RESEARCH ARTICLE

RSP Science Hub

International Research Journal on Advanced Science Hub
2582-4376
www.rspsciencehub.com
Vol. 06, Issue 07 July

Check for updates

http://dx.doi.org/10.47392/IRJASH.2024.026

Block Buy: Block Chain Powered Marketplace

Aniket Wagh[1], Nikita Sarje[2], Rajlaxmi Warat[3], Dipika Paranjape[4]
[1,2,3]B-Tech CSE-AI Student, NCER, Pune-MH, India.
[4]Guide, NCER, Pune-MH, India.
Emails: *contact@aniketwagh.com[1], nikitasarje2000@gmail.com[2], rajlaxmiwarat2002@gmail.com[3]*

Article history
Received: 29 June 2024
Accepted: 04 July 2024
Published: 27 July 2024

***Keywords**:*
Blockchain; Ethereum; Flutter; IPFS; Smart Contracts;

Abstract

Blockchain technology has the potential to transform marketplaces by allowing decentralized, secure, and transparent transactions. This study introduces a marketplace architecture based on block chain to overcome the limitations of centralized platforms. Our design utilizes smart contracts to automate transactions, maintain integrity, and remove intermediaries. We detail the essential elements of the system, such as user registration, product listing, payment, and conflict resolution. This marketplace is built using Ethereum block chain, Flutter, and IPFS for data storage. Furthermore, we assess the system's performance and security through various simulations. The outcomes show that the proposed blockchain-based marketplace provides significant benefits in efficiency, transparency, and trust, showing promise to revolutionize the e-commerce sector.

1. Introduction

The world of online shopping has gone through significant changes in the last twenty years, altering how people and businesses from all over the world engage with each other. Big names in e-commerce like Amazon and Flipkart have transformed the retail landscape by providing unmatched convenience and variety. Despite their dominance, these platforms face limitations due to their centralized operational methods [15].

1.1 Historical Background and Context

The rise of e-commerce marked a revolutionary shift in retail, allowing customers to shop for goods and services right from their homes [11]. Companies like Amazon, founded in 1994, led the way in online shopping by leveraging technology to simplify purchasing, logistics, and customer service [1]. This shift not only changed consumer habits but also drove innovation in supply chain management and digital advertising strategies [5]. A key factor in these platforms' success is their capability to compile vast amounts of consumer data, which is utilized to personalize recommendations and improve inventory management [2]. However, this centralized control over data poses risks, such as susceptibility to cyber-attacks and concerns over data confidentiality [13]. The dominance of a few major players also raises concerns regarding market control and competition, potentially restricting choices for customers and opportunities for smaller businesses [7].

1.2 Issue Identification

Despite their benefits, traditional e-commerce platforms encounter several significant challenges affecting their effectiveness, security, and user confidence. These challenges fall into three primary categories:

1.2.1 Centralized Control and Security Vulnerabilities

The centralized nature of traditional e-commerce platforms creates vulnerabilities to cyber threats and system failures [8]. Centralized databases holding sensitive user data are appealing targets for malicious entities looking to exploit security loopholes [18]. Data breaches not only risk consumer trust but also expose individuals to identity theft and financial fraud [12].

1.2.2 High Transaction Costs and Intermediary Charges

Transactions on traditional e-commerce platforms frequently involve multiple intermediaries like payment processors and logistics providers [3]. Each intermediary adds complexity and costs to the transaction process, resulting in higher fees that impact both consumers and sellers [9]. High commission rates, usually between 15% to 30% of revenue, can significantly reduce the profit margins of small and medium-sized businesses (SMBs), dissuading their involvement and growth on these platforms [16].

1.2.3 Trust and Reliability in Logistics

Logistics operations are critical to e-commerce success but present challenges concerning transparency and reliability [17]. Third-party logistics providers (3PLs) responsible for order fulfilment and delivery may not consistently meet service expectations, leading to delays, inaccurate order tracking, and customer dissatisfaction [19]. False logistics data further aggravates these issues, undermining trust in the e-commerce platform and its commitment to timely and dependable service [6].

1.3 Our Solution: Block Buy

To address the limitations of traditional e-commerce models, we introduce Block Buy, an innovative solution harnessing block chain technology, Interplanetary File System (IPFS), and advanced reputation assessment methods [14]. Block Buy represents a shift towards decentralized e-commerce, aiming to enhance security, transparency, and efficiency in online transactions [20].

1.3.1 Block chain Technology for Transparent Transactions

Block Buy’s core is a block chain-powered transaction system designed to replace conventional intermediary roles with smart contracts [4]. Smart contracts ensure secure and transparent transactions by automating payment and fulfilment processes while adhering to predefined terms [15]. By removing intermediaries, Block Buy lowers transaction costs and reduces fraud risks, promoting financial inclusivity and transaction efficiency [19].

1.3.2 Interplanetary File System (IPFS) for Secure Data Storage

Block Buy utilizes IPFS to securely store detailed product information [10]. Unlike traditional centralized databases, IPFS disperses data across a decentralized node network, ensuring redundancy and data integrity [19]. Product information stored on IPFS is linked to the block chain, creating an unchangeable history and ownership record [6]. This decentralized method optimizes storage, boosts data security, and streamlines information retrieval for both buyers and sellers [19].

1.3.3 Advanced Reputation Evaluation Methods

To foster trust and reliability within the Block Buy ecosystem, we introduce a robust reputation evaluation system based on Simple Weighting (SAW) and Multi-Criteria Decision Making (MCDM) methods [7]. This system assesses participants' reputations using factors like transaction completion times and feedback quality from trade partners [14]. By encouraging genuine feedback and discouraging fraudulent behavior, Block Buy aims to create a fair and accurate reputation system that boosts user trust and encourages positive seller-buyer interactions.

1.4 Objectives of Block Buy

Block Buy’s primary goal is to establish a blockchain-based marketplace that addresses traditional e-commerce weaknesses while offering improved security, transparency, and cost-effectiveness [15]. Key objectives include:

1.4.1 Technological Innovation and Security Enhancement

By incorporating block chain and IPFS technologies, Block Buy leads technological advancements in e-commerce, setting new benchmarks for data security and transaction transparency [17]. Decentralized technologies mitigate risks linked to central control and enhance platform resilience against cyber threats and data breaches [19].

