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BECP: Blockchain Enabled Charity Process Framework for Effective Donation Management during Disasters

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Abstract

The integration of block chain technology in disaster relief donation processes offers a transformative approach to enhance transparency, efficiency, and trust. Although the conventional methods can be easy to use and reasonably priced, they could not provide the transparency and immutability that block chain-based alternatives provide. The block chain based charity process framework(BECP) aims to overcome the difficulties of conventional methods in terms of transparency and immutability, The Proposed approach explores the implementation of a block chain-based donation system during disasters, highlighting its potential to address longstanding challenges in traditional donation methods. By leveraging the immutable and decentralized nature of block chain, the proposed system ensures secure and traceable transactions, minimizing the risk of fraud and misappropriation of funds. Smart contracts automate the allocation and disbursement of donations, reducing administrative overhead and expediting aid delivery to affected areas. Furthermore, the transparent ledger allows donors to track their contributions in real-time, fostering accountability and encouraging sustained support. This innovative approach leverages distributed ledger technology to create an immutable record of all transactions, ensuring that every donation is traceable and accounted for. This technology not only streamlines the donation process but also fosters trust among donors, beneficiaries, and relief organizations, potentially encouraging increased participation in disaster relief efforts. This study examines the technical architecture, benefits, and potential obstacles of implementing such a system, providing insights into its feasibility and impact on improving the overall effectiveness of disaster relief efforts.

Keywords: Block Chain Technology, Charity, Disasters, Emergencies, Ethereum, Trusts.

Introduction

The extensive use of blockchain technology in recent years has created new opportunities to enhance the effectiveness and transparency of non-profit organizations, particularly when it comes to disaster assistance (1). Blockchain's intrinsic qualities-decentralization, immutability, and smart contracts—can help with persistent issues in the non-profit industry, such as a lack of accountability, trust, and real-time donation tracking. This research paper explores the potential applications of blockchain technology in the management of charitable donations during disaster relief efforts. Specifically, it examines how blockchain-powered platforms can revolutionize the donation process, enhancing transparency, streamlining fund allocation, and empowering donors to attach conditions to their contributions. Conventional centralized software platforms and systems are commonly used in non-blockchain contribution management solutions. Customer relationship management (CRM) technologies designed specifically for non-profits are frequently included in these packages. These tools enable organizations to organize fundraising campaigns, track donor information, and produce reports. Organizations may process gifts, maintain donor data, and automate receipting procedures with the help of cloud-based donation management systems, which are accessible and scalable. Some platforms offer tools for volunteer organizing and event administration, as well as integration with accounting software. Although these solutions can be easy to use and reasonably priced, they could not provide the transparency and immutability that blockchain-based alternatives provide. Nonetheless, they frequently offer strong security protocols, adherence to financial laws, and the ability to integrate with current organizational systems.The blockchain based charity process framework aims to overcome the difficulties of

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conventional methods in terms of transparency and immutability, Donation tracking systems powered by blockchain, Blockchain technology's potential to build an open and impenetrable donation tracking system is one of its main advantages for charitable organizations. For example, the platform Donation Chain uses blockchain technology to create a safe, decentralized method for tracking donations. Donation Chain promotes confidence and accountability within the charity ecosystem by keeping track of all transactions on the blockchain, allowing donors to keep an eye on how their contributions are being used and allocated.

Applications of Blockchain in Disaster Management and Charity Processes

Blockchain technology has emerged as a promising solution in various domains, including disaster management and charitable processes. In the context of disaster management, blockchain's decentralized and secure nature can address several challenges. One key application of blockchain in disaster management is the tracking and management of relief supplies and donations. By using unique tags and blockchain's immutable record-keeping, organizations can ensure transparency and traceability in the distribution of aid, preventing misuse or theft. Furthermore, blockchain-based platforms can facilitate direct peer-to-peer transactions, enabling efficient and secure fund transfers to disaster victims, bypassing traditional intermediaries and reducing administrative costs (1). Another potential application of blockchain in disaster management is the verification and management of affected individuals' identities and records. Blockchain's ability to maintain secure and tamper-evident data can help in the accurate identification of disaster victims, ensuring that aid and resources reach the intended beneficiaries. Blockchain's applications extend to the charitable sector as well. The technology can enhance the transparency and accountability of charitable organizations, allowing donors to track the utilization of their contributions and verify that funds are being used as intended. Furthermore, blockchain can facilitate direct donations and micropayments, enabling individuals to contribute to causes they care about without the need for intermediaries (2). Blockchain offers a revolutionary approach to addressing some of the most pressing challenges in these fields. By leveraging its decentralized and transparent nature, blockchain can significantly improve the efficiency, accountability, and trust in disaster relief efforts and charitable donations, transforming the way aid is delivered and monitored. In the realm of disaster management, blockchain enables real-time tracking of resources, ensuring that aid reaches the intended recipients quickly and accurately. This capability is particularly crucial in the chaotic aftermath of natural disasters or humanitarian crises, where the timely distribution of supplies can mean the difference between life and death. Blockchain's immutable ledger can provide a comprehensive and tamper-proof record of all transactions and movements of goods, allowing relief organizations to optimize their logistics and prevent the duplication of efforts.

