Group Number: 7

Students name: Hirva Patel, Harshit Kumar, Kuncham Padma Priyanka, Vineetha Mallu.

TITLE: BLOCKCHAIN BASED SOCIAL MEDIA WITHOUT BOTS AND GAS FEES

Problem Definition:

The current issue in the realm of social media platforms revolves around centralized control, leading to problems such as the proliferation of bots, dissemination of fake news, and privacy concerns. Traditional social media platforms are owned and managed by single entities, creating vulnerabilities to cyberattacks, data breaches, and censorship. Bots and spam attacks manipulate content and engagement metrics, distorting the genuine user experience. Additionally, these platforms impose transaction fees or "gas fees," limiting access for economically disadvantaged users and hindering their ability to participate fully.

Motivation:

Addressing these challenges is crucial for several reasons:

1. Security and Privacy: A decentralized social media platform eliminates central points of failure, enhancing security and safeguarding user data against breaches and cyber threats. Privacy is preserved as users have greater control over their personal information.

2. Authenticity and Trust: Bots and fake accounts erode trust in online interactions. Implementing technologies like smart contracts and decentralized identity systems ensures genuine user participation, fostering authenticity and trust within the community.

3. Financial Inclusivity: By eliminating gas fees, the platform becomes financially accessible to users from diverse economic backgrounds. Economic inclusivity empowers a broader user base, promoting diverse perspectives and experiences.

4. Fostering Transparency: Transparent blockchain technology ensures an open and verifiable platform. Users can trust the authenticity of the content and interactions, leading to a more credible online environment.

5. Addressing Societal Concerns: The spread of fake news and misinformation on centralized platforms impacts public opinion and trust. A decentralized platform mitigates these concerns by offering transparent, trustworthy information.

6. Promoting Free Expression: A platform free from centralized control and censorship encourages users to express their opinions and ideas without fear of suppression. It supports the fundamental principles of free speech.

7. Environmental Sustainability: The energy efficiency of blockchain technology aligns with environmental concerns. By reducing the need for extensive computational resources, a blockchain-based platform contributes to a more sustainable digital ecosystem.

8. Global Relevance: Inclusivity and authenticity cater to diverse demographics, ensuring that users worldwide, regardless of economic status or geographical location, can participate meaningfully in social discourse.
In summary, resolving these issues is essential for creating a social media platform that prioritizes security, authenticity, inclusivity, transparency, and freedom of expression, ensuring a positive and enriching online experience for users across the globe.

Why Blockchain?

Blockchain technology offers several key advantages that align with the proposed social media platform's goals and requirements:

1. Decentralization: Traditional social media platforms are centralized, meaning that user data is stored on central servers controlled by the platform. This centralization can lead to issues such as data breaches and misuse of personal information. Blockchain, being decentralized, ensures that user data is stored across a network of nodes, eliminating a single point of failure and significantly enhancing security.

2. Security: Blockchain employs cryptographic techniques to secure transactions and data. Once information is added to the blockchain, it becomes nearly impossible to alter or delete it without consensus from the network participants. This immutability ensures the integrity of the content shared on the platform, fostering trust among users.

3. Transparency: Every transaction and data entry on the blockchain is publicly recorded and verifiable. In the context of social media, this transparency ensures that users can trust the authenticity of the content they encounter. With a transparent system, users can easily trace the source of information, promoting credibility and reducing the spread of misinformation.

4.Eliminating Bots and Ensuring Authenticity: By implementing zero-knowledge identity and proof-of-personhood systems, the platform can guarantee that users are real individuals, not automated bots. This ensures that interactions on the platform are genuine and eliminates spam, fostering a more authentic community experience.

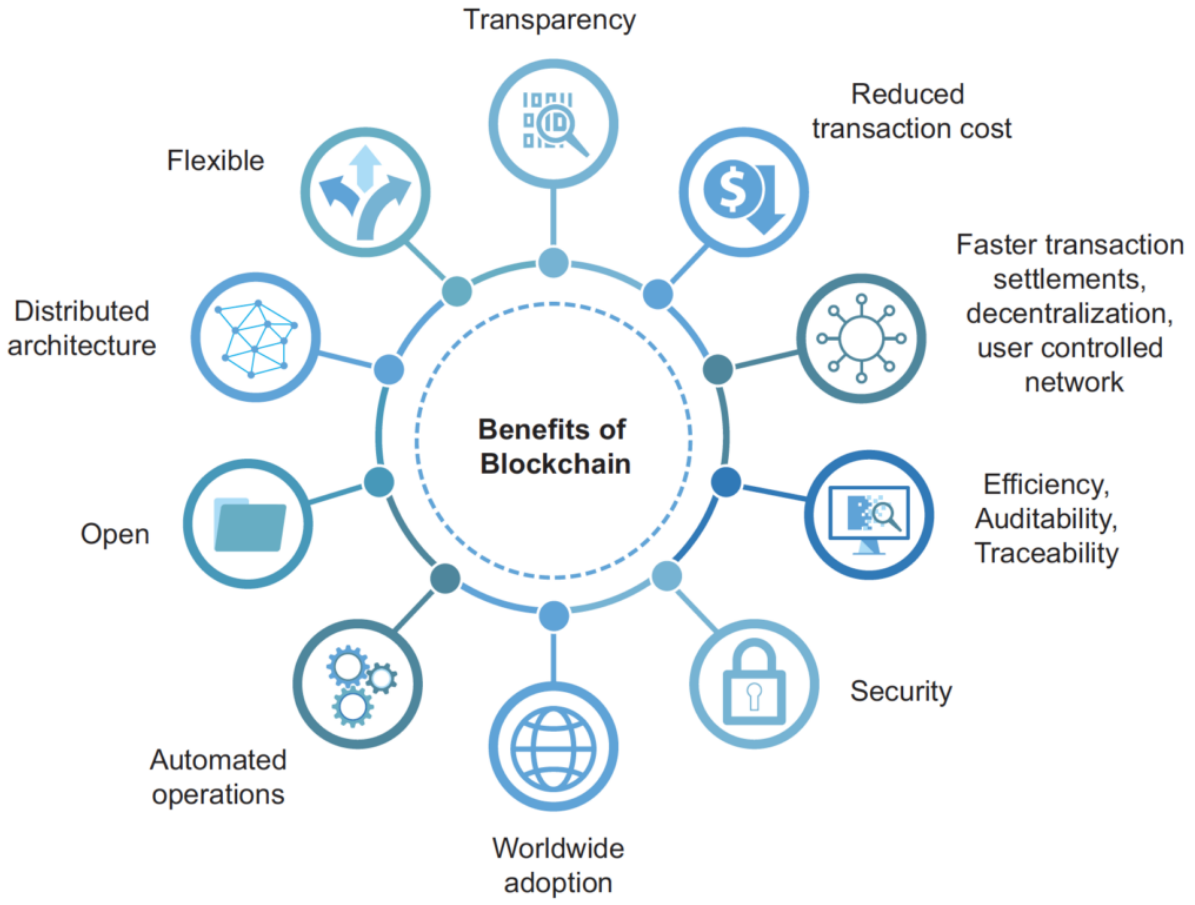
5. Reduced Transaction Costs: Traditional blockchain networks like Ethereum often incur gas fees, making microtransactions impractical. However, by utilizing solutions like the Polygon Mumbai Blockchain, the platform can drastically reduce these fees, making transactions affordable and accessible for all users.

6. Ownership and Control: Through the use of NFTs and decentralized social graph protocols, users gain complete ownership and control over their content. Each post being

minted as an NFT ensures that users can prove ownership and transfer their content securely between platforms. This approach empowers users, fostering a sense of ownership and control over their online presence.

7. Smart Contracts for Token Gating: Smart contracts enable the implementation of token gating functionalities, allowing content creators to monetize their work directly. By controlling access through these contracts, producers can ensure that consumers pay a fair price for their content, enabling a sustainable ecosystem for creators.

In summary, blockchain technology offers the necessary infrastructure to build a secure, transparent, and user-controlled social media platform. Through its decentralized nature, cryptographic security, transparency, and innovative features like NFTs and smart contracts, blockchain provides the foundation to create a social media environment free from centralized control, high fees, and malicious actors like bots.



Literature Survey:

The existing research papers reveal the growing interest in utilizing blockchain technology to address the challenges faced by traditional social media platforms and online identity verification systems. Here's a summary of the findings from the literature survey and their relevance to the proposed project:

Research Paper-1 Title: Incentivized Blockchain-based Social Media Platforms: A Case Study of Steemit Publication-WebSci '19: Proceedings of the10th ACM Conference on WebScience, June 2019, pages145-154 Authors-Chao Li, Balaji Palanisamy

The study on incentivized blockchain-based social media platforms, such as Steemit, sheds light on the innovative ways blockchain can reshape social interactions. These platforms introduce a decentralized reward system, promoting high-quality content creation and user engagement. However, the shortcomings highlighted, such as bot networks and centralization concerns, emphasize the need for a more robust and secure solution.

