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Online Auction System Using Blockchain Technology

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ABSTRACT

Online auction platforms have revolutionized the way digital assets and products are bought and sold. However, traditional auction systems are typically hosted on centralized servers, exposing them to several vulnerabilities such as data tampering, single points of failure, and manipulation of bid values. This research paper proposes an Android-based decentralized online auction system that integrates a custombuilt blockchain ledger using the SHA-256 hashing algorithm to store all bid records securely. Unlike existing blockchain auction platforms that use smart contracts our system excludes smart contracts entirely and instead uses a simulated recharge wallet for handling virtual bid payments. Firebase is utilized as the backend database to handle authentication and real-time data sync. The system architecture promotes trustless interactions while remaining lightweight and mobile-accessible. This paper discusses the detailed architecture, blockchain logic, wallet mechanism, and the system's realtime capability, showing its potential as a practical and secure auction platform without needing smart contracts.

Keywords: Blockchain Technology, SHA-256, Online Auction, Recharge Wallet, Smart Contract Alternative

1. INRODUCTION

Online auction platforms have become a major part of modern e-commerce, enabling users to bid competitively on products and services. These systems allow multiple users to place bids in real-time, and the highest bidder at the auction's end typically wins the item. However, most traditional auction platforms are centralized, relying on a central server or authority to manage the bidding process, transactions, and auction rules. This centralized approach raises several

concerns. First, there's a lack of transparency—users cannot verify how bids are handled or whether manipulation has occurred. Second, data tampering is possible, either from malicious administrators or external hackers. Third, there is a single point of failure, meaning that if the server goes down or is attacked, the entire system could be disrupted. All of these factors reduce user trust in the fairness and reliability of the auction process. To address these challenges, blockchain technology offers a more secure alternative. Blockchain is a decentralized digital ledger where data is stored in blocks, each linked to the previous one using cryptographic hashes. The SHA-256 algorithm, a widely trusted cryptographic function, ensures that each block's data is secure and tamper-proof. Any modification in a block's data would change its hash and break the chain, making unauthorized changes easy to detect. Most blockchain-based auction systems use smart contracts, especially on Ethereum. Smart contracts automate the auction process, ensuring rules are followed without human interference. However, smart contracts have their drawbacks, including high gas fees, complex coding requirements, and dependency on third-party blockchain platforms, which can limit accessibility and increase costs. This research proposes an alternative approach—a mobile-based online auction system that uses SHA-256 hashing for blockchain-style security but does not rely on smart contracts. Instead, it implements a custom blockchain logic directly within the app and uses a recharge wallet system where users bid using virtual tokens. The app is built for Android and uses Firebase for real-time data management and user authentication. This combination offers a secure, transparent, and efficient online auction platform, ideal for use cases where simplicity, trust, and cost-efficiency are priorities.

2. LITERATURE REVIEW

The design and development of secure and efficient online auction systems have been an active area of research, especially with the rise of blockchain technology. Several previous works have focused on decentralization, smart contract-based automation, and cryptographic integrity. This section reviews key contributions that influenced and contrasted with our proposed model.

2.1 Agrawal, A., & Goyal, M. (2024). The Future of Auction Platforms: A Blockchain Approach.

Agrawal, A., & Goyal, M. (2024), titled "The Future of Auction Platforms: A Blockchain Approach", explores how blockchain technology can transform online auction platforms. It discusses the limitations of traditional, centralized auction systems, such as trust issues, high fees, and fraud. The authors propose blockchain as a solution to these problems by offering a decentralized, secure, and transparent auction environment.

2.2 Liu, W., et al. (2024). A Decentralized Auction System Using Blockchain Technology

The paper proposes a decentralized auction system using blockchain technology to enhance security, reduce costs, and increase transparency. By utilizing smart contracts, the system automates bidding and payment processes, making auctions more efficient and trustworthy. The paper also highlights the challenges and areas for future research to make blockchain-based auction systems more scalable and widely adopted.

2.3 Raza, M., & Khan, A. (2023) – Enhancements in Auction Systems Using Blockchain

Blockchain offers a decentralized and immutable solution that can enhance the efficiency, security, and transparency of auctions. The paper provides an overview of blockchain technology and identifies the challenges in traditional auctions that blockchain can address. It explores existing blockchain-based auction systems and evaluates their effectiveness in mitigating issues such as bid manipulation and fraud. The impact of blockchain on auction participants is also discussed, including benefits like increased trust and reduced transaction costs, as well as challenges related to adoption and scalability.

