

# **BEYOND TRUST: Blockchain Enabled Transparent Charity System**

**Prof. Pritesh Patil<sup>1</sup>, Pranav Dhote<sup>2</sup>, Sanaya Kulkarni<sup>3</sup>, Ketan Agrawal<sup>4</sup>**

Professor, Department of Information Technology<sup>1</sup>

Students, Department of Information Technology<sup>2-4</sup>

AISSMS Institute of Information Technology, Pune, India

**Abstract:** *Modern interconnected society creates ongoing challenges to charitable giving because donors need greater assurance of transparency and financial accountability. A new Ethereum-based solution from our research removes intermediaries by establishing an application dedicated to charitable activities. The DApp provides an integrated system for traditional offers and conditional funding structures which operates on blockchain technologies at base level. A framework of Solidity smart contracts connects with React.js frontend components and Ethers.js implements the blockchain communication protocols to deliver a smooth donor transaction process. The platform features milestone-based withdrawals that functions to distribute crowdfunded money after specific campaign targets have been reached thus building transparent reporting. The system gives contributors complete control between funding registered organizations directly and specific projects where each financial transaction is recorded permanently on the blockchain ledger. The unbending nature of blockchain as a record system provides historic visibility for all charitable transactions. Through distributed ledger technology implementation our framework provides donors both simple donation processes and a modern model for reliable philanthropic activities which allow full monitoring of every charitable contribution.*

**Keywords:** Blockchain, Decentralized Application, Smart Contracts, Ethereum, Charity Crowdfunding, Transparent Donations, Ethers.js, Solidity, Web3, Milestone-Based Fund Release

## **I. INTRODUCTION**

Traditional charity systems face challenges because donors face difficulties tracking donations due to they have low transparency and fund mismanagement and high costs associated with intermediaries. Blockchains support CharityConnect's operation of a secure donation platform that operates as a decentralized and transparent system. This Ethereum-based platform allows donation transfers to reach certified charities with a crowdfunding feature that distributes funds only after reaching predetermined objectives. The Solidity-based smart contracts establish automated transactions that deliver unalterable verification for every process while eliminating intermediary involvement thereby reducing fraudulent events.

A user-friendly customer interface stems from React.js but Ethers.js connects blockchain transactions while Hardhat facilitates smart contract test execution. The platform allows donors two donation options between direct payments or outlined crowdfunding periods while maintaining permanent blockchain transaction records for complete tracking purposes. The system supports testing within the Hardhat environment and active usage on Sepolia as well as other networks for adaptable deployment scenarios. The use of security features together with efficiency and transparency makes CharityConnect transform philanthropic practices by providing donors and charities with a trust-free automated charitable funding solution that prevents fraud.

## **II. LITERATURE REVIEW**

### **2.1 Blockchain Technology**

Blockchain technology brought a critical shift to transaction security while enhancing transparency to applications that exceeded Bitcoin at its base [4]. The distributed ledger technology establishes an irreversible decentralized record



management solution which cannot be altered. Every blockchain consists of linked blocks that create an immutable chain by using cryptographic links while each new block contains information about its previous block [5]. The system achieves consensus among multiple spread-out participants to validate data instead of using a centralized authority so no individual can modify information. Blockchain technology features three essential elements that make it operate successfully:

1. Block header – Contains temporal data, cryptographic nonce, previous block reference, and Merkle Tree root
2. Transaction information structures the Block body through a Merkle Tree design.
3. The network achieves consistency of the ledger and validates transactions through its built-in consensus protocol.

