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Blockchain Based Online Multiplayer Card Game

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Abstract— This paper presents a project aims to develop a decentralized, blockchain-powered online multiplayer card game designed to enhance transparency, security, and fairness in gameplay. By leveraging smart contracts and distributed ledger technology, the game ensures truthful interactions between players, eliminating intermediaries and providing verifiable outcomes. Each in-game action such as card transactions, player interactions, and match results is recorded on the blockchain, ensuring immutability and transparency. Players retain full ownership of their in-game assets, represented as non-fungible tokens (NFTs), allowing them to trade, sell, or utilize their assets across various platforms. The project integrates Web3 technologies to deliver a seamless user experience while blending traditional card game mechanics with decentralized gaming principles, ultimately creating a secure, engaging, and player-driven multiplayer environment.

I. INTRODUCTION

The integration of blockchain technology into online multiplayer card games represents a groundbreaking shift in the gaming industry. As digital gaming continues to evolve, blockchain offers unparalleled security, transparency, and player autonomy, addressing longstanding issues such as data manipulation, centralized control, and unfair advantages. By leveraging decentralized systems and smart contracts, blockchain ensures that gameplay remains truthful, provably fair, and resistant to manipulation.

This research explores how blockchain can redefine multiplayer card games, creating a fairer, more immersive, and player driven gaming environment. Unlike traditional games, where assets and game logic are controlled by centralized entities, blockchain technology allows players to own their in-game assets in the form of non-fungible tokens (NFTs). These digital assets, stored on an immutable ledger, enable true ownership, allowing players to trade, sell, or utilize them across different platforms. This new model introduces a decentralized gaming economy, where players' investments hold real-world value beyond the game itself.

While blockchain gaming presents exciting opportunities, its implementation comes with challenges, including scalability, user adoption, transaction costs, and infrastructure requirements. This paper will explore these obstacles alongside potential solutions, evaluating the feasibility of blockchain integration in mainstream gaming. It will also examine existing blockchain-based games, highlighting both success stories and areas for improvement.

Looking ahead, the potential for blockchain to revolutionize not just multiplayer card games but the entire gaming industry is immense. From decentralized gaming economies to enhanced player-driven governance, blockchain offers exciting possibilities that extend far beyond what we see today. This report will examine how blockchain can unlock these future opportunities, reshaping the digital gaming ecosystem for years to come.

II. PROPOSED SYSTEM

The framework for the blockchain-based online multiplayer card game is designed to provide a secure, transparent, and decentralized gaming experience. It leverages blockchain technology to eliminate intermediaries, ensuring fair gameplay, true digital ownership, and a provably fair game logic. Below is a high-level breakdown of the framework

1. Game Design and Mechanics:

Core Game Logic:

- Game Rules: Traditional card game rules (e.g., Poker, Hearthstone, or custom rules) are implemented as the core mechanics of gameplay.
- Game Flow: The flow will include game initiation, turn taking, card actions (e.g., draw, play, discard), and game outcomes (win/lose conditions).
- Player Interaction: Real-time actions, such as cardplaying and strategic decisions, are communicated via the user interface.

Game State Management:

- Smart Contracts: Blockchain-based smart contracts will govern the rules of the game, validate moves, and determine outcomes. Each move is verified through a decentralized process to ensure fair gameplay.

2. Blockchain Architecture:

Blockchain Selection:

- Layer 1 or Layer 2: The blockchain infrastructure must support high throughput, low latency, and low transaction fees. Ethereum (Layer 1), or more scalable options like Polygon or Binance Smart Chain (Layer 2), could be considered depending on scalability and cost.

Smart Contracts:

- Card Logic Contracts: Smart contracts govern the game mechanics, ensuring that cards are drawn and played fairly.
- NFT Ownership: Each unique card or in-game asset (e.g., collectibles, skins) is tokenized as an NFT (Non-Fungible Token) on the blockchain. Players will own, trade, or sell these NFTs within or outside the game.
- In-Game Economy Contracts: Smart contracts manage the in-game economy, including NFT trading, staking, and rewards distribution.

