**Revolutionizing Ethereum**

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# ABSTRACT

Ethereum is a blockchain platform that allows developers to develop dApps and implement smart contracts, made by Vitalik Buterin in 2015, and has since become one the most popular blockchain platforms. It is the blockchain with the biggest community of developers and users, that has given up on its fundament of being decentralized and is falling into the hands of big MNCs who are becoming the oligarchs in the space. Core problems like high storage costs on the chain and validator nodes stacking are being exploited to take control. The core developers with governance tokens continuously mutate the protocol and hard forking the chain, stopping the network from maturing. In this paper, we dive deeply into these problems and propose improvements and changes necessary to keep Ethereum from becoming equity and also talked about our future plans for the same.

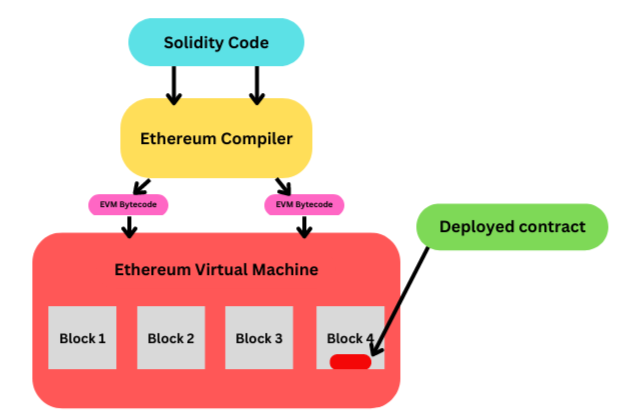
**KEYWORDS**

Decentralization, Ethereum Blockchain, Gas Fees, Smart Contract, Validators.

**1. INTRODUCTION**

Ethereum is a decentralized blockchain platform that helps in the formation of smart contracts and dapps. However, like all blockchain systems, it is not immune to specific problems and challenges. Centralization of mining power, growing complexity of the code, and difficulty in smart contracts are among the main challenges the platform faces. The existing solutions are not capable of handling private and confidential data as well as other specific business requirements. Furthermore, becoming a validator has a high cost of entry. [1]

This paper aims to propose solutions to these problems by analyzing them to make Ethereum more stable and secure. The submitted paper looks to solve the issues in the Ethereum by studying the existing problems and analyzing the issues and their impact on the current market. The paper then describes what current solutions have been implemented and their shortcomings, which will help create new solutions. There is a need for further work on the Ethereum blockchain to improve its ability to scale and reduce gas costs and increase transaction throughput. The proposed research aims to take the following steps toward scalability by Developing a new approach to state channels, The paper also discusses the issues around governance, including the need for incentives for validators and the problems with conflicting interests when developing solutions requiring coordination across all network nodes. It further analyzes potential solutions to these problems by proposing different mechanisms through which nodes can be incentivized and ways to increase participation in governance decisions. Finally, the paper concludes by describing how the proposed work can be implemented on top of existing Ethereum infrastructure and how it could scale the current system to support billions of daily transactions.



**Fig.1** shows the working architecture of Ethereum.

**2. RELATED WORK**

Many solutions have been proposed to address the scalability, cost, and decentralization challenges facing the Ethereum blockchain. Here are a few examples:

Off-chain transactions: Off-chain transactions, also known as state channels, allow users to transact directly with each other without the need to broadcast every transaction to the entire network. This can increase the speed and efficiency of transactions and reduce gas costs.

Buterin, Vitalik [1] , This whitepaper talked about the main idea behind Ethereum. The primary goal of Ethereum is to create a cover protocol for building decentralized operations and to provide an indispensable set of tools that can be used for a range of decentralized operations.

C. T. Nguyen et al . [2], This paper is devoted to studying PoS mechanisms, from basic to advanced PoS based protocols, as well as analyzing applications, especially in the vehicular Internet segment.

Gencer, Adem Efe, et al [3] This research paper presents an analysis of the two most popular Blockchain Bitcoin and Ethereum. Small miners earn more than big miners in Ethereum due to their high frequency.

Praitheeshan, Purathani, et al. [4], This paper mainly discusses some of the issues concerning the masses. They charted 16 vulnerabilities and 19 software security issues.

