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Event Ticket Scalping Prevention System using Blockchain and AI

Mr. Amol Rajpure
Department of Information Technology
VPKBIET, Baramati Pune,India

Ismail Sayyed
Department of Information Technology
VPKBIET, Baramati Pune,India

Kalyani Pachangane
Department of Information Technology
VPKBIET , Baramati Pune India

Asim Sayyad
Department of Information Technology
VPKBIET, Baramati Pune, India

Anagha Bhosale
Department of Information Technology
VPKBIET, Baramati Pune, India

***Abstract*—Currently, tickets scams and counterfeits are the main issue within the ticket purchasing platforms. This creates an unfair pricing strategy and diminishes users' confidence in them. Traditional platforms have issues with transparency, cannot control unauthorized re-selling and excessive buying. Rexell uses a combination of blockchain technology and artificial intelligence for solving these problems. The tickets are generated from smart contracts in the form of non-fungible tokens (NFTs) for providing security and traceability. The AI anti-scalping component monitors users' actions and informs about any potential scam activities, including use of bots and fast transactions. The implementation of the controlled resale process with permission from the organizers prevents price manipulation. The system strives to be convenient, safe, transparent and have fraud prevention algorithm. The experiment proves that the proposed approach is effective in preventing the scam attempts and increasing the integrity of the system.**

***Index Terms*—Blockchain, NFT, Artificial Intelligence, Ticket Scalping, Smart Contracts, Fraud Detection**

I. Introduction

Currently, there is a great problem with ticket scalping and fraudulent activities during the purchasing process. High prices and low trust are consequences of such activities. The current platforms are opaque, do not protect from unauthorized re-selling and bots' activity effectively. The current research presents Rexell – decentralized platform for tickets distribution, built with the help of blockchain technology and artificial intelligence. Tickets are distributed via issuing non-fungible tokens with smart contract implementation. Such approach allows providing reliable and safe possession, uniqueness of each ticket and tracking its further transactions. Anti-scalping AI-module analyses user's actions and defines suspicious activities such as use of bots and rapid ticket purchase. Regulated resale function requires the organizer's confirmation in order to prevent price manipulation. Such an approach increases safety, transparency and efficiency of the system.

II. Research Contributions

The primary contributions of this research work are summarized as follows:

- A blockchain-enabled event ticketing system is proposed to improve transparency and security in ticket distribution through NFT-based ownership management.
- A regulated resale framework is introduced, allowing ticket transfers only after organizer approval, thereby reducing the possibility of unfair resale practices.
- An intelligent monitoring mechanism is incorporated to identify unusual purchasing patterns and help mitigate ticket scalping activities.
- Decentralized storage is utilized for managing ticket-related information, ensuring data integrity and accessibility.
- A secure ownership verification process is implemented using blockchain transactions, enabling reliable tracking of ticket ownership throughout its lifecycle.

III. Literature Review

Fraud and scalping issues are increasingly becoming significant with the rise of digital ticketing. In this context, many studies focus on possible solutions using blockchain and artificial intelligence (AI).

The blockchain technology was introduced by Nakamoto and provides decentralized transaction handling capabilities. Later on, Ethereum added smart contract capabilities that provide a completely automated and trustless environment for transactions. Blockchain technology is useful for improving transparency and integrity of the distributed systems.

A wide range of researchers applies blockchain technologies in ticketing solutions. For example, Li et al. suggested a solution that preserves the security of ticket ownership and provides anti-duplicate mechanisms. On the other hand, Zhang proposed a solution based on a decentralized system design, which increases transparency; however, the solution has insufficient reselling control features and fraud detection capability.

Many scholars also use AI technologies for fraud detection purposes. For instance, Chen et al. demonstrated the efficiency of using machine learning to detect fraudulent patterns. More-

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over, Smith focused on behavior analysis in bot detection, while Kumar studied the anomaly-based transaction frauds.

