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Original Article

Decentralized Crowdfunding on Blockchain: A Promising Path to Sustainable Economic Growth

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Abstract *- Blockchain and decentralized technologies, in alignment with Sustainable Development Goal 8, enhance traditional economic interactions. Crowdfunding helps stabilize the financial system by diversifying and broadening the loan market while also fostering long-term entrepreneurship, a key driver of global economic growth. This work aims to identify inconsistencies in the crowdfunding market and eradicate them by combining smart contracts in a trustless decentralized application built on Ethereum – an open-source Blockchain. The proposed technique highlights the potential of decentralized crowdfunding applications to minimize market inefficiencies by eliminating third parties and simplifying transactions on secondary marketplaces. With state-of-the-art Blockchain technology, the implementation results have demonstrated promising results in achieving the stated objectives.*

Keywords *- Crowdfunding, Blockchain, Decentralization, Economic growth, Ethereum, Sustainable Development Goals.*

1. Introduction

Crowdfunding can be defined as a novel method for funding various innovations, allowing independent owners of for-profit, cultural, or social projects to request funding from the population, mainly in return for equity or rewards [1]. Modest artistic undertakings to investors seeking large sums in seed funding as an alternative to conventional venture capital investment can all benefit from potential donors.

Crowdfunding provides broader economic benefits, such as fulfilling the financial requirements of projects and campaigns, which are overlooked by traditional financial organizations. It can help early-stage start-ups to surmount huge financial gaps. It can help stabilize the financial system by diversifying and broadening the credit market, at the same time holding up the financing of long-term entrepreneurship [2]. Thus, crowdfunding fosters financial inclusivity, empowering communities to address decent work and economic growth in alignment with Sustainable Development SDG 8 by the United Nations [3]. Many crowdfunding platforms use a central server and third-party payment services regulated and controlled by central authorities to collect the funds. The transactions made using the funds are not made public, and there is no way to trace the funds after the funders have made the donation. The central authorities that control the platform take a percentage of funds for every donation that is being made and have complete control of the funds. The lack of transparency has led to many frauds and demoralizes the funders to invest in crowdfunding campaigns.

The primary objective of this research is to eradicate the misuse of crowdfunding platforms and provide a safe and easy process for crowdfunding. This is done by designing smart contracts that provide transparency and give control of the funds to the contributors by democratizing the funding process. It also makes the process of crowdfunding trustless and available for anyone to use.

Blockchain facilitates peer-to-peer models with trustless interactions. These two goals are directly related to crowdfunding. The major drawback of the traditional digital currency is its reliance on trusted third-party services to solve the double-spending problem and certify the value of the currency. Satoshi Nakamoto's Bitcoin protocol solved the problem of double-spending. It proposed a cryptography-based mechanism that uses digital signatures with unique falsifiable notes and a proof-of-work consensus mechanism running on a distributed public ledger [4]. Cryptocurrency represents only a tiny part of the applications of Blockchain technology. The potential of Blockchain in social and economic values remains to be uncovered in other advanced applications of Blockchain. Blockchain technology has progressed from cryptocurrencies to more flexible infrastructures that enable an infinite range of applications. The principal tool of these ecosystems is smart contracts. A smart contract is a computer protocol for digitally facilitating, verifying or enforcing contract negotiation and performance. Smart contracts enable the execution of trustworthy transactions without the involvement of a third party.

By implementing smart contracts with all the necessary constraints and requirements of a real crowdfunding platform, we can create a trustless, decentralized, autonomous crowdfunding platform that can replace traditional intermediaries and platforms. Ethereum is a Blockchain that facilitates writing smart contracts through a Turing-complete programming language and publishing them on any Ethereum public or private network. This will enable developers to create decentralized applications with their ownership, transaction formats, and state transition functions [5]. Decentralized applications (Dapps), an extension of smart contracts, are central to the Blockchain economy. Researchers have defined a firm as just a "nexus of contracts." Blockchain-based "smart" contracts will eventually reinvent the firm. In our work, we discuss the design of smart contracts for donation-based crowdfunding and equity-based crowdfunding. By designing smart contracts, we also propose a framework to create smart contracts for crowdfunding.