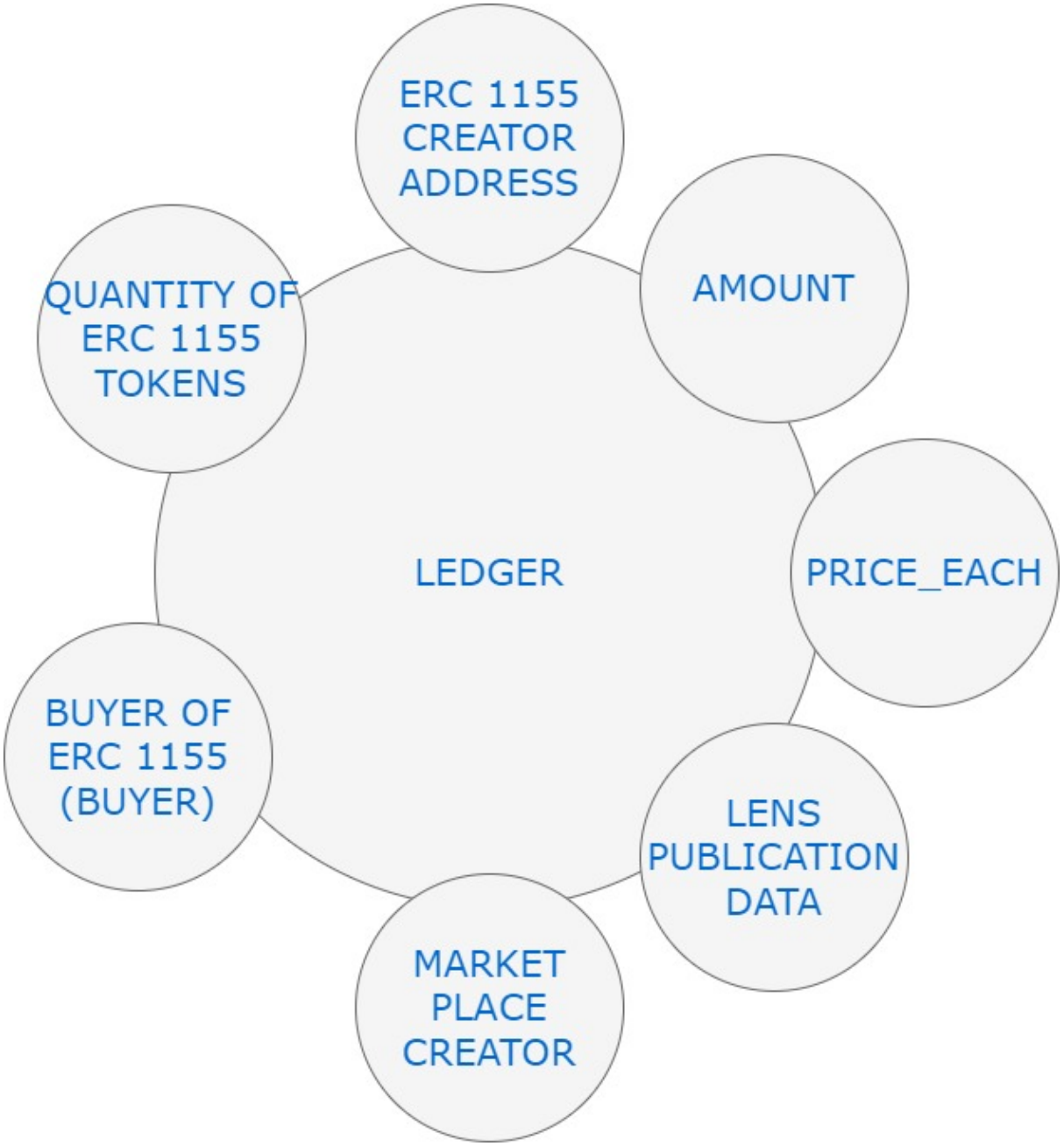
Research Paper: 2 Title: Blockchain-Based Identity Verification System. Publications: 2019, IEEE 9th International Conference on System engineering and technology,7th october 2019. Author: Arshad Jamal, Rabab Alayham Abbas Helmi, Mariam-Aisha Fatima and Ampuan Siti Nurin Syahirah

The research paper on a blockchain-based identity verification system presents a novel approach to secure and efficient identity verification. By utilizing blockchain and cryptographic techniques, the proposed system addresses the challenges of fraud and inefficiency in traditional identity verification methods. However, the concerns about Ethereum gas fees and storing sensitive user data on a public blockchain underscore the importance of addressing these issues in the proposed project.

Research Paper-3 Title: A Review of Blockchain for Security Data Privacy with Metaverse Publication:2022 International Confrences on ICT for Smart Society (ICISS) Author: Safriadi M Yunus Aks, Mila Karmila, Bryan Givan Et al

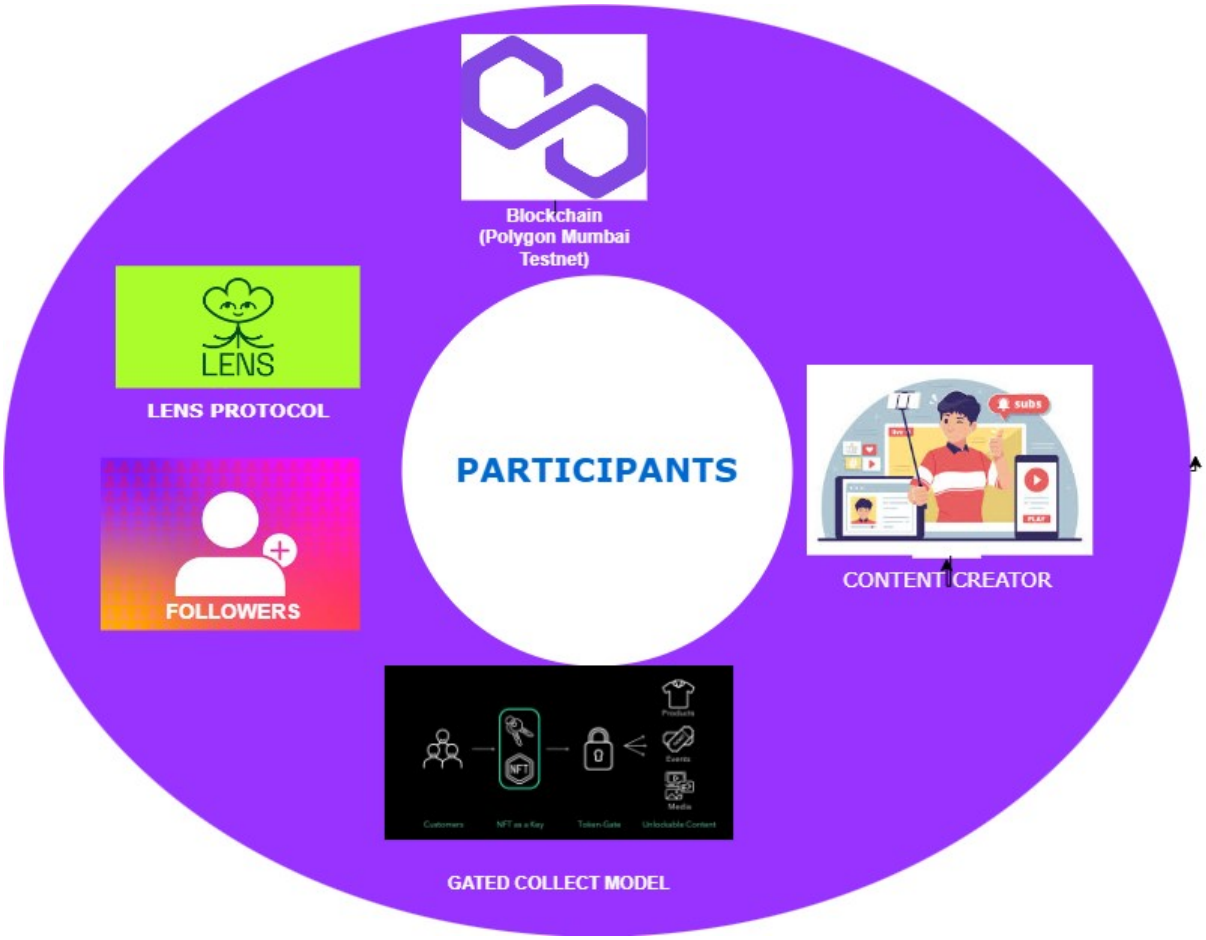
The study focusing on the application of blockchain in the Metaverse highlights the critical security and privacy concerns within virtual reality environments. The paper explores the potential of blockchain technology in creating a secure and private Metaverse ecosystem. Challenges related to blockchain scalability and interoperability are acknowledged, emphasizing the need for comprehensive research and multidisciplinary collaboration.

LEDGER:



- User Profiles: Including user information, content creation history, and ownership details.
- Content Ownership: Records indicating which user owns specific content, stored as NFTs.
- Transaction History: Details of all transactions, including purchases, likes, shares, and comments.

Participants in Blockchain



Content Creators: Users who create and post content on the social media platform.

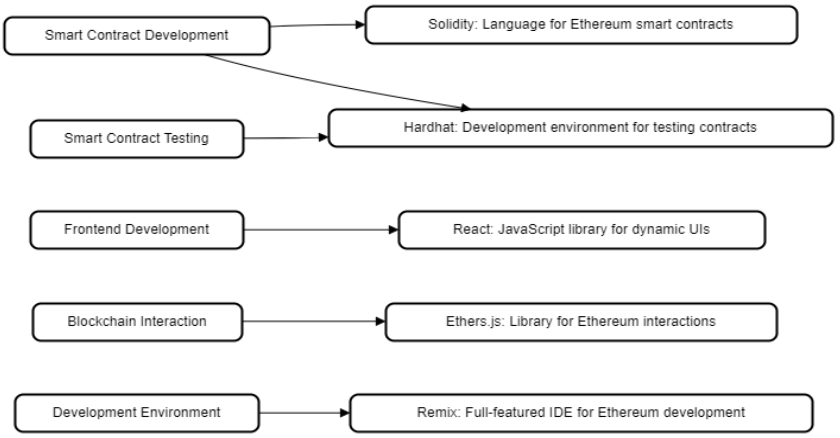
Consumers/Followers: Users who view, interact, and engage with the content posted by content creators.

Blockchain (Polygon Mumbai Testnet): The underlying blockchain network used for the social media platform, providing secure and gasless transactions.

Lens Protocol: A decentralized social graph protocol ensuring users' data ownership and control. Posts are minted as NFTs stored in users' wallets.