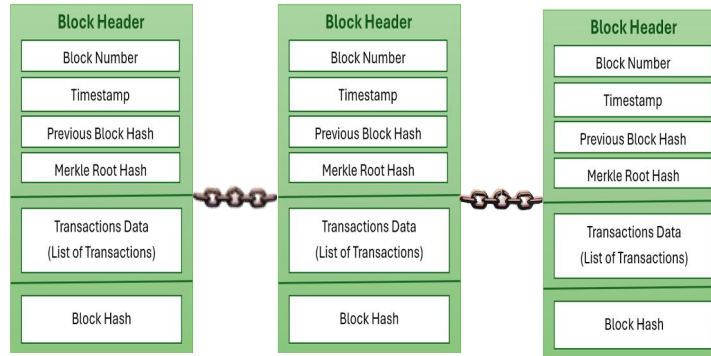


Figure 1 Structure of block

### 2.2 Comparative Study of Charity Platform

Modern digital fundraising platforms used by charitable organizations face ongoing problems regarding operational effectiveness combined with cost efficiency when linked to transparency issues. The existing donation systems face major critical problems according to documented research. These research works show donor distrust develops from transparent deficits [3] and meaningful administrative expenses in centralized platforms decrease direct donations according to [2]. The automated execution of smart contracts enhances donations with blockchain because it combines with its transparent tracking abilities to provide effective solutions. The study conducted by [17] showed that blockchain works successfully in disaster relief funding while demonstrating its decentralized method of delivering funds through direct channels bypassing middlemen. The research report of [14] established that untrusted cryptographic transaction methods speed up emergency relief funds distribution.

Table 1. Comparative study of Traditional and Blockchain based Platform

Features	Traditional Platforms	Blockchain-Based Platforms
<b>Transparency</b>	Low – Requires donors to trust intermediaries.	High – Transactions are recorded on a public ledger.
<b>Security</b>	Centralized storage, prone to fraud and misuse	Decentralized with cryptographic security.
<b>Transaction Speed</b>	Slow – Banks process transactions manually.	Fast – Smart contracts execute transactions instantly.
<b>Fees</b>	High – Platforms charge up to 10% in service fees.	Low – Only minimal gas fees for transactions.
<b>Fund Allocation</b>	Donors have no visibility into fund usage.	Funds are tracked in real-time and automatically distributed.



Table 2. Major Literature Review

Sr No.	Author	Book/Journal/Article	Limitations
1.	Nakamoto, S.	Bitcoin: A Peer-to-Peer Electronic Cash System	Limitations are faced by capacity of 7 transaction leading to scalability challenges in bitcoin. Decentralization is reduced by the dominance of mining pools. The limit of 21-million supply, a negative effect is created.
2.	Zheng, Z., Xie, S., Dai	An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends.	Security vulnerabilities like risk of attacks and bugs in smart contracts. Proof-of-Work (PoW) and Proof-of-Stake (PoS) are energy-intensive and concerning regarding security respectively.
3.	Wang, J., & Chen, H.	Application Analysis and Research of Blockchain Technology in China's Philanthropy.	Blockchain adoption is hindered by unclear regulations, lack of technical knowledge in charities, and trust issues regarding its reliability and security.
4.	Li, Q., Li,	Charity Application Model and Platform Based on Blockchain Technology	Requirement of financial investment and technical resources is essential, which at times is challenging for current charitable systems.
5.	Rizal, M. N., Rahman, M. H	Blockchain Sadaqa Mechanism for Disaster Aid Crowdfunding.	Legal barriers, transaction delays, and complex smart contract rules hinder effective crowdfunding and disaster assistance.
6.	Jayasinghe, D., Cobourne, S	Philanthropy on the Blockchain.	Slow processing speeds, cryptocurrency volatility, unclear tax rules, and limited authentication increase challenges for secure and stable donations.

### III. SYSTEM ARCHITECTURE

#### 3.1 Philanthropy Framework Blueprint

Registered charity organizations benefit from the proposed charity system mode which provides secure and transparent milestone-based fund distributions. The system presents three central entities which are donors and charity organizations as well as beneficiaries as shown in Figure. The model employs blockchain technology to enable direct donations along with strong fund storage capabilities and vertically structured withdrawals and makes all transactions permanently trackable on blockchain.

The platform requires its owner to approve registration of charity organizations before donations become available to them. On the platform donors access a list of verified charity projects then they can route their contributions straight to the smart contract. Registered charities can withdraw contributions from the donation contract safely since only authorized recipients have access to these funds. Contributions to the blockchain are visible to all users through real-time logging of each financial transaction allowing donors to see where donations go precisely in real-time.

Milestone-based crowdfunding within the system serves to improve accountability by allowing funds to distribute through specific milestones. Prior to launching their fundraising efforts charities need to set precise milestone targets for future project developments. The milestone achievement triggers an automatic process which distributes the next fundraising amount to support charitable projects as per their designated funding plan



The charity may withdraw all remaining funds in one transaction after the last milestone completes the fundraising successfully. The lowering of fund mismanagement risk and donor trust enhancement and financial transparency are achieved through this method.