1.4.2 Cost Reduction and Financial Inclusivity

Block Buy intends to reduce transaction costs by removing intermediaries and unnecessary traditional e-commerce fees [14]. By fostering direct peer-to-peer transactions facilitated by block chain smart contracts, Block Buy enables sellers to retain more of their revenue, encouraging economic growth and financial inclusivity [19].

1.4.3 Trust and Reliability in E-Commerce

Enhancing trust and reliability underpin Block Buy's mission [19]. Through transparent transactions and a robust reputation assessment system, Block Buy aims to create a trustworthy environment where users can conduct online business confidently without fear of fraud or misinformation [14]. By utilizing block chain's inherent transparency and immutability, Block Buy ensures all transactions and product details are verifiable and tamper-proof [19].

1.5 Project Scope

The Block Buy project's scope covers developing a user-friendly mobile app (Android and iOS) and a web platform accessible to global consumers [19]. Key features include:

1.5.1 User-Centric Design and Accessibility

Block Buy emphasizes user experience with straightforward interfaces and seamless navigation across mobile and web platforms [19]. The design focuses on accessibility to enable easy product browsing, purchasing, and order tracking [19].

1.5.2 Diverse Product Range and Pricing Flexibility

Sellers on Block Buy have control over pricing and product listings, enabling them to personalize their storefronts and attract an international audience [19]. The platform supports various products, from electronics to handmade crafts, fostering diversity and competition in the e-commerce marketplace.

1.5.3 Secure Transactions and Fraud Prevention

By implementing escrow systems and real-time transaction monitoring, Block Buy enhances security and mitigates fraudulent activities [19]. Smart contracts ensure that funds are only released upon successful delivery and customer satisfaction confirmation, safeguarding both buyers and sellers' interests [19].

2. Literature Survey

2.1 History

The development of electronic commerce platforms has primarily favoured centralized structures, which are proficient in gathering and overseeing data but are susceptible to various risks. Centralized control introduces vulnerabilities, makes platforms susceptible to cyber threats, and raises questions about data privacy and user. Table 1 explains the Literature Review.

2.2 Block chain Technology and Ethereum

Blockchain technology, notably pioneered by Ethereum, has emerged as a revolutionary innovation extending beyond its initial application in digital currencies. Its decentralized framework tackles the limitations of centralized systems by distributing control, ensuring transparency, and maintaining unchangeable records. In the realm of electronic commerce, block chain shows potential in enhancing transaction security, cutting operational expenses, and transforming supply chain management through smart contracts.

Table 1 Literature Survey

S. No.	Name of Paper	Abstract	Methodology	Outcome	Limitations
1	An overview of blockchain technology: Concepts, applications, and research	This paper delves into the realm of blockchain technology, exploring its core concepts, real-world applications, and ongoing research efforts.	This paper conducts a thorough analysis of existing literature on blockchain technology, highlighting its fundamental concepts, diverse applications, and existing challenges.	This paper offers a comprehensive insight into the world of blockchain technology and its potential use cases.	This paper is confined to a purely theoretical exploration of blockchain technology.

2	A secure and efficient e-commerce platform based on block chain and IPFS	This paper puts forward a proposal for a secure and efficient e-commerce platform that leverages the power of block chain technology and the Interplanetary File System (IPFS).	The paper proposes a system architecture that makes use of block chain to manage access control details and IPFS for storage of digital files, ensuring robust security and operational efficiency.	The findings demonstrate the efficacy and reliability of the proposed e-commerce platform.	This paper is limited to a theoretical discussion of the proposed system.
3	Blockchain e-commerce: Opportunities and challenges for retailers	This paper addresses the potential opportunities and hurdles that block chain technology presents to e-commerce businesses, particularly focusing on retailers.	By reviewing existing literature on block chain and e-commerce, this paper unveils the key chances for growth and obstacles faced by retailers in adopting block chain technologies.	The paper suggests that integrating block chain could revolutionize supply chain management in e-commerce, minimizing fraudulent activities.	The discourse predominantly revolves around theoretical considerations regarding the adoption of block chain for e-commerce.
4	Design and implementation of a secure and transparent e-commerce supply chain management system using block chain technology	This paper outlines a design blueprint for an e-commerce supply chain management system that ensures both security and transparency through the utilization of block chain technology.	The proposed system, PRODCHAIN, tracks product life cycles effectively using block chain, promising enhanced product quality and fraud mitigation.	PRODCHAIN's implementation showcases improvements in product quality and fraud reduction.	This paper is restricted to a case study focusing solely on PRODCHAIN .
5	A secure and transparent e-commerce supply chain model using blockchain technology	This paper presents a model designed to bring security and transparency to e-commerce supply chains through the integration of blockchain technology.	The proposed model harnesses blockchain technology to trace and validate transactions throughout the supply chain, enhancing operational efficiency and trustworthiness.	The demonstrated benefits suggest that the model can significantly enhance the integrity and credibility of supply chains.	The discussion is constrained to a theoretical examination of the proposed model.
6	Blockchain for e-commerce: Improving trust, transparency, and security	This paper delves into the transformative potential of block chain technology in fostering trust, ensuring transparency, and bolstering security within the realm of e-commerce.	Through a comparative analysis, this paper evaluates how block chain can positively impact trust, transparency, and security in e-commerce operations.	The study concludes that block chain has a substantial capacity to enhance trust, transparency, and security in e-commerce environments	The discourse primarily revolves around theoretical discussions with limited practical applications.