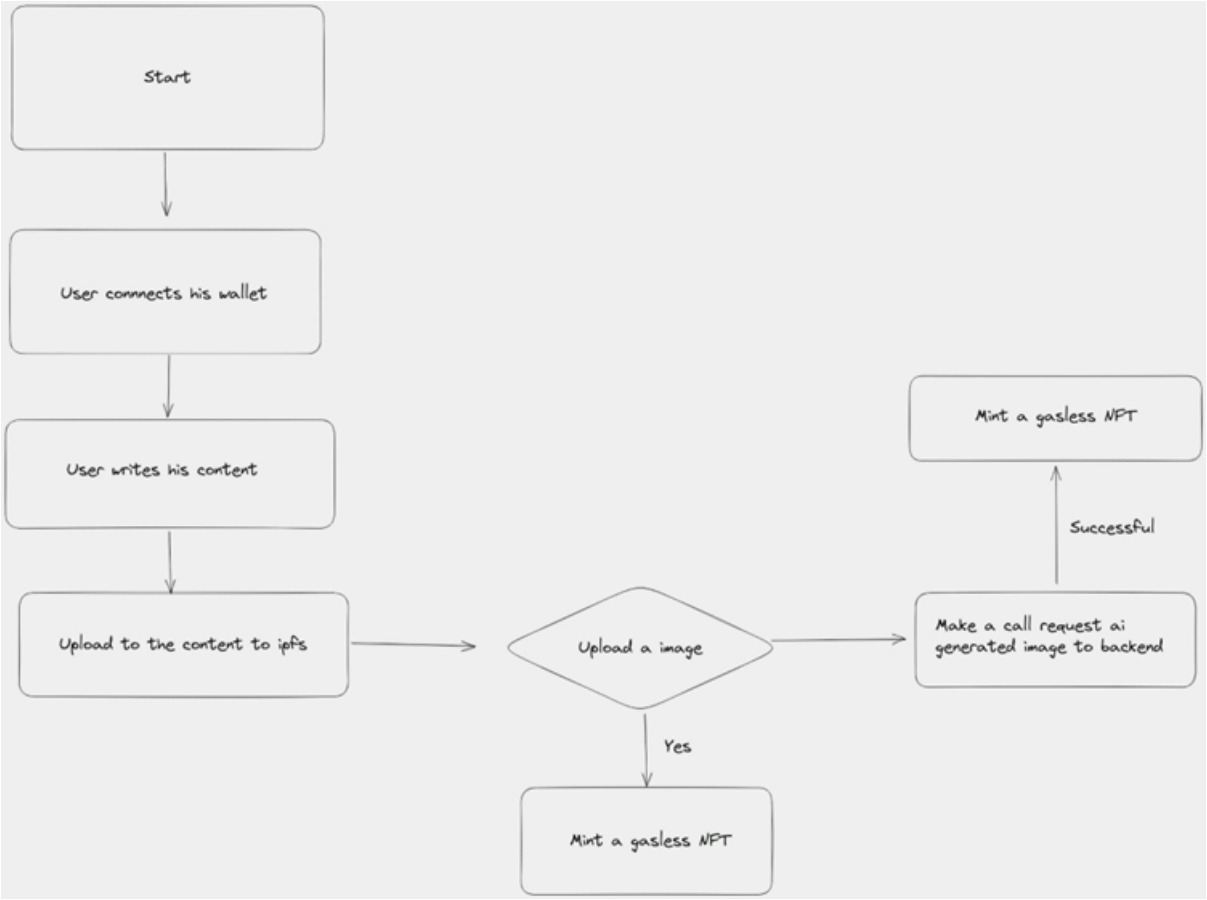
Gated Collect Model: Functionality enabling content creators to control access to their content, ensuring consumers pay a fair price for access

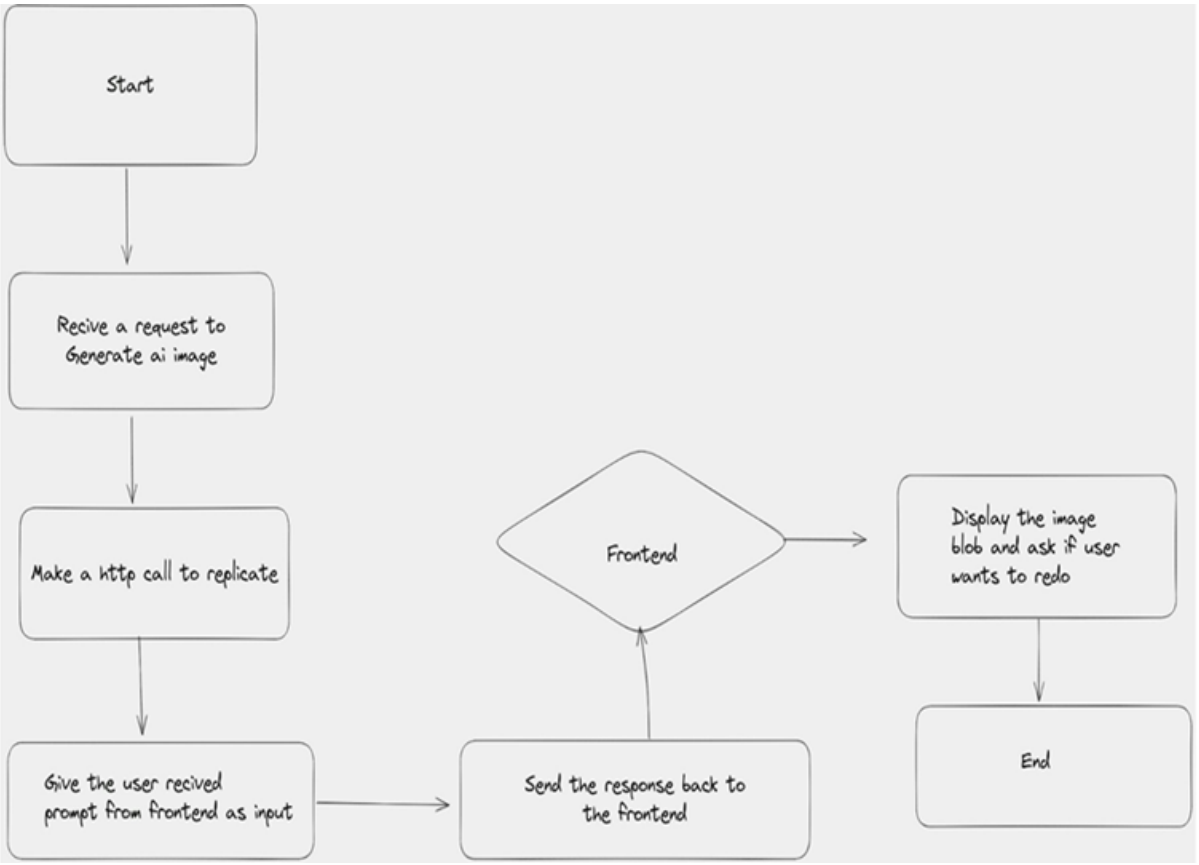
TECHNOLOGY STACK:



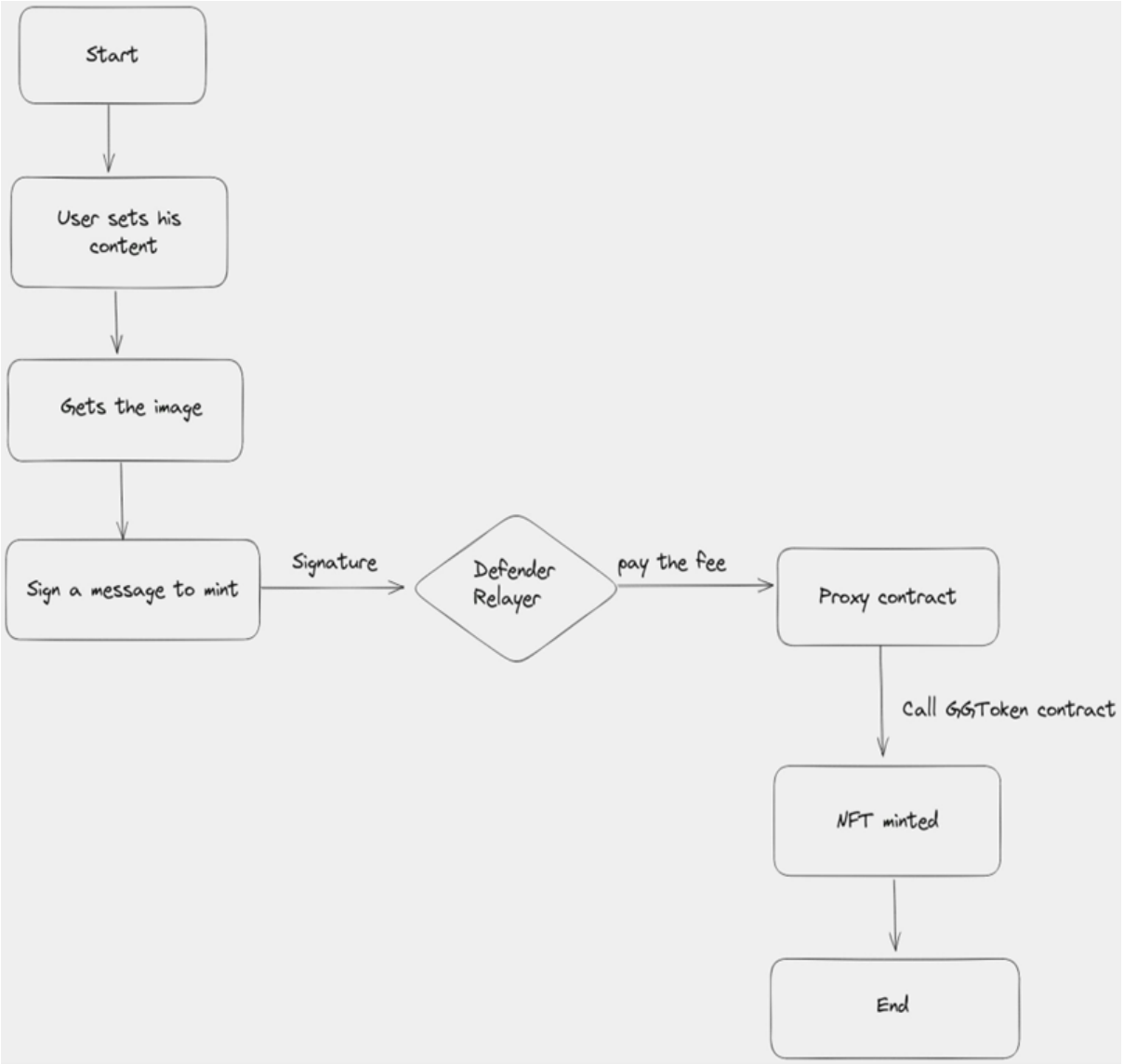
- Smart Contract Development:
  - Solidity: Language for Ethereum smart contracts.
  - Hardhat: Development environment for testing contracts.
- Frontend Development:
  - React: JavaScript library for dynamic UIs.
- Blockchain Interaction:
  - Ethers.js: Library for Ethereum interactions.
- Smart Contract Testing:
  - Hardhat: Framework for testing smart contracts.
- Development Environment:
  - Remix: Full-stack web framework for modern web apps.
- Decentralized Data Storage:
  - IPFS: Protocol for distributed file storage.