The blockchain provides donors with proof of donation on a secure blockchain ledger which ensures their donations are properly verified for intended use. Blockchain technology reveals every transaction process because it makes sure that both fund transfers and permanent documentation avoid corrupt conduct.

Using blockchain technology, a charity system can eliminate intermediaries by offering secure donation processing, structured fund withdrawal, and milestone-based disbursements, which also promotes transparency and trust between charitable organizations.

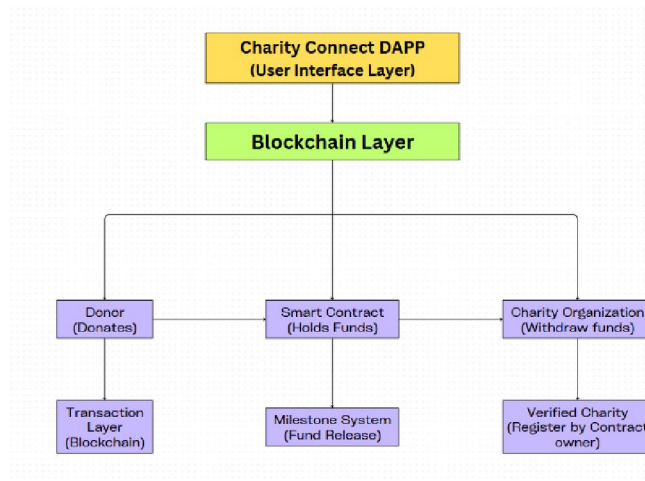


Figure 2 Platform Framework-shows the elements in layers

**3.2 Drafted Platform Structure**

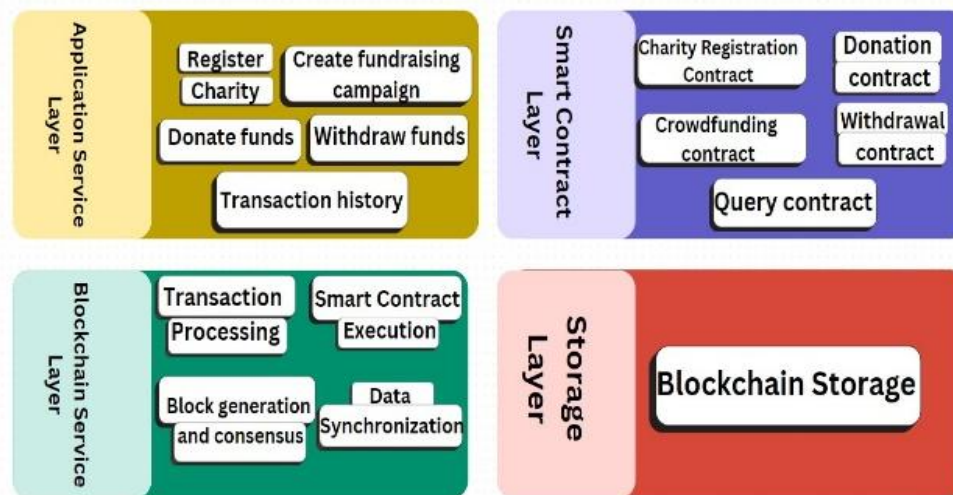


Figure 3 Platform Structure- shows the layers of framework



It suggests a platform architecture that would provide security, transparency, and efficiency for the blockchain-based charity donation system both as direct donations and milestone-driven crowdfunding. The proposed architecture is particularly good in principle. There are four primary layers that make up the platform's architecture. The ADL's Application Service Layer enables users to interact with the system by registering verified charities, creating fundraising campaigns, securely donating funds, withdrawing funds upon reaching milestones, and monitoring transaction history. This layer provides an uncluttered interface for donors, charities, and administrators. The Smart Contract Layer manages the platform's fundamental logic, guaranteeing that only the owner of the instance can use the Charity Registration Contract. While the Donation Contract is a secure means of raising funds, milestone-based crowdfunding is managed through the Crowdfunding Contract, which ensures that money is distributed in steps. Withdrawal Contract allows users to withdraw funds only from registered charities, while Query Contract permits them to access donation and campaign information directly from the blockchain. The Blockchain Service Layer is responsible for ensuring the safety and legitimacy of transactions. While managing consensus and data synchronization across the blockchain network, it handles transactions such as funds, smart contracts (such as OTP services), and block generation. Data is stored in the Storage Layer, where Blockchain storage ensures that all transactions are preserved forever and a Local Database stores information only for easy retrieval when necessary. The architecture guarantees that no fraudulent transactions, transparent donations, or charities receive the money they receive. What's more, this is built around a system of trust. Through the use of blockchain, funds are used in a responsible manner to prevent mismanagement while maintaining trust between donors and beneficiaries.