7	Decentralized e-commerce: Blockchain as a trust facilitator	This paper examines the pivotal role of block chain in decentralizing e-commerce operations and facilitating trust among participants.	By scrutinizing existing literature and practical instances, this paper highlights block chain's vital role in enhancing trust levels in e-commerce transactions.	Blockchain emerges as a critical technology for fostering trust in the landscape of e-commerce.	The narrative predominantly leans towards theoretical discussions with minimal real-world examples.
8	Implementing block chain for e-commerce transaction efficiency	This paper investigates the efficiency of e-commerce transactions when integrated with block chain technology.	The study adopts a comprehensive approach, utilizing case studies and simulations to analyse the impact of block chain implementation on transaction efficiency.	Results point towards increased transaction efficiency and reduced operational costs in the e-commerce domain.	The paper does not delve into long-term scalability issues associated with block chain implementation.
9	Blockchain and the future of digital marketplaces	This paper envisions the transformative impact of block chain technology on shaping the future landscape of digital marketplaces.	By reviewing existing block chain applications and projecting future trends, this paper underscores block chain's significant role in revolutionizing digital marketplaces.	The analysis forecasts a substantial influence of block chain on the dynamics of digital marketplaces.	The narrative adopts a speculative tone and lacks empirical data to substantiate the claims.
10	Challenges of integrating block chain with existing e-commerce systems	This paper outlines the obstacles in merging block chain with current e-commerce systems.	It employs a qualitative method by interviewing industry professionals.	Significant integration challenges are highlighted, encompassing technical and regulatory issues.	The paper lacks quantitative data and is restricted to expert opinions.
11	Blockchain technology in online retail: Benefits and drawbacks	This paper delves into the advantages and disadvantages of using block chain in online retail.	The study utilizes SWOT analysis to identify strengths, weaknesses, opportunities, and threats.	Blockchain offers benefits such as heightened security but poses challenges like high implementation costs.	The study relies on theoretical analysis with limited empirical data.
12	A framework for blockchain-based e-commerce platforms	This paper presents a framework for creating blockchain-based e-commerce platforms.	It entails designing and testing a prototype block chain e-commerce platform.	The proposed framework enhances transparency and security in e-commerce.	The prototype is not executed in a live setting.

13	Evaluating the impact of block chain on e-commerce logistics	This paper evaluates the influence of block chain technology on e-commerce logistics.	Case studies are employed to assess the implementation of block chain in logistics.	Blockchain is discovered to augment logistics transparency and efficiency.	The study is confined to a few case studies and lacks broader applicability
14	Enhancing e-commerce security with block chain	This paper investigates how block chain can boost security in e-commerce.	The study conducts a systematic review of current literature.	Blockchain is proven to enhance security measures in e-commerce transactions.	The review is confined to existing literature and does not include new empirical research.
15	Blockchain as a solution to e-commerce fraud	This paper explores the potential of block chain in diminishing fraud in e-commerce.	It utilizes a qualitative research method, including interviews and literature reviews.	Blockchain can efficiently lessen various types of e-commerce fraud.	The study is confined to theoretical discussions and expert opinions.
16	Comparative study of block chain e-commerce platforms	This paper compares various block chain e-commerce platforms to highlight best practices.	Comparative analysis techniques are employed in the study.	Significant differences in efficiency and security are found across platforms.	The study is confined to available data and does not cover proprietary platforms.
17	Blockchain in e-commerce: A comprehensive review	This paper provides an extensive review of block chain applications in e-commerce.	A wide range of literature on the topic is reviewed in the study.	The paper emphasizes the potential and challenges of block chain in e-commerce.	The review is broad but lacks depth in specific areas.
18	The economic impact of block chain on e-commerce	This paper examines the economic consequences of adopting block chain in e-commerce.	Economic modelling is used to forecast the impact.	The adoption of block chain is anticipated to lower costs and enhance economic efficiency in e-commerce.	The models are theoretical and may not fully capture real-world complexities.
19	User perceptions of block chain in e-commerce	This paper investigates user perceptions of block chain technology in e-commerce.	Surveys and interviews are conducted to gather data.	Users generally view block chain as boosting security and trust in e-commerce.	The study is confined to user perceptions and does not include technical evaluation.

20	The role of smart contracts in blockchain-based e-commerce	This paper explores the utility of smart contracts in block chain e-commerce platforms.	Case studies are utilized to exemplify the application of smart contracts.	Smart contracts can automate and secure e-commerce transactions.	The study is limited to specific use cases and does not explore broader applications

2.3 Challenges and Gaps

Despite the potential benefits of blockchain and related technologies, existing literature identifies several challenges and gaps in implementing comprehensive solutions tailored for ecommerce ecosystems. These include:

2.3.1 High Transaction Costs

Traditional ecommerce platforms often impose high commission fees, ranging from 15% to 30% of revenue, on sellers. These fees significantly impact profitability, particularly for small and medium-sized enterprises (SMEs), and discourage their participation in online marketplaces.

2.3.2 Data Security and Privacy

Centralized storage of sensitive data in ecommerce platforms poses risks of breaches and unauthorized access. Blockchain offers a decentralized alternative that enhances data security through encryption and distributed ledger technology, thereby mitigating these risks.

2.3.3 Integration of Block chain and IPFS

There is a notable gap in integrating blockchain with technologies like InterPlanetary File System (IPFS) for efficient and secure data storage in ecommerce. IPFS provides a decentralized storage solution that complements blockchain's transparency and immutability, yet practical implementations in ecommerce are still emerging.

Advanced Reputation Systems: Existing reputation systems on ecommerce platforms often struggle with authenticity and reliability. Blockchain-based reputation systems can incentivize genuine user feedback and mitigate issues such as fake reviews and unfair ratings, thereby enhancing trust and credibility in online transactions.

3. System Architecture

The e-commerce platform's system design integrates various components to ensure a seamless, secure, and efficient user experience. In Figure 1, we detail the system architecture, outlining each component and its role within the overall design.