Nevertheless, most existing solutions rely only on one of two discussed approaches. Thus, blockchain ensures transparency but lacks smart fraud detection capability, whereas AI technologies can detect fraud patterns but do not guarantee the ticket ownership's security or traceability. The proposed solution Rexell addresses those limitations using blockchain-based ticketing together with NFT ticket issuance, identity verification, and intelligent fraud detection.

IV. Problem Statement

Online ticketing has introduced new issues concerning fairness, security, and ticket distribution. Scanning refers to the practice whereby individuals or software programs acquire multiple tickets and resell them at inflated prices, denying real customers the opportunity to access tickets and fostering unfair competition.

Conventional systems suffer from centralization, making it difficult to determine ownership and prevent fraud, such as ticket counterfeiting and unauthorized sales. Furthermore, these systems cannot authenticate user identities and curb the activities of bots.

The blockchain technology works quite perfectly since it makes sure that all transactions are done securely. It is common that most people making use of the blockchain technology do not know how they can protect themselves from any kind of fraudulent activity. On the other hand, making use of AI to do certain activities lacks an effective mechanism for ensuring protection in terms of property ownership; hence, its implementation cannot be considered to be working well.

Therefore, what we need is a system where property ownership will be guaranteed and, at the same time, where there is the capability of detecting fraudulent activities. The objective of this study is to design a blockchain-powered and transparent ticketing platform that would avoid reselling of tickets without any permission and identify fraudulent activities.

V. Methodology

A fresh approach kicks off by mixing blockchain with artificial intelligence, aiming to block those who hoard tickets then resell them for more. Safety in how tickets get handed out comes next, built right into the design.The proposed system provides a secure and efficient platform for ticket transactions. Blockchain technology ensures transparency and data integrity, while artificial intelligence detects suspicious activities and potential fraud. By combining these technologies, the system enables fair, reliable, and secure ticket management.

A. System Design Approach

The proposed system consists of three main components: a blockchain module, an AI-based detection module, and a user interface. The blockchain module secures ticket transactions, while the detection module identifies suspicious activities. The user interface enables interaction between users and the system. These components work together to provide a secure and efficient ticketing platform.

B. Blockchain-Based Ticket Lifecycle

Tickets are taken care of using contracts and they have a certain way of working. They go through a steps:

- **Ticket Creation:** Event organizers make tickets and they are, like special items that are unique these are made as NFTs by event organizers.
- **Ticket Purchase:** when users buy tickets using the blockchain it is a way to do it.
- **Ticket Verification:** when we check who really owns the ticket we use the blockchain to make sure.
- **Ticket Resale:**when someone wants to sell their ticket this is also controlled by contracts and the event organizer has to say it is okay.

The whole process of tickets makes sure that everything is safe and we can see what is happening it also stops people from making tickets. Tickets are managed in a way that prevents duplication tickets are secure because of this.

C. AI-Based Fraud Detection Process

It examines behavioral aspects such as frequency of purchases, quantity of purchases, and inter-purchase duration. It generates risk scores for transactions, which are then classified into approved, suspicious, or denied categories to prevent fraud from happening in real time.

D. Identity Verification Mechanism

A unique identity token is generated for each user to verify his/her identity. Users that have been verified are allowed access to perform certain critical operations such as reselling.

E. System Workflow

The steps involved are creation of events, generation of NFT tickets, buying of tickets using cryptocurrency wallets, transaction evaluation through AI, storing transactions in a blockchain system, and management of resale activities.

F. Integration of Blockchain and AI

Combining blockchain technology and artificial intelligence allows us to develop a sophisticated yet robust platform where the transactions performed are safe and transparent.

VI. Proposed System

The proposed system,*Rexell* is a platform for buying and selling event tickets that uses blockchain and artificial intelligence. This is done to stop people from buying tickets just to sell them at a price and to make sure tickets are given to people safely. Rexell makes things more transparent it reduces cheating. It helps find suspicious things happening in real time with the Rexell system. The Rexell system is really good, at doing these things because it uses blockchain and artificial intelligence to run the Rexell platform.