### 3.3 Platform Usage Process

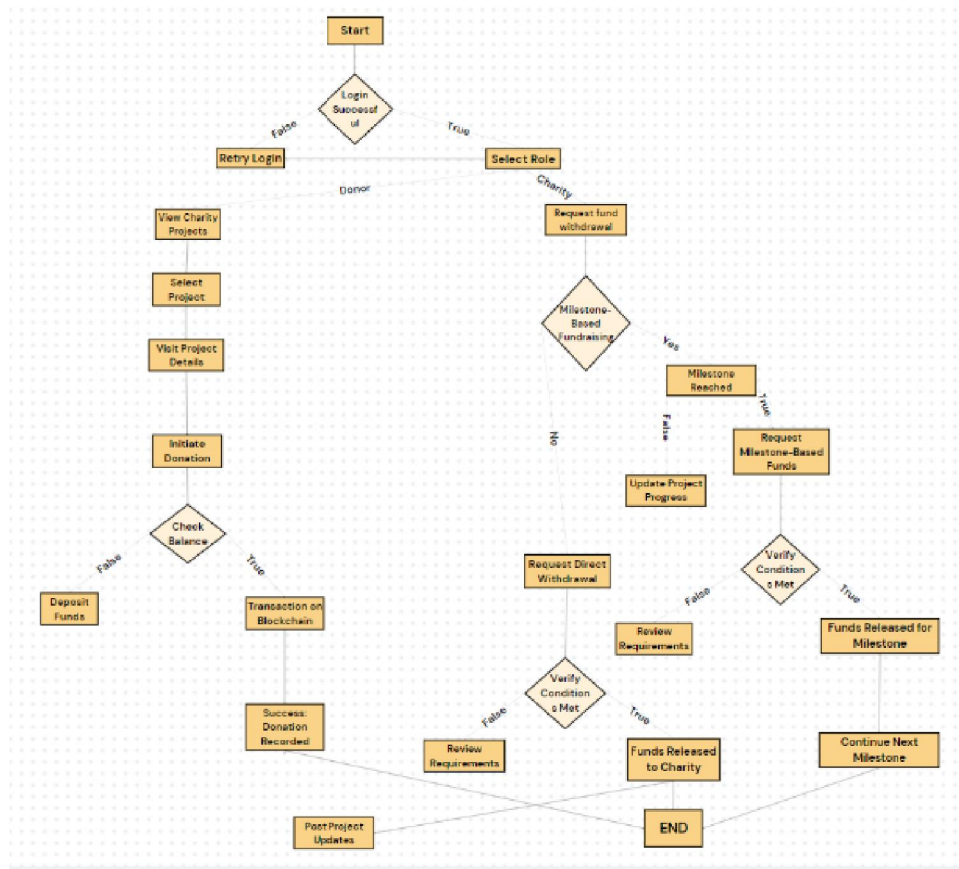


Figure 4 Flowchart representing the usage process



Upon login, the system initiates the platform usage process. When a login fails, the user is instructed to try again. Upon successful login the user selects whether they are Donor or Charity. The process for Donors begins with a search through the charity projects listed on the site. The donors have the option to view detailed information on a project's goals, funding requirements, and progress once they have chosen it. They initiate a donation once they have decided to contribute.' Currently, the system evaluates their account balance to ensure they have enough funds.' In the event of a surplus, they're encouraged to deposit more money. ". Once the donation is completed, a transparent and immutable transaction takes place on the blockchain. Direct Fund Withdrawal and Milestone-Based Based Withdraw are the two methods by which Charities can withdraw their funds on the platform. In a Direct Withdrawal, the charity requests access to the funds collected in the smart contract. It also checks the withdrawal conditions are met. The charity must meet the necessary criteria before proceeding if any are not met. After fulfilling all the requirements, funds are distributed to the charity and they're prompted not to disclose any developments regarding this project. The decision is made to maintain transparency.