Zhou, Liyi, et al. [5], In this paper, authors focuses on combination of front and back-running for a single Decentralized exchange (DEX) in short.

T. Krupa et al . [6], Here authors have focused on the matters of smart contracts. They provided the necessary information and an introduction about Ethereum and Solidity, 'the smart contract language' runs on the Ethereum blockchain, with insight into code issues.

Chen, J et al. [7], authors have conducted an empirical study on Ethereum smart contract maintenance issues in this paper. They also conducted an online study to confirm the research questions.

S. Nakamoto. [8], This paper presents a resolution to the issue of double-spending by using a peer-to-peer network, enabling direct online payments between parties without the need for a financial institution's involvement.

Z. Wang et al. [9], This paper conducts a comprehensive review of previous research conducted between 2015 and 2019, focusing on the security of Ethereum smart contracts. The authors specifically examine the potential for malicious exploitation of smart contracts and summarize the existing efforts in this field.

S. S. Kushwaha et al. [10], The main objective of this paper is to provide a review of the analysis tools available for Ethereum smart contracts. By presenting certain categorization, the paper aims to offer a valuable resource for researchers and practitioners interested in analyzing Ethereum smart contracts.

A. A. Monrat et al. [11], The primary focus of this paper is to present a comparative study of blockchain technology. It explores and analyzes the different aspects of blockchain, including its taxonomy and architecture. Additionally, the paper highlights the potential future scope of blockchain technology. By examining these areas, the paper aims to provide valuable insights into the current state and future possibilities of blockchain technology.

S. Rouhani et al. [12], The motive of this paper is to investigate Ethereum transactions and analyze the performance of the two widely used Ethereum clients. By conducting this analysis, the paper aims to gain a deeper understanding of how different clients impact the overall performance of the Ethereum network. The study provides valuable insights into the comparative performance of Geth and Parity, shedding light on their respective effects on Ethereum transaction processing.

T. Ahram et al. [13], In this paper, the authors talk about how Blockchain technology is revolutionizing the digital world by offering security, resiliency, and efficiency of systems.

Q. Lin et al. [14], In this paper, the author has presented comparative studies and analysis of decentralization in the two most effective cryptocurrency blockchains, which are Bitcoin and Ethereum.

C. Schwarz-Schilling et al. [15], In this paper, researchers have discovered several hacking attacks that can be done by validators on the Ethereum blockchain in order to increase their profit.

**Table 1.**  Shows the table of Literature review

|  |  |  |
| --- | --- | --- |
| Ref.no / Year | Techniques | Applications |
| [1] V.Buterin (2014) | Smart Contracts, Decentralized Application Platform | Development of smart contracts and decentralized applications |
| [2] Nguyen et al. (2019) | PoS Mechanisms | Exploring the Potential and Limitations of PoS Mechanisms |
| [3] Gencer et al. (2018) | Decentralization in Bitcoin and Ethereum | Analysis of the degree of decentralization in Bitcoin and Ethereum networks |
| [4] Praitheeshan et al. (2019) | Smart contract security | Survey of security analysis methods for Ethereum smart contract vulnerabilities |
| [5] Zhou et al. (2021) | high-frequency trading on on-chain exchanges | Analysis of high-frequency trading on decentralized on-chain exchanges |
| [6] Krupa et al. (2021) | Security Issues in Ethereum Smart Contracts | Examines various security issues of smart contracts in Ethereum platforms and proposes possible solutions |
| [7] Chen et al. (2021) | Maintenance for Ethereum Smart Contracts that are Post deployed | Analysis of maintenance issues for post-Ethereum smart contract development |
| [8] S.Nakamoto (2008) | Bitcoin as electronic cash | This introduces the concept of Bitcoin as a P2P electronic cash system. |
| [9] Z. Wang et al. (2021) | Smart contract security research | Developing secure smart contracts |
| [10] S. S. Kushwaha (2021) | Smart contract analysis tools | Analyzing smart contracts for security and functionality |
| [11] A. A. Monrat et al. (2019) | Study of the blockchain technology | Overview of blockchain technology and Its Uses |
| [12] S. Rouhani et al. (2017) | Performance analysis of Ethereum transactions | Analyzing the performance of Ethereum transactions in private blockchains |
| [13] T. Ahram et al. (2021) | Blockchain technology innovations | Overview of new and innovative uses of blockchain technology |
| [14] Q. Lin et al (2021) | Assessing Decentralization in Bitcoin and Ethereum | Analyzing as well as comparing the decentralization of Bitcoin and Ethereum |
| [15] C. Schwarz-Schilling (2022) | Attacks on Proof-of-Stake Ethereum | Analyzing and identifying vulnerabilities in the Proof-of-Stake consensus mechanism of the Ethereum |