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TABLE I
COMPARATIVE ANALYSIS OF EXISTING NFT TICKETING SYSTEMS AND PROPOSED SYSTEM

No.	Existing System	Key Features	Limitations	Proposed System Improvement
1	PureNFT (ICCE 2025)	AI-assisted detection for unfair resale, ERC-721 token usage, lightweight architecture	Detection errors may occur after ticket purchase completion	Introduces pre-transaction behavioral monitoring using client-side and server-side AI with dynamic risk scoring to reduce incorrect decisions
2	Secure NFT Ticketing (ICUIS 2024)	Blockchain-based ownership validation and secure ticket transfer	High transaction costs and complex onboarding for non-crypto users	Integrates stablecoin-based payments (cUSD) with simplified wallet connection and seamless frontend interaction to enhance accessibility
3	IPL NFT Ticketing (ICEI 2024)	Designed for large-scale ticket distribution in sports environments	Adoption challenges due to technical complexity and lack of automation	Provides intuitive user interface with automated AI decision-making and real-time validation to simplify user interaction
4	Blockchain Ticket Sales (ICCSEC 2023)	Smart contract-enabled ticket sales and resale control	Limited user experience and insufficient monitoring of resale misuse	Implements AI-driven resale tracking combined with policy enforcement mechanisms to regulate secondary market behavior
5	NFT Ticketing System (MMSP 2022)	NFT minting and ownership verification using blockchain	Absence of mechanisms to detect bots or abnormal resale patterns	Incorporates dedicated bot detection and scalping detection modules using behavioral analytics and machine learning models
6	Smart Contract Ticket Mgmt (JEEIT 2023)	Transparent ticket management with decentralized execution	Integration difficulties with existing systems and limited flexibility	Uses modular microservices architecture (FastAPI-based) enabling scalable integration with external services and APIs
7	akaTick Hybrid System (MetaCom 2023)	Combines centralized database with blockchain for improved performance	Centralized database may create performance bottlenecks and scalability issues	Utilizes distributed caching (Redis) and asynchronous processing with message queues to minimize bottlenecks and improve throughput
8	Decentralized Ticketing (2022)	Secure and distributed ticketing framework using blockchain	Scalability limitations and high transaction costs under heavy load	Offloads computation-intensive tasks to off-chain AI services and optimizes blockchain interaction to improve efficiency and scalability
Proposed System Summary: The system will use an approach that incorporates blockchain technology alongside artificial intelligence algorithms. Real-time behavioral data collection will be done using a client-side software development kit (SDK). Bots will be identified using bot detection microservices that run in the background of the system, and machine learning algorithms will be applied to make inferences from the collected data. The system will assess risk and implement policies aimed at preventing fraudulent activity prior to transactions. Soulbound identities will also be used to confirm users' authenticity.				

A. System Overview

The proposed system combines blockchain, artificial intelligence, and user authentication to improve ticket security. Blockchain provides transparent and tamper-resistant transaction records, while AI detects suspicious user activities. Authentication mechanisms verify user identities and support secure ticket transfers. Together, these components help prevent counterfeit tickets and enable regulated ticket resale.

B. Blockchain-Based Ticketing

Tickets are issued as unique NFTs through smart contracts. The blockchain securely records ticket ownership and all related transactions, ensuring transparency, traceability, and protection against duplication.

C. AI-Based Anti-Scalping Mechanism

The system monitors purchasing behavior, such as transaction frequency and bulk purchases, to detect suspicious activities. Based on risk assessment, transactions can be approved, flagged, or blocked to reduce ticket scalping and fraud.

D. Identity Verification System

Each user receives a unique identity token linked to their verification status. Verified users gain access to additional platform features, including ticket resale. This mechanism improves security and prevents unauthorized participation.

E. Controlled Resale Mechanism

Ticket resale is governed by organizer-defined policies. Resale requests are subject to approval and may include restrictions on ticket quantity and resale price. These controls help prevent unfair pricing and promote equitable ticket distribution.