2.4 Vukovic, S., & Zhang, L. (2024) – Future Outlook on Blockchain in Auctions

The paper discusses the future potential of blockchain in revolutionizing auction systems by increasing automation and reducing fraud through the use of smart contracts.

2.5 Firebase Documentation (2023) – Firebase Authentication and Realtime Database

Firebase, developed by Google, provides cloud-based backend services including authentication, realtime database, and cloud storage, all of which are essential for mobile app

development. Firebase's Realtime Database supports live bid updates, while Firebase Authentication enables secure user login and session management. Its cloud-based, scalable infrastructure makes it suitable for dynamic applications like auctions. In our system, Firebase plays a crucial role in synchronizing auctions, tracking wallet balances, and maintaining user profiles—bridging the blockchain ledger with real-time usability in a mobile environment.

3. PROBLEM STATEMENT

Online auction platforms have gained significant traction in the digital commerce space, offering users the ability to buy and sell goods and services through competitive bidding. Despite their popularity, traditional and even blockchain-based auction systems are still plagued by several critical issues that limit their trustworthiness, accessibility, and cost efficiency.

3.1 Key Issues in Existing Systems

- **Centralized Control and Data Manipulation:**

Most online auction systems are operated by centralized servers that have full control over the storage and management of bids. This introduces a single point of failure and creates opportunities for fraudulent activity, such as bid rigging or post-auction manipulation by insiders or administrators.

- **Lack of Transparency and Verifiability:**

Users have no mechanism to independently verify that the bidding process was fair. Once a bid is placed, its integrity and order in the sequence are completely controlled by the central system. This lack of auditability reduces user trust in the auction outcomes.

- **Dependence on Third-Party Blockchain Platforms:**

Blockchain-based auctions that utilize smart contracts often rely on public blockchain networks like Ethereum. This dependency introduces additional risks such as network delays, reliance on external infrastructure, and exposure to security vulnerabilities outside the control of the developers.

- **Smart Contract Complexity and Cost:**

While smart contracts can automate auction logic, they are difficult to design and debug securely. Errors in smart contract code can result in severe financial consequences. Furthermore, deploying and executing smart contracts on public blockchains incurs gas fees, which can be prohibitively expensive for small-scale or frequent auctions.

- **Limited Mobile Accessibility:**

Many existing systems are web-based and do not offer an optimized experience for mobile users. Even fewer provide offline capability or lightweight architecture suitable for mobile environments, which limits their reach in areas with poor internet infrastructure.

3.2 Proposed Solution

This research proposes the development of a custom online auction system that eliminates these limitations by implementing a simplified, yet secure and transparent architecture:

- **Custom Blockchain Implementation with SHA-256:**

Instead of relying on external platforms, the system incorporates a self-implemented blockchain within the Android application. Each bid is stored in a block that is hashed using the SHA-256 cryptographic algorithm, ensuring data integrity, tamper-resistance, and auditability.

- **Smart Contract-Free Architecture**:

By designing the system logic within the mobile application and backend, we completely eliminate the need for smart contracts, thus avoiding gas fees, security risks, and dependency on public blockchain platforms.

- **Recharge Wallet System for Simulated Payments:**

A virtual wallet mechanism is integrated into the app, allowing users to recharge their wallet with tokens and use them to place bids. This controlled economic model ensures safe, simulated transactions without involving real financial risk.

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- **Mobile-First Approach with Firebase Integration:**

The system is developed as an Android mobile application using Firebase Realtime Database and Authentication for backend services. This ensures real-time synchronization, user session management, and scalability, while being accessible on a wide range of mobile devices.