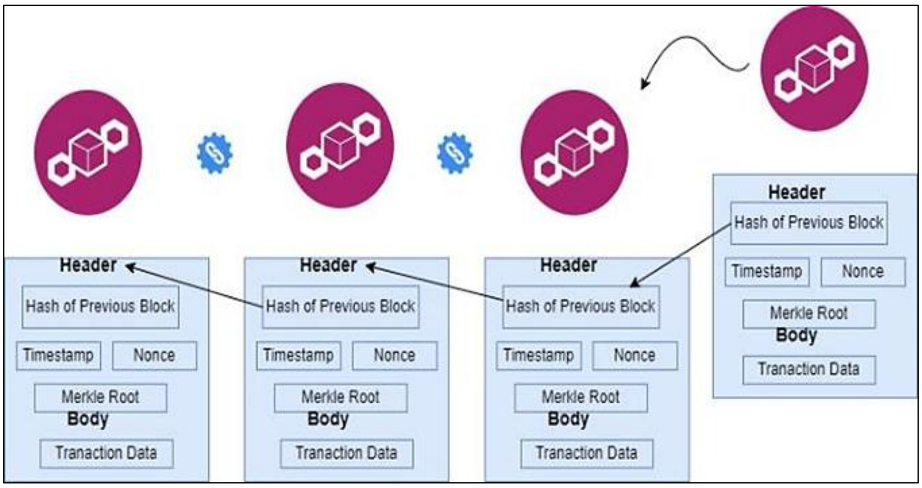

Figure 1: Block Chain Architecture

Moreover, blockchain can facilitate secure and rapid fund transfers, allowing for immediate financial assistance to affected areas. Traditional banking systems often face challenges in disaster zones due to damaged infrastructure or overwhelmed networks. Blockchain-based cryptocurrencies can bypass these obstacles, enabling direct peer-to-peer transfers that can reach beneficiaries within minutes, regardless of geographical barriers or the state of local financial institutions. The general architecture of blockchain technology is depicted in Figure 1.

For charitable processes, blockchain provides a transparent ledger of donations, allowing donors to track their contributions and verify how funds are utilized. This increased visibility into the flow of donations addresses one of the most significant concerns in the nonprofit sector: the lack of transparency in fund management. By providing a clear and auditable trail of transactions, blockchain technology can help combat fraud and mismanagement in charitable organizations, ultimately encouraging more people to donate with confidence. The transparency offered by blockchain extends beyond just financial transactions. It can also be used to track the entire lifecycle of donated goods, from their origin to their final distribution. This level of traceability can help prevent the diversion of aid and ensure that resources are used as intended, addressing long standing issues of corruption and inefficiency in aid distribution.

Furthermore, blockchain-based smart contracts can automate the allocation of funds according to present criteria, greatly expediting the aid delivery process and cutting down on administrative burden. When certain requirements are fulfilled, such confirming a disaster event or reaching a project milestone, these self-executing contracts may cause the flow of money or resources. In addition to expediting the aid delivery process, this automation lowers the possibility of human error or manipulation. The application of blockchain in disaster management and charitable processes also opens up new possibilities for crowdfunding and microfinance initiatives. By removing intermediaries and reducing transaction costs, blockchain can enable more direct connections between donors and beneficiaries, potentially increasing the impact of each contribution. Better coordination between various government agencies and assistance organizations involved in disaster relief efforts can also be facilitated by blockchain implementation. By providing a shared, real-time view of available resources and ongoing operations, blockchain can help prevent duplication of efforts and identify gaps in aid coverage more efficiently. However, it is important to note that the implementation of blockchain technology in these sectors is not without challenges. Issues such as scalability, energy consumption, and the need for widespread adoption must be addressed. Additionally, there is a need for standardization and interoperability between different blockchain platforms to ensure seamless cooperation among various stakeholders. Blockchain technology holds immense potential to revolutionize disaster management and charitable processes. Its ability to enhance transparency, efficiency, and trust can lead to more effective aid delivery, increased donor confidence, and ultimately, a greater positive impact on those in need. As the technology continues to evolve and mature, its integration into humanitarian and charitable efforts is likely to become increasingly prevalent, paving the way for a more responsive and accountable system of global aid distribution.