F. Workflow of the System

The workflow starts with event creation and NFT ticket issuance on the blockchain. Users purchase tickets through smart contracts, which automatically validate transactions. Verified users can transfer or resell tickets through authorized channels. Blockchain records and verification mechanisms ensure secure and transparent ticket management throughout the process.

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VII. System Architecture

The proposed framework integrates blockchain and artificial intelligence to create a secure and scalable ticketing platform. The architecture consists of four interconnected layers that collectively ensure transparency, security, and efficient ticket management.

A. Frontend Layer

The frontend layer provides functionalities such as event creation, ticket purchasing, and ticket resale. It serves as the interface between users and the underlying blockchain and AI components.

B. Blockchain Layer

The blockchain layer records all ticket-related transactions in a secure and immutable manner. Smart contracts automate ticket issuance, ownership transfers, and resale operations, ensuring transparency and preventing ticket duplication.

C. AI Layer

The AI layer evaluates user behavior and transaction patterns to identify suspicious activities. Based on risk analysis, transactions may be approved, flagged, or blocked to reduce fraudulent actions.

D. Storage Layer

The storage layer utilizes decentralized solutions such as IPFS to store ticket metadata and event information. This approach improves data availability, enhances security, and reduces reliance on centralized storage systems.

E. System Workflow

A single moment kicks off a chain - first comes an event taking shape. Next appears a digital pass, minted as an NFT. Someone buys it, handing over value for access. At the gate, artificial intelligence checks authenticity in real time. Finally, ownership locks into place across the distributed ledger.

F. Operational Workflow

The workflow begins with event creation and NFT ticket generation on the blockchain. Users connect their digital wallets to purchase tickets, after which the AI module evaluates the transaction for potential fraud. Based on the risk assessment, the transaction is either approved or flagged for review. Once confirmed, ownership details are securely recorded on the blockchain. Ticket resale is permitted only when predefined conditions are satisfied and organizer approval is obtained.

From the start, security in ownership tracking stands strong thanks to how the system is built. Clear records of every transaction appear without delay, showing each change openly. Instead of guessing, risky patterns get flagged by smart checks that learn over time. Because of this setup, reselling tickets unfairly becomes far harder to pull off.

VIII. Implementation

Starting fresh, Rexell builds on Web3 alongside smart algorithms to shape a secure space for tickets that grows without breaking trust. While code runs deep, safety stays sharp even when crowds swell fast.

A. Frontend Implementation

Next up, combining Next.js with React helps handle event planning smoothly. Tickets can be bought or handled later through the same system. Resale requests? They fit right into the workflow too. With Web3, logging in becomes safer through wallet-based identity checks while transactions happen directly from personal wallets. A different way to handle access and money moves online shows up when users rely on decentralized tools instead of traditional forms. Security shifts because control stays with individuals rather than centralized systems managing everything behind closed doors.

B. Blockchain Implementation

The system is implemented using Solidity smart contracts deployed on the Celo blockchain. Tickets are issued as ERC-721 NFTs, ensuring unique identification and verifiable ownership. Smart contracts automate ticket issuance, transfer, and resale while enforcing predefined rules throughout the ticket lifecycle.

C. Smart Contract Functions

Smart contracts manage core platform operations, including event creation, ticket minting, ownership transfer, and resale approval. All transactions are permanently recorded on the blockchain, providing transparency, traceability, and secure ownership management while reducing dependence on intermediaries.

D. AI Module Implementation

The AI module analyzes transaction frequency, purchase volume, and transaction timing to identify suspicious behavior. Based on the detected patterns, a risk score is assigned to each transaction, allowing it to be approved, flagged, or blocked when necessary.

E. AI Model Training and Evaluation

A test used fake ticket buying data to check how well the fraud detector worked. Normal actions mixed with odd patterns filled the collection - like many tries to buy, loading up on tickets, or rapid buys close together in time. Each behavior showed different signs, yet only some raised red flags. Quick repeats stood out more than steady activity. What looked routine at first often hid unusual rhythms underneath.

