IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DECENTRALIZED SOCIAL MEDIA APPLICATION USING ETHEREUM

Yashwanth M Student

Vamshi K V Student

Uppara Uday Kumar Student

Elluru Deekshith Kumar Student

Bachelor of Technology, CSE, CMR University, Bangalore, Karnataka, India

ABSTRACT : A decentralized social media network on Ethereum redefines the nature of interaction on the internet with an emphasis on privacy, ownership, and transparency. There is no one point of control such as for central sites, making censorship and abuse of data unthinkable. User activity like posting and sharing is controlled by automatically acting smart contracts that bring in trust and finality. Web3 wallets like MetaMask eliminate the traditional logins with added security and reduced data breaches. Direct users own their contents, encouraging the existence of an uncensored society. A rewarding system compensates users for user participation in blockchain tokens, encouraging user-led and fair social networking.

Keywords: MetaMask, Blockchain, Ethereum, IPFS

1. INTRODUCTION

Blockchain is a core technology for secure and decentralized data management, employing cryptographic security, consensus protocols, and distributed ledgers to provide transparency and tamper resistance. Decentralized blockchain systems, as opposed to centralized networks, provide greater security and reliability and are best suited for applications where data integrity and user trust are of critical importance. These applications include finance, healthcare, supply chains, and identity verification, where secure, verifiable, and immutable records must be kept.

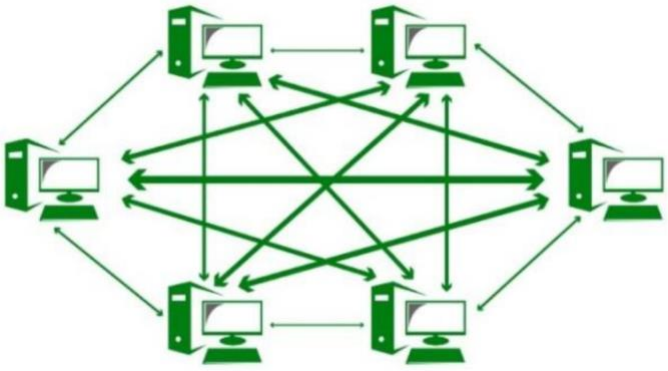

Fig 1.1 : Decentralized Application Structure

1.1 Background

Centralized social media platforms rely on servers, which pose problems of privacy, data leakage, censorship, and message tampering. Decentralized social media apps eliminate the need for central control, allowing users to have control over their data and share messages securely. Our site, based on the Ethereum blockchain, uses smart contracts to offer tamper-proof, open, and censorship-free messaging. Users are authenticated by Web3 authentication, logging in through blockchain wallets instead of vulnerable email-password credentials. Peer-to-peer (P2P) infrastructure facilitates hassle-free interaction without a central server. An incentive-based mechanism exists that compensates user participation in the form of blockchain coins.

1.2 Motivation

Legacy social media platforms are confronted with an unprecedented set of challenges including data privacy violation, censorship, centralized power, and security risks. Users enjoy little control over content, with platforms monetizing personal data against users' intent. Additionally, discriminatory moderation policies and algorithmic tampering violate freedom of expression, rendering social media less transparent and fair. These challenges necessitate the development of a decentralized, user-controlled platform improving privacy, security, and transparency in online interactions.

Our Ethereum Decentralized Social Media Application addresses these problems by leveraging blockchain technology and smart contracts to offer a censorship-resistant, secure, and trustless platform. Users retain full control over their data, eschewing the risks of centralized storage. Web3 authentication supplants traditional login methods with an added layer of enhanced security and reduced data breaches. Additionally, a reward system compensates user behavior with blockchain tokens, a transparent, open, and user-driven social network in which fairness and decentralization are appreciated.

1.3 Problem Statement

Centralized social media platforms compromise user privacy, security, and autonomy by storing data on centralized servers that can be hacked, censored, and manipulated. Users do not own their data, and platforms make money from personal data without consent. To address these limitations, a decentralized social media platform on Ethereum needs to be deployed, safeguarding privacy, security, transparency, and censorship resistance. With blockchain and smart contracts, users have full control over their data and interactions.