FLOW DIAGRAM:

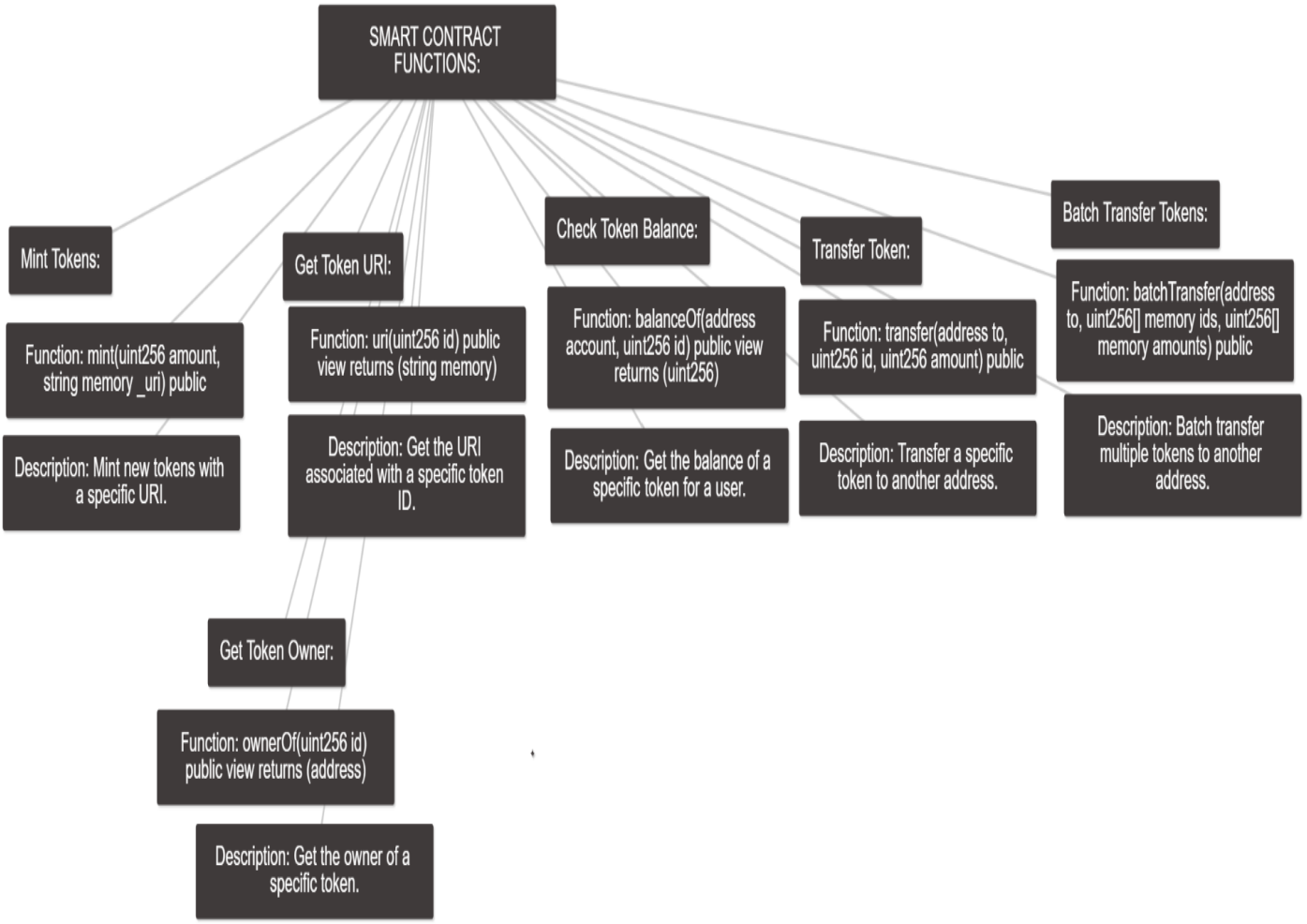



Start
Recive a request to Generate ai image
Make a http call to replicate
Give the user recived prompt from frontend as input
Send the response back to the frontend
Frontend
Display the image blob and ask if user wants to redo
End

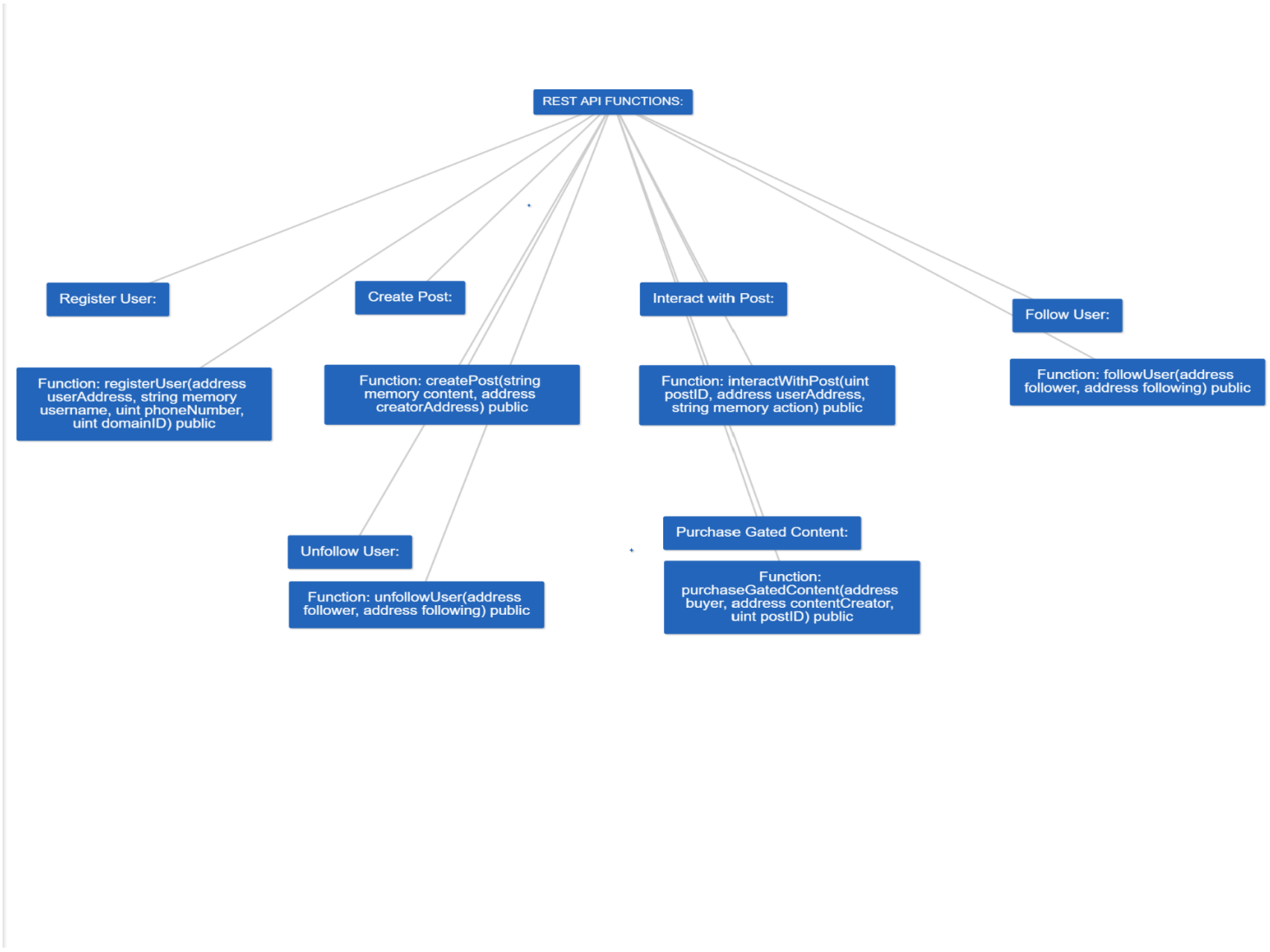
Blockchain Based Social Media Without Bots and Gas Fees



SMART CONTRACT FUNCTIONS:



REST API FUNCTIONS:



METHODOLOGIES:

Research and Planning: The first step in the methodology would be to research and plan the project. This would involve identifying the key features of the GameGuides platform, understanding the requirements for integrating with Lens Protocol and other tools like Replicate and Tatum, and designing the user interface and experience for the platform.

2. **Development Environment Setup:** The next step would be to set up the development environment for the project. This would involve installing and configuring the necessary software tools and libraries, setting up accounts on various blockchain platforms, and configuring the deployment environments. 3. Smart Contract Development: The core functionality of the GameGuides platform would be implemented through the development of smart contracts using Solidity language. This would include the ERC1155 token contract for minting and selling tokens, as well as other smart contracts for various platform functionalities such as token gating and user authentication.

4. **User Interface Development:** In parallel with the smart contract development, the user interface for the GameGuides platform would be designed and developed using Javascript and React. The user interface would need to be intuitive, user-friendly, and aesthetically pleasing, while also being fully integrated with the smart contracts and other backend tools.

5. **Integration with Lens Protocol and other tools**: The GameGuides platform would need to be fully integrated with Lens Protocol to enable the token gating functionalities and other features. Additionally, tools like Replicate and Tatum would need to be integrated to enable text-based image generation and uploading of NFT metadata to IPFS.

6. Testing and Deployment: Once the platform is fully developed and integrated, it would need to be rigorously tested to ensure that it functions as intended, is secure, and can handle a high volume of traffic. Once the testing phase is complete, the platform would be deployed to the Polygon Mumbai blockchain and made available to users. 7. User Adoption and Feedback: The final step in the methodology would be to encourage user adoption of the GameGuides platform and gather feedback from users to inform future improvements and updates to the platform. This would involve marketing and outreach efforts, as well as actively soliciting feedback from users through surveys, focus groups, and other means.

Blockchain-based architecture: A blockchain-based architecture refers to a system or application that is built using blockchain technology. At its core, a blockchain is a decentralized and distributed digital ledger that records transactions and data across a network of computers. In a traditional architecture, data is stored in a central location and controlled by a single entity, such as a company or organization.