Block Chain in Disaster Management and Charity Process

Blockchain technology has emerged as a promising solution for enhancing disaster management and charitable processes, offering a revolutionary approach to addressing some of the most pressing challenges in these fields. By leveraging its decentralized and transparent nature, blockchain can significantly improve the efficiency, accountability, and trust in disaster relief efforts and charitable donations. In disaster management, blockchain enables real-time tracking of resources; ensuring aid reaches intended recipients quickly and accurately. Its immutable ledger provides a comprehensive record of transactions and movements of goods, optimizing logistics and preventing duplication of efforts. For charitable processes, blockchain offers a transparent ledger of donations, allowing donors to track contributions and verify fund utilization. This increased visibility addresses concerns about transparency in fund management, combating fraud and mismanagement. Smart contracts can automate aid distribution based on predefined conditions, streamlining processes and reducing administrative overhead. While challenges such as scalability and widespread adoption exist, blockchain's potential to revolutionize disaster management and charitable processes is significant, promising more effective aid delivery and increased donor confidence. Enhanced Transparency and Accountability: Blockchain technology enables transparent tracking of donations from source to recipient, addressing issues of fund mismanagement and corruption in traditional charity systems (3). Improved Efficiency: Smart contracts automate donation distribution, reducing administrative overhead and expediting aid delivery to disaster-affected areas (4). Increased Trust: The immutable nature of blockchain records builds donor confidence by providing verifiable proof of fund utilization (5). Real-time Monitoring: Blockchain allows real-time tracking of donations and aid distribution, enabling better coordination among relief organizations and donors (6). Decentralized Aid Distribution: Blockchain facilitates peer-to-peer transactions, potentially bypassing intermediaries and reducing transaction costs (7). Challenges in Implementation: Studies highlight technical challenges such as scalability, interoperability, and energy consumption of blockchain systems in disaster scenarios (8). Integration with Existing Systems: Research emphasizes the need for seamless integration of blockchain solutions with existing disaster management infrastructures (9). Data Privacy Concerns: Literature addresses the balance between transparency and data privacy, especially concerning sensitive information of aid recipients (10). Regulatory Frameworks: Studies discuss the need for appropriate regulatory frameworks to govern blockchain-based charity systems in international contexts. Case Studies: Several papers present case studies of pilot projects implementing blockchain in disaster relief, providing insights into practical challenges and successes (10). This survey indicates that while blockchain technology offers significant potential to improve charity processes during disasters, further research is needed to address technical, regulatory, and implementation challenges. The charity system has many problems, such as privacy and donor transparency. In order to address the issue of transparency, this study suggests a blockchain-based smart contract-based contribution method. The authors also propose a onetime address system that uses the same smart contract concept to protect anonymity. Donations are made here using a donor account address that is generated just once to maintain anonymity (11). Better coordination between various government agencies and assistance organizations involved in disaster relief efforts can also be facilitated by blockchain implementation. The paper's goal is to describe the creation of a blockchain-based donation tracking system. The system, which is based on blockchain technology, offers contributors, charity foundations, and recipient's transparent accounting of operations. A platform for charities should have a mechanism to demonstrate total transparency, enabling contributors to keep tabs on the whereabouts and expenditures of their donations (12). This study provides a detailed analysis of the state of blockchain technology and its potential applications in the nonprofit sector. Subsequently, the concept of Charity Wall is examined in the study. This system combines an automated audit system with an NGO social network. This system tracks not just transactions but all documents as well. It explains how Charity Wall expedites contribution procedures in the best interests of the final recipients, lowers operating expenses, improves the entire supply chain, and rebuilds connections with small and medium-sized contributors (13). This study provides a blockchain-based charity model and explores the relationship between philanthropy and blockchain technology. Donors utilize smart contracts to complete donations and spend monies. To improve transparency and guarantee money traceability, every transaction is documented on blocks. According to the report, a DApp it developed has verified certain essential elements and takes the next step towards realizing a comprehensive blockchain-based charity system (14). With the help of blockchain technology, contributions from each donor may be monitored and updated. All transactions on the platforms are conducted with tokens, which are created by the system from real money. Donors send these tokens, and upon delivery to recipients, additional algorithms are employed to disperse them. We evaluate and analyze the comparability of suggested algorithms based on execution time and execution cost (15). In light of the COVID-19 epidemic, which increased information asymmetry and contributed demand, this article explores how charitable service providers may use blockchain technology as a fast and secure solution. Because of this blockchain technology use, the researchers were able to guarantee the accuracy and caliber of information during the pandemic. They describe the service system's architecture and execution (16). The authors developed a blockchain-based contribution method to increase transparency in this investigation. Donations are transparent thanks to this process. Encrypting the donation made by a particular donor to a certain NGO safeguards the privacy of system users (17).

Contribution

In order to improve the efficiency of the donation process during disaster or pandemic events, we propose an efficient framework and algorithms for a user-centered solution that uses Ethereum to grant contributors, beneficiaries, and charitable organizations access management policies.A report on their donation history generated by the system is sent to donors, which helps with trust concerns. Communities impacted by pandemics or natural disasters can receive assistance via the suggested system. The following are the research's main goals such as creating a blockchain-based system to improve transparency in the contribution process, to prevent intermediary fraud and manipulation in order to guarantee the security and safety of philanthropic transactions, to foster trust between different parties, including recipients, donors, and non-profits, to evaluate and compare the proposed technique's performance to that of the current systems.

Methodology

Donations must be traceable by all parties involved in order to attain a high level of transparency and confidence amongst the parties participating in charity giving operations. until facilitate the tracking of charitable donations from the time they are made by the donor until the time they are received by the designated beneficiaries, we have developed a blockchain-enabled charity process (BECP) framework. In addition to increasing the degree of trust and openness surrounding it, our goal is to automate the entire charity donation process. The framework of the blockchain-enabled fundraising system for charitable trusts during disasters described here. Three different nodes are involved in the operations of the proposed model as shown in Figure 2. The roles and interactions among beneficiaries, donors, and trustees. Beneficiaries of trust assets or charitable donations. They may receive income, principal, or specific assets from the trust and often have limited control over trust management. Recipient can potentially enforce the terms of the trust. Donors provide assets or funds to the trust or charitable organization. They can establish the purpose and terms of the trust or donation and retain some control through specific instructions or conditions. Donors can receive tax benefits for their contributions.