4. SYSTEM ARCHIETECTURE

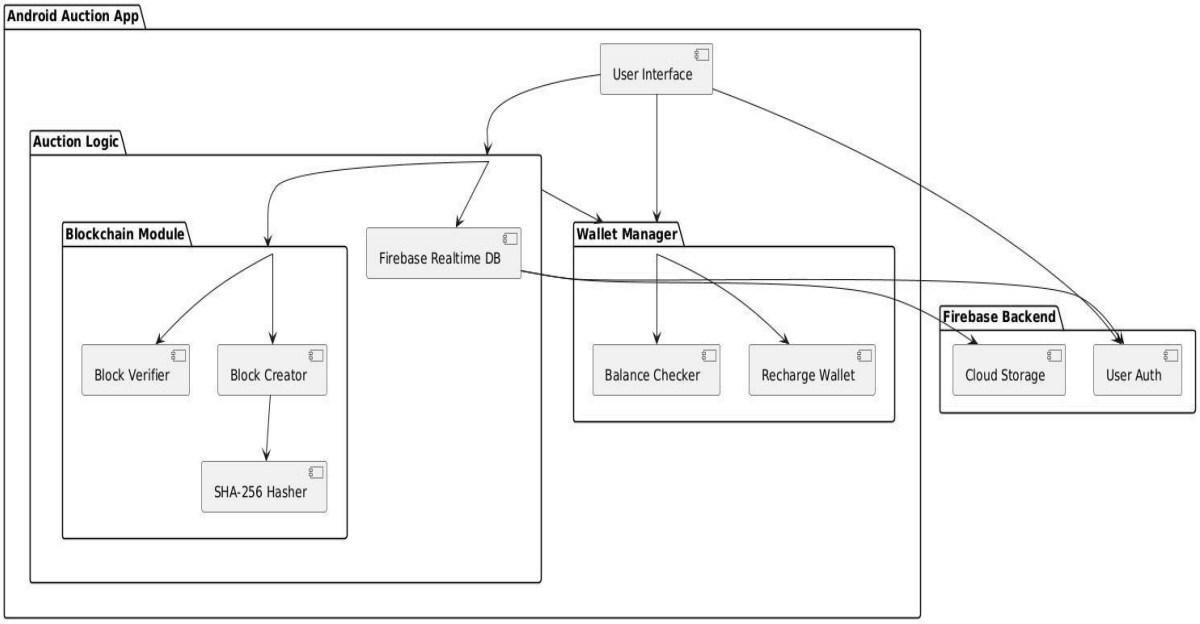

Fig1: System Architecture

- **Android Auction App :**

The outermost box represents the entire mobile application, which includes different logic and service modules**.**

- **Auction Logic :**

This is the core logic of the auction, handling bids, auctions, and interactions with other modules like blockchain and wallets.

- **Blockchain Module:**

This part ensures the integrity and security of auction transactions using blockchain principles.

- Block Verifier: Validates the blocks before they're added to the chain.
- Block Creator: Creates new blocks for each successful auction transaction.

- SHA-256 Hasher: Hashing algorithm used to secure the block data and ensure immutability.

Flow:

When an auction completes, data is hashed using SHA-256, then passed to Block Creator, and finally validated by Block Verifier.

Verified data is stored in the Firebase Realtime DB.

- **Firebase Realtime DB :**

Acts as the central data storage for the auction data, user interactions, and blockchain data. Interacts

with the Blockchain Module for storing auction transactions.

Supplies data to Wallet Manager and User Interface.

- **Wallet Manager :**

Handles all wallet-related operations within the app.

- Balance Checker: Checks current balance for a user.
- Recharge Wallet: Allows users to add funds to their wallet.

These operations interact with Firebase Realtime DB to fetch and update wallet balance

- **Firebase Backend :**

Provides cloud services and user authentication.

- Cloud Storage: Likely used to store images or documents (e.g., product pictures for auctions).
- User Auth: Manages authentication and user sessions, connected to both the User Interface and Wallet Manager.

- **User Interface :**

Front-end interface of the app that interacts with:

- Auction Logic: For placing bids and participating in auctions.
- Wallet Manager: For checking balance and recharging wallet.
- Firebase Backend: For login/signup functionality.

5. METHODOLOGY

The proposed system follows a mobile-first approach to build a secure and transparent online auction platform. The architecture is designed to operate without smart contracts and instead uses a custom blockchain powered by SHA-256 hashing, integrated with a virtual recharge wallet and Firebase backend for real-time operations.

5.1 System Design

The system is divided into five major components:

1. Android Front-End:

Developed using Android Studio, this interface allows users to register/login, browse auction items, recharge their wallet, and place bids in real time.

2. Blockchain Module (Custom Implementation):

Every bid placed is stored as a new block containing the user ID, bid amount, timestamp, and previous block's hash. The SHA-256 hashing algorithm ensures each block is uniquely linked and tamper-resistant. This custom blockchain ensures transparency and verifiability without depending on external platforms like Ethereum.