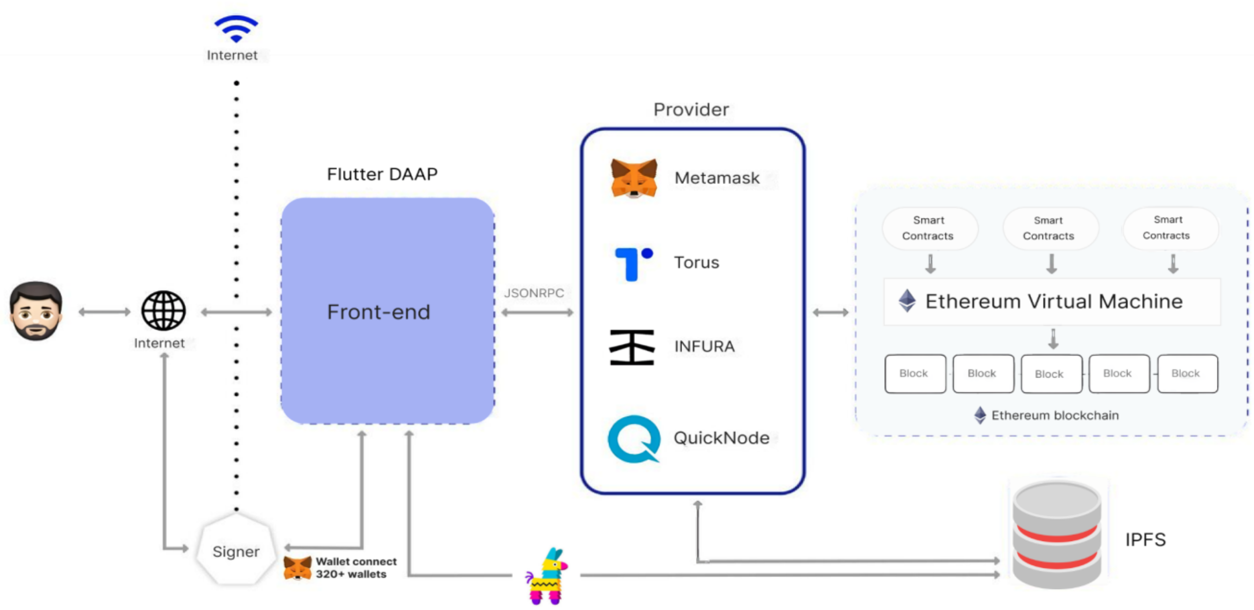


Figure 1 System Architecture of Block Buy

3.1.1 Block chain (Ethereum)

Role: Decentralized Ledger; Function: Ethereum serves as the foundational layer for the platform, ensuring all transactions are secure, transparent, and immutable. It supports smart contract execution, enabling automated and trustless transactions.

3.2 Infura

Role: Blockchain Gateway; Function: Infura provides reliable and scalable access to the Ethereum block chain without requiring users to run their own nodes. It handles the communication between the platform and the Ethereum network, facilitating transactions and smart contract interactions.

3.3 Smart Contracts

Role: Automated Contract Execution; Function: Smart contracts on Ethereum automate the execution of agreements between parties. They enforce the terms and conditions coded into them, reducing the need for intermediaries and enhancing trust.

3.4 Escrow Smart Contract

Role: Transaction Security; Function: The escrow smart contract holds funds in trust until the predefined conditions of a transaction are met. This ensures both buyers and sellers fulfill their obligations before funds are released, adding a layer of security to the platform.

3.5 Flutter Pinata (IPFS Provider)

Role: Decentralized Storage; Function: Flutter Pinata interfaces with the IPFS network to handle file storage and retrieval. This ensures that all data, such as product information and transaction records, is stored in a decentralized manner, enhancing data integrity and accessibility.

3.6 Wallet Connect (Crypto Wallet Service Provider)

Role: User Wallet Integration; Function: WalletConnect allows users to connect their crypto wallets to the platform seamlessly. Supporting over 320 wallets, it ensures users can manage their crypto assets and authenticate securely using their preferred wallet.

3.7 Sign in by Crypto Wallet

Role: Secure User Authentication; Function: Users authenticate their identity using their crypto wallets, leveraging cryptographic methods for secure and decentralized login. This reduces the risk of identity theft and enhances user security.

3.8 Hardhat

Role: Development and Testing Environment; Function: Hardhat provides tools for compiling, deploying, testing, and debugging smart contracts. It ensures that contracts are thoroughly tested and function correctly before being deployed to the Ethereum network.

3.9 Truffle

Role: Smart Contract Lifecycle Management; Function: Truffle offers a comprehensive framework for managing the development lifecycle of smart contracts. It simplifies tasks such as contract compilation, migration, and network management, facilitating efficient development and deployment processes.

4. Workflow

The Below diagram illustrates the sequence of actions involved in a decentralized e-commerce transaction process using various technologies like blockchain, IPFS (InterPlanetary File System), and smart contracts. Here's an explanation of each step:

4.1 User Interaction with BlockBuy App:

- The user launches the BlockBuy app.
- The app displays a "Connect Wallet" option.
- The user selects "Connect Wallet" and chooses their preferred wallet from a list of supported wallets.
- The app redirects the user to their wallet for authentication.
- Upon granting permission, a secure session is established between the app and the wallet, and the user is logged in.

4.2 Seller Adds New Product:

- The seller adds a new product by providing details and uploading description files and images.
- The BlockBuy app prompts the seller to upload files.
- The uploaded files are sent to IPFS for storage, which generates unique hashes for the content.
- If the hash already exists, the product is recognized as existing; otherwise, the files are saved across IPFS nodes, and the file hashes are returned to the app.

4.3 Transaction Creation and Recording

- The BlockBuy app creates a transaction with the IPFS hash and other details.
- The transaction is recorded on the blockchain.
- The user is redirected to sign the transaction using their wallet.
- The user signs the transaction, and it is sent to the blockchain for execution.
- The blockchain executes smart contracts, verifies the transaction, and adds it to the ledger.

4.4 Product Listing Notification

- The BlockBuy app notifies the seller of the successful listing of the product.

4.5 User Interaction with Products

- The user browses products on the app, which fetches product listings from the blockchain.
- Product details and images are fetched from IPFS and displayed to the user.
- The user interacts with the products and decides to buy a specific product.

4.6 Purchase Process Initiation

- The user confirms the purchase, initiating the purchase process.
- The BlockBuy app creates a transaction, which is signed by the user's wallet and sent to the blockchain.