**3. METHODOLOGY**

Ethereum has some major projects going on under its belt which can revolutionize the way that we interact with the world around us.

* Azure Active Directory: A cloud-based identity and access management (IAM) service that helps organizations to manage their users and devices. Microsoft is using Ethereum to develop a decentralized identity platform that will allow users to store their identities on the blockchain. This can help to improve security and reduce fraud.

One of the main benefits of using a decentralized identity platform is that it can help to reduce the risk of identity theft. When users store their identities on the blockchain, they are not giving their personal information to a central authority. This makes it more difficult for hackers to steal their identities.

Another benefit of using a decentralized identity platform is that it can help to improve the user experience. When users have their identities stored on the blockchain, they can use them to access a variety of different services without having to create new accounts or remember multiple passwords.

* Intel Sawtooth Lake: Sawtooth Lake is a blockchain-based supply chain management platform that is being developed by Intel. Sawtooth Lake allows businesses to track the movement of goods and to ensure that products are authentic. This can help to reduce fraud and improve efficiency.

Using a blockchain-based supply chain management platform can help to improve transparency. When businesses track the movement of goods on the blockchain, providing their customers with information in real time about their products. This helps build relationships with your customers..

Another benefit of using a blockchain-based supply chain management platform is that it can help to reduce fraud. When businesses track the movement of goods on the blockchain, it is more difficult for counterfeiters to introduce fake products into the supply chain. This can help to protect businesses from financial losses.

**4. UNDERSTANDING AND ANALYSING THE PROBLEMS**

**4.1 Proof of stake leading to centralization**

One issue that has been widely discussed in the context of Ethereum is centralization. Despite being designed as a decentralized system, certain aspects of Ethereum's infrastructure and governance are controlled by a small group of individuals or organizations. Additionally, the mining of new blocks on the Ethereum network is primarily controlled by a small number of mining pools, which could give them outsized influence.

Another issue raised about Ethereum is the control of large multinational corporations (MNCs). Some have argued that MNCs could use their resources and influence to gain a dominant position in the Ethereum ecosystem, potentially leading to a concentration of power and undermining the platform's decentralized nature. The below image shows that 68% of Ethereum nodes are hosted and running on AWS. This looks highly concerning as it goes against the decentralization narrative in Ethereum.[2]

A picture containing diagram

Description automatically generated

**Fig. 2** The chart is provided by Ethereum.org [22]. It shows that 68% of Ethereum nodes are hosted and running on AWS

**4.2 High costs for joining and using the network**

According to the Ethereum Foundation, the merger will go from the present proof-of-work mining model, which uses a lot of energy to run the mining rigs that process transactions, to a PoS consensus mechanism, which is anticipated to consume over 99% less energy.

When the Ethereum mainet makes that transition, it'll be validators, not miners, who verify transactions and add them to the blockchain. However, becoming a validator invites several hazards and a hefty entry fee. To become a validator and maintain hardware and software to avoid downtime fines, investors need to deposit 32 ETH in collateral (worth around $52,000). Staking pools have developed as a result [19].

**4.3 High storage cost and gas fees**

According to a survey done by Albert Palau in 2018, it requires $4,444 to load the 1MB of stored data and $44,443 to hold the 1MB of data on the Ethereum blockchain [17]. This makes storing data permanently on Ethereum extremely expensive. According to the founder of Ethereum, transaction fees should be around $0.05 to $0.06. But as we can see in the graph, the transaction fees are approximately $50 to $60 in 2021-22 and reached as high as $200.