The charity can use a Milestone-Based Withdrawal to access funds in phases, determined by predetermined project milestones. Once the milestone has been reached, the charity submits a request for fund release. The. It then checks whether the conditions for that milestone have been met. The charity must then update its progress on the project and meet all the requirements.' If not, After the verification is completed, the smart contract releases any remaining funds to ensure that donated funds are used effectively and according to project plans.cg. This procedure continues until the total fundraising goal has been achieved, after which the remaining funds can be withdrawn. Through blockchain technology, donors and fund withdrawals can be recorded securely and immutable, ensuring responsible spending is avoided. This method builds trust between donors and provides charities with a stable, transparent undistributable mechanism for managing and receiving funds.

### 3.4 Smart Contract Structure

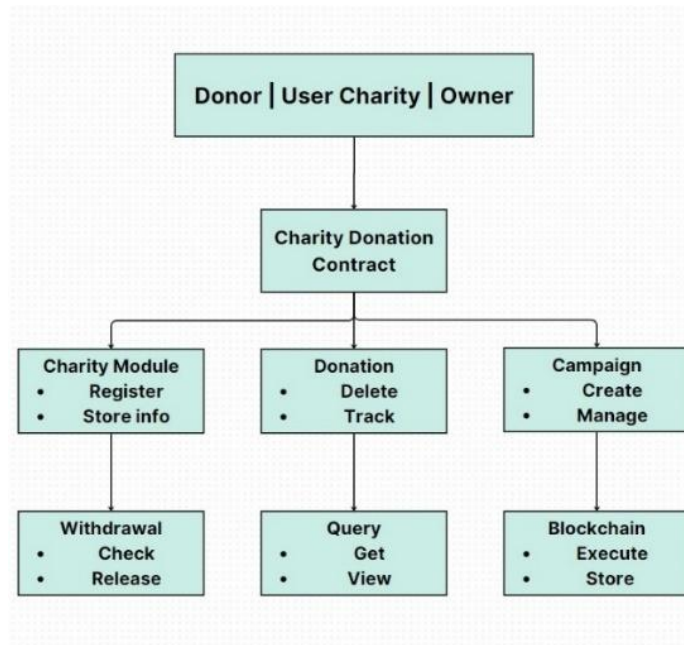


Figure 5 Overall flow of services in smart contract

Fund management in the Charity Donation Smart Contract promotes secure transactions with full transparency combined with accountable stewardship for charitable giving and milestone achievements of crowdfunding. Multiple essential modules in the system deal with precise functionality needs of the platform.



The main feature of the Charity Module gives platform owners exclusive rights to register approved charitable organizations only. Each registered charity operates through a distinct wallet address that lets it monitor total donations alongside the withdrawn funds. The withdrawal method for registered charities features encryption to limit access to authorized donors of collected money. The Donation Module gives platform users the ability to transmit funds either to registered charities or to defined crowdfunding projects. Donors can view donation transactions directly through blockchain records because they are tracked transparently. The contract system produces an event to track donations in real time whenever someone makes a gift.

The Campaign Module presents a tool that enables registered charities to create crowdfunding initiatives which use milestone objectives. The system requires every campaign to contain a distinct ID label together with a title description and numerical specification for goal amount and milestone amount. People who donate to crowdfunding campaigns will enable charities to obtain contributions step-by-step when their projects meet specified funding targets. The release of funds is controlled through this system because funds become available only after particular objectives have been achieved.

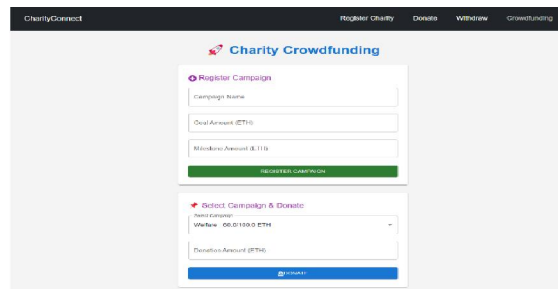
Through the Withdrawal Module the system performs safe withdrawal processing by confirming charitable organizations meet established requirements. The system maintains a thorough record of withdrawals which make it possible to conduct audits anytime.

Through the Query Module the general public can obtain access to essential information including charity details together with campaign information as well as donation history records. Through this feature the system allows anyone to check transactions which creates trust between contributors and the organizations they support.