Out of the gathered information, one portion fed the learning stage while another checked how well guesses held up when spotting real versus suspicious actions. Purchase habits played a role, along with ticket volume, when payments happened, how digital wallets behaved over time, also records of past resales. Instead of mixing everything, separation helped clarity. Each detail added context without overwhelming the process.

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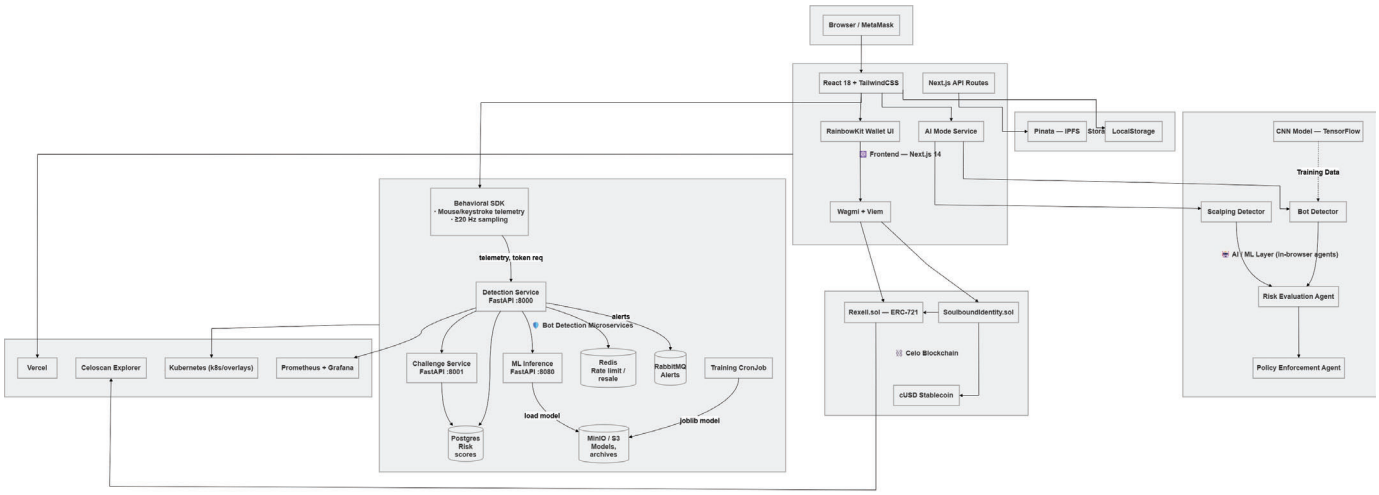

Fig. 1. System Architecture of Rexell

Timing mattered just as much as frequency did. Patterns emerged only after looking closely at repeated behaviors across accounts.

The system assigns a risk score to each transaction based on user behavior and transaction patterns. Depending on the score, transactions are classified as legitimate, suspicious, or fraudulent. This approach helps identify potential ticket scalping activities and supports fair ticket distribution.

F. Storage Implementation

The system uses IPFS to store ticket metadata and event-related information. While transaction records remain on the blockchain, metadata is stored off-chain to reduce storage costs and improve scalability and performance.

G. Integration and Deployment

The platform integrates blockchain, smart contracts, cloud services, and a user interface into a unified architecture. Smart contracts handle core blockchain operations, while the cloud-hosted interface enables seamless user interaction. Continuous communication among components ensures reliable and efficient system performance.

TABLE II
TECHNOLOGY STACK

Component	Technology
Frontend	Next.js, React
Blockchain	Celo Sepolia
Smart Contracts	Solidity
Wallet	MetaMask
Storage	IPFS
Backend API	FastAPI
Database	PostgreSQL
Cache	Redis
AI Module	Python, Scikit-learn

IX. EXPERIMENTAL RESULTS AND DISCUSSION

A. Blockchain Performance Metrics

Experimental results demonstrate that the proposed system provides secure and efficient ticket management. NFT-based ticket issuance ensures unique ownership and prevents ticket duplication, while blockchain technology maintains transparent and immutable ownership records. The platform achieved a high transaction success rate, and ticket issuance, transfer, and verification operations were completed within acceptable confirmation times, indicating stable performance under different operating conditions.