**Fig. 3** The graph is provided by Etherscan.io [21] which shows the transaction fees of Ethereum from Feb 7 2021 to Dec 31, 2022.

Lucrative placement of scalable smart contracts is an important issue for developers to address. The investors have to deal with challenges from many points contributing to deals that, if left unchecked, could lead to a serious global environmental crisis. [23 citation is from students/faculty of Chitkara University.]

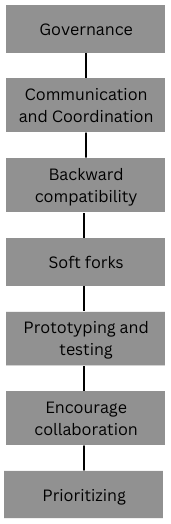
**5. SOLUTIONS**

**5.1 High Node Charges**

One solution to reduce Ethereum validator node charges is to use a more cost-effective hosting provider or cloud service. This can be achieved by shopping for the best deals and negotiating lower prices with providers. Another solution is to optimize the validator node's hardware and software configuration to minimize resource consumption and reduce costs.

**5.2 Constant hard forking**

Constant hard forks can be disruptive to a blockchain network and can lead to confusion and mistrust among users and developers. Ways to avoid endless hard forks in a blockchain network like Ethereum:

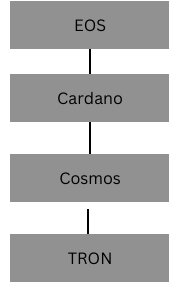


**Fig.4** shows the points to avoid endless hard forks in a blockchain network like Ethereum.

* Governance: Having transparent and well-functioning governance can help ensure important decisions about network upgrades are made
* Communication and Coordination: Communicating and coordinating changes and upgrades with the community can help minimize the need for hard forks.
* Backward compatibility: This can help ensure that old systems can continue to function and avoid hard forks.
* Soft forks: Soft forks can be used to introduce new features or upgrade protocols. Soft forks mean that old versions of the software can continue to function on the updated blockchain.
* Prototyping and testing: Testing the changes with users and developers before they are implemented can reduce the bugs or unexpected behavior.
* Encourage collaboration: By fostering cooperation between developers, users, and stakeholders, it's more likely that proposed changes will have broad support.
* Prioritizing: Prioritizing significant changes over less important or less urgent ones to avoid unnecessary hard forks.

**5.3 Ethereum alternatives**

There are several projects that aim to address the challenges and limitations of Ethereum or to provide an alternative platform for decentralized applications and smart contracts. Here are a few examples:



**Fig.5** contains some of the alternatives for the Ethereum

* EOS: it is a decentralized operating system that provides developers with a platform to build and deploy decentralized applications. The algorithm used by Ethereum uses a consensus algorithm called delegated proof-of-stake (DPoS) to work faster and more efficiently than proof-of-work (PoW)..
* Cardano: Cardano is a blockchain platform that utilizes a PoS algorithm called Ouroboros. It is planned to be more scalable and secure than other PoS systems and aims to support applications, including smart contracts and decentralized applications.
* Cosmos: independent decentralized system, scalable and compatible blockchains. It aims to provide a platform to build scalable and secure decentralized applications and enable the interoperability of different blockchain networks.
* TRON: TRON is a decentralized open-source protocol that aims to create a global free content entertainment system. It utilizes a PoS consensus algorithm called TPoS, and is designed to be highly scalable and is capable of processing a high volume of transactions.

Currently, there are several problems related to blockchain technology, such as high energy consumption, slow processing speed, and lack of expertise. As a result, only a few organizations use their power. There is a need for lightweight consensus algorithms to overcome problems such as high energy consumption and low processing speed [24 citation is from students/faculty of Chitkara University.]

**6. CONCLUSION**

An essential introduction to the Ethereum platform and its working with an all-inclusive understanding of issues and ways to mitigate them and also a brief outline and analysis of issues in the Ethereum working mechanism is provided in this paper. We also proposed the solutions for the issues discussed and presented the possible solutions.

In this paper, We mainly focused on the detailed analysis of problems in the Ethereum working mechanism and possible solutions for the issues. In future work, we plan to simplify our focus on implementing the solutions. We hope our advice will help to make Ethereum more reliable and secure.

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