The contributions of the proposed work are as follows:

1. Existing crowdfunding platforms do not focus on giving the contributors any control over the transactions and have no transparency over the donated funds. Our proposed smart contracts overcome this by democratizing the spending process and providing complete transparency of funds by making transactions on Ethereum.
2. The work presents the design of smart contracts for managing donation-based crowdfunding campaigns that can meet the diverse requirements of users.
3. The work further proposes the design of smart contracts for equity-based crowdfunding, in which we discuss creating a voting system using snapshot-based ERC20 tokens, which prevents double spending of tokens.

This paper is organized as follows: Section 2 summarizes the existing work related to crowdfunding platforms based on decentralized applications. Section 3 presents the Donation-Based and Equity-Based crowdfunding approaches for developing the application. Experimental results that demonstrate the performance of the proposed smart contract design are stated in Section 4. The conclusion and future scope of work are discussed in Section 5.

2. Related Work

Hartmann, Grottolo, Wang, and Lunesu [6] shed light on the success factors for Blockchain-based crowdfunding and traditional crowdfunding. The paper highlights the three different types of tokens that reflect their characteristics, i.e., Utility-type, payment-type, or investment type. The paper lists thirteen various factors and their significance that determine the success of a crowdfunding campaign, namely company characteristics, strong partners, strong early adopters, project innovativeness, project stage, team composition, team experience, founder dedication, social media traction, campaign design, campaign traction, white paper quality, campaign transparency.

These factors help better understand distinctive success factors for Blockchain-based crowdfunding. Experimental and verifiable studies are required to validate and measure the effect of each factor defined. The lack of transparency in donation-based crowdfunding systems can be solved technically using Blockchain-based crowdfunding systems. Baokun Hu He Li [7] discusses the smart contract structure and architecture of a Blockchain-based charity system with a mode of operations to enforce transparency. Zhao, Hongjiang, and Coffie [8] explain the difficulties with crowdfunding in regard to misuse, trust, secrecy, and accountability, as well as how the usage of Blockchain technology in crowdfunding contracts might give a much-needed answer. They have put forward a conceptual framework to help overcome the problems related to crowdfunding using Blockchain technology.

Khan and Ouaich [9] elucidate the functional architecture of Zakaah dapp with the design goal of transparency, auditability, and security. In Zakaah, the donor and the charities register through the smart contract. The donors have to purchase Zakaah coins by transferring cash to the Bank of Waqf. Data and experiment-driven distributed Ethereum application (Zakah) was created as proof of work. However, this decentralized donation-based crowdfunding lacks equity-based crowdfunding, a more practical approach for funding innovative ventures. Hassija, Chamola, and Zeadally [10] have proposed an iterative auction algorithm for cost-optimal project assignments in a crowdfunding environment. Their proposed system eliminates any manual negotiation between investors and developers for the project's parameters. The numerical analysis results demonstrate that the proposed algorithm could satisfy all the desired properties and improve both the investor's revenue and the developer's project assignment compared to other existing approaches.

Entrepreneurs urge individuals to either pre-order the product or advance a certain amount of money in exchange for a share of future profits (or equity), according to Belleflamme, Lambert, Schwienbacher [11]. They also mention that the entrepreneur favours pre-ordering if the initial capital required is little compared to the market size and profit-sharing if the first capital requirement is large. The work presented by Nikhil and Sarasvathi [12] describes a solution to tackle the drawbacks of centralized crowdfunding platforms by using Blockchain and Ethereum. The authors democratize the decision of spending the contributions using Ethereum, which has a voting system for every spending request the campaign manager has made. This work discussed only one type of crowdfunding, i.e., Donation-Based Crowdfunding. Kapsoules et al. [13] discuss how Know Your Customer (KYC) processes depend on identity management and serve as a building block for anti-money laundering efforts by financial institutes. The Blockchain approach to identity management does not offer full-flavored identity management functionality and possibilities to interact with third-party off-chain services.