4.7 Escrow Setup and Product Dispatch

- The blockchain sets up an escrow for the purchase.
- The app notifies the seller to dispatch the product.
- The seller acknowledges the notification and dispatches the product.

4.8 Product Delivery Confirmation or Rejection

- waits for product delivery and confirms or rejects it upon receipt.

4.9 Funds Release or Refund

- As shown in Figure 2, If the user confirms the delivery, the funds are released from escrow to the seller, completing the transaction.
- If the user rejects the delivery, refunds are released from escrow to the buyer.
- This sequence diagram demonstrates how decentralized technologies facilitate trustless e-commerce transactions by ensuring transparency, security, and fair dispute resolution.

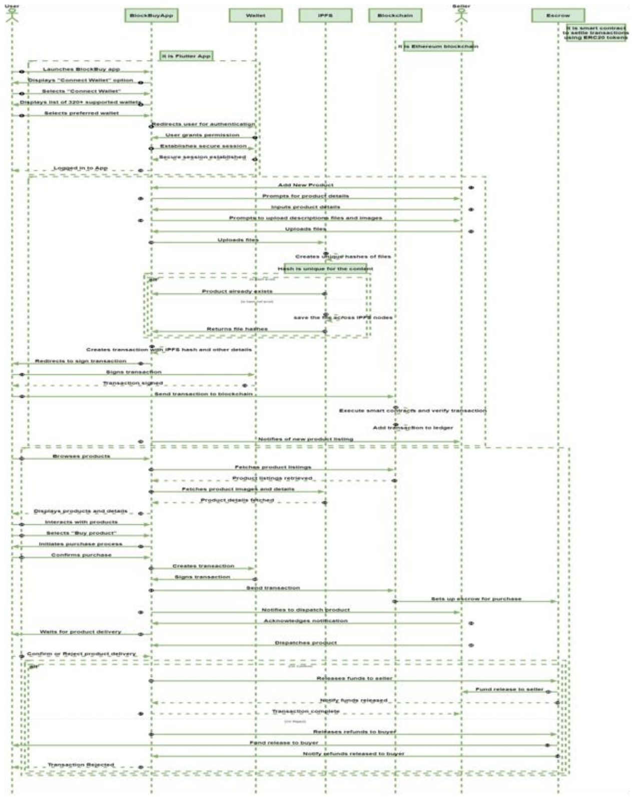


Figure 2 Sequence Diagram of Block Buy

5. Methodology

5.1 Blockchain (Ethereum)

System Design: Ethereum serves as the foundational layer for the e-commerce platform, offering a decentralized ledger for secure and transparent transaction processing. It supports smart contracts that automate business logic and enforce agreements without intermediaries. Implementation Approach: To integrate Ethereum:

Setup: Configure Ethereum accounts using MetaMask and connect to the network via Infura for reliable API access.

Development: Write smart contracts in Solidity and utilize frameworks like Hardhat or Truffle for compiling, testing, and deploying contracts.

Deployment: Test contracts on Ethereum's test networks (e.g., Ropsten) before deploying them to the mainnet.

Monitoring: Use tools like Etherscan for real-time monitoring of transactions and contract interactions.

5.2 Infura

System Design: As shown in Figure 3, Infura acts as a gateway to the Ethereum blockchain, providing scalable and reliable access without requiring developers to run their own nodes. It facilitates seamless communication between the platform and Ethereum, ensuring robust transaction handling. Implementation Approach:

Setup: Create an Infura account, obtain project credentials, and configure the application to interact securely with Infura's API endpoints.

Integration: Implement Infura's API into the platform for blockchain connectivity, ensuring data security and integrity.

Testing: Validate API connectivity through Ethereum's test networks to ensure reliable operation before deployment.

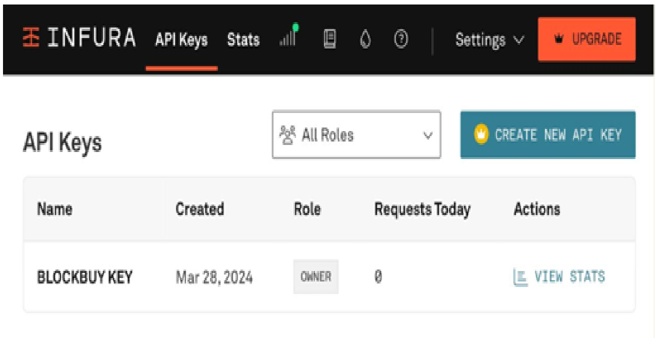


Figure 3 **Infura Endpoint**

5.3 Smart Contracts

System Design: Smart contracts on Ethereum automate transaction execution based on predefined rules, enhancing transparency and efficiency in business operations. Implementation Approach:

Development: Define contract logic in Solidity, ensuring contracts reflect business requirements and comply with security best practices.

Testing: Use development frameworks like Hardhat or Truffle for unit testing and simulate contract interactions in a local blockchain environment.

Security: Conduct security audits using tools like MythX to identify and mitigate potential vulnerabilities before deployment.

Deployment: Deploy audited contracts sequentially on testnets and mainnet to ensure functionality and reliability.

5.4 Escrow Smart Contract

System Design: The escrow smart contract securely holds funds until predefined conditions of a transaction are met, ensuring trust between transacting parties. Implementation Approach:

Design: Define escrow conditions and integrate the contract with payment workflows to handle funds securely.

Testing: Conduct end-to-end tests to verify the contract's functionality under various transaction scenarios.

Deployment: Deploy the escrow contract on testnets and mainnet, ensuring smooth integration and reliable operation in real-world transactions.

5.5 Flutter

System Design: As shown in figure 4, Flutter provides a robust framework for building cross-platform mobile applications, ensuring a consistent user experience across iOS and Android devices. Implementation Approach:

Setup: Install Flutter SDK and set up development environments for iOS and Android.

Development: Use Flutter's widget-based architecture to create intuitive user interfaces and interactive components for the e-commerce platform.

Integration: Integrate Flutter with backend services, including blockchain transactions and API interactions, to provide real-time updates and seamless user interactions.

Testing: Conduct comprehensive testing across different device emulators and real devices to ensure compatibility and performance.