1.4 Literature Review

Ethereum social media decentralized reviews recent research, technologies, and challenges in social networking on blockchain. Social networks are beset with issues like intrusion of data privacy, censorship, and central control, which has resulted in the development of decentralized social media. Research shows how Ethereum smart contracts enable secure, tamper-proof interactions without the involvement of intermediaries. Studies also include IPFS for decentralized storage, serving content without depending on central servers.

Scalability problems such as high gas fees and slow transactions are generally addressed by Ethereum 2.0 and Layer-2 solutions. Token-based monetization models are the focus of some research to support fair revenue sharing with cryptocurrencies and NFTs. Research also speaks of adoption barriers in users, referencing the need for better UI/UX and less complicated blockchain interactions. Overall, the survey provides an outline of the areas of improvement, strengths, and weaknesses of decentralized social media apps in the future.

2. IMPLEMENTATION

2.1 Requirements Analysis

2.1.1 Functional Requirements

- User Authentication and Registration: Users register and authenticate using Web3 wallets such as MetaMask or WalletConnect, providing safe, decentralized authentication without the employment of conventional credentials. Their blockchain address is used as their identity on the site.

- Content Security and Ownership: All that is posted, liked, commented, or shared is stored on the Ethereum blockchain, providing immutability, transparency, and censorship resistance. Users own their data entirely.

- Smart Contract Governance: All the user interactions like posting, liking, commenting, and rewarding are governed through Ethereum smart contracts, without any central authority.

- Decentralized Content Storage: Posts and media are stored via distributed storage solutions (e.g., IPFS), which secure content, keep it tamper-proof, and make it readable without a central server.

- User Interface (UI): The platform has an intuitive UI that is blockchain wallet-compatible, with an easy-to-use experience for non-technical and blockchain-conscious users.

2.1.2 Non-Functional Requirements

- Security: The platform uses blockchain-smart contracts, encryption, and authentication to prevent unauthorized access, data tampering, and cyber attacks.

- Privacy: The users have complete ownership of their data as the platform does away with centralized storage, safeguarding private data from exploitation or leakage.

• Performance: The platform is designed with the capability to process high-speed transactions, using Ethereum Layer 2 scaling technologies to prevent latency and optimize response time.

• Scalability: The platform supports an increasing number of users, transactions, and data efficiently without compromising performance through the use of distributed storage solutions.

2.2 System Architecture

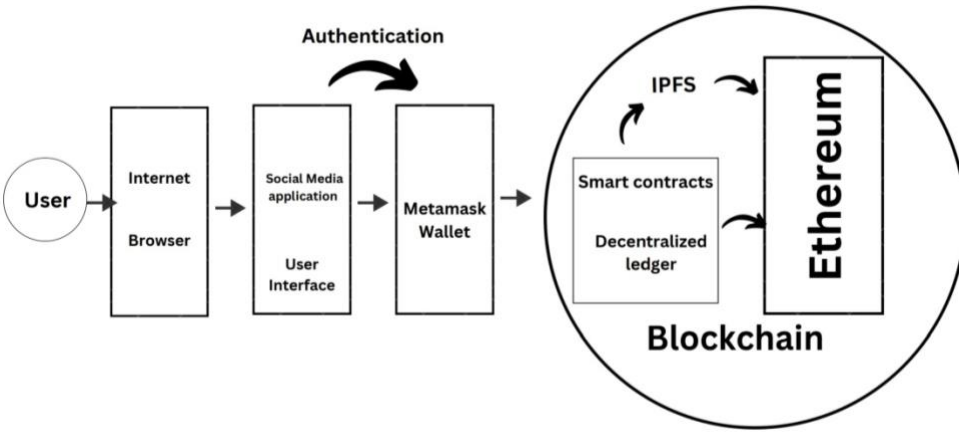

Fig 2.2.1 System Architecture

1. User Devices:
Both mobile and desktop is our Decentralized Social Media App, featuring effortless user interface. The devices of users handle the front-end interface with no obstacles so they can safely share, make, like, comment, and connect through ensured data privacy and decentralization by utilizing blockchain technology.