3. Recharge Wallet System:

Users have a virtual wallet that can be recharged with tokens. These tokens are used to place bids. The system checks wallet balance before allowing a bid to ensure bid legitimacy and simulate secure financial behavior.

4. Auction Management Engine:

Handles creation of auctions, timing, bid validation, and determining the winning bidder at auction close. This logic is embedded in the Android application for realtime operation.

5. Firebase Backend Integration:

- Firebase Authentication: Secures login and session management.
- Firebase Realtime Database: Synchronizes bids and auction data across device instantly.

5.2 Workflow

- A user registers/logs in through the Android app.
- The user recharges their wallet using predefined token options.
- Available auction items are listed, and users can place bids.
- On placing a bid:
  - Wallet balance is checked.
  - Bid is added to the blockchain via the SHA-256 hash logic.
  - The bid is saved in the Firebase database and synced across all clients.
- Once the auction timer ends, the highest bid is identified, and the winner is announced.

5.3 Testing and Verification

Testing Aspect	Details
Functionality	Ensured that features like bidding, wallet deduction, and auction timers operated correctly.
Blockchain Integrity	Verified correct linking of hashes between blocks and ensured no tampering was possible.
Real-time Performance	Observed the performance of Firebase synchronization under multiple concurrent users.
Security	Validated the authentication process, wallet access control, and blockchain hash security.