As an increasing number of applications in financial technology are being implemented on Blockchains, KYC processes are quintessential for coupling valid identity management with privacy-preserving techniques to comply with regulations such as the General Data Protection Regulation (GDPR). Joo, Nishikawa, and Dandapani [14] have discussed how an Initial Coin Offering (ICO) can be a better option than an Initial Public Offering (IPO) in terms of costs, duration, and ease of process. ICO provides better audiences due to its global nature. The paper also draws attention to the general public and policy-makers to more effective regulation. The paper provides a comprehensive review of ICOs and a comparison of ICOs and IPOs.

WeiFund is another example of a crowdfunding platform on an Ethereum Blockchain. It is beneficial for launching tokens that are utilized for novel applications. It uses smart tokens by returning the contributions with refunds if the campaign goal is not met—with the help of customizable hooks to supply tokens to contributors as necessary. However, it does not provide any mechanism for decision-making or democratizing the process of spending funds locked in the contract [15].

Pierluigi, Ferro, and Moncada [16] have suggested a morphological token categorization framework that has the mission of offering a tool for the detailed and thorough description of a token, covering the gaps of other frameworks that are now accessible. Li, Wu, Pei, and Yao discuss that tokenization solves the liquidity problem of real-world assets that cannot be quantified. They also discuss the open asset protocol (OAP) and have applied OAP to insurance and instanced Policy-backed tokens [17]. Despite these contributions by various researchers, designing smart contracts for managing donation-based crowdfunding campaigns that can meet the diverse requirements of users remains an open issue, which is addressed in this work.

3. Proposed Approach

The ideal design for smart contracts should be able to maintain the decentralization of the power in campaigns. It should require no regulation or intervention in creating campaigns, donating to campaigns, and spending funds from the campaigns. The system should be able to verify the legitimacy of the campaign manager and the campaign without any human intervention and prevent the campaign manager from spending the campaign funds for personal use. The proposed approach for donation-based and equity-based crowdfunding is presented in the forthcoming sub-sections.

3.1. Proposed Approach for Donation-Based Crowdfunding

For Donation-Based crowdfunding, there are three types of users: the Campaign Manager, Donors, and Vendors. The campaign manager creates a campaign through the platform; Donors learn about the projects and donate. The campaign manager creates a spending proposal to spend any amount of money that has been donated. The donors vote on whether a spending should be done, and finally, if a particular spending request has more than 50% votes, the campaign manager can finalize the proposal. The transaction occurs when the money is sent to the vendor.

After completing the KYC process, the campaign manager creates, views, and monitors a campaign. The campaign manager is provided with a contract address and other administrative rights for the campaign. The campaign manager can create a spending proposal, finalize it, and send money to the vendors based on the votes acquired by the donors. The ownership of the campaign can also be transferred with its campaign manager's approval. The donors can view all the campaigns and their details, including the total donations made, the campaign manager's address, and all the spending requests. The donors can only vote for the spending requests if they have contributed to the campaign.

Vendors have to go through the KYC process to get verified. The campaign manager can only add verified vendors as recipients while creating the spending proposal. Every Donation-based crowdfunding proceeds in two phases: Crowd Sale and Decentralised Autonomous Organization (DAO). After the campaign is created, the crowdsale collects donor funds. The crowd sale has a deadline, a funding goal, and a funding cap. The funding cap is the minimum donation required to earn voting rights. The campaign manager can forward the funds to the DAO if the funding goal is reached. If the crowd sale fails, the donors can withdraw the donated amount. Figure 1 depicts the proposed approach for donation-based crowdfunding. In our work, we implement a democratized DAO with a direct voting system for every fund transfer proposal with predefined voting rules determined by the organization's manager. Every spending proposal has a recipient, the amount to be spent, the description, the proposal hash, the time period for voting, and the minimum number of donors that should vote. The donors are required to vote within the time period specified by the campaign manager. The weight of each vote of the donors would be decided by the amount of each donated. The proposal hash helps keep track of the integrity of the information and documents presented while creating the spending proposal.