Together with carefully structured operation rules the system protects donations while funds are released according to valid requirements and all blockchain transactions are documented. The transparent automated workflow facilitates financial responsibility in addition to creating confidence for donor groups involved in charitable donations.

### 3.5 Platform Development

This blockchain-based charity platform uses development methodology to establish secure transparent and efficient processes for handling charitable transactions. A smart contract on Ethereum blockchain enables the system to manage Direct Donations, Charity Withdrawals and Milestone-Based Crowdfunding together. Through the combination of React.js and Ethers.js libraries the platform enables instantaneous data processing as well as unalterable transaction records. The Sepoliatestnet allows for real-world simulations but local testing occurs through Hardhat. The structured system enables secure and accurate transfers with tamper-evident logs that create a trustworthy and easy-to-use charitable environment.



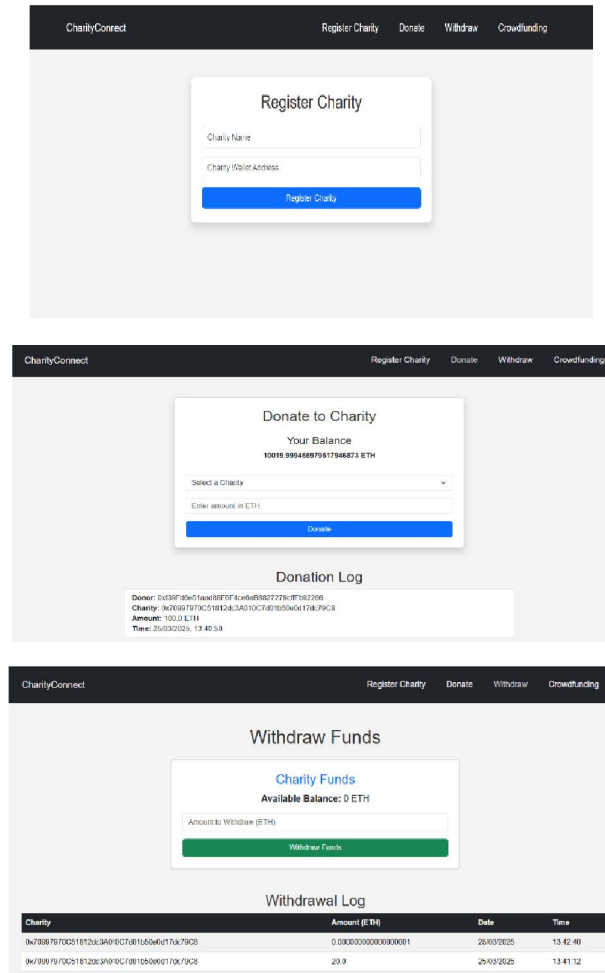


Figure 6 Interface of charity connect

#### IV. RESULT AND DISCUSSION

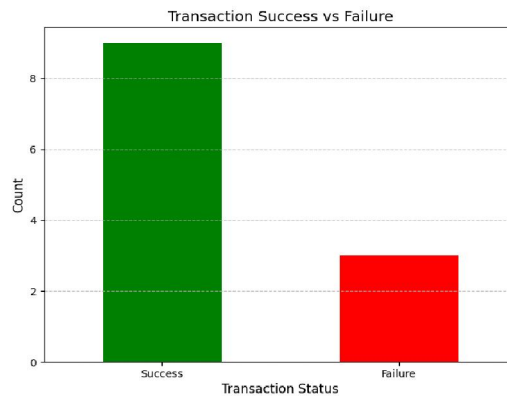


Figure 7 Graph showing the success and failure rate of transactions





#### 4.1 Seamless Transactions: Success vs. Setbacks

This is the breakdown of transactions that have and have not, in the context of blockchain-based charity donations.' If a transaction is successfully executed and verified on the blockchain, it will fail due to invalid conditions, insufficient gas, or contract reversion. However,

It has three key failure points. When a user fails to have enough balance, the transaction will be refunded by an automated smart contract. In the event that a donation attempt contains an incorrect amount, such as 0 or 1, it should be noted. ETH's contract stipulated that the minimum amount of donation must be met and rejects the transaction. In case the campaign ID is not present, a withdrawal request for an unregistered campaign will result in ambiguity regarding the transaction.

It is desirable that the number of successful transactions exceeds the count of failed transactions to maintain system performance and enhance user experience. A high failure rate indicates possible problems such as inadequate transaction handling, absence of validation checks, or frequent abuse of contract functions by users. A strong validation check is necessary within the smart contract to minimize such failures.)