This centralization can make the system vulnerable to attacks, failures, and corruption. In contrast, a blockchain-based architecture is decentralized, meaning that the data is stored across a network of computers, or nodes, without any central control. The blockchain architecture provides several benefits:

1. Decentralization: Because the data is distributed across a network of nodes, there is no single point of failure or control. This makes the system more resilient and resistant to attacks.

2. Transparency: All transactions and data on the blockchain are publicly visible and verifiable, meaning that anyone can view them. This helps to build trust among users and ensures that the data is accurate and trustworthy.

3. Security: The blockchain uses cryptography to secure transactions and data, making it very difficult for anyone to tamper with them. This provides a high level of security and ensures the integrity of the data.

4. Immutability: Once a transaction or piece of data is added to the blockchain, it cannot be deleted or modified. This provides a permanent and tamper-proof record of all transactions and data on the platform. Overall, a blockchain-based architecture is a powerful tool for building decentralized and secure systems and applications that are resistant to attacks, failures, and corruption. It has many potential applications in areas such as finance, healthcare, logistics, and more.

Proof of Stake Conesus Algorithms: Proof of Stake (PoS) is a consensus algorithm used by some blockchain networks to validate transactions and create new blocks in the blockchain.

It is an alternative to the Proof of Work (PoW) algorithm, which is used by Bitcoin and other cryptocurrencies. In a PoS system, validators are chosen to create new blocks based on the amount of cryptocurrency they have staked or locked up in the network.

Validators are incentivized to act in the best interest of the network because they risk losing their stake if they attempt to create fraudulent transactions or act maliciously. Here is how the PoS algorithm works in more detail.

1. Validators lock up their cryptocurrency: In a PoS system, validators must hold a certain amount of cryptocurrency as a stake in the network. The more cryptocurrency they hold, the greater their chance of being chosen to validate transactions and create new blocks.

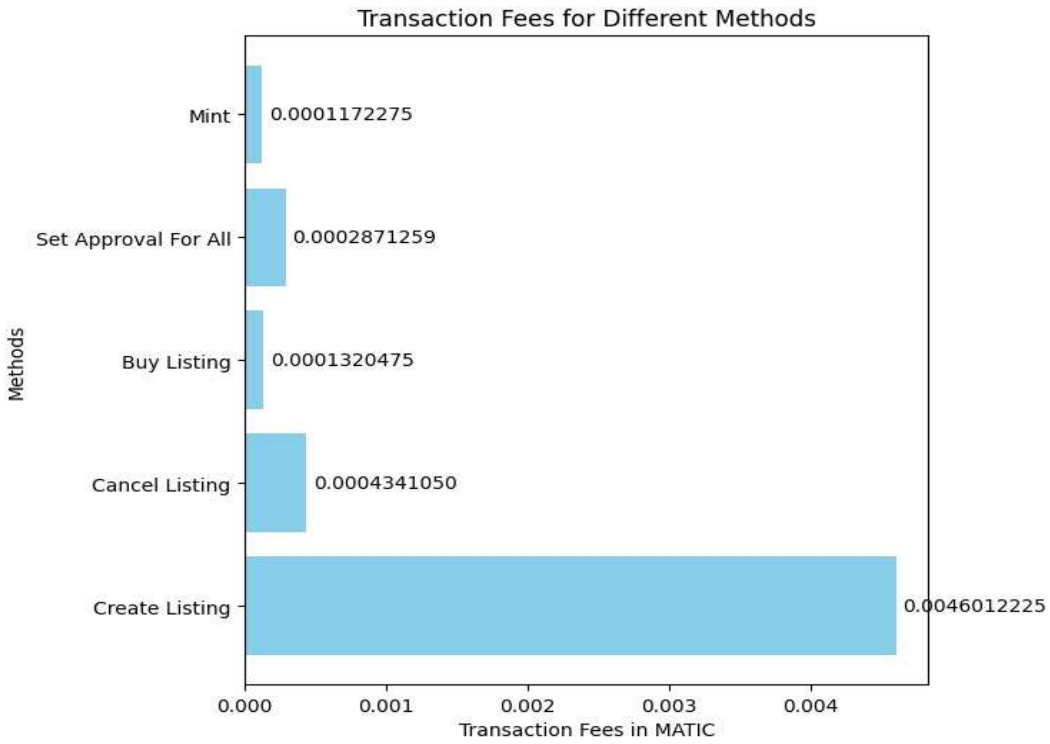
2. Validators are chosen to validate transactions: Validators are chosen to validate transactions based on a random selection process that takes into account the amount of cryptocurrency they have staked. The more cryptocurrency a validator has staked, the greater their chance of being chosen to validate transactions.

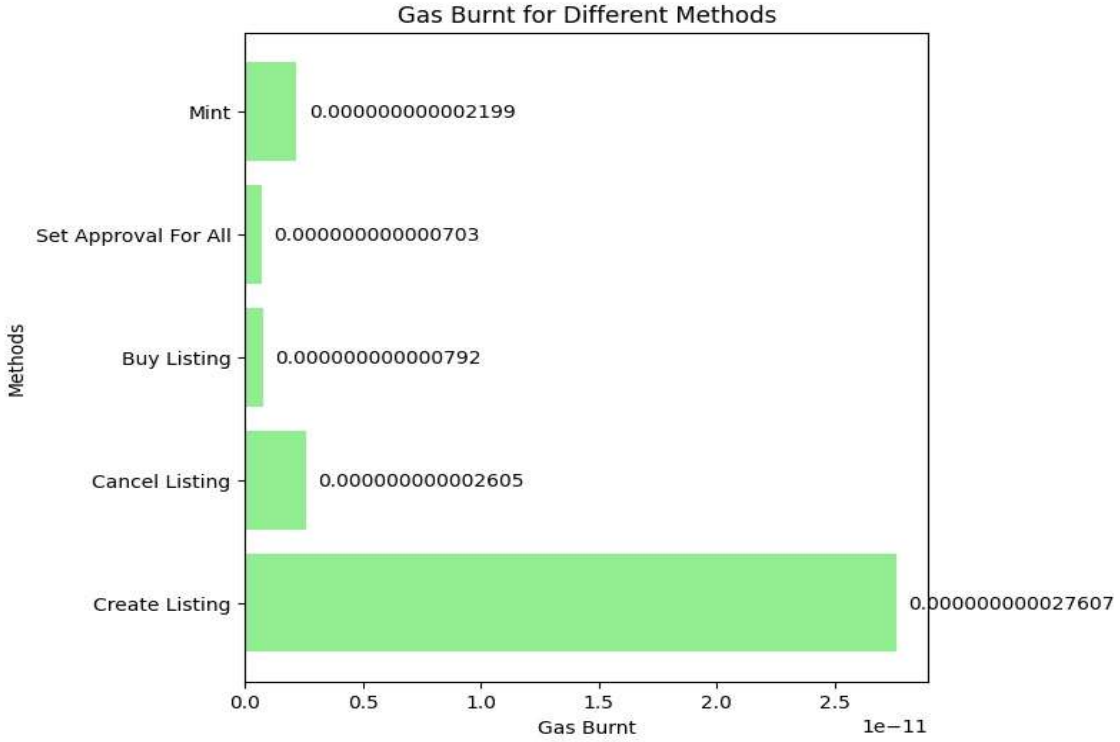
3. Validators validate transactions: Once a validator has been chosen to validate transactions, they must confirm the transactions are legitimate and add them to the blockchain.

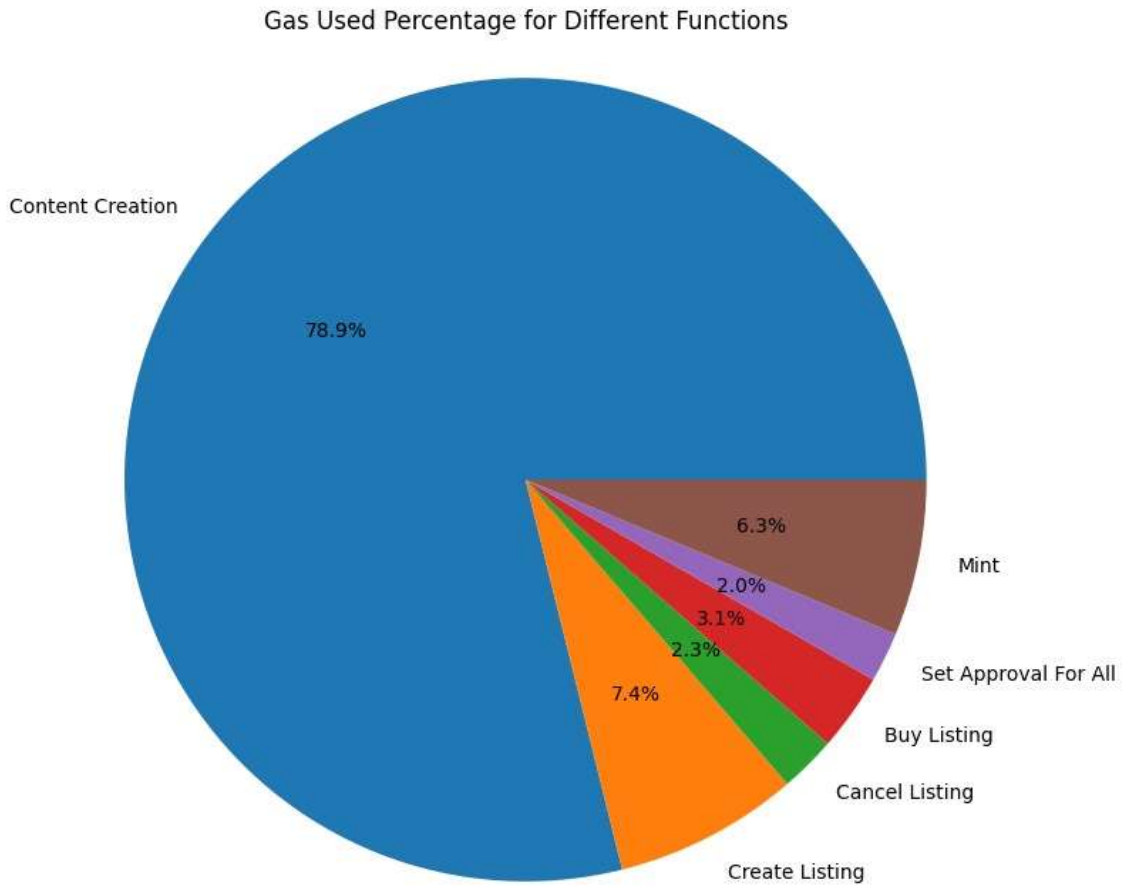
4. Validators are rewarded: Validators who successfully validate transactions and add them to the blockchain are rewarded with cryptocurrency. The amount of cryptocurrency they receive depends on the amount of cryptocurrency they have staked.