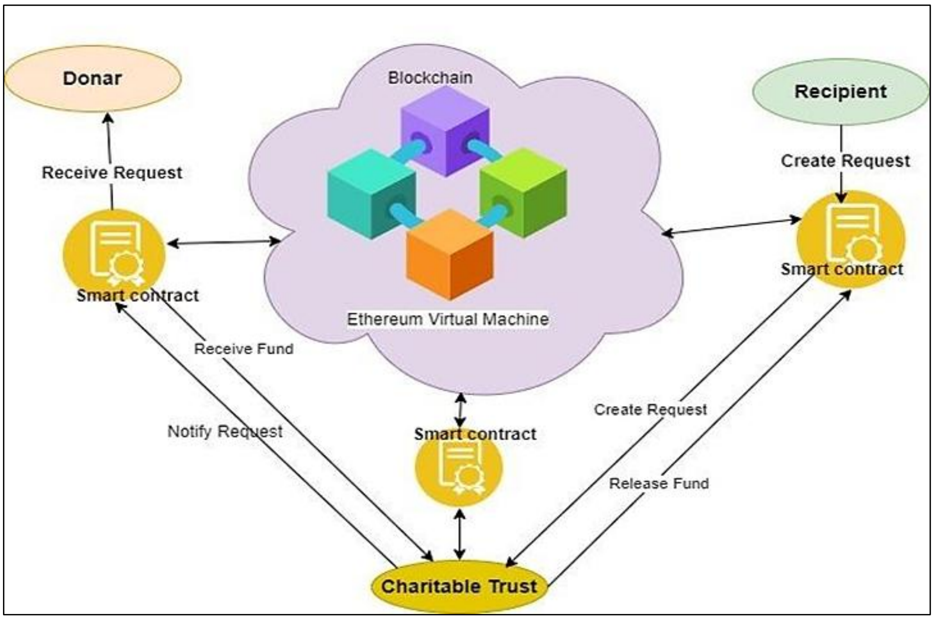

Figure 2: Architecture of Blockchain-Enabled Charity Process (BECP) Framework

Trustees can manage and administer the trust or charitable funds and have a fiduciary duty to act in the best interests of beneficiaries. Trustees are responsible for investing and distributing assets according to trust terms and maintain accurate records and provide regular reports.

Donors create trusts or make donations, designating beneficiaries and appointing trustees. Trustees manage assets and distribute funds to beneficiaries as per donor instructions. Beneficiaries may communicate needs or concerns to trustees. Trustees report to donors and beneficiaries on trust performance. Donors may retain some oversight or decision-making power, depending on the trust structure. These roles and interactions aim to ensure effective management of assets, fulfil donor intentions, and provide benefits to the intended recipients while maintaining legal and ethical standards. The charity trust requires recipients and donors to register. User connections to the block chain environment are made upon authentication. The database contains records of the data that users submitted. Donors and recipients alike may request access to monies from the administrator. In order to provide efficiency, openness, and trust in the handling of charitable donations, the suggested system ensures the real-time traceability of all donations until the appropriate recepient receives them. Additionally, in order for any party to be able to access the system's functionality, they must first authenticate themselves. The capacity to construct cases is shared by trustees and needy parties alike. However, before needy parties' cases can begin receiving donations, trustees must approve them. Furthermore, contributors can follow the development of their contributions at every turn of the donation procedure. The suggested system makes use of blockchain technology by creating an Ethereum chain with public authorization and then utilizing the Solidity programming language to create smart contracts. The necessary functionality is provided by the system through the integration of multiple distinct components. The architecture of the BECP system is shown in Figure 2. Its main purpose is to track charitable donations and confirm that all requirements were met during the donation procedure. To create public and private addresses for each person participating in a transaction, the suggested approach makes use of a crypto currency wallet. Every party's identity on the network, regardless of their private identity, is their public key (17). Inviting the trustee and individuals on the needy list to join the network will deter con artists from joining in an effort to make money. Moreover, a donor has to submit a joining request in order to become a member of the network. A verification code will be issued to a donor following the validation of their information. Everybody involved will be part of a single decentralized network and will have a personal blockchain account on the network. By using Smart contracts, when it comes to conditional payments, the agreement might be set up to release money only once certain requirements are fulfilled, including quality control inspections or delivery confirmation. As a result, less manual intervention is required to guarantee correct and timely payments. Smart contracts might include arbitration procedures or pre-set resolution protocols for resolving disputes. Certain conditions, such missing deadlines or opposing claims, can cause these to activate automatically. Predetermined actions, including releasing partial payments, starting a third-party review, or even reversing the transaction, can then be carried out by the contract. This automated dispute resolution method can preserve fairness and transparency for all parties while drastically cutting down on the time and expenses related to conventional legal procedures. The suggested system can handle a number of tasks related to tracking charitable contributions. These features were discovered by a review of the literature and an examination of every feature mentioned in earlier research on systems for charitable donations. All parties who have successfully joined the network can access the capabilities of the system. Figure 3 displays the primary features available to the different parties within the system. As the picture illustrates, the primary responsibilities of donors are to donate and track down donations, whereas the primary responsibilities of needy parties are to open new cases. In addition, the primary responsibilities of trustees include initiating new cases, approving or disapproving cases, and tracking down donations. Lastly, after a case is finished, the system sends out a notification to every donor who has contributed to that specific case.