Deployment: Publish Flutter applications to Google Play Store and Apple App Store, ensuring accessibility to a wide range of users.

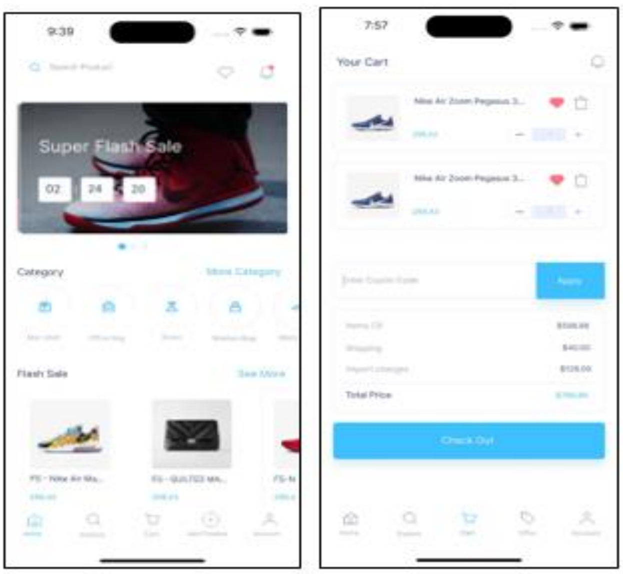


Figure 4 **Flutter App UI**

5.6 Pinata (IPFS Provider)

System Design: As shown in Figure 5, Flutter Pinata integrates with IPFS, a decentralized storage solution, to store and retrieve data such as product information and transaction records securely. Implementation Approach:

Setup: Obtain API keys from Pinata and configure them for use in the platform's file management system.

Integration: Implement Pinata APIs to handle file uploads and retrievals, ensuring data integrity and availability.

Testing: Validate file operations by uploading and retrieving test files on IPFS to ensure seamless integration and reliable data handling.

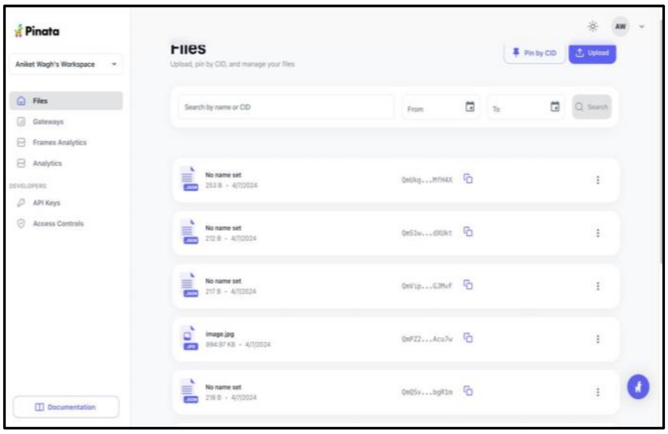


Figure 5 Pinata Dashboard

5.7 Wallet Connect (Crypto Wallet Service Provider)

System Design: As shown in Figure 6, Wallet Connect enables users to connect their crypto wallets to the platform securely, supporting a wide range of wallets for asset management and transaction signing. Implementation Approach:

Integration: Integrate Wallet Connect SDK to facilitate wallet connections and transaction signing within the platform.

Testing: Validate wallet connectivity with various supported wallets to ensure compatibility and seamless user experience.

Deployment: Ensure robust implementation of Wallet Connect to enhance user accessibility and security in managing crypto assets.

Figure 6 320+ Wallet Connectivity

5.8 Sign in by Crypto Wallet

System Design: Users authenticate securely using their crypto wallets, leveraging cryptographic methods for decentralized login and reducing reliance on traditional passwords. Implementation Approach:

Implementation: Integrate wallet-based authentication flows into the platform, enabling secure sign-in processes for users.

Testing: Conduct usability tests to ensure intuitive user experience during wallet sign-in and validate security measures.

Deployment: Deploy wallet-based authentication to enhance platform security and user convenience in accessing services.

5.9 Hardhat

System Design: Hardhat provides a development environment for Ethereum smart contracts, offering tools for compiling, testing, and deploying contracts efficiently. Implementation Approach:

Setup: Install and configure Hardhat for the project's development and deployment needs.

Development: Utilize Hardhat for local blockchain simulation and contract development, ensuring code efficiency and reliability.

Testing: Test contracts comprehensively using Hardhat's built-in testing framework to verify functionality and performance.

Deployment: Deploy contracts to Ethereum's test networks and mainnet using Hardhat, ensuring seamless integration and operational readiness.

5.10 Truffle

System Design: Truffle simplifies the development lifecycle of Ethereum smart contracts, providing tools for compilation, migration, and network management. Implementation Approach:

Setup: Install and configure Truffle to streamline contract development and deployment processes.

Development: Use Truffle for writing and managing smart contracts, optimizing development workflows for efficiency.

Testing: Test contracts using Truffle's testing framework to ensure contract functionality and performance meet business requirements.

Deployment: Deploy contracts to Ethereum's test networks and mainnet using Truffle migrations, ensuring smooth deployment and operational readiness.

6. Results and Discussion

6.1 Deployment of Smart Contracts

We evaluated the deployment costs for three specific smart contracts: Store, Escrow, and Block Buy Token. The costs associated with these functionalities are shown in Table 2.

Table 2 Smart Contract Deployment Cost

Smart contracts	Gas	Cost (ETH)	Cost (USD)
Store Contract	25,63,149	0.00395811	$13.64
Escrow Contract	114,9,045	0.00175976	$6.8
BlockBuy Token Contract	40,66,851	0.00623235	$21.50

In deploying smart contracts on Ethereum, we focused on three core functionalities: product listing, transaction execution, and escrow services. The costs associated with these functionalities are shown in Figure 3

Table 3 Frequent Operations Cost

Function	Gas	Cost (ETH)	Cost (USD)
Add Product	2,19,670	0.00037712	$1.30
Buy Product	1,35,181	0.00023235	$0.8

6.2 Storage Costs on IPFS

We evaluated the costs of storing data on IPFS, considering product images and transaction logs. The monthly costs are shown in Figure 4.