Table 1: Testing Aspects and Validation Details

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6. RESULT

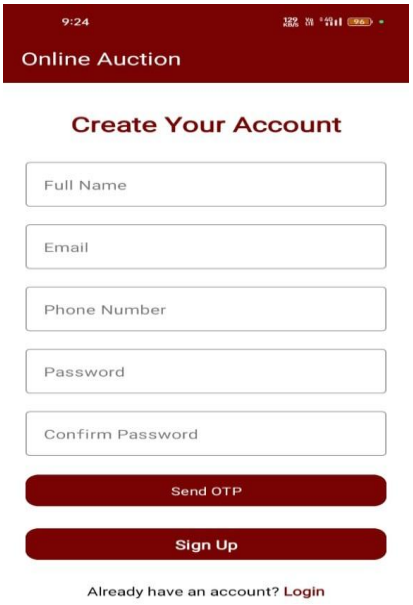

Figure 1: Create Your Account

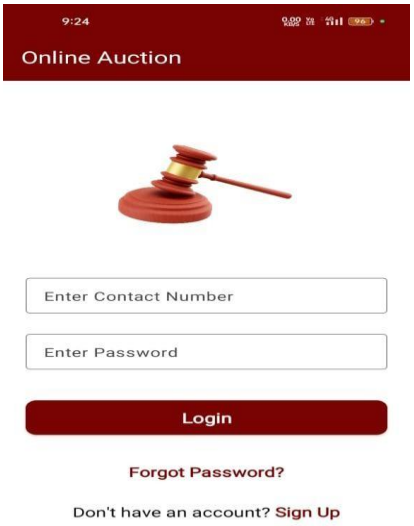

Figure 2: Login Account

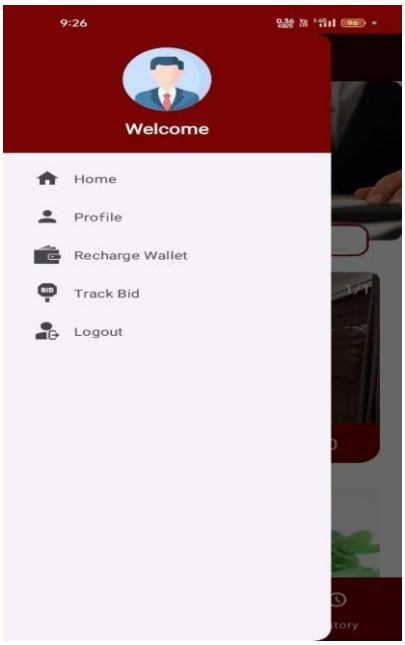

Figure 3: User Dashboard

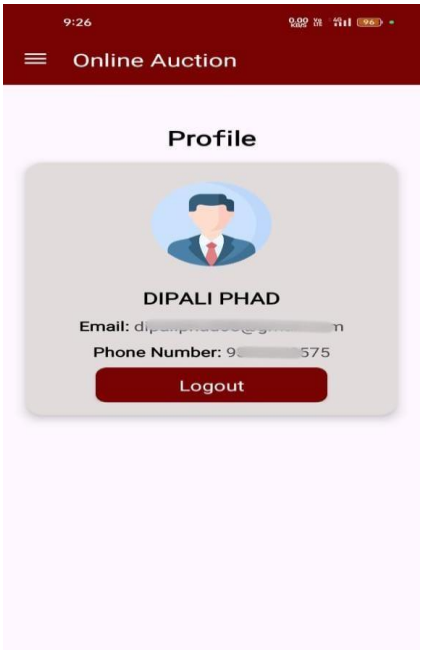

Figure 4: User Profile Interface

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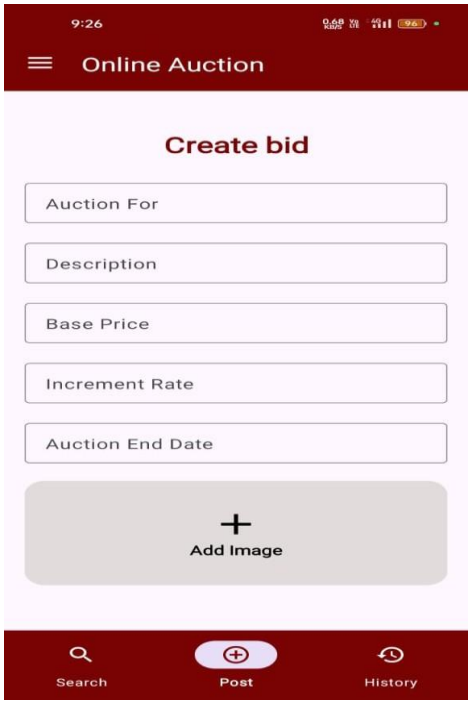

Figure 5: Create Bid Using Image & Details of product (Auction Creator)

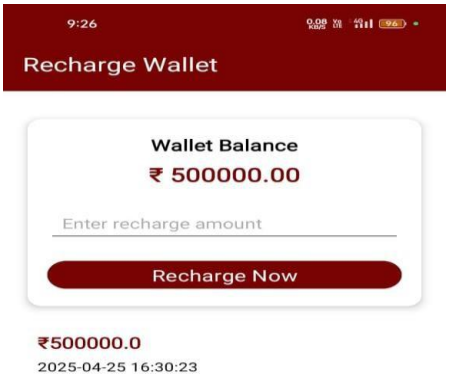

Figure 6: Wallet Recharge Screen

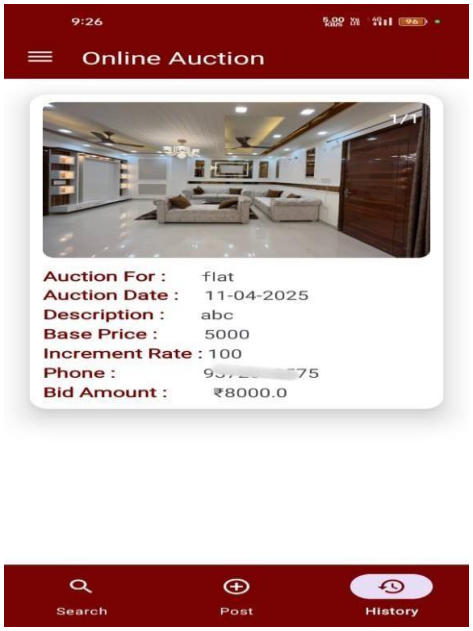

Figure 7: Bid History of User (Bid Raised by User)

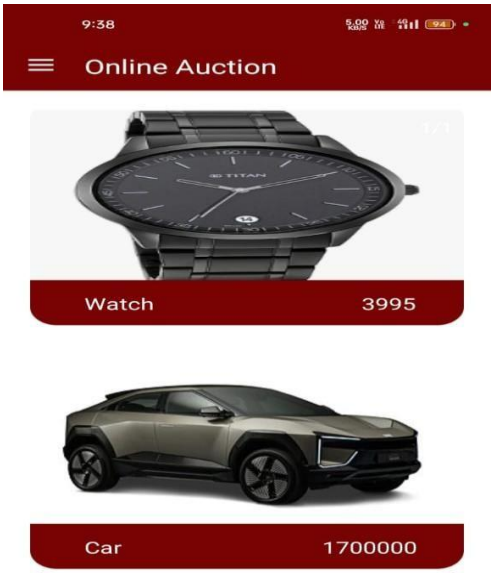

Figure 8: Track Bid (Bid Post By the Auction Creator)