2. User Interface
• UI Components: UI Components is a group of pre-styled React components through which the developers can make their app responsive and good-looking with high speed. Navigation bars, forms, and buttons are some of its features.
• React.js: A React framework which handles the routing and server rendering. These make the apps smoothly run, quickly load, SEO-friendly, and with smooth inter page transition.
• JavaScript: JavaScript powers the front and back of our Decentralized Social Media Application to enable user interaction and blockchain interaction seamlessly.

3. Ethereum Integration:
• Smart Contracts (Solidity): Used to enable user interactions like posting, liking, commenting, and reward distribution securely on the Ethereum blockchain.
• Web3.js / Ethers.js: JavaScript libraries that enable frontend interaction with Ethereum smart contracts.

4. Backend Services:
• IPFS (InterPlanetary File System): A decentralized storage protocol for safe storage and retrieval of media content irrespective of the central servers.
• ERC-20 / ERC-721 Tokens: User compensation and digital assets management token protocols on the platform.
• Ethereum Virtual Machine (EVM): Executes smart contracts, enabling secure and trustless execution of operations on the platform

2.3 System Design

The Decentralized Social Media Application (DSMA) system architecture is based on a blockchain architecture that facilitates transparency, security, and decentralization. The architecture does not rely on centralized control, thus the platform is censorship-resistant and trustless. The system has a number of layers: smart contracts, decentralized storage, frontend, and optional backend services for indexing and performance optimization.

1. **Smart Contract Layer (Ethereum Blockchain)**
• Smart contracts on the Ethereum blockchain manage the core features, i.e., user profiles, posts, interactions, and monetization.
• User Profiles: The users are identified by their Ethereum wallet address. There is hardly any data kept on-chain, e.g., profile metadata (username, bio, profile picture hash), while the content is kept in decentralized storage such as IPFS.

• Post Upload: Posts (text, images, videos) are uploaded to IPFS or Arweave, and the resulting content hash is stored on-chain. This ensures data integrity at minimal blockchain storage cost.
• Likes and Comments: To conserve gas fees, likes are stored as smart contract events rather than on-chain data. Comments can be stored off-chain (IPFS) with their hashes stored on-chain or stored on-chain directly if they are short.

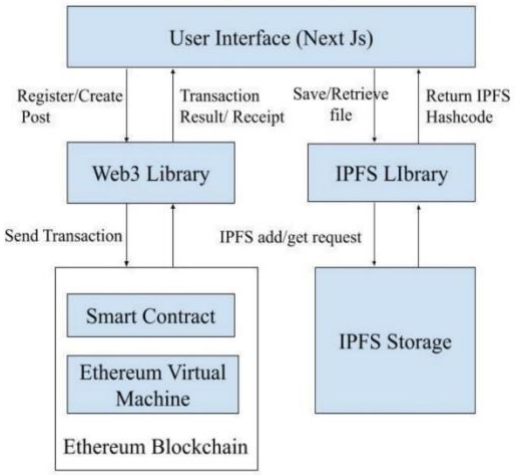

Fig 2.3.1: System design

2. Decentralized Storage Layer (IPFS)
• Storing media files on Ethereum is costly, so IPFS (InterPlanetary File System) is utilized for decentralized storage.
• IPFS: Content is broken down into separate content-addressed hashes. Data is accessed by users through these hashes rather than centralized URLs.
• Smart Contract Integration: Blockchain maintains only pointers (IPFS/Arweave hashes) to save efficiency without causing high storage costs.

3. Frontend Layer (React.js & Web3 Integration)
• Decentralized frontend web app (dApp) in React.js or Next.js that communicates with the Ethereum blockchain using Web3.js or ethers.js.
• Wallet Authentication: Authentication is done via MetaMask, WalletConnect, or Coinbase Wallet by signing a message for verification.
• Data Fetching: Comments, posts, and likes are retrieved using The Graph Protocol or Infura/Alchemy APIs for performance enhancement.
• Real-Time Updates: WebSockets or event listeners are used to monitor on-chain updates in real time.