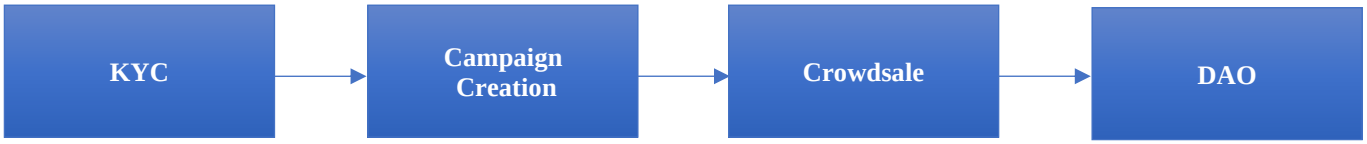

Fig. 1 Proposed Approach for Donation-Based Crowdfunding

3.2. Proposed Approach for Equity-Based Crowdfunding

Equity-based crowdfunding is a method for individuals, start-ups, and corporations to raise funds from a large pool of investors in exchange for shares of a respected organization. Organizations offer company tokens to potential investors in exchange for financing. Equity-based crowdfunding is a superset of donation-based crowdfunding and includes all the features of donation-based crowdfunding explained in the former half. The structure of DAO in equity-based crowdfunding varies from donation-based to two phases: tokens and a voting system. The proposed design of the DAO contract meets the diverse requirements of organizations. The entire flow of equity-based crowdfunding is explained in Figure 2. Tokens - Initial Coin Offering (ICO) is a method of raising funds by an organization in exchange for services or company securities. It is an asset distribution method in the form of a token on a decentralized, peer-to-peer network. Tokens can virtually represent anything on Ethereum, such as a company's financial assets and digital currency. Tokens are bound to a specific private key and can be exchanged just like other cryptocurrencies. Token holders can trade these tokens on parallel markets. After every successful funding campaign, the funders would be given tokens in return for equity-based crowdfunding. These tokens follow the ERC20 standard, and the funders can exchange these tokens with other users on secondary markets. The number of tokens owned by the funder for a particular campaign represents the voting power of the funder for spending proposals that would be created in the respective campaign. This process happens in the crowd sale phase of equity-based crowdfunding, as seen in Figure 2.

In the DAO and Investor Relations phase, crowdfunding DAO plays a central role. Investments are not directly transferred to the entrepreneur but are held by the DAO contract instead. This contract manages money flow and the rights interactions between contributors. DAO design predefines rules such that the entrepreneur's investment access depends on the right holders' decisions. The voting system in an equity-based crowdfunding system differs from a donation-based one. Implementing the voting system on donation-based crowdfunding is quite simple, as there are no transfers of voting rights between donors. On the contrary, in equity-based crowdfunding, tokens represent the voting power of an investor, and these tokens are fungible. Fungible tokens are equivalent and interchangeable like fiat currencies, where one can exchange the same amount of currency, which would not affect the currency's value. Since these tokens can be exchanged, the problem of double-spending of tokens arises. There are three ways to implement the voting system to prevent the double-spending of tokens.

1. Pausable ERC20 Tokens: In Pausable ERC20 Tokens whenever the moderator of the DAO creates a proposal, the transfer of tokens is paused for that specific amount of time. Each proposal has a voting period; during that voting period, the transfer of tokens would be paused. Once the voting period has passed, the transfer of tokens will be resumed. This technique is very efficient in terms of time and space complexity and will reduce the gas fees required, but it is not practical to stop the exchange of tokens for every spending proposal.
2. Blockable ERC20 Tokens: In Blockable ERC20 Tokens, the transfer of tokens is allowed for all the wallets, but it is only restricted to the wallets that have cast their votes for any active proposal. These wallets will be blocked from transferring the tokens until the voting period has expired. This technique is also very efficient and will reduce gas fees, but impractical.

Snapshot-Based ERC20 Tokens: This Implementation of Snapshot-Based ERC20 Tokens extends the ERC20 with the support for the snapshot mechanism. When a snapshot is created, the total balances and token supply are recorded for future use at that instant in time. This implementation of ERC20 tokens can be safely used to create features based on the total token supply and balances of tokens for each wallet, such as dividends and weighted voting. In the standard ERC20 implementation, it is possible to double-spend the same tokens for voting by transferring them to different accounts. This problem of double spending can be eliminated by using snapshot-based ERC20 Tokens.