TABLE III
BLOCKCHAIN PERFORMANCE RESULTS

Metric	Result
Ticket Minting Success Rate	98%
Average Confirmation Time	3.2 sec
Ownership Verification	100%
Ticket Duplication	0 Cases

B. AI Performance Evaluation

he AI module was evaluated based on its ability to identify suspicious transactions while minimizing false classifications. Results show that the system effectively detects abnormal ticket purchasing behavior with consistent performance across key evaluation metrics. The risk assessment mechanism successfully distinguishes legitimate transactions from potentially fraudulent activities. The obtained results are presented in Table IV.

TABLE IV
PERFORMANCE METRICS OF THE FRAUD DETECTION MODULE

Metric	Value
Accuracy	94.6%
Precision	92.3%
Recall	90.8%
F1-Score	91.5%

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Performance analysis also indicates that the blockchain infrastructure processes transactions efficiently under varying workloads. Although the AI module experienced slightly higher processing times during peak loads, the overall system remained stable and suitable for practical deployment.

Blockchain: Successful 98

AI: Accuracy: 94.6

Resale restrictions: 100

The evaluation confirms that the proposed approach enhances ticket security, transparency, and fraud prevention when compared with traditional ticketing systems. Key benefits include:

- Prevention of ticket duplication through NFT-based ownership
- Detection of fraudulent activities using AI-based analysis
- Enhanced transparency through blockchain records
- Secure and regulated ticket resale

X. System Testing

From tiny pieces to full flow, each part of the new ticket system got checked. Not just alone - how they fit together mattered too. Tests ran at every stage, making sure nothing broke when joined. Modules worked on their own before being linked up. Checking one thing led to checking how it behaved with others.

TABLE V
Summary of Testing Results

Module	Test Cases	Passed
Event Creation	10	10
Ticket Minting	15	15
Ticket Purchase	20	19
Resale Requests	10	10
Marketplace Purchase	10	10
Wallet Integration	10	10

Despite one hiccup, nearly every function held up under scrutiny. From start to finish, managing events flowed without issue. Ticket creation followed smoothly, then moved into resale operations - each step confirmed working. Transactions on the marketplace linked properly, just like wallet connections did later. A single test around buying tickets needed extra attention, though everything else passed outright. Close to 98

Security gets stronger when blockchain teams up with artificial intelligence in ticketing, one study shows. Reliability climbs too, not by chance but through system design. Fairness follows a similar path - built in, not added later. Each piece connects differently than before, shifting how trust forms behind the scenes.

The figure shows the interface used by organizers to create events by entering details such as event name, location, date, and ticket information.

This interface displays all available events, allowing users to browse and select events for ticket purchase.

The figure illustrates the event details page where users can mint NFT-based tickets through blockchain transactions.