Consensus Mechanism of Block chain

Blockchain consensus methods are protocols that guarantee that every node in a distributed network has a consensus regarding the blockchain's current state and the legitimacy of transactions. These mechanisms are crucial for maintaining the integrity and security of decentralized systems (18). Some key consensus mechanisms include Proof of Work (PoW) where Miners compete to solve complex mathematical puzzles and high energy consumption,used by Bitcoin and Ethereum (pre-2.0). Proof of Stake (PoS) in which validators are chosen based on the amount of cryptocurrency they "stake" and more energy-efficient than PoW, implemented by Ethereum 2.0 and Cardano. Delegated Proof of Stake (DPoS) where token holders vote for a limited number of delegates to validate transactions, faster and more scalable than traditional PoS which is used by EOS and Tron. Practical Byzantine Fault Tolerance (PBFT) where nodes reach consensus through multiple rounds of voting and suitable for permissioned blockchains, implemented by Hyperledger Fabric. Proof of Authority (PoA) which relies on a set of pre-approved validators and suitable for private or consortium blockchains.Each consensus mechanism has its own advantages and trade-offs in terms of security, scalability, and decentralization. The choice of mechanism depends on the specific requirements and goals of the blockchain network. Blockchain technology has the potential to revolutionize charitable processes by enhancing transparency, accountability, and efficiency. The consensus mechanism plays a crucial role in ensuring the integrity and security of blockchain-based charity systems (19). Several key aspects warrant consideration: Transparency is achieved through consensus mechanisms in blockchain-based charity processes facilitate real-time tracking of donations and fund allocation, providing donors with visibility into the utilization of their contributions. The distributed nature of blockchain, in conjunction with consensus mechanisms, ensures the immutability of transaction records, thereby mitigating the risk of fraud and manipulation in charitable activities. Consensus mechanisms enable the execution of smart contracts, which can automate donation disbursement based on predefined conditions, ensuring efficient and transparent fund allocation. Proof of Stake (PoS) is particularly suitable for charity-focused blockchains, as it offers greater energy efficiency compared to Proof of Work (PoW) and aligns with the sustainability objectives of numerous charitable organizations. Consensus mechanisms can facilitate stakeholder participation, including donors and beneficiaries, in decision-making processes related to fund allocation and project selection. Blockchain consensus mechanisms can expedite international donations and reduce associated costs by eliminating intermediaries and minimizing transaction fees. The transparency afforded by consensus mechanisms can enhance donor trust and engagement, potentially leading to increased contributions and long-term support for charitable causes. Consensus mechanisms ensure the verification and recording of all transactions, facilitating the accountability of charitable organizations for their actions and use of funds (20). As charitable organizations expand and manage larger volumes of donations, consensus mechanisms must be designed to maintain efficiency and speed in transaction processing. Consensus mechanisms should support interoperability between diverse blockchain networks to enhance the overall effectiveness of charitable initiatives.

Transaction Structure of BECP Framework

The challenges with the current centralized contribution mechanisms include user privacy and transparency. We developed a blockchain-based donation system to promote transparency. The outcome of this approach is a greater transparency in donations. Users of the donation system are kept anonymous by not tracking a donation from a specific giver to a specific recipient. The Structural diagram for blockchain based charity process framework is shown in the Figure 3.

Implementation

By creating an Ethereum chain with public permissions and then utilizing the Solidity programming language to create smart contracts, the suggested framework makes use of blockchain technology. To deliver the necessary functionalities, the system combines a number of distinct components.

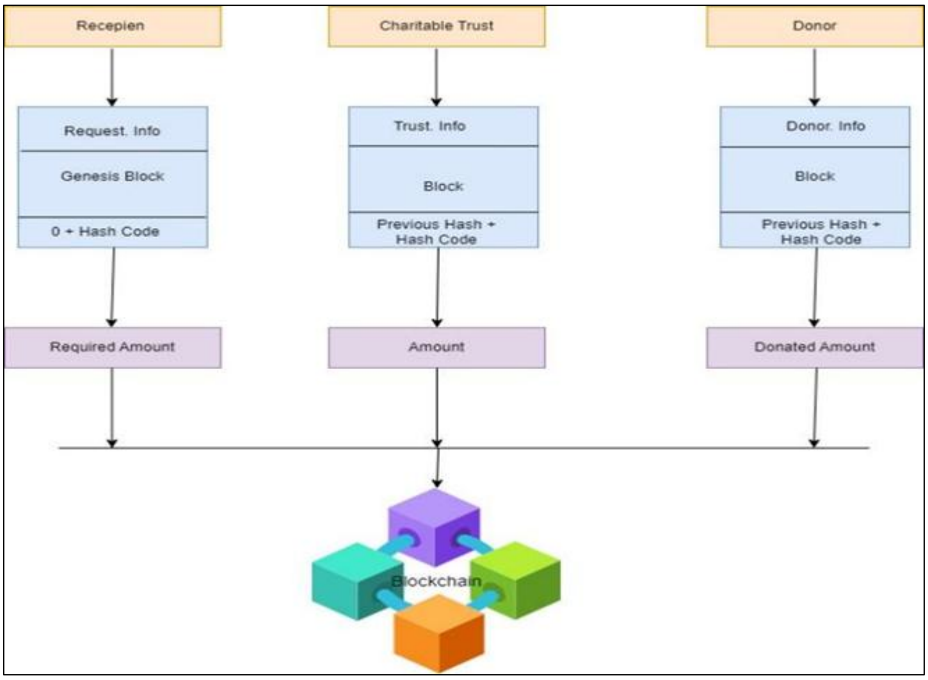

Figure 3: Structural Diagram for Blockchain Based Donation Process

The architecture of the BECP system, which is primarily intended to track charitable contributions and confirm that all requirements were met during the donation process, is shown in the following algorithms.