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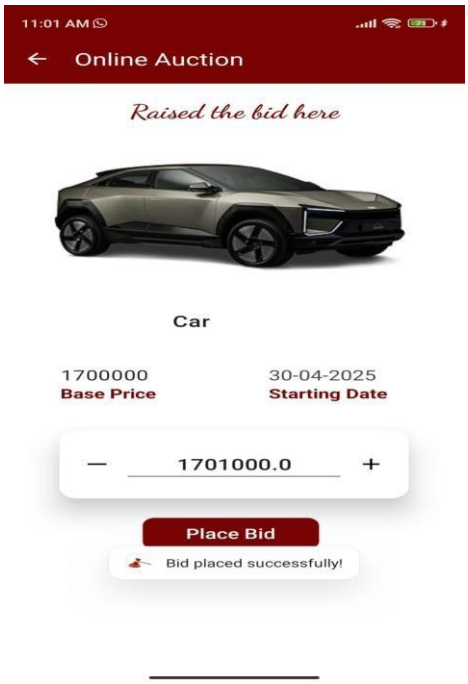

Figure 9: Raised Bid Interface User)

Figure 10: Bid Closed by Auction (for Creator

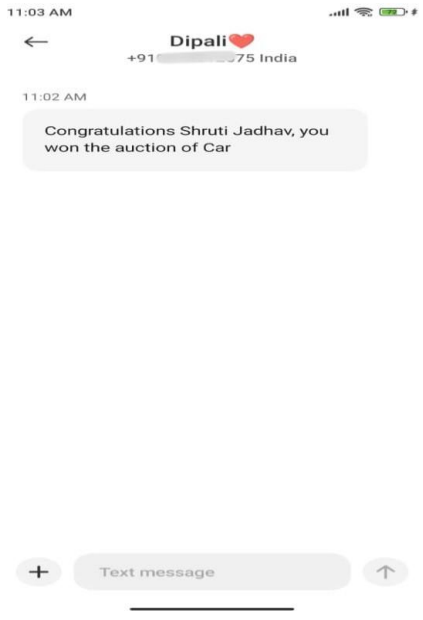

Figure 11: Winner Selection Message to the User From the Auction Creator

7. CONCLUSION AND FUTURE SCOPE

This research successfully demonstrates a secure, transparent, and mobile-accessible online auction system using a self-implemented blockchain model powered by SHA-256 hashing. By eliminating the dependency on smart contracts and public blockchain networks, the proposed system offers a lightweight and cost-effective solution suitable for academic, experimental, and small-scale commercial use. The integration of a **recharge wallet mechanism** adds a layer of transaction simulation, ensuring that users only place valid bids with sufficient balance. Moreover, the use of **Firebase** for real-time synchronization and authentication makes the system highly responsive and secure, especially for mobile users. The custom blockchain implementation ensures that every bid is recorded immutably, making the auction process auditable and tamper-proof. This approach bridges the gap between traditional centralized systems and fully decentralized platforms by providing blockchain transparency without the complexity and cost associated with smart contracts.

Future Scope

Although the system meets its current goals, there are several areas where future enhancements could make it even more robust and scalable:

1. **Multi-User Consensus Logic**:

Introducing a lightweight consensus mechanism among multiple user devices could help decentralize block validation and further increase trust in a peer-to-peer environment.

2. **Encrypted Wallet Tokens**:

Currently, the wallet system uses simple token values. Future versions could implement public-private key cryptography for wallet transactions and secure token exchanges.

3. **Cross-Platform Support**:

Extending the system to work on iOS and web platforms would make it more accessible to a wider audience.

4. **Offline Bidding Support**:

A caching mechanism for bids in offline mode could be added, syncing automatically when the user is back online.

5. **Integration with Real Cryptocurrency**:

Although the current system uses a virtual wallet, future versions could integrate with real- world cryptocurrency APIs for actual financial transactions—once smart contractfree crypto transactions are standardized.

6. **Auction Analytics Dashboard**:

A web-based admin dashboard with auction insights, user behavior analytics, and bid trends could add significant value for moderators and sellers.

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