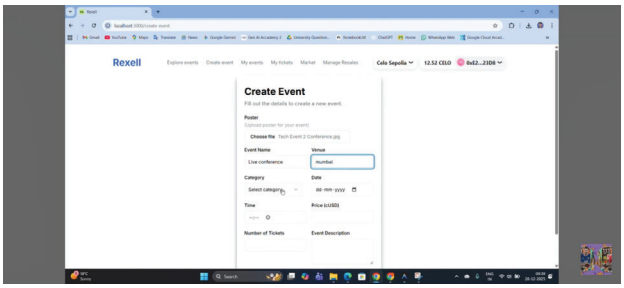

Fig. 2. Event Creation Interface

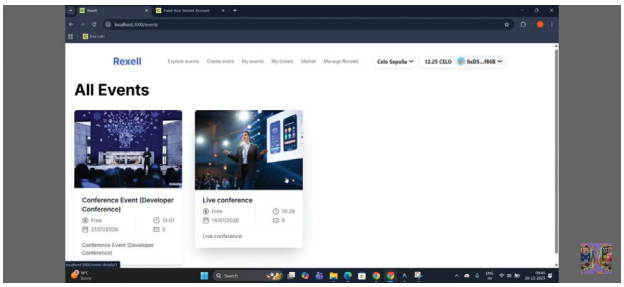

Fig. 3. All Events Listing

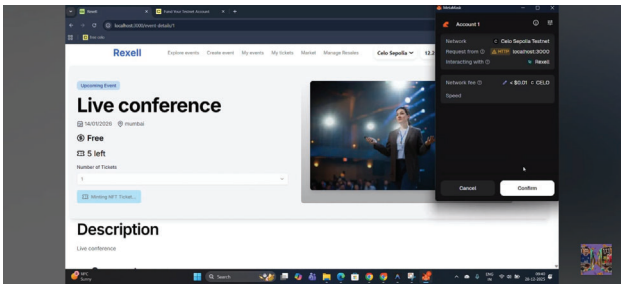

Fig. 4. Event Details and NFT Ticket Minting

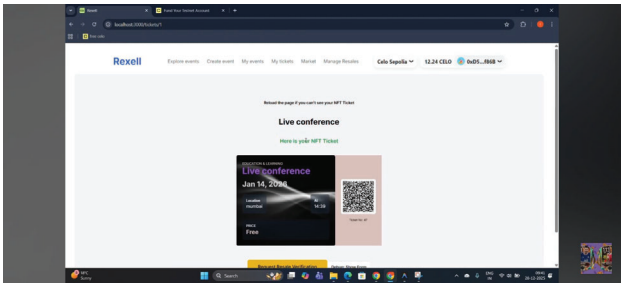

Fig. 5. Generated NFT Ticket with Unique Identity

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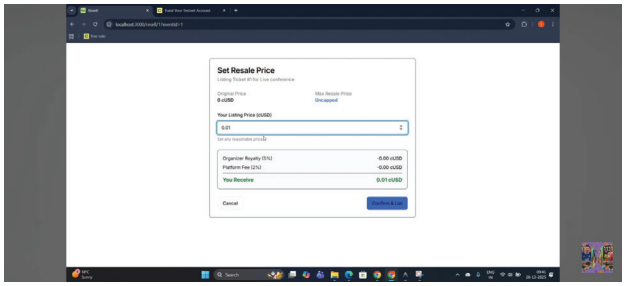

Fig. 6. Setting Resale Price for Ticket

The generated NFT ticket contains a unique identifier and QR code, enabling secure ticket ownership and verification.

. Users can list tickets for resale by setting a price within platform-defined rules, including royalty and fee policies.

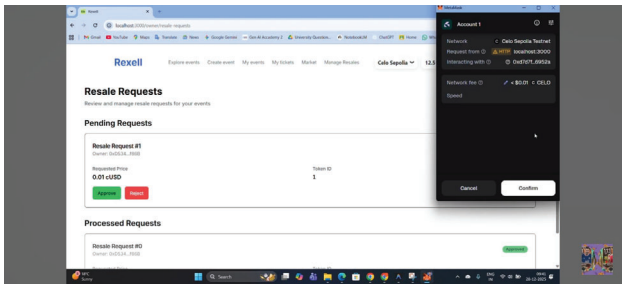

Fig. 7. Organizer Approval for Resale Requests

Event organizers can review and approve resale requests to ensure controlled and authorized ticket distribution.