Proposed Algorithms

To request assistance and make donations, recepientand donor entities must first register on the network. Figure 4 illustrates how the registration contract is implemented in terms of recipient and trust functions and offers the user registration function as shown in Figure 6. Donors and beneficiaries can sign up for the system by providing the required identity and personal data, which is validated by charity trusts using a public database. Whether they are a donor or a recipient, each user must choose their position on the network. A system produces a relevant donor or recepientID for each participant to enable access to the blockchain network. Figure 5 illustrates the donor's function in this suggested methodology. The system is entirely within the administrator's authority, including the ability to write, interpret, amend, and ban users. The administrator can add a donor to the network and grant them access to the blockchain, transaction data, and donor's record if the donor's system-generated ID is authentic.

```
Algorithm 1 : Functions for recipient and trustee
If recipient_status==Authorized
        function create_request()
                Input : Explanation
                Assign values to request variables (i.e. request id)
                Alter request_status to Evaluated
                Evaluate the request
                Release create_request(next request id,sender,timestamp)
        End function
        function approve_request()
                Input : request id
                Require request status is processing
                Assign values to recipient target request record (next request id,sender,timestamp)
                Alter request_status to Evaluated
                Evaluate the request
                Release approve_request record(next request id,sender,timestamp)
        End function
        function decline_request()
                Input : request id,target amount,request evaluation
                        Request status is processing
                        Alter request_status to rejected
                        Release decline_request record(request id,recipient,sender,timestamp)
        End function
Else
        Default.
```

Figure 4: Recipient and Trust Functions

The administrator updates the transaction history and provides the giver with information about their gifts when a donor makes a contribution. If the beneficiary's ID is authentic, the administrator can grant access to the beneficiary's record and transaction data, as well as add the recipient to the blockchain network. The administrator modifies the transaction history, sends the necessary funds, and confirms the beneficiary's assistance request. A member whose involvement is judged inappropriate may be banned by the administrator through comments on the Ethereum blockchain network. The algorithm depicted in Figure 4 governs the actions of the trustees and the parties in need. The recipient can access the wallet Balance, withdraw, and establish case functionalities. A request that a needy party creates needs to be reviewed by the trustee using the approve request or reject request function. The functions of the trustees and the needy parties are governed by the algorithm shown in Figure 4. The recipient can access the wallet Balance, withdraw, and establish a case functionality. A request that a needy party creates needs to be reviewed by the trustee using the approve request or reject request function. Essentially, the create request, approve-request, reject-request, withdraw, and wallet Balance operations are all performed by the trustee. A trustee may initiate a request, and it will be accessible without requiring permission.

```
Algorithm 2 : Function for Donor
If donor_status == Authorized
        function donate()
        Input : request id
                Specify request_status is Evaluated
                Specify(msg.value>0)
                Allocate values to donate variables(ie.,request id,donate id,amount)
                if (current amount>target amount)
                        Calculate refund=current amount. Add(value+target amount)
                        Add donation amount into request amount
                        Deposit refund to donor
                        Calculate administrative fees using calc_adminfees function
                        Deposit recepient amount using calc_adminfees
                        Assign value to request current amount
                        Alter request status to completed
                        Release donate_record(request id,sender,value,timestamp)
                        Stop timestamp
                        Release End request record(request id,recipient,trust,timestamp)
                Else if (current amount == target amount)
                        Assign value to request current amount
                        Deposit adminfees(amount)
                        Deposit recipient amount using calc_adminfees
                        Alter request status to completed
                        Release donate_record(request id,sender,value,timestamp)
                        Stop timestamp
                        Release End request record(request id,recipient,trust,timestamp)
  Else
                Default.
```

Figure 5: Donor Functions

The system's donor functions—donate, withdraw, and wallet balance—are governed by the algorithm shown in Figure 5. Crucially, a donor can utilize the withdraw option to get their money back if they donate more than what is needed to finish the case. This will help to boost the confidence of all parties involved in the BECP system.

During transaction execution, a smart contract locks all donated amounts, even if the "charity" contract will record each donation amount for each party's address. As a result, a direct money transfer between the parties won't be necessary because each can withdraw the specified amount to their wallet address. As seen in Figure 7 and Figure 8, the "wallet" smart contract, which performs three tasks, is in charge of the wallet functioning. Amounts are implicitly distributed among the corresponding accounts using the deposit function; the relevant parties will thereafter retrieve these amounts. Following implementation, each smart contract is deployed and listed as a transaction on the blockchain. Interfaces of the BECP system can communicate with the smart contracts as the application binary interface and address of each smart contract are known.