#### 4.2 Gas Consumption Across Various Transactions

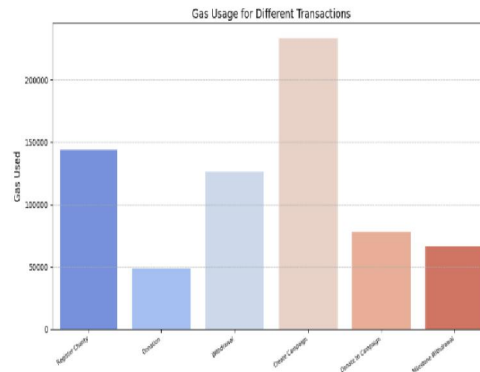


Figure 8 Shows the gas usage for transactions

Gas is required for Ethereum transactions to operate while more intricate transactions use greater amounts of gas power. Platform users must pay gas according to their chosen transaction activities among donation funding withdrawal and campaign registration. Achieving enhanced usability in blockchain-based donation requires gas utilization minimization because this reduces transaction costs which benefits the overall service experience. Transacting with storage requires greater gas than basic data retrieval demands because modifying donation records and adding campaign entries costs a significant amount of gas. Users need to pay close attention to cost management since gas fees fluctuate according to network congestion and shifts in gas prices in the market. The logic within smart contracts needs optimization to decrease gas expenses. The system displays enhanced performance when users prevent additional modifications to storage while replacing arrays with mappings for data retention purposes. The execution costs of the system decrease when off-chain computation methods are deployed for possible operations. This enables the blockchain system to operate more economically.



### 4.3 Transaction Execution Time: Speed & Performance Insights

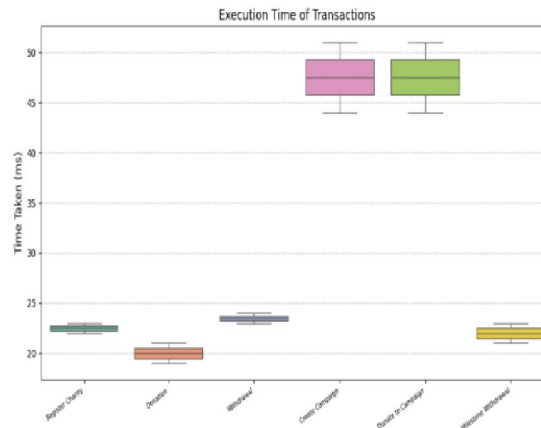


Figure 9 Shows the time required for execution of transactions

The processing timeline for blockchain operations depends on three main aspects: network overburden, transaction intricacy and payment expenses. The duration for transaction confirmation extends when operations have demanding computational requirements and storage modifications, but it shortens when operations remain simple. Block mining time significantly influences how long transaction confirmations stay pending since miners need to include transactions in their mined block to validate them across the blockchain. The speed of executing basic transactions, such as campaign detail retrieval, quickly occurs at the same time as complex changes to storage and withdrawal operations result in elongated processing durations. The network execution times for transactions depend on their gas usage because miners tend to focus on transactions with higher fees during times of congestion.

Improvement of smart contract execution needs optimization as a fundamental requirement. Storage through event logging proves more effective than direct storage updates because it lowers blockchain processing requirements. Users can accelerate time-sensitive operations by paying escalated gas fees. The execution performance benefits from efficient state management in smart contracts because it reduces both computational requirements and storage modifications which leads transactions to use less time and cost resources.

### 4.4 Transaction Success Rate: A Comparative Analysis

The execution and logical premises in smart contracts decide how successful blockchain transactions will be while determining what execution criteria must be met. Donations need a high success rate in blockchain operations since these fund transfers work in a straightforward manner. Fund withdrawals and other funds-based transactions face termination in cases where available balance is insufficient along with rule violations in contract terms. The assessment of different transaction types reveals inadequate smart contract validation together with consistent user mistakes as possible reasons behind low success rates. The process of moving funds between accounts faces the highest probability of failure because of not having sufficient funds or entering incorrect information or exceeding withdrawal restrictions. The success rate can be increased by using thorough smart contract error detection methods as well as robust input validation systems. User experience improvement depends on showing users informative error alerts that help them avoid normal usage mistakes. Real-world operations become more efficient by conducting complete smart contract tests using tools like Hardhat or Truffle which helps detect possible failure points prior to deployment.