Table 4 IPFS Storage Cost

Function	IPFS Storage (GB)	Cost (per GB)	Cost (USD)
Product Images	5	0.25	$1
Transaction Logs	1	0.25	$1

6.3 Integration with Wallet Connect:

Wallet Connect was integrated to enable secure user authentication without requiring users to input their private keys directly. This feature supports over 320 wallets, enhancing user convenience and security.

6.4 Comparison of Ethereum with Other Block Chain Platforms:

To provide a comprehensive analysis, In table 5 We compared Ethereum with two other leading block chain platforms, EOS and Tron, focusing on transaction costs, scalability, and security.

Table 5 Block Chain's Comparisons

Block-chain Platform	**Strengths**	**Weaknesses**
Ethereum	Robust ecosystem and developer support. Established security and reliability	Higher transaction costs compared to EOS and Tron. Scalability challenges during high network congestion
EOS	Lower transaction costs and faster transaction speeds Scalability for high-throughput applications	Less mature ecosystem and developer support Security concerns due to delegated proof-of-stake consensus
Tron	Low transaction costs and high scalability Fast transaction processing	Centralized governance structure Limited adoption and developer community

6.5 Ethereum's Superior Capabilities

6.5.1 Security and Reliability

Ethereum: Known for its rigorous security measures, Ethereum provides a reliable platform for smart contracts, ensuring robust protection against vulnerabilities and malicious attacks. EOS and Tron: While offering faster transaction speeds, these platforms have faced criticism regarding their security protocols, making them less suitable for applications requiring high security.

6.5.2 Cost Efficiency

Ethereum: Despite higher gas fees, Ethereum's transparent fee structure allows for predictable and manageable costs. This predictability is crucial for planning and budgeting in long-term projects. EOS and Tron: Both platforms offer lower transaction fees, making them attractive for high-frequency transaction applications. However, the savings may come at the expense of security and ecosystem maturity.

6.5.3 Scalability and Speed

Ethereum: Ethereum is working towards improving scalability with solutions like Ethereum 2.0. Current scalability issues are balanced by its established ecosystem and support infrastructure. EOS and Tron: These platforms provide superior transaction speeds and scalability, making them suitable for applications with high throughput requirements. However, the trade-offs include potential security concerns and less developer support.

6.6 Use of IPFS for Decentralized Storage

Integrating IPFS with Ethereum enhances data integrity and scalability, offering a cost-effective solution for decentralized storage. IPFS's decentralized nature ensures:

6.6.1 Immutable Data Storage

Cryptographic hashes in IPFS provide tamper-proof storage, enhancing trust and security in e-commerce transactions.

6.6.2 Cost-Effective Scalability

IPFS's peer-to-peer network efficiently handles large volumes of data, making it a scalable solution compared to traditional on-chain storage or centralized databases.

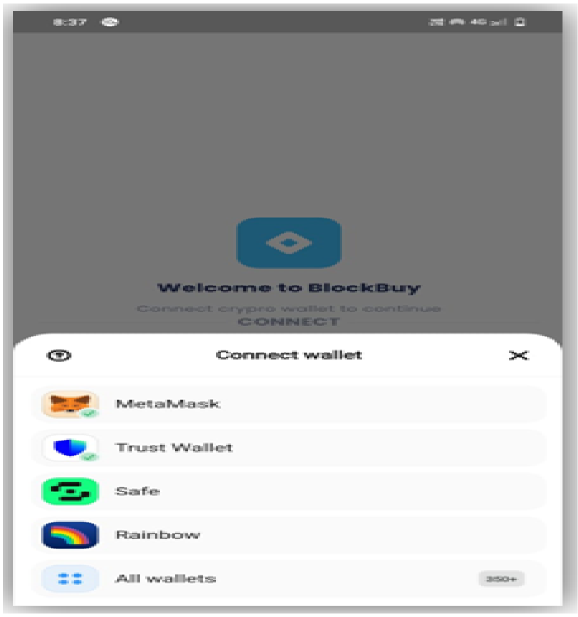
6.7 Flutter as Frontend

User Experience: Flutter provides a seamless and responsive user interface, enhancing the overall user experience for the e-commerce platform. Cross-Platform Compatibility: Flutter allows the development of applications that run smoothly on both iOS and Android, broadening the platform's accessibility.

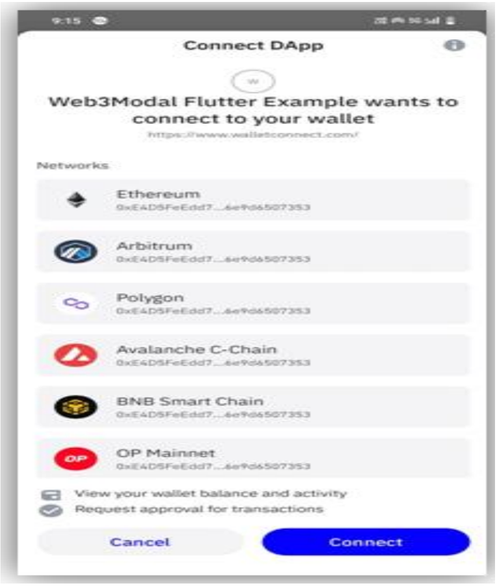
6.8 Wallet Connect for Secure Login

User Convenience: Wallet Connect supports over 320 wallets, enabling users to connect their preferred crypto wallets without needing to input private keys manually. Enhanced Security: By leveraging cryptographic methods for authentication, Wallet Connect ensures a secure and decentralized login process, reducing the risk of identity theft. UI Screens are shown in Figure 7.