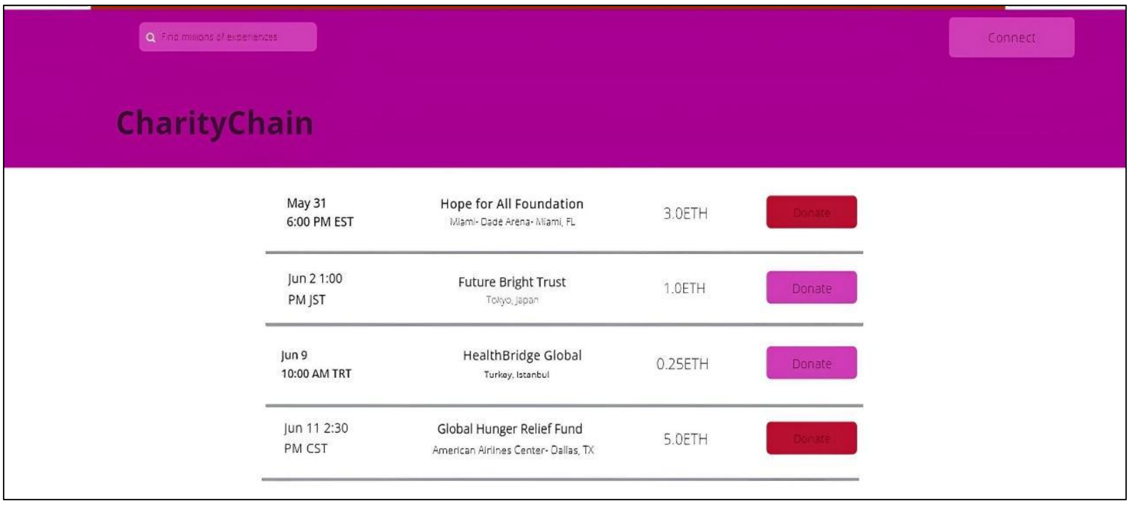

Figure 6: User Registration

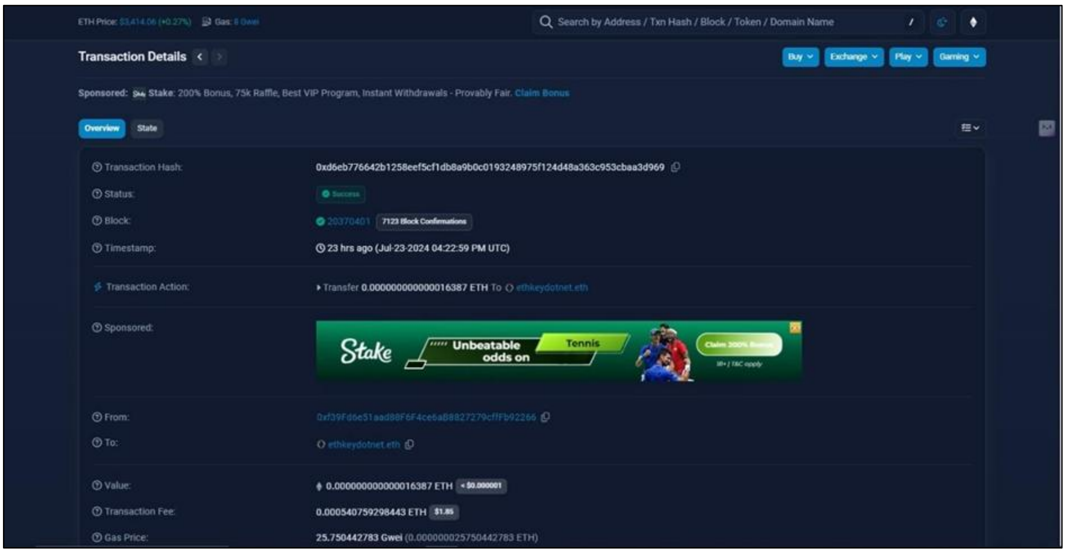

Figure 7: Transactions of Tokens

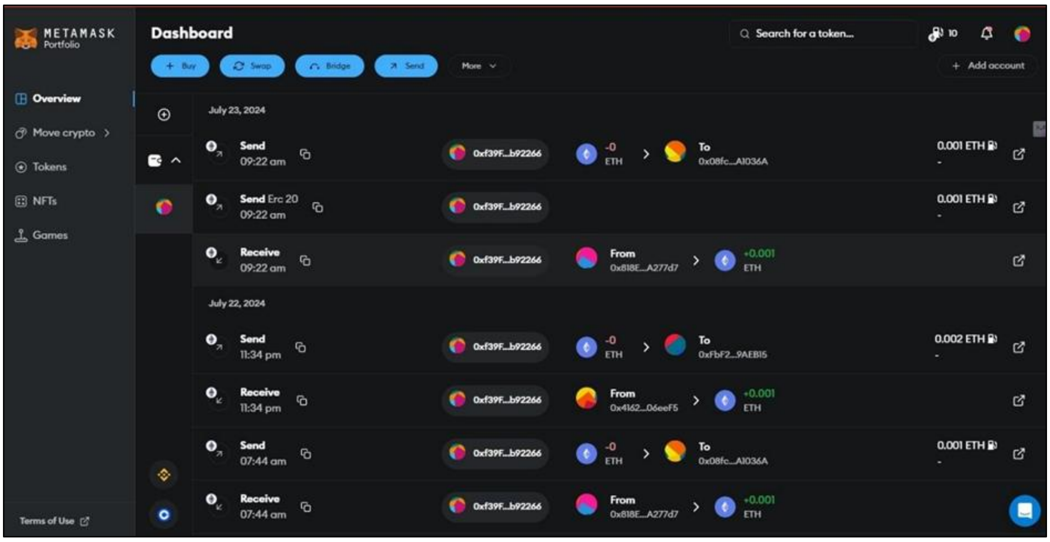

Figure 8: Minting of Tokens

Use Case Structure for Request during Disasters

In the event of a pandemic or tragedy, the user asks for help in order to survive financially. The charity agency confirms the user's request, previous transaction history, and donation history since the user has submitted a support request to the work. In order to provide financial support, it makes transactions to the recipients' accounts. The money from donations can be used by charitable organizations to buy basics and help those in need by providing the services they require. The current use case scenario model is seen in Figure 9. Users register on the platform to start the procedure. Identity data obtained from the official database is used to authenticate users. Users are admitted to the network after their information has been verified. The system can only be accessed by authenticated users. Beneficiaries can submit an assistance request after registering. Charitable organizations can receive requests for assistance from beneficiaries.

The organization has confirmed the request by obtaining the current timestamp and the prior history from the beneficiaries' database. In order to initiate the fund transfer, donors must also register with the system. The charity organizations receive the money directly from the givers after confirming their accounts.

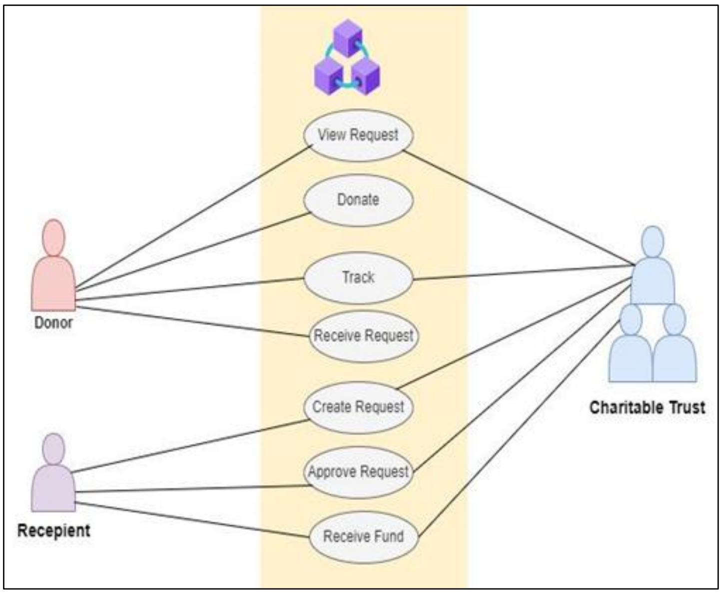

Figure 9: Use Case Structure for Requesting Donations

Only legitimate requests are granted, and charitable organizations work with disaster teams to provide finances or vital aid support. Following a successful transfer, the contributor receives a transaction report with the recipient details and a legitimate justification for the transfer. Figure 10 and Figure 11 explains about the functions for user registration and minting tokens. Every transaction results in an update to the recipient database. Since every participant had registered and been granted authorization to track the charity operations in the blockchain, all of the activities were recorded as permanent entries in the blockchain.