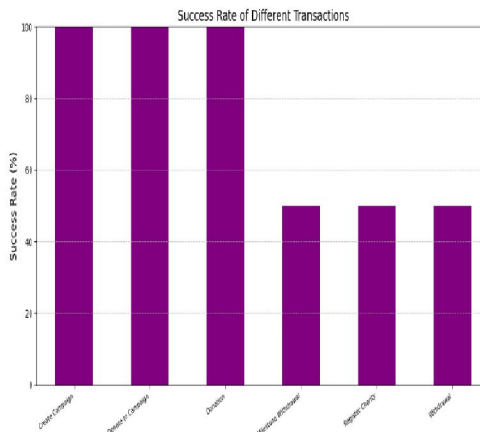


Figure 8 Analyzing the success rate

#### 4.5 Gas Consumption vs. Execution Time: Transaction Efficiency Breakdown

A study of blockchain transaction execution time in relation to gas consumption exists in this figure. Higher usage of gas leads to longer execution times because complex computational operations are necessary. The execution of transactions which alter multiple state variables needs additional gas resources as well as takes a longer duration to run. Process of retrieving campaign details needs minimal gas and performs these requests instantly while other operations use more gas variations.

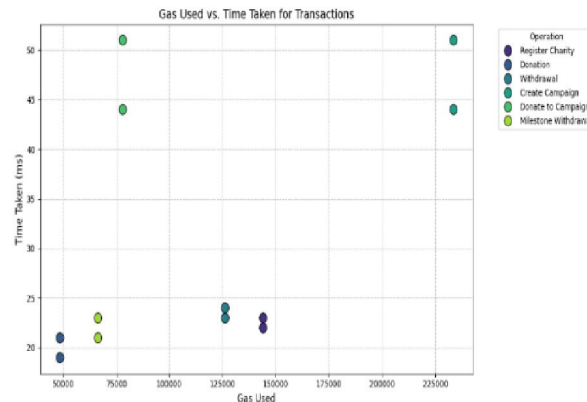


Figure 9 Graph showcasing the gas consumption with the time execution

Smart contract logic optimization allows users to achieve optimal gas efficiency while also increasing transaction speed when comparing various transaction types. Smart contracts perform better while keeping gas costs down when they cut back storage modifications and maintain efficient data structure and conduct few on-chain operations. Classifying execution events with trigger-based systems instead of continuous state changes enhances both contract efficiency and execution time efficiency along with reduced gas expenses.

#### V. CONCLUSION

The Blockchain-Based Charity Donation System revolutionizes how charitable gifts are managed through blockchain techniques. Blockchain technology enables the platform to deliver trustworthiness and security and speed to every phase of donations from beginning to end. The blockchain secures each donation process while building an unalterable record system that creates confidence between those who contribute and non-profit entities. Through this system donors can make direct donations while the platform supports funding releases in planned milestones after projects achieve



their established goals. The system builds donor accountability through donation tracking features that help donors verify their funding impacts while maintaining strong chaity utilization of funds.

The system presents a main advantage through its architectural structure combining user interfaces, smart contracts, blockchain services and data storage components. Through the Application Layer users can interact with the system through features that permit charity registrations and campaign launches as well as real-time fund tracking functionality. Through automated processes running on the Smart Contract Layer the platform manages donations and withdrawals together with the application of rules without requiring human oversight. The Blockchain Service Layer offers secure operating functionality and distributed network data synchronization, and the Storage Layer securely retains both cryptographically resilient transaction records and quick access to off-chain database information. The complete framework enables secure operation and maximum transparency and efficient performance of the platform.

The automated system built upon decentralization reduces dependence on intermediaries which then minimizes excessive administrative costs and prevents mismanagement. Verified charities can run their campaigns autonomously using the platform which provides secure opportunities for donors to pledge support for their causes. Under the smart contract system only authorized withdrawal operations for registered charities are possible which bars misuses and protects donor trust.

The Blockchain-Based Charity Donation System reimplements charitable giving through solutions that resolve trust and transparency and efficiency problems. The practical demonstration of blockchain allows future developments toward enhancements. The system enables digital philanthropy to expand while delivering donations with integrity and delivering actual results in needed locations.

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