Whenever a snapshot is created, the total supply of tokens and the balance of each account is recorded. The creation of a snapshot is efficient and has a time complexity of O(1), and the retrieval of balances and the total supply of tokens can be done in O(log(N)) in the number of snapshots that have been created. A constant overhead for transferring tokens will be attributable to the additional accounting. This overhead would only be significant for the initial transfer of tokens that follows instantly after a snapshot. The successive transfer would have a normal cost until another snapshot is created. Fig. 3 describes the data structure used for storing snapshots for each address. Whenever a snapshot is queried for its balance, three possibilities are considered:

1. The balance of the wallet address was not modified after the snapshot was taken. Thus, the snapshot entry for the wallet address was never created for this snapshot ID, and consequently, all the snapshot IDs stored for this wallet address are smaller than the current snapshot ID. Hence, the value corresponding to the smallest ID is the current balance of the wallet address.
2. The balance of the wallet address was modified after the snapshot was taken. Thus, there will be an entry with the requested snapshot ID for the wallet address, and its value will be returned.
3. More snapshots were created after the requested snapshot ID, and the value of that wallet address was modified later. There will be no entry for the requested snapshot ID, and the balance of the wallet address can be queried by finding the upper bound for the current snapshot ID, i.e., The value corresponding to the requested snapshot ID will be the smallest snapshot ID that is larger than the requested one.