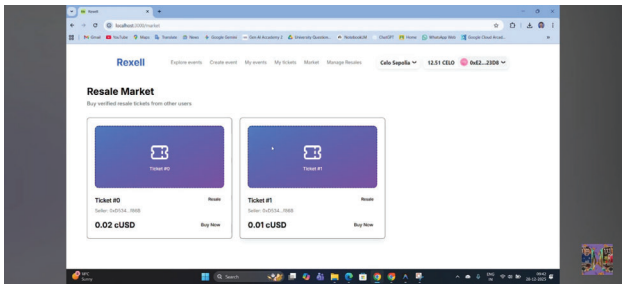

Fig. 8. Resale Market for Verified Ticket Trading

The resale marketplace allows users to buy verified tickets securely and transparently from other users.

XI. Limitations

Although the proposed system achieved encouraging results, certain limitations remain. The implementation was tested on the Celo Sepolia network, and its performance may differ in a production-scale environment with higher transaction volumes. Factors such as scalability and transaction latency require further evaluation under real-world conditions. In addition, the fraud detection module was developed using synthetic transaction data. Therefore, its ability to identify emerging and previously unseen fraud patterns should be validated using real-world datasets. Future research should focus on large-scale deployment and testing to further improve system reliability, scalability, and adaptability.

XII. Challenges, Research Gaps, and Future Directions

A. Current Limitations in Existing Systems

1) Synthetic Data Limitations: Many fraud detection systems rely on generated datasets because real transaction data is difficult to obtain. As a result, their effectiveness in real-world environments may require further validation.

2) Transaction Cost and Latency: Blockchain platforms can experience higher transaction costs and slower processing during periods of heavy network activity.

3) Scalability Issues: Handling a large number of users simultaneously remains challenging, as increased traffic can reduce system performance and transaction throughput.

4) Usability Challenges: Managing wallets and private keys can be difficult for new users, which may affect the overall user experience.

B. Research Gaps

1) Limited Blockchain-AI Integration: Most existing systems use blockchain and AI as separate technologies. Their combined potential is still not fully explored.

2) Lack of Interoperability: Many ticketing solutions operate on a single blockchain, limiting interaction with other networks.

3) Privacy Concerns: User verification may expose sensitive information. More effective privacy-preserving methods are needed.

4) Limited Real-World Validation: Many proposed solutions have been tested only in controlled environments, with limited evaluation in real-world scenarios.

5) Regulatory Challenges: Variations in legal and regulatory requirements across regions can hinder the adoption of blockchain-based ticketing systems.

C. Future Research Directions

1) Hybrid Architectures: Using a combination of on-chain and off-chain processing may improve scalability and reduce operational costs.

2) Decentralized Governance: Decentralized governance models can support transparent decision-making and greater user involvement.

3) Digital Identity Integration: Privacy-focused digital identity solutions can enhance user verification while protecting personal information.

4) Advanced AI Techniques: Advanced machine learning methods may improve the accuracy and effectiveness of fraud detection systems.

5) Quantum-Resistant Security: Future platforms should consider quantum-resistant cryptographic approaches to strengthen long-term security.

6) Sustainable Blockchain: Energy-efficient consensus mechanisms can reduce resource consumption and improve the sustainability of blockchain networks.

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D. Future Work

Future work will focus on improving the scalability, security, and practicality of the proposed system.

- **KYC Integration:** Incorporate real-world identity verification to strengthen user authentication.
- **Cross-Chain Support:** Enable ticket transfers across different blockchain networks.
- **Enhanced Fraud Detection:** Explore advanced machine learning techniques for more accurate fraud detection.
- **Privacy Protection:** Apply zero-knowledge proof mechanisms to support secure user verification.
- **Performance Evaluation:** Conduct large-scale testing to assess system reliability and scalability under real-world conditions.

XIII. Conclusion

Blockchain and artificial intelligence can improve the security and efficiency of event ticketing systems. Blockchain provides transparent and tamper-resistant records, while AI helps identify fraudulent activities and automate ticket management. Together, they support secure ownership verification and fair ticket distribution.

Despite these benefits, challenges such as scalability, regulatory requirements, and real-world deployment remain. Future work may focus on cross-chain support, improved smart contracts, and privacy-preserving identity verification to enhance system reliability and usability.

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