Results and Discussion

The suggested framework makes it possible to trace charitable contributions from the beginning of a case to its conclusion and to authenticate the identity of the parties involved. Crucially, everyone concerned is able to take part in tracking down the information pertaining to the donation. A hybrid qualitative method based on determining whether the blockchain framework is appropriate for the task at hand in order to analyse the performance of the suggested framework. The traceability system was evaluated. By uniting several parties, a test of every system feature was carried out to demonstrate the suggested architecture. If a party's address is on the list of approved addresses, they can utilize the system's features; if not, they must apply to join the system and receive authorization (21). The technical aspects and evolution of the recommended technique are covered in this section of the paper. In order to transfer money in a reliable and safe manner while leveraging the BCT's capabilities, this section explains the implementation details of the suggested system entities and operations. The platform architecture and how the components work together are shown in Figure 9.

```
function App() {
  const [provider, setProvider] = useState(null)
  const [account, setAccount] = useState(null)

  const [tokenMaster, setTokenMaster] = useState(null)
  const [occasions, setOccasions] = useState([])

  const [occasion, setOccasion] = useState({})
  const [toggle, setToggle] = useState(false)

  const loadBlockchainData = async () => {
    const provider = new ethers.providers.Web3Provider(window.ethereum)
    setProvider(provider)

    const network = await provider.getNetwork()
    const tokenMaster = new ethers.Contract(config[network.chainId].TokenMaster.address, TokenMaster, provider)
    setTokenMaster(tokenMaster)

    const totalOccasions = await tokenMaster.totalOccasions()
    const occasions = []

    for (var i = 1; i <= totalOccasions; i++) {
      const occasion = await tokenMaster.getOccasion(i)
      occasions.push(occasion)
    }
```

Figure 10: Function for User Registration

```
function mint(uint256 _id, uint256 _seat) public payable {
    // Require that