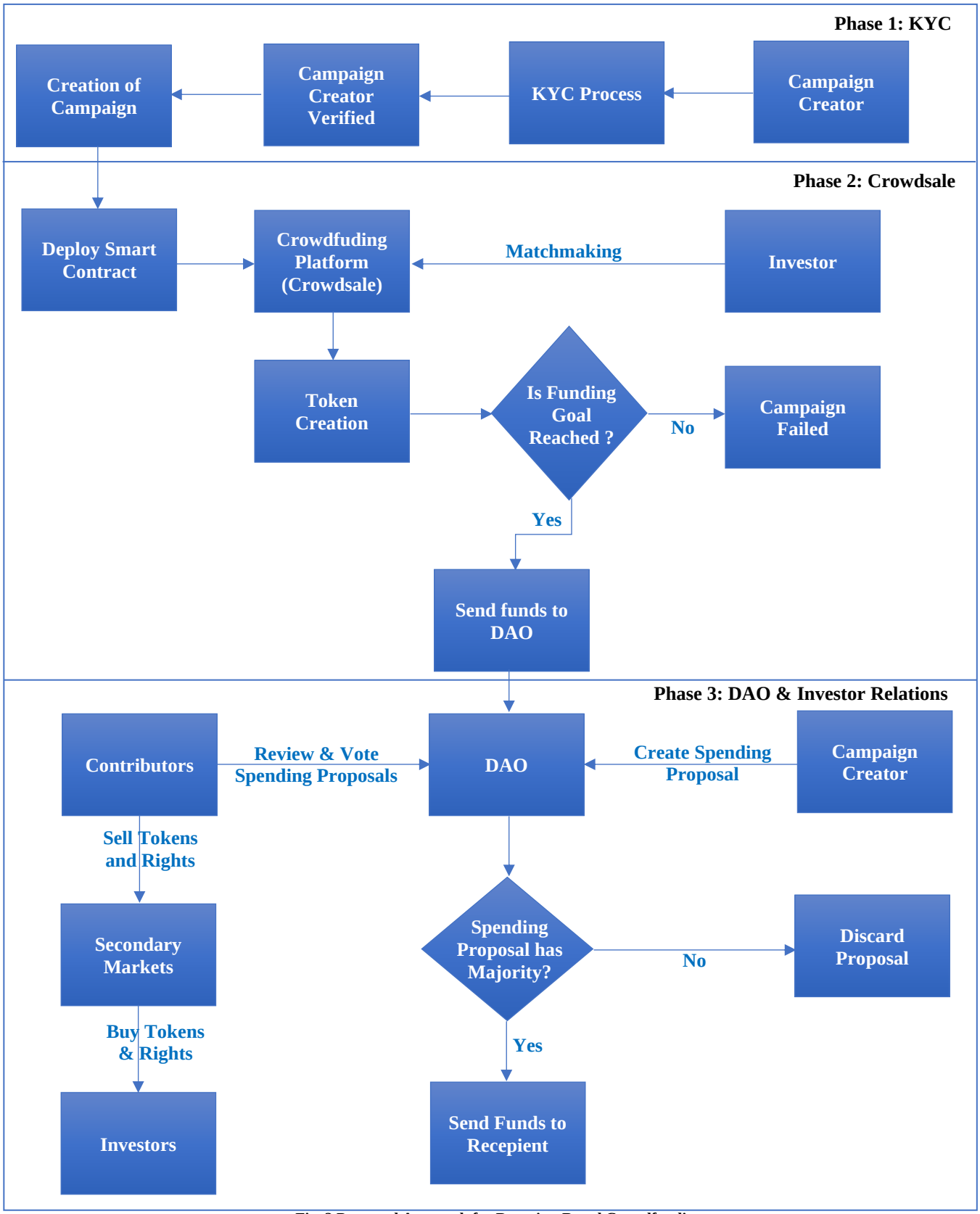

Fig. 2 Proposed Approach for Donation-Based Crowdfunding

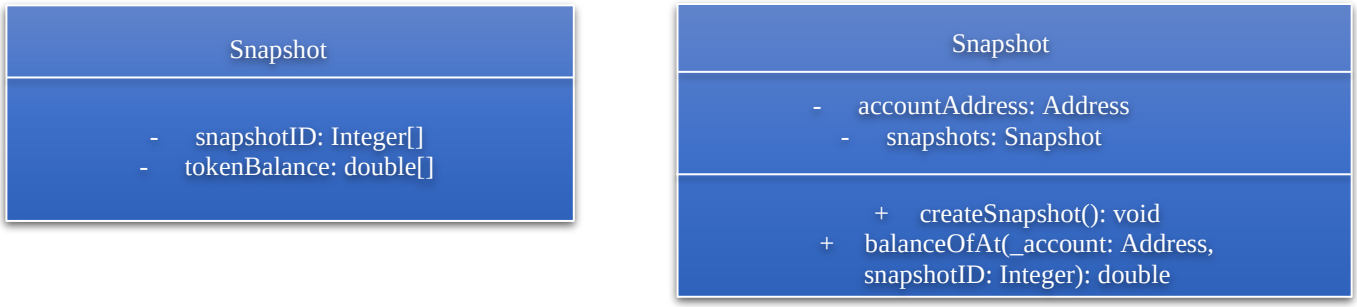

Fig. 3 Data structure for storing snapshots

Table 1. Test accounts

Account	Account Address	Balance (ETH)
Donor A	0xD5Cd74Db427944d5d2D34b6d04ED3c2d013dB0D	100
Donor B	0xD0c6932a43130a90cF3EAE1A4d011749b24c3A45	100
Donor C	0xF7acb284Afb239Fa48eE803d14E03B81d96e3fC0	100
Campaign Manager	0xf6d50505A959d2b60fC8CB6Fa8695094A85047c8	100
Vendor A	0x431A5F7577fC309280db79B230d4D5D43186b946	100
Vendor B	0xF95CAcB58d571D188B74eA7A0829F393ca368204	100

Table 2. Donation-based Campaign State

Attribute	Values
Campaign Manager	0xf6d50505A959d2b60fC8CB6Fa8695094A85047c8
Minimum Contribution	0.1 ETH
Number of Spending Proposals	0
Number of Contributors	0
Campaign Balance	0
Contract Address	0x354eC2d063718ec997178113C139409854Cb3d81
Debating Period	10 Seconds
Duration of Crowd Sale	1000 Seconds

Table 3. Equity-Based campaign state

Attribute	Values
Campaign Manager	0xf6d50505A959d2b60fC8CB6Fa8695094A85047c8
Minimum Contribution	0.1 ETH
Number of Spending Proposals	0
Number of Contributors	0
Campaign Balance	0
Contract Address	0x354eC2d063718ec997178113C139409854Cb3d81
Debating Period	10 Seconds
Duration of Crowd Sale	1000 Seconds
Token Price	0.1 ETH

Table 4. Contributions (Donation-Based Crowdfunding)