(a)

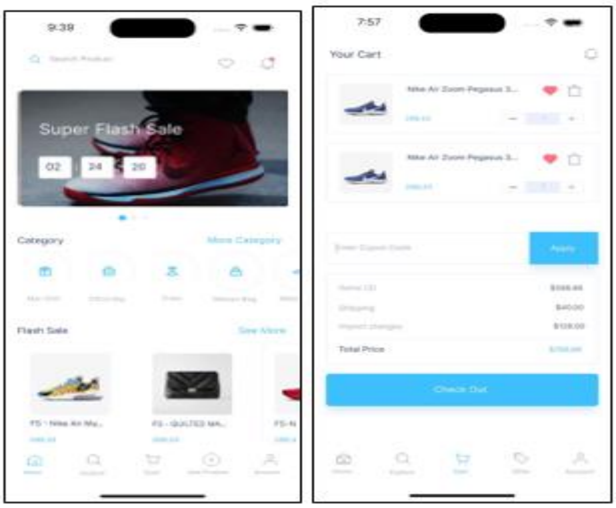


(b)



(c)

(d)



(e)

Figure 7 (a), (b), (c), (d), (e) UI Screens

Conclusion

In conclusion, this project report has detailed the development and implementation of a decentralized e-commerce platform utilizing Ethereum block chain technology. The integration of block chain ensures secure, transparent, and immutable transactions, fostering trust between buyers and sellers. Through the use of smart contracts, the platform automates business logic, reducing the need for intermediaries and enhancing efficiency. Infura has been instrumental as a gateway, providing scalable access to the Ethereum network without the complexity of running personal nodes. Flutter facilitated the development of a seamless, cross-platform user interface, ensuring a consistent user experience across different devices. Pinata's integration with IPFS offers a decentralized storage solution, enhancing data integrity and accessibility. Wallet Connect has enabled secure crypto wallet integrations, streamlining user authentication and transaction management. The use of Hardhat and Truffle has provided robust environments for developing, testing, and deploying smart contracts, ensuring they are secure and functional. Overall, this project demonstrates the potential of block chain technology in revolutionizing e-commerce by providing a secure, efficient, and user-friendly platform. The methodologies and technologies employed have laid a solid foundation for future enhancements and scalability, promising a transformative impact on how online transactions are conducted. This decentralized approach not only improves security and transparency but also paves the way for innovative business models and enhanced user trust.

Future Scope

- Enhanced Scalability: With the upcoming Ethereum 2.0 upgrade, further improvements in transaction throughput and reduced gas fees are anticipated, making Ethereum even more scalable and cost-effective for large-scale applications.
- Cross-Chain Interoperability: Exploring interoperability with other block chain networks can provide additional flexibility and reduce dependency on a single platform, enhancing the overall robustness of the e-commerce solution.

Acknowledgements

I would like to express my sincere gratitude to my project guid Mrs. Dipika Paranjape, for their invaluable guidance and support throughout the development of this research. I also thank my peers for their constructive feedback and collaboration. Lastly, I extend my appreciation to the CSE-AI department for providing the necessary resources and a conducive research environment.

References

[1]. Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system.

[2]. Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). An overview of blockchain technology: Architecture, consensus, and future trends. In 2017 IEEE International Congress on Big Data (BigData Congress) (pp. 557-564). IEEE.

[3]. Reyna, A., Martín, C., Chen, J., Soler, E., & Díaz, M. (2018). On blockchain and its integration with IoT. Challenges and opportunities. Future Generation Computer Systems, 88, 173-190.

[4]. Kshetri, N. (2018). Blockchain's roles in meeting key supply chain management objectives. International Journal of Information Management, 39, 80-89.

[5]. Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology: Beyond bitcoin. Applied Innovation, 2(6-10), 71.

[6]. Wang, Y., Han, J., & Beynon-Davies, P. (2019). Understanding blockchain technology for future supply chains: A systematic literature review and research agenda. Supply Chain Management: An International Journal, 24(1), 62-84.

[7]. Catalini, C., & Gans, J. S. (2016). Some simple economics of the blockchain (No. w22952). National Bureau of Economic Research.

[8]. Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2018). Blockchain challenges and opportunities: A survey. International Journal of Web and Grid Services, 14(1), 352-375.

[9]. Viriyasitavat, W., Da Xu, L., Bi, Z., & Sapsomboon, A. (2018). Blockchain-based business process management (BPM) framework for service composition in industry 4.0. Journal of Intelligent Manufacturing, 29(2), 391-410.

[10]. Conoscenti, M., Vetro, A., & De Martin, J. C. (2017). Blockchain for the Internet of Things: A systematic literature review. In 2016 IEEE/ACS 13th International Conference of Computer Systems and Applications (AICCSA) (pp. 1-6). IEEE.

[11]. Swan, M. (2015). Blockchain: Blueprint for a new economy. O'Reilly Media, Inc.

[12]. Shrier, D., Wu, W., & Pentland, A. (2016). Blockchain and transaction privacy: A framework for privacy-preserving smart contracts. MIT Connection Science.

[13]. Xu, X., Weber, I., & Staples, M. (2019). Architecture for blockchain applications. Springer.

[14]. Beck, R., Müller-Bloch, C., & King, J. L. (2018). Governance in the blockchain economy: A framework and research agenda. Journal of the Association for Information Systems, 19(10), 1.

[15]. Tapscott, D., & Tapscott, A. (2016). Blockchain revolution: How the technology behind bitcoin is changing money, business, and the world. Penguin.

[16]. Banerjee, A., & Sangma, M. (2019). An overview of blockchain applications in the Internet of Things. In 2019 IEEE 9th Annual Computing and Communication Workshop and Conference (CCWC) (pp. 0721-0725). IEEE.

[17]. Christidis, K., & Devetsikiotis, M. (2016). Blockchains and smart contracts for the Internet of Things. IEEE Access, 4, 2292-2303.

[18]. Wang, S., Ouyang, L., Yuan, Y., Ni, X., Han, X., & Wang, F. Y. (2019). Blockchain-enabled smart contracts: Architecture, applications, and future trends. IEEE Transactions on Systems, Man, and Cybernetics: Systems, 49(11), 2266-2277.

[19]. Xu, X., Pautasso, C., Zhu, L., Gramoli, V., Ponomarev, A., Chen, S., & Chen, W. (2016). The blockchain as a software connector. In 2016 13th Working IEEE/IFIP Conference on Software Architecture (WICSA) (pp. 182-191). IEEE.