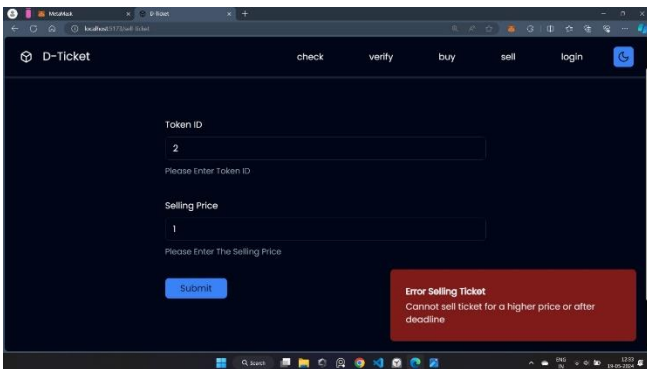**Fig.9.** Buy Page with error displayed

Fig.10. Sell Page with error displayed

CONCLUSION

Our project presents an innovative approach to combat ticket scalping at concerts and sporting events by utilizing Non-Fungible Tokens (NFTs) for ticket generation and distribution. Through the implementation of smart contracts, each ticket is endowed with specific logic, enabling us to enforce restrictions such as setting resale price limits and imposing time constraints on transfers or purchases. While our project still allows for peer-to-peer resale, the prevalence of online distribution significantly diminishes the impact of scalping compared to traditional offline methods. Hence, our solution offers a viable means to mitigate the rampant illegal resale of tickets within the concert and sporting industry, thereby fostering a fairer and more equitable ticketing ecosystem.

Future Enhancements include:

- Allow users to view their ticket image through their blockchain wallet instead of having to use website every time.
- Create a secondary ticket marketplace so users can view all tickets up for sale.
- Add QR code feature so that their address can be retrieved from scanning it, instead of manually entering their address into a text box.

REFERENCES

[1] Y. YuanJiang and J. T. Zhou, "Ticketing System Based On NFT," 2022 IEEE 24th International Workshop on Multimedia Signal Processing (MMSP), Shanghai, China, 2022, pp. 01-05, doi: 10.1109/MMSP55362.2022.9948706. keywords: {Industries;Fans;Smart contracts;QR codes;Signal processing;Motion pictures;Multiple signal classification;blockchain;NFT;tickets;secondary market},

[2] P. Sombat and P. Ratanaworachan, "A Blockchain-Based Ticket Sales Platform," 2023 27th International Computer Science and Engineering Conference (ICSEC), Samui Island, Thailand, 2023, pp. 226-230, doi: 10.1109/ICSEC59635.2023.10329682. keywords: {Computer science;Fans;Codes;Smart contracts;Standards organizations;Organizations;Censorship;Ticket sales platforms;Non-fungible tokens (NFTs);Avalanche blockchain;Ethereum blockchain},

[3] D. C. Calderone, "Event Management Evolution Through Non-Fungible Tokens," 2023 IEEE International Workshop on Sport, Technology and Research (STAR), Cavalese - Trento, Italy, 2023, pp. 85-89, doi: 10.1109/STAR58331.2023.10302446. keywords: {Industries;Fans;Technological innovation;Finance;User experience;Cryptocurrency;Nonfungible tokens;Sport;Event Management;Fan Engagement;Blockchain;Non-fungible Tokens;Ticketing},

[4] T. Le, Y. Kim and J. -Y. Jo, "Implementation of a Blockchain-Based Event Reselling System," 2019 6th International Conference on Computational Science/Intelligence and Applied Informatics (CSII), Honolulu, HI, USA, 2019, pp. 50-55, doi: 10.1109/CSII.2019.00016. keywords: {Contracts;Systems architecture;Uniform resource locators;Memory management;Testing;Blockchain;Ethereum;Smart Contract},

[5]   H. -Q. Nguyen, H. T. Nguyen and T. -T. Pham, "Applying Smart Contract in Blockchain Technology to Manage the Ticketing Issuance and Ticketing Traceability," 2023 IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology (JEEIT), Amman, Jordan, 2023, pp. 160-164, doi: 10.1109/JEEIT58638.2023.10185771.   keywords: {Electrical engineering;Databases;System performance;Operating systems;Urban areas;Smart contracts;Blockchains;Solidity;Smart contract;Blockchain},

[6]   K. -P. Lin, Y. -W. Chang, Z. -H. Wei, C. -Y. Shen and M. -Y. Chang, "A Smart Contract-Based Mobile Ticketing System with Multi-Signature and Blockchain," 2019 IEEE 8th Global Conference on Consumer Electronics (GCCE), Osaka, Japan, 2019, pp. 231-232, doi: 10.1109/GCCE46687.2019.9015425.   keywords: {Contracts;Random access memory;Logic gates;Smart phones;Bitcoin},

[7]   https://link.springer.com/content/pdf/10.1007/s10922-022-09675-3.pdf

[8]   https://www.researchgate.net/profile/Christos-Timplalexis/publication/325787732_Blockchain_for_Business_Applications_A_Systematic_Literature_Review/links/5c6d4672a6fdcc404ebf40ca/Blockchain-for-Business-Applications-A-Systematic-Literature-Review.pdf

[9]   https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7961146

[10] https://ijrpr.com/uploads/V4ISSUE4/IJRPR12057.pdf