Donor	Amount (ETH)	Message	Remarks
Donor A	0.1	Success	-
Donor B	0.01	Failed	Less than minimum
Donor C	0.2	Success	-

Table 5. Contributions (Equity-Based Crowdfunding)

Donor	Amount (ETH)	Message	Remarks	Token Balance
Donor A	0.1	Success	-	1
Donor B	0.01	Failed	Less than minimum contribution	0
Donor C	0.2	Success	-	2

Table 6. Traditional Crowdfunding Approach versus Proposed Blockchain-Based Crowdfunding Approach

Parameters	Traditional Approach	Blockchain-Based Approach
Transparency of Transactions	×	✓
Eliminate Cyber Attacks	×	✓
High Availability	×	✓
High Liquidity	×	✓
Eliminate Systematic Risk	×	✓

4. Results and Discussion

This section presents the results of the implementation of the proposed approach. The smart contracts were tested on the local RPC network provided by Ganache. The contracts were written in solidity, and Truffle was used to compile, test, and deploy the contracts. A NextJS client-side application was created to interact with the deployed contract, and MetaMask was used as a wallet provider.

Table 1 displays the test accounts used to send the transactions while testing the contracts. Tables 2 and 3 displayed the state of donation-based and equity-based crowdfunding when they were created. Tables 4 and 5 describe the results of transactions that were done from the test accounts. In equity-based crowdfunding, tokens are assigned for every contribution that is made. Experimental results show that smart contracts achieve all the functionalities that were proposed with efficiency and precision.The traditional crowdfunding systems and blockchain-based crowdfunding systems are compared based on an analysis of all the parameters and presented in Table 6. The subsequent explanation and discussion explain the benefits of the proposed work for clarity.

1. Transparency of Transactions: Centralized platforms collect funds with the help of a third-party payment system, and these transactions are not public, whereas, in blockchain-based crowdfunding, all the transactions happen on the open distributed ledger and are visible to everyone. This also significantly reduces the chances of fraud and assures transparency in operations, which is a critical requirement for various applications.

2. Eliminate Cyber Attacks: Based on its core qualities of immutability, transparency, auditability, data encryption, and operational resilience, Blockchain potentially strengthens cyber security by securing and preventing fraudulent activities through consensus processes and detecting data tampering.

3. High Availability: The downtime of the Ethereum network is very low compared to the traditional central server managed by large tech companies in the world.

4. High Liquidity: The tokens made available to the users are easily tradable in the secondary markets. They are not bound to a particular exchange or platform; only the owner of the tokens can transfer them.

5. Eliminate Systematic Risk: A private key is required to create digital signatures to transfer the tokens by proving ownership of the tokens. These tokens cannot be controlled by governments or other central authorities as long as the private key is secure.

The analysis depicts the benefits and promising outcomes of the proposed work.

5. Conclusion and Future Scope

Establishing a decentralized crowdfunding application has a smorgasbord of benefits for society. In reality, its distributive nature is cost-efficient since, without mediators, transaction costs are minuscule; in addition to a trustless environment, asymmetric information hazards are limited.

Its real potential lies in decreasing the cost of capital and boosting economic growth by dispersing its value among the population. Insignificant entry and processing costs and ease in creating dapps should allow for broader acceptance. Cutting expenses improves access to financial tools and fills gaps left by the previous approach. The purpose of this study was to identify the inadequacies of the crowdfunding industry and fix them by merging smart contracts with smart property in a comprehensive and permissionless decentralized application. This has proven to offer a great potential to minimize inefficiencies generated by asymmetric knowledge, such as adverse selection, principal-agent issues, and moral hazards. These findings tackle investment-related risks and, hence, the possibility of decentralized crowdfunding apps to mitigate the cost of financing.

This paper illustrates the practical nature of solidity's programming language and proves by example that economic commodities can be decentralized with smart contracts. This has been accomplished by establishing an equity crowdfunding decentralized application that can be operated by any user attempting to support and manage equity funds. The study also examines several strategies to implement ERC20 Tokens for the decision-making process of DAO to enforce the voting mechanism.