5. Validators risk losing their stake: Validators who attempt to create fraudulent transactions or act maliciously risk losing their stake. This provides an incentive for validators to act honestly and in the best interest of the network. Overall, the PoS algorithm is more energy-efficient than the PoW algorithm because it does not require as much computational power to validate transactions and create new blocks. Additionally, the PoS algorithm incentivizes validators to act honestly and prevents the use of bots or other malicious behaviour

Transaction fees and Gas used:







Content Creation:

The transaction fee for content creation is 0.004601222527607335 MATIC, with a gas limit of 1,840,489 and usage at 100%. This high transaction fee and gas usage suggest a potentially intricate process, possibly involving extensive validations or complex operations. This reflects a substantial requirement of network resources and computational steps.

Create Listing:

For creating a listing, the transaction fee is 0.00043410500260463 MATIC, with a gas limit of 173,642 utilized at 100%. This lower transaction fee and gas usage imply a comparatively simpler process than content creation. Creating a listing might involve fewer computational steps and validation checks, impacting resource consumption.

Cancel Listing:

The transaction fee when canceling a listing is 0.000132047500792285 MATIC, with a gas limit of 52,819 used at 100%. These notably lower fees and gas usage suggest a straightforward and efficient operation, indicating minimal resource consumption and computational overhead.

Blockchain Based Social Media Without Bots and Gas Fees

Buy Listing:

The transaction fee for buying a listing stands at 0.000287125891221442 MATIC, with a gas limit of 72,818 utilized at 96.15%. This moderate to high fee and gas usage imply significant network resources and computations, likely due to multiple validations, fund transfers, and confirmations.

Set Approval For All:

The transaction fee for setting global approvals is 0.000117227500703365 MATIC, with a gas limit of 46,891 used at 100%. This function demonstrates relatively low fees and gas usage, indicating a streamlined and efficient process with minimal resource consumption.

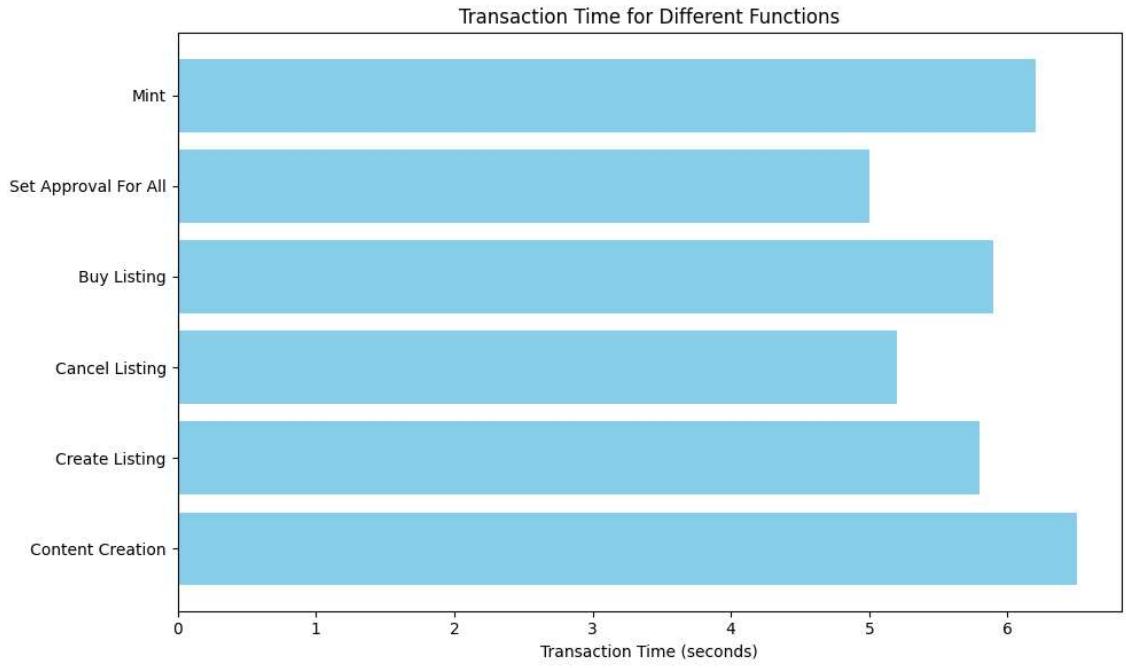
Mint:

Minting bears a transaction fee of 0.00036651000219906 MATIC, with a gas limit of 146,604 utilized at 100%. This moderate fee suggests a moderately complex process involving token creation and allocation.

Regarding independent and dependent variables, the different functions (Content Creation, Create Listing, etc.) act as independent variables, while transaction fees and gas usage function as dependent variables influenced by factors like gas limits, network conditions, and smart contract configurations. These variables showcase varying behaviors due to the complexity of operations within each function and their corresponding resource requirements.

Linear and nonlinear behaviors are apparent across these functions. Linear behavior correlates transaction fees and gas usage with the complexity of operations. Nonlinear behavior could arise from unexpected complexities or optimizations in implementations, deviating from a straightforward relationship between the function and transaction metrics. This could also be due to external factors impacting transaction behavior, creating more intricate relationships.

TRANSACTION TIME :



Transaction time represents the duration it takes for a specific function or transaction type to execute on the blockchain.

1. Content Creation:

- Transaction Time: 6.5 seconds
- This function might involve complex operations or require multiple steps, potentially due to the creation of content involving various data manipulations or storage actions. The longer transaction time could imply more intricate processing.

2. Create Listing:

- Transaction Time: 5.8 seconds
- Creating a listing appears slightly quicker than content creation, suggesting that this operation involves fewer steps or less complexity. It might involve setting up specific parameters for listing creation.

3. Cancel Listing:

- Transaction Time: 5.2 seconds
- Canceling a listing seems relatively fast compared to the creation process, indicating it involves fewer steps or less computational work. It might simply involve updating or removing an existing entry.

4. Buy Listing:

- Transaction Time: 5.9 seconds
- Buying a listing involves financial transactions and might need validation and confirmation steps. It's relatively close in time to content creation, indicating potential complexity due to financial transfers or validations.

5. Set Approval For All:

- Transaction Time: 5.0 seconds
- This action seems to be the quickest, indicating it might involve minimal computational work or validation steps. It might involve setting global permissions or approvals.

6. Mint:

- Transaction Time: 6.2 seconds
- Minting involves the creation of new tokens or assets. It's slightly longer in duration, suggesting it might require additional validation or more complex token generation processes.

Gasless Minting as a Metric:

1. **Enhanced Accessibility:** Gasless minting extends accessibility, enabling users to interact with the platform without the barrier of transaction fees.

2. **User-Friendly Experience**: Eliminates the need for users to hold ETH or navigate complex gas settings, ensuring a seamless and intuitive experience.

3. **Increased User Adoption:** Lowers the entry barrier, attracting more users to engage, mint, or participate without incurring transaction costs, driving higher adoption rates.

4. **Cost-Efficient Transactions:** Facilitates cost-efficient transactions, particularly beneficial for microtransactions or token-based activities, promoting frequent user engagement.

5. **Boosts Engagement and Retention:** Encourages increased participation and prolonged user engagement by removing the financial friction associated with gas fees.

6. **Community-Centric Approach:** Fosters a community-centric ecosystem, promoting inclusivity and participation from users who might be deterred by transaction fees.

7. **Economic Incentives:** Drives user retention and loyalty by providing incentives to holders or frequent participants through gasless interactions, fostering a robust user community.

Token Gating as a Metric:

1. **Enhanced Security Measures:** Token gating fortifies the platform's security, ensuring that users meet specific criteria or hold tokens to access certain functionalities or benefits.

2. **Community Involvement:** Encourages community involvement and governance by rewarding token holders with exclusive privileges, incentivizing long-term engagement and ownership.

3. **Monetization Strategy:** Provides an effective monetization model by tokenizing access or features, creating value for token holders and potentially generating revenue streams for the platform.

4. **Curated Access Levels:** Offers different tiers or levels of access based on token ownership, providing curated experiences for users based on their commitment or investment in the platform.

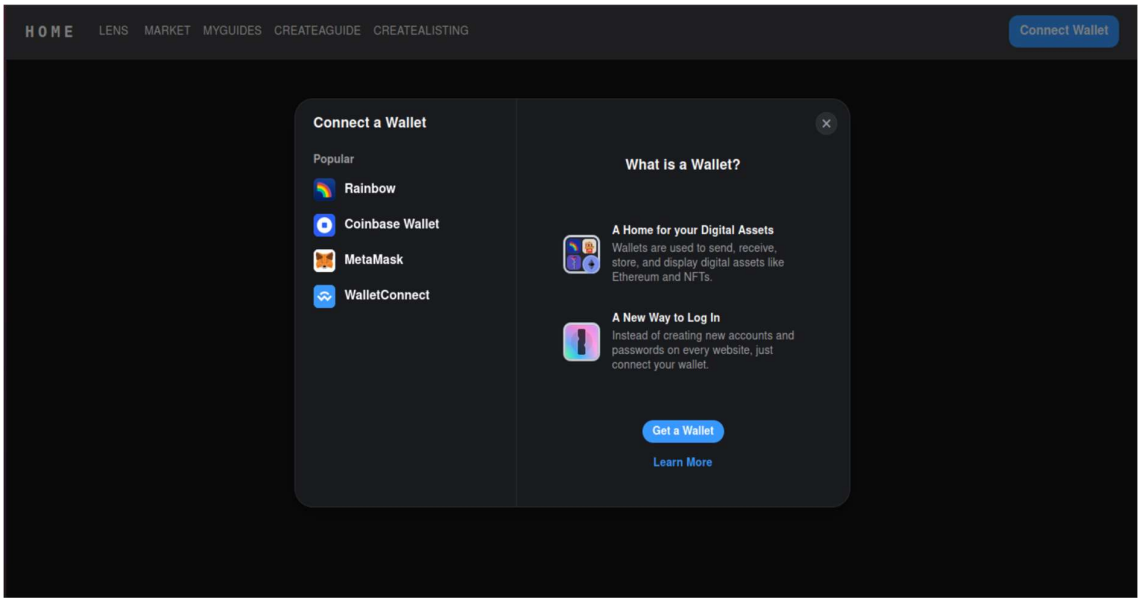
5. **Incentivized Participation:** Motivates users to hold or acquire tokens, driving engagement and active participation to unlock additional functionalities or exclusive content.