Decentralized Ledger

- Transaction Records: Every interaction between players and the game (e.g., card draws, trades, or moves) is logged on the blockchain for transparency and accountability.
- Game State Synchronization: The current state of the game (including players' hands, board, etc.) is synchronized in a decentralized manner using the blockchain to prevent tampering or cheating.

3. User Interface (UI) & User Experience (UX):

Web or Mobile Interface:

- Front-End Development: The game's front end is built using modern web technologies (React, Vue.js) or mobile app frameworks (Flutter, React Native) for cross-platform compatibility.
- User Wallet Integration: Players interact with the game using a crypto wallet (e.g., MetaMask, WalletConnect) that allows them to manage their NFTs and tokens. Wallets are used for transaction signing (card trades, NFT minting, and stake rewards).
- Game Lobby: The UI includes a multiplayer lobby where users can join or create games, choose game modes, and invite friends.

4. Security & Fairness Mechanisms:

Provably Fair Gameplay: Blockchain ensures that card shuffling and game outcomes are transparent and tamperproof.

Data Encryption & Privacy: Player data is securely stored using cryptographic techniques to protect personal information.

Anti-Cheating Mechanisms: Decentralized verification processes prevent exploits or unfair advantages.

5. Challenges and Solutions:

Scalability: Layer 2 solutions optimize transaction speeds and reduce costs.

User Adoption: A user-friendly interface and gasless transactions can ease onboarding for non-crypto users

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Infrastructure: Reliable backend architecture ensures smooth game performance while leveraging decentralized storage for assets.

III. MODELLING AND ANALYSIS

To model and analyze the proposed blockchain-based online multiplayer card game, the system is designed with the following key components:

1. Game State Management via Blockchain: Smart Contracts: Enforce game rules, validate moves, and determine game outcomes in a decentralized manner. Decentralized Ledger: Ensures all game actions (e.g., card draws, plays, and wins) are recorded on the blockchain, preventing tampering.

2. Data Processing

Transaction Logging: Each game action (card play, trade, or interaction) is stored on-chain for auditability.
Game Data Security: Blockchain ensures encryption and immutability of game records, preventing fraud or cheating.

3. Feature Extraction

Game Metrics: Player rankings, win/loss ratios, and in-game economy statistics are extracted from on-chain data. NFT Ownership: Cards and collectibles are tokenized as NFTs, ensuring true digital ownership.

4. Consensus Mechanisms for Fair Gameplay Proof-of-Game (PoG): A novel approach where game moves are verified via smart contracts before they are finalized. Layer 2 Scalability: Optimized blockchain networks (e.g., Polygon, Binance Smart Chain) are used for low-cost, highspeed transactions.

5. Security and Fairness

Provably Fair Play: Random card draws and game outcomes are generated through cryptographic algorithms for fairness. Anti-Cheating Mechanisms: Blockchain validation prevents unauthorized game state changes.

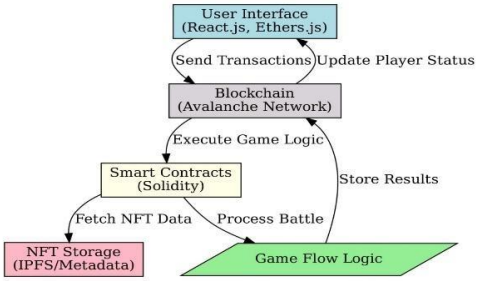

Fig.1.1 Design Details

6. User Interaction and Game Experience Decentralized Matchmaking: Smart contracts ensure unbiased player pairing.

Wallet Integration: Players use crypto wallets to manage game assets, sign transactions, and participate in the in-game economy.