The devised decentralized crowdfunding project employs a safe crowd-sale campaign tied to a decentralized

organization containing transferable equity shares, voting rights, and transparency of operations. Enhancing the efficiency of smart contracts and crowdfunding can be undertaken as further research and development.

More research is needed in analysing user behaviour and making smart contracts that complement the behaviour of investors and fundraisers. The DAO smart contract can be designed based on the needs and requirements of the current structure of organizations. A risk assessment system can be implemented to help investors make better judgments for investments based on prior transactions and the reputation of fundraisers.

References

[1] Alex Norta, Chad Fernandez, and Stefan Hickmott, "Commercial Property Tokenizing with Smart Contracts," *2018 International Joint Conference on Neural Networks (IJCNN)*, Rio de Janeiro, Brazil, pp. 1-8, 2018. [CrossRef] [Google Scholar] [Publisher Link]

[2] Ethan Mollick, "The Dynamics of Crowdfunding: An Exploratory Study," *Journal of Business Venturing*, vol. 29, no. 1, pp. 1-16, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[3] 17 Goals to Transform Our World, Sustainable Development Goals United Nations, 2022. [Online]. Available: https://https://www.un.org/sustainabledevelopment/

[4] Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System," *Bitcoin*, pp. 1-9, 2008. [Google Scholar] [Publisher Link]

[5] Andrew Urquhart, "Under the Hood of the Ethereum Blockchain," *Financial Research Letters*, vol. 47, 2022. [CrossRef] [Google Scholar] [Publisher Link]

[6] Felix Hartmann et al., "Alternative Fundraising: Success Factors for Blockchain-Based vs Conventional Crowdfunding," *2019 IEEE International Workshop on Blockchain Oriented Software Engineering (IWBOSE)*, Hangzhou, China, pp. 38-43, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[7] Baokun Hu, and He Li, "Research on Charity System Based on Blockchain," *IOP Conference Series: Materials Science and Engineering*, vol. 768, no. 7, pp. 1-11, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[8] Sandeep Kumar Panda et al., *Blockchain Technology: Applications and Challenges*, Intelligent Systems Reference Library, pp. 1-300, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[9] Nida Khan, and Rachid Ouaich, "Feasibility Analysis of Blockchain for Donation-Based Crowdfunding of Ethical Projects," *Smart Technologies and Innovation for a Sustainable Future, Advances in Science, Technology and Innovation*, pp. 129-139, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[10] Vikas Hassija, Vinay Chamola, and Sherali Zeadally, "BitFund: A Blockchain-based Crowd Funding Platform for Future Smart and Connected Nation," *Sustainable Cities and Society*, vol. 60, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[11] Paul Belleflamme, Thomas Lambert, and Armin Schwienbacher, "Crowdfunding: Tapping the Right Crowd," *Journal of Business Venturing*, vol. 29, no. 5, pp. 585-609, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[12] Nikhil Yadav, and V. Sarasvathi, "Venturing Crowdfunding using Smart Contracts in Blockchain," *2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT)*, Tirunelveli, India, pp. 192-197, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[13] Nikolaos Kapsoulis et al., "Know Your Customer (KYC) Implementation with Smart Contracts on a Privacy-Oriented Decentralized Architecture," *Future Internet*, vol. 12, no. 2, pp. 1-13, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[14] Mohammad Hashemi Joo, Yuka Nishikawa, and Krishnan Dandapani, "Cryptocurrency, A Successful Application of Blockchain Technology," *Managerial Finance*, vol. 46, no. 6, pp. 715-733, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[15] The WeiFund Vision, WeiFund, 2022. [Online]. Available: http://weifund.io/

[16] Pierluigi Freni, Enrico Ferro, and Roberto Moncada, "Tokenization and Blockchain Tokens Classification: A Morphological Framework," *2020 IEEE Symposium on Computers and Communications (ISCC)*, Rennes, France, pp. 1-6, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[17] Xuefeng Li et al., "Tokenization: Open Asset Protocol on Blockchain," *2019 IEEE 2nd International Conference on Information and Computer Technologies (ICICT)*, Kahului, HI, USA, pp. 204-209, 2019. [CrossRef] [Google Scholar] [Publisher Link]