4. Backend and Indexing Services
• Even though the system is decentralized, the backend is used for indexing blockchain data to make it readily available.
• Node.js/Express.js Backend (Optional): Allows to cache often used data, manage notifications, and deliver a better UX.

5. Security and Scalability Issues :
• Gas Optimization: Off-chain activities and storage minimize gas costs. Layer-2 scaling (Optimism, Arbitrum) can be activated for low-level transactions.
• Smart Contract Audits: Protects against attacks such as reentrancy, overflow, and unauthorized reading.
• Data Integrity: Storage of IPFS hashes on-chain ensures data cannot be tampered with after publication.

3. METHODOLOGY

3.1 Phases of Methodology

1. Requirement Analysis
The beginning step while constructing the platform is to examine issues regarding central social media networks like invasion of privacy, data tampering, censorship, and content control by a third party. Conventional social media sites are prone to monetizing and leveraging user data and cause security violation and exploitation. To counter these failures, there needs to be decentralization where the users own their content and data in its virgin form. The platform imagined provides transparency and no way in which the content can be deleted or altered by a central power.

2. Blockchain & Smart Contract Development
Ethereum smart contracts are responsible for the security, transparency, and automation of the platform. Composed in Solidity and deployed onto the Ethereum blockchain, the smart contracts guarantee significant operations like publishing articles, liking, sharing, commenting, and rewarding users. Because there isn't a centralized governing authority with regard to the fact that smart contracts run automatically, they guarantee non-interference in any interaction form, and ever

3. Front-End & Web3 Integration
The front-end of the platform is built with React.js to provide a responsive and user-friendly interface. Web3.js and Ethers.js are integrated to provide ease of interaction with the client-side application as well as the Ethereum blockchain. Using the two libraries, users can connect wallets, sign transactions, and take actions like publishing content, comments, and rewards on the blockchain. One of the key points of emphasis in this stage is creating an accessible UI/UX that will aid the ease of use while using blockchain. The majority of the users will not have even a basic understanding of Web3 technology, so the UI must nudge the user in a straightforward direction towards wallet integration, transaction processing, and interaction on the decentralized network.

4. Decentralized Authentication & Storage
To eliminate the requirement for conventional login procedures (password and email), Web3-based authentication is utilized by the platform. Customers log in through their MetaMask, WalletConnect, or other Web3 wallets, with complete authority over access to their accounts residing in their hands. This form of authentication eschews the weaknesses of centralized databases like hacking, data leaks, and unauthorized access.

For hosting user-uploaded media like posts, images, and videos, the platform is dependent on IPFS (InterPlanetary File System). Contrary to centralized cloud storage, where the data is controlled by a single central authority, IPFS stores the files on numerous other nodes in an effort to achieve eternity as well as immunity to censorship.