6. **Fair Distribution:** Ensures a fair distribution of access or benefits based on token ownership, promoting inclusivity and rewarding loyal community members.

7. **Deters Spam and Misuse:** Acts as a barrier against spam or misuse, requiring a genuine commitment from users to participate, contributing to a cleaner, more engaged user base.

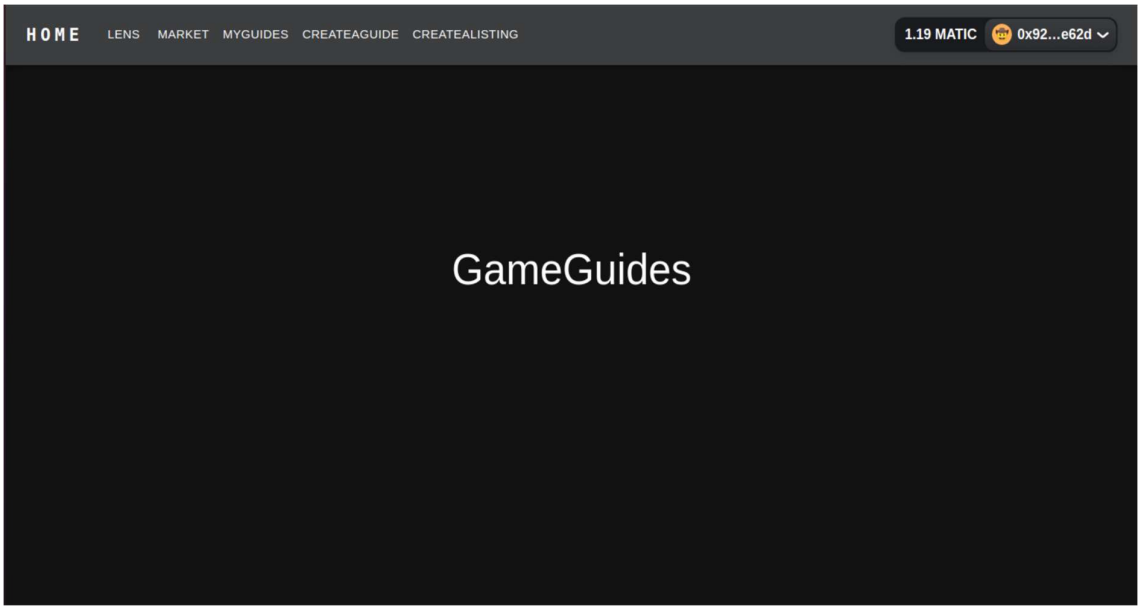
RESULTS : (SCREENSHOTS)

Welcome to the versatile frontend interface designed to seamlessly integrate with various extensions like Coinbase and MetaMask, among others.

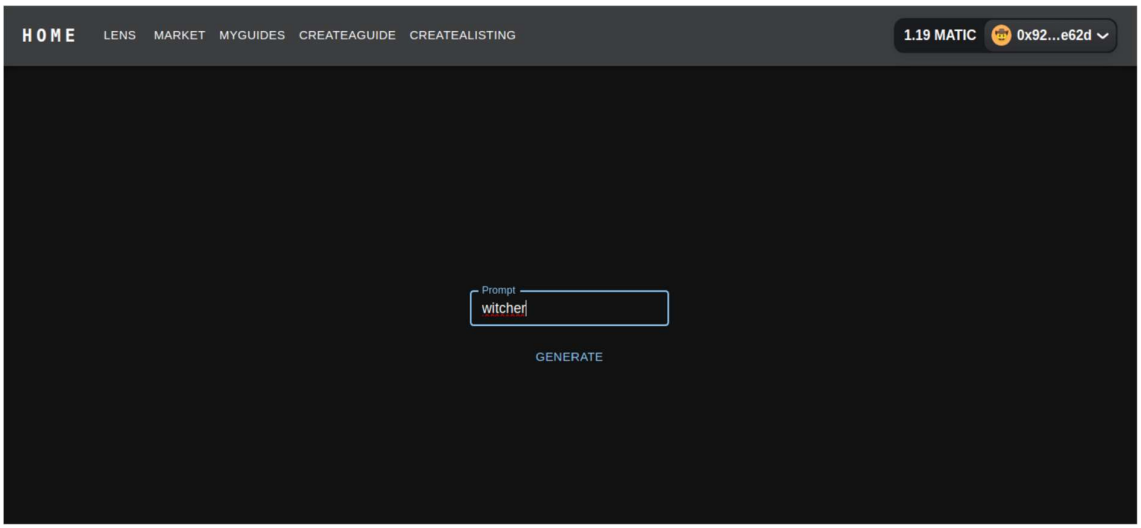


Blockchain Based Social Media Without Bots and Gas Fees

User flow:

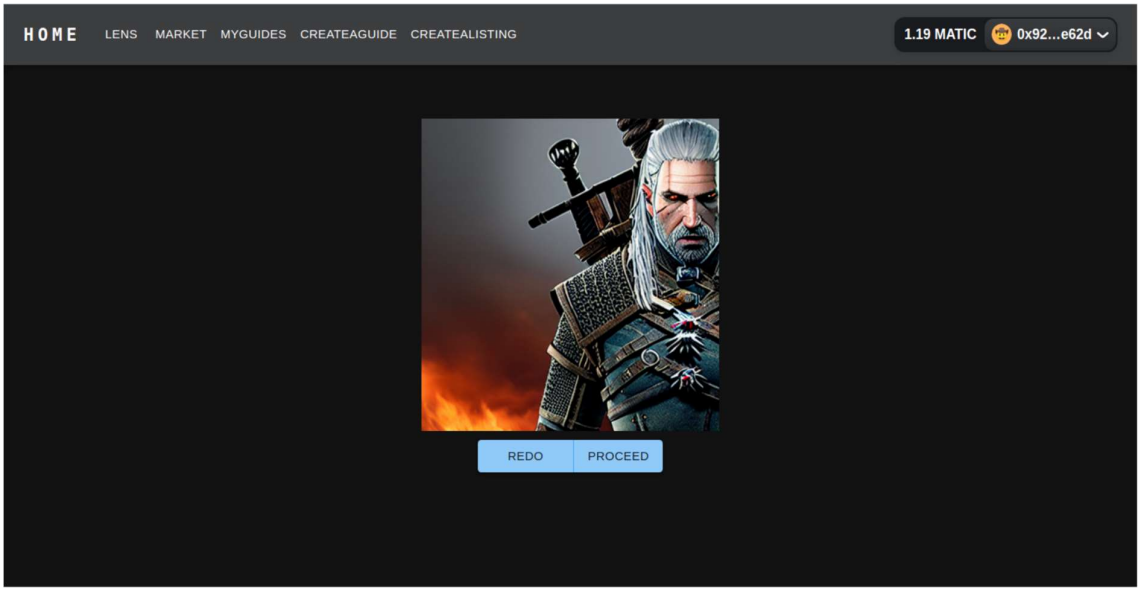


Designed an intuitive interface where users can input details for creating guides or listings. This might include fields for title, description, category, images, pricing, and any other relevant information.

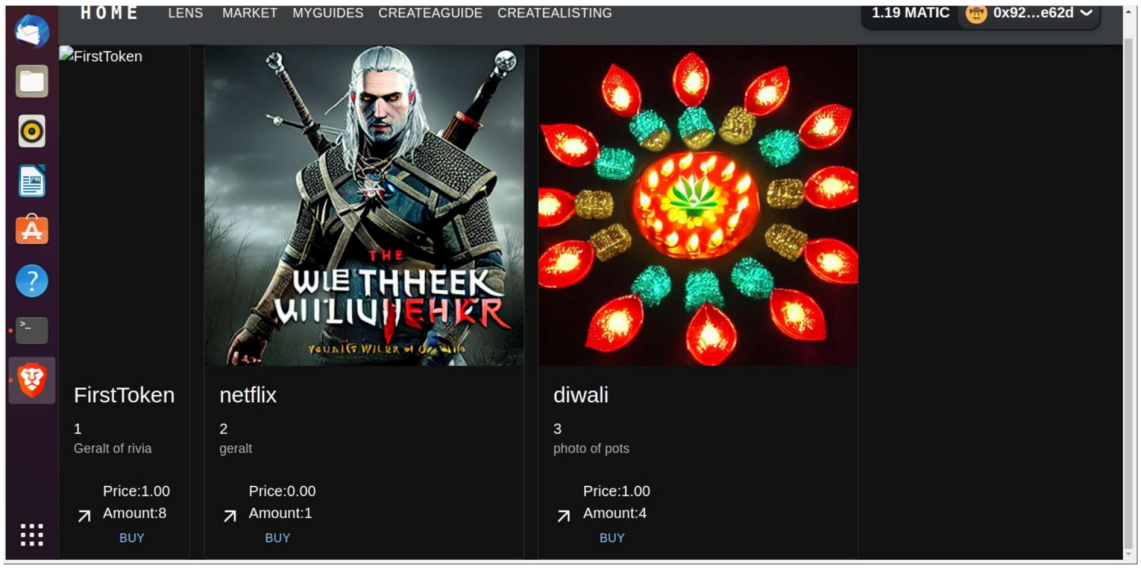


Utilize the text-to-image functionality by inputting the collected listing information into the Stable Diffusion AI tool.