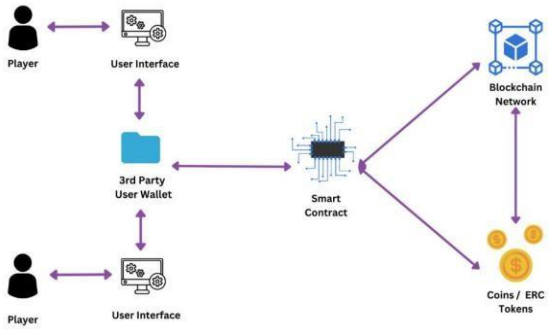

Fig.1.2 System Architecture

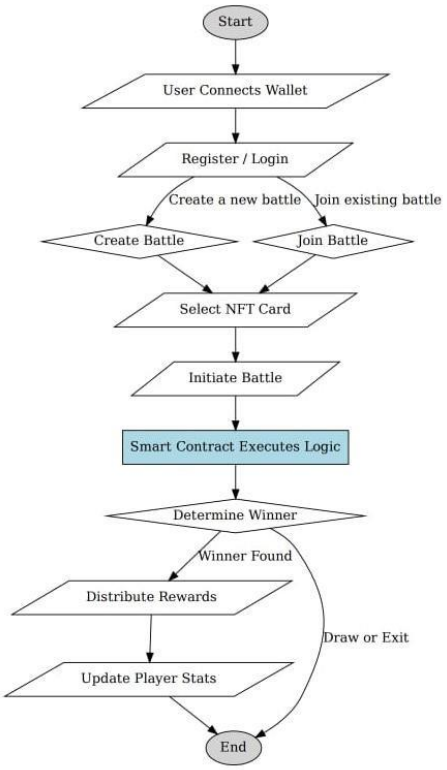

Fig.1.3 Work flow

The flowchart illustrates a Web3-based multiplayer battle game using blockchain. The game starts when a user connects their wallet, registers, or logs in. Players create or join a battle, select an NFT card, and initiate gameplay. A smart contract executes logic in a decentralized manner. The system determines the winner, and if found, rewards are distributed. In case of a draw or exit, the game proceeds without rewards. Finally, player stats update on the blockchain, ensuring transparency and immutability before concluding the process.

For validation, the following performance evaluation parameters will be considered:

Performance Metrics - Gas Consumption: Smart contract optimizations reduced transaction costs.

Transaction Speed: Average confirmation time is 1 second on Avalanche C-Chain.

Security: On-chain battle logic prevents unauthorized modifications.

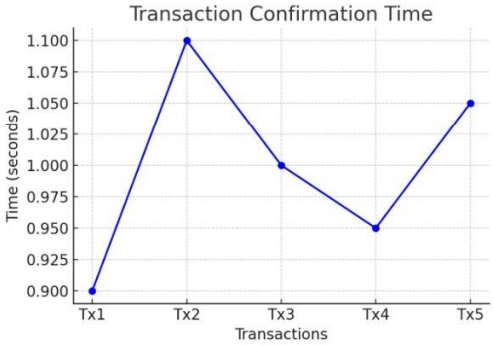

Fig.1.4 Transaction Confirmation Time Graph

The graph shows the confirmation time for five transactions (Tx1 to Tx5) on the blockchain. The fluctuations indicate network conditions and gas optimizations affecting transaction speeds. The average confirmation time remains close to 1 second, ensuring efficient processing.

IV. CONCLUSION

The proposed blockchain-based online multiplayer card game provides a secure, transparent, and decentralized gaming experience. By leveraging smart contracts and NFT-based assets, the system ensures fairness, digital ownership, and immutability of game states. This research paper explores the integration of blockchain technology in gaming, outlining the architecture, game flow logic, and security mechanisms that enhance trust among players.

The findings highlight that using blockchain networks with low transaction fees, such as Ethereum Layer 2 or Binance Smart Chain, significantly improves scalability and user adoption. Additionally, the integration of provably fair gameplay mechanisms and decentralized matchmaking ensures a tamper-proof gaming experience.

Future work should focus on optimizing transaction efficiency, enhancing user experience, and expanding interoperability with multiple blockchain networks. Further improvements can include real-time analytics for game statistics and AI-driven matchmaking for fairer competition.

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