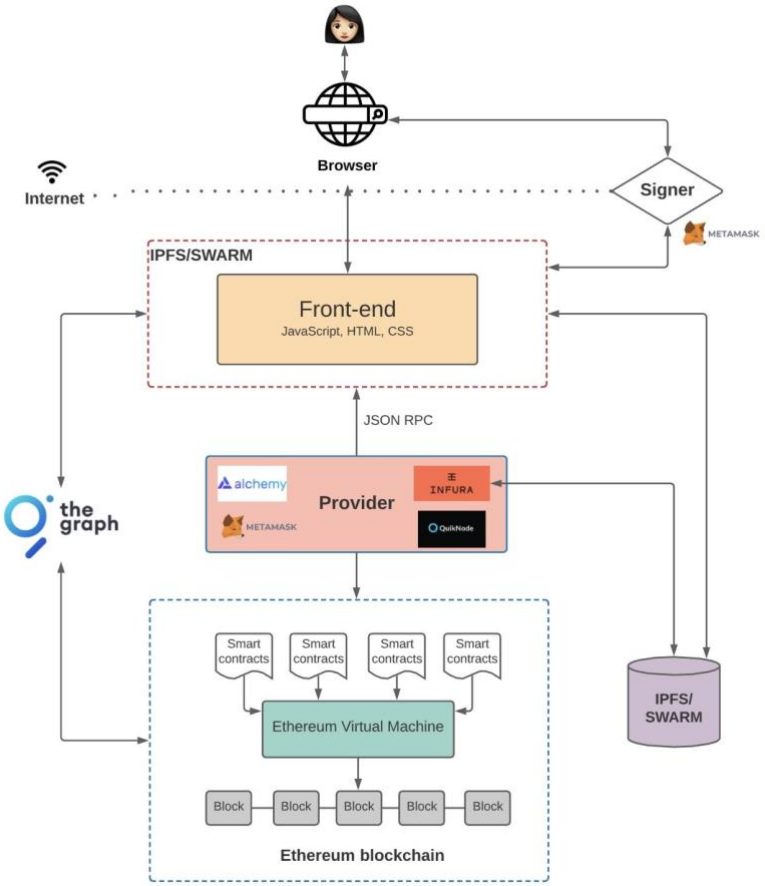

Fig 3.1.1 : Flow diagram

5. Back-End Development & API Integration
The back-end is Node.js and Express.js powered and has a strong API layer that facilitates processing of user requests, blockchain incorporation, and data processing. The API is used as a gateway between the front-end, Ethereum blockchain, and decentralized storage networks. The back-end takes care of smart contract interactions, reading user operations, and secure verification of transactions.

For quicker queries of blockchain data, The Graph Protocol is utilized. The platform can subsequently query smart contract events at the optimal rate of lower latency and greater speed. The configuration maintains the platform as responsive, efficient, and manageable even with high traffic.

6. Testing & Security Audits

Security is of utmost importance in blockchain deployments, and strict smart contract auditing is performed to identify and remove loopholes. Smart contracts are subjected to standard attacks such as reentrancy attacks, overflow bugs, and unwanted access to ensure they are secure and execute well.

Besides security audits, the platform also undergoes extensive functional, usability, and stress testing. There is performance testing to ensure transaction processing speed, API response time, and decentralized storage efficiency. There is also user testing to find out and optimize the UI/UX to ensure seamless onboarding of both blockchain-aware and non-technical users.

7. Deployment & User Adoption

After it has been tested, the platform is deployed on the Ethereum mainnet or Layer 2 solution for cost and scalability improvement. Deployment involves deploying the smart contracts, front-end UI, and decentralized storage settings. After-deployment monitoring is continuous to ensure that the system operates as intended without any hiccups. For the adoption motive, there exists a token rewards system. Contributors receive platform tokens for making posts, commenting on them, and referrals. Governance of the platform is done within a community governed by token voting on enhancements of the platform, releases of new features, as well as policies of moderation and content.

4. IMPORTANCE OF SYSTEM

4.1 Advantages of proposed system

- User Data Privacy : Your data is yours only, and there is no company that can sell or profit off of it. Your information is confidential and secure.
- Improved Security : Since information is being placed on a blockchain, it is extremely difficult for hackers to take or manipulate. There's not one database that needs to be hacked, as opposed to the legacy platforms.
- Increased Transparency : All data on the blockchain are written and visible to all, and therefore one cannot hide or modify information. Users are assured that nothing is being manipulated in secret.
- Fewer Fake Accounts and Bots : Blockchain authentication is harder for bots and fake accounts to spread misinformation. This translates to more genuine user experience.
- Free Access – The government or corporate users cannot be prevented from accessing the platform. This facilitates open and free conversation to any person globally.
- No Nuisance Targeted Ads – As opposed to the conventional platforms, which track individuals to offer adverts, decentralized social media does not collect personal information for ads.
- Users Rule – Instead of a company imposing what can and cannot be done, the community helps to rule the site. It is more fair and less complicated for users.