Blockchain Based Social Media Without Bots and Gas Fees

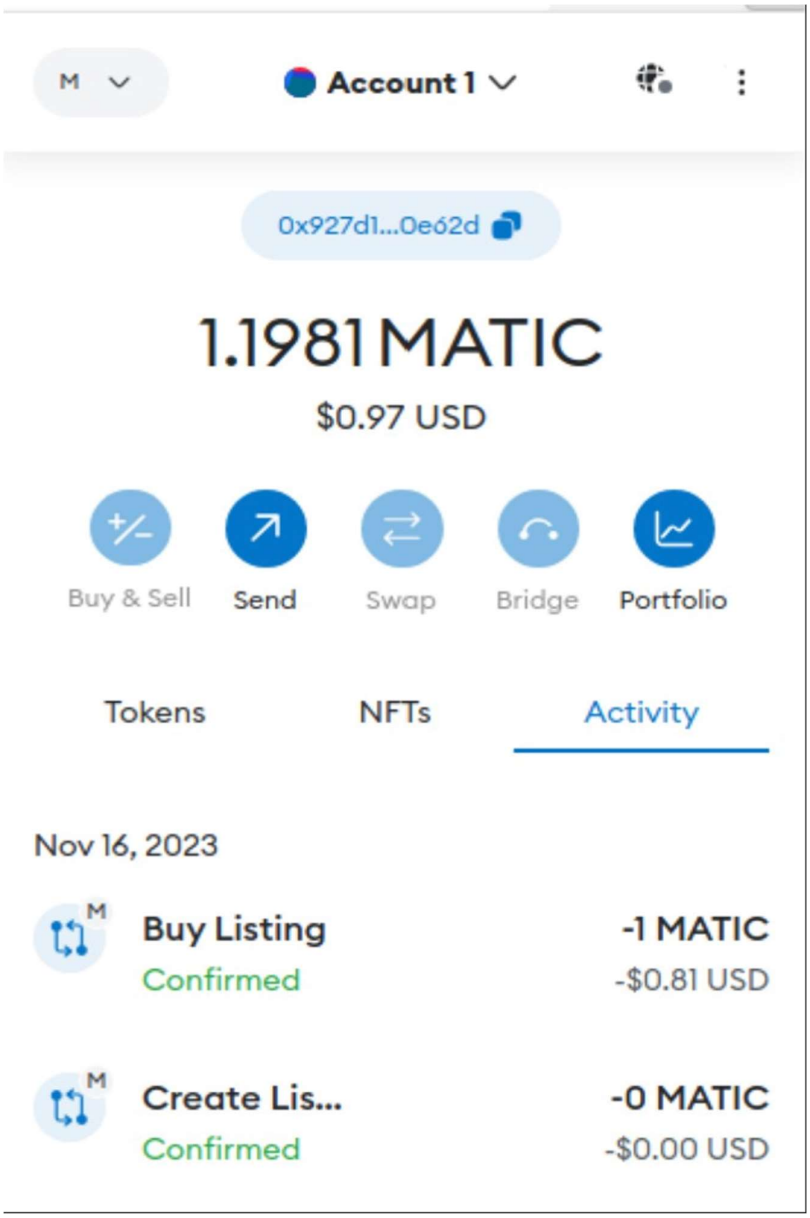


Transforming text into captivating visuals: Enhancing listings with AI-generated images for an immersive user experience and after that minted the image by signing with the help of the metamask

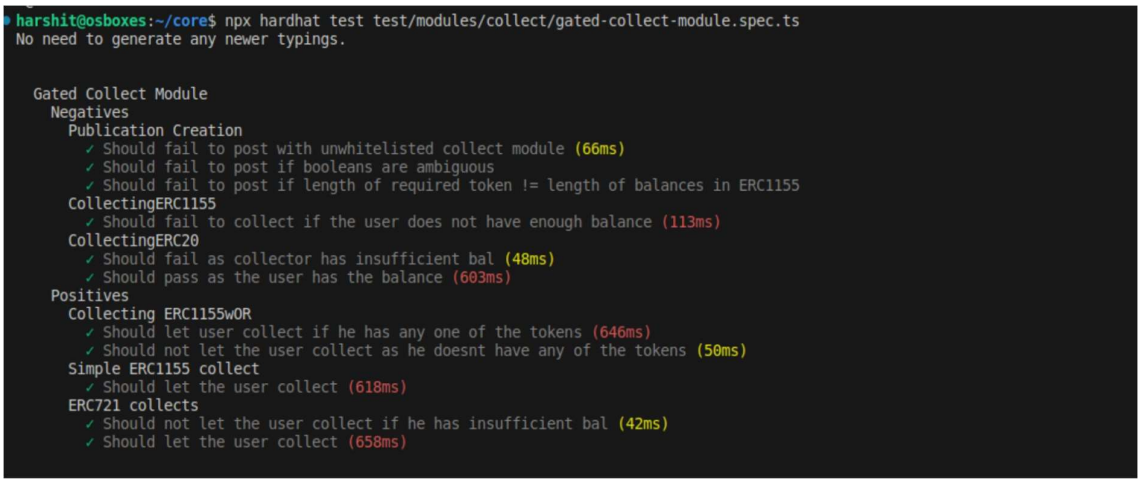


It is the list of all the users' made content in the market for buying in our project's results

Blockchain Based Social Media Without Bots and Gas Fees



Successfully created and purchased the listed product, completing the transaction with a secure payment.



Implemented the 'GatedCollect' Solidity smart contract facilitating controlled access to profile publications. It ensures secure token or NFT collection by validating ownership and balances, enabling controlled access based on specified conditions.

Conclusion:

In a groundbreaking fusion of gasless minting, token gating, and robust anti-spam measures, our project stands as a beacon of innovation and accessibility within the blockchain realm.

By harnessing the power of Stable Diffusion AI for text-to-image generation, we've transcended conventional barriers, enabling users to create captivating listings effortlessly. This breakthrough technology not only enhances the visual appeal of our platform but also streamlines the creation process, empowering users with unprecedented ease and creativity.

Gasless minting, a cornerstone of our initiative, democratizes participation by eliminating transaction fees. This pivotal feature makes engagement inclusive, allowing users to mint assets without financial constraints, fostering a vibrant and engaged community.

Token gating, coupled with stringent security measures, guarantees a fair ecosystem for token holders. It not only rewards engagement but also offers exclusive benefits, nurturing a strong, loyal community invested in the platform's success.

Moreover, our unwavering commitment to a botless, spam-free environment ensures authentic interactions, bolstering trust and fostering genuine engagement among users.

In essence, our project revolutionizes user engagement by marrying innovative AI technology, gasless transactions, and community-driven token gating. It sets the stage for an inclusive, secure, and visually immersive blockchain experience, empowering users to participate, create, and thrive within our vibrant ecosystem.

GITHUB REPOSITORY https://github.com/harshitkumar007/GROUP7

CONCLUSION:

Addressing Core Issues:
Vendor Locking: Resolved through decentralization, empowering users with data ownership.
Data Ownership: Lens Protocol empowers users to retain ownership and tokenize their content (ERC1155 tokens), ensuring fair revenue distribution.
Fair Revenue Distribution: Enabled through tokenization and open market availability, allowing creators to monetize their content fairly.

Technological Solutions:
Gas Fee Reduction: Integration with Polygon Mumbai significantly lowers gas fees, making user interaction feasible.
Token Gating & Interaction: Enhanced interaction between creators and consumers, allowing exclusive monetization of loyal fan bases.
Innovative Features: Lens Protocol's Collect module and Stable Diffusion enrich the platform by allowing exclusive content gating and image generation from text.

User-Centric Experience:
Seamless User Experience: OpenZeppelin Defender Relayer facilitates gasless ERC1155 token minting, reducing barriers for new creators.
Fair Revenue & Data Ownership: GameGuides highlights the potential of blockchain-based platforms to ensure fair revenue and data ownership while providing an excellent user experience.

Future Directions:
Your conclusion also hints at potential future research avenues, suggesting the expansion of platform functionalities by integrating additional blockchain technologies and leveraging AI-generated content. This forward-thinking approach opens doors for continuous innovation and improvement.

Overall, your project showcases how blockchain-based social media platforms can revolutionize revenue distribution models, prioritize data ownership, and enhance user experiences, paving the way for a fairer, more user-centric digital landscape.

References:

- **Research Paper- 1 :**
- Incentivized Blockchain-based Social Media Platforms: A Case Study of Steemit Publication-WebSci '19: Proceedings of the10th ACM Conference on WebScience, June 2019, pages145-154 Authors-Chao Li, Balaji Palanisamy - https://dl.acm.org/doi/10.1145/3292522.3326041

- Title: Blockchain-Based Identity Verification System. Publications: 2019, IEEE 9th International Conference on System engineering and technology,7th october 2019. Author: Arshad Jamal, Rabab Alayham Abbas Helmi, Mariam-Aisha Fatima and Ampuan Siti Nurin Syahirah - https://ieeexplore.ieee.org/document/8906403

- **Research paper-2 Title:**

BCOSN: A Blockchain-Based Decentralized Online Social Network

Online social networks (OSNs) are becoming more and more prevalent in people's life, but they face the problem of privacy leakage due to the centralized data management mechanism. The emergence of distributed OSNs (DOSNs) can solve this privacy issue, yet they bring inefficiencies in providing the main functionalities, such as access control and data availability. In this article, in view of the above-mentioned challenges encountered in OSNs and DOSNs, we exploit the emerging blockchain technique to design a new DOSN framework that integrates the advantages of both traditional centralized OSNs and DOSNs. By combining smart contracts, we use the blockchain as a trusted server to provide central control services. Meanwhile, we separate the storage services so that users have complete control over their data. In the experiment, we use real-world data sets to verify the effectiveness of the proposed framework.**Published in:** IEEE Transactions on Computational Social Systems (Volume: 6, Issue: 6, December 2019)

Research Paper: 3 Title: Blockchain-Based Identity Verification System. Publications: 2019, IEEE 9th International Conference on System engineering and technology,7th october 2019. Author: Arshad Jamal, Rabab Alayham Abbas Helmi, Mariam-Aisha Fatima and Ampuan Siti Nurin Syahirah. The research paper discusses the potential use of blockchain technology for identity verification. Identity verification is an essential component of many online services, such as banking, e-commerce, and social media. However, the current methods of identity verification are often cumbersome, time-consuming, and susceptible to fraud.

http://dx.doi.org/10.1109/ICSEngT.2019.8906403