4.2 Limitations of Proposed System

- Excessive Transaction Fees – As every action (posting, liking, commenting) is logged on the blockchain, users pay gas fees, and this can get expensive, especially when there's network congestion.
- Slower Performance – Unlike regular social media, Ethereum is subject to a limitation on the number of transactions one can perform in a second, and it may lead to lag if everyone is online at the same time.
- Non-Technical User-Friendly – Booting up a Web3 wallet and dealing with private keys is less intuitive than setting up an email and password account, so it is harder for the occasional user to just boot up.
- Content Can't Be Deleted – Once something is posted in the blockchain, it stays there. If a person posts something that is personal or makes a mistake, they can't delete it like it's being deleted somewhere else.
- Restricted Media Storage – Big files like images and videos cannot be directly stored on Ethereum because it's too expensive, so decentralized storage elsewhere like IPFS is used, which sometimes results in slow loading or link breaks

4.3 Decentralized Social Media Application Future Using Ethereum

Decentralized social networking is still in the nascent stage, but good times are coming as more and more people develop awareness of privacy and data safety issues. The more frustrated they get about the way traditional social networking sites process user information, the more their chances of trying blockchain-based social networking increase. Since Ethereum has transparency and decentralization, users can fully own their content with no fear of censorship or misuse of data.

One of the most significant fields of development in the future will be scalability. Ethereum currently experiences high gas costs and slow transaction rates, making interactions costly and at times annoying. But with developments such as Ethereum 2.0 and layer-2 scaling solutions (Polygon, Optimism, Arbitrum), the cost of transactions may significantly reduce, making decentralized social media that much more practical for use on a large scale. Another intriguing opportunity is enhanced user experience. As of now, it may be difficult for users who are not technical to get a Web3 wallet and store private keys. Future platforms can simplify this process with straightforward wallet integrations and intuitive interfaces, and blockchain social media as effortless as social media today.

Monetization models will be altered, too, and to the advantage of consumers and creators. Unlike centralized social media sites that get humongous checks for advertisements on behalf of companies, decentralized social media sites can potentially introduce more

even methods for users to get paid. In tokenized rewards, NFTs, and crypto-enabled tipping, content providers would get paid in a direct manner by their patrons rather than from ads.

5. RESULTS

Our project offers is an prototype model of a decentralized social media platform build over Ethereum. Everything that's necessary for a social media platform, from posting to liking, commenting to sharing, and even looking at profiles, is possible from a user's side. For every post a user makes, there's a small reward in Ethereum given to him/her, which keeps users engaged on the site.

The posts made by users appear on the homepage, making it easy to explore recent content. We've focused on keeping the interface simple and user-friendly, so even those new to blockchain can use it without much confusion. The login system is handled through MetaMask, and all the content is stored on IPFS, while smart contracts take care of the interactions like posting and liking. Whileit is not a final product yet, this prototype has successfully demonstrated that a decentralized social network can be functional in real-world usage, putting more power and advantages into the hands of users compared to a central corporation.

Fig 5.1: Home Page Screenshot

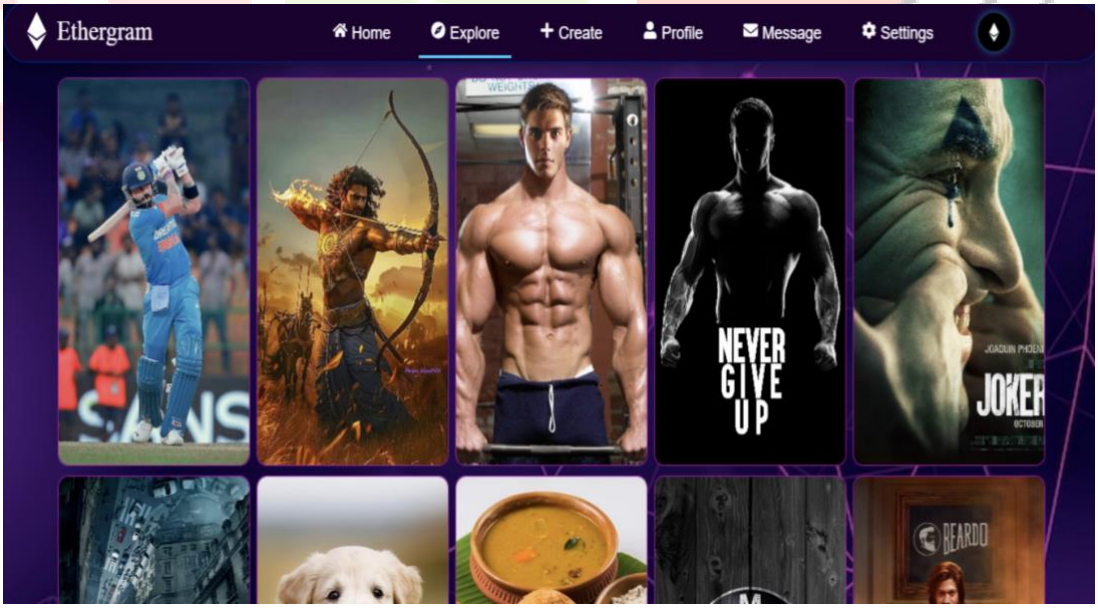

Fig 5.2: Explore Page Screenshot

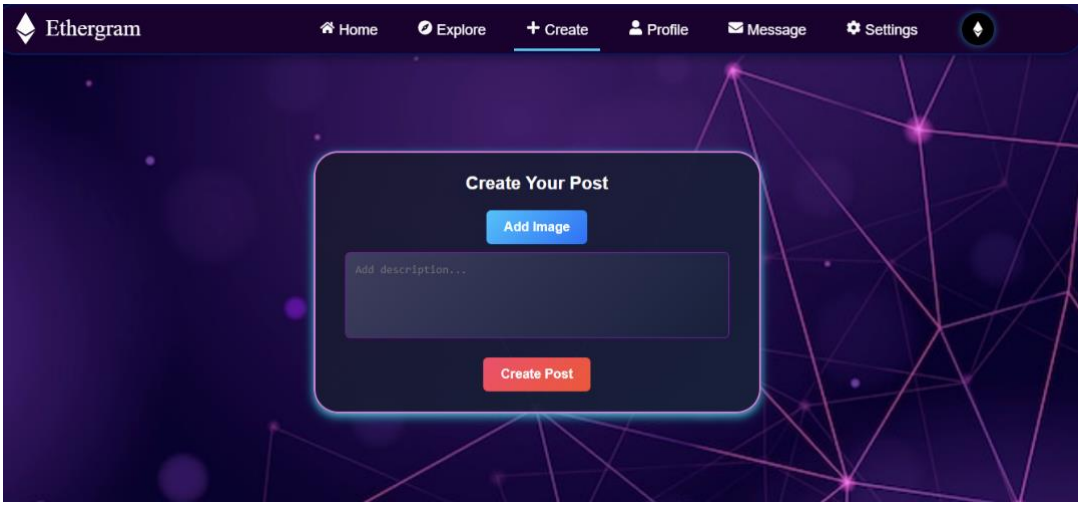

Fig 5.3: Create Page Screenshot

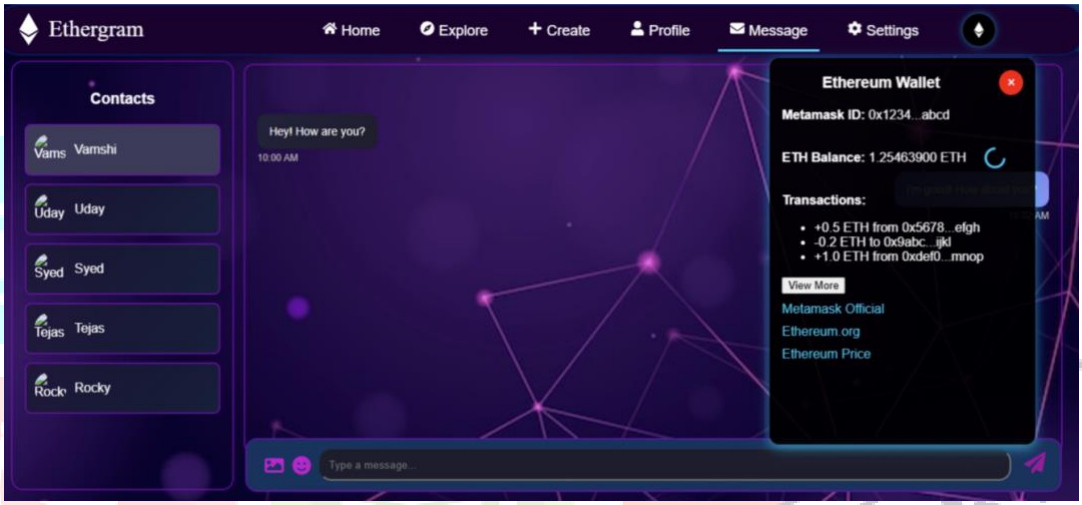

Fig 5.4 : Ethereum wallet screenshot

CONCLUSION

Ethereum-based Decentralized Social Media Application provides censorship resistance, freedom of speech, and data ownership because it eliminates the centralized authority. By leveraging Ethereum smart contracts, users are able to secure their content, interactions, and monetization without third-party involvement. Decentralized storage networks like IPFS or Arweave prevent data loss and tampering, ensuring content longevity. Wallet-based authentication improves privacy and moves away from traditional login systems, making it more secure. The platform allows direct monetization through crypto payments, with creators able to earn decently without third-party commissions.

DAO-based community governance guarantees transparent and open decision-making and user contribution to platform building. Decentralized indexing gives power to fair, unbiased content discovery, reducing algorithmic control. Layer-2 scaling solutions make transactions cheaply and efficiently with improved access to the platform. The platform natively interoperates with Web3, metaverses, and blockchain environments for future technology integration. As a whole, this project offers an open, transparent, and user-driven social networking experience, setting the tone for digital interaction in the future.

REFERENCE

1. Christos Aslonglou, Nikos chondros, Mema Rousspolus. "A Decentralized connectivity service for private social apps ". IEEE Xplore July 22 3024
2. Julian Marx, Marc Cheong,"Decentralised Social Media: Scoping Review and Future Research directions".Australasian Conference on Information Systems 2023, Wellington

3. Shuai Zeng1,2,4, Yong Yuan1,2, Fei-Yue Wang1,"A Decentralized social networking architecture enhanced by blockchain". Published in IEEE Xplore , 12 may 2019
4. Seong, Seok-Won, et al. "a decentralized social networking infrastructure." Proceedings of the 1st ACM Workshop on Mobile Cloud Computing & Services. ACM, 2010
5. Hassan Khan, Rajput Jawwad, Amaan Chhaprar. "Decentralised Social Media Application".International Journal of Scientific Development and Research (IJSDR).
6. Dr. Vishal Khatri, Aman Sharma, Hritik Kaushik, Chandrabhanu."DWITTER: A DECENTRALIZED SOCIAL MEDIA PLATFORM". A survey Online Soc. Netw. Media 2017
7. Tejasurya Siddhartha, Raj Animesh, Yvan Christ. "Impact of Blockchain on Social Networking Sites".ICONIC RESEARCH AND ENGINEERING JOURNALS April 2023
8. Shu, K.; Sliva, A.; Wang, S.; Tang, J.; Liu, H. Fake News Detection on Social Media: A Data Mining Perspective. SIGKDD Explor. Newsl. 2017, 19, 22–36.
9. Kaur, S.; Chaturvedi, S.; Sharma, A.; Kar, J. A research survey on applications of consensus protocols in Blockchain. Secur. Commun. Netw. 2021, 2021, 1–22.
10. Thakur, S.; Breslin, J. Rumour prevention in social networks with layer 2 blockchains. Soc. Netw. Anal. Min. 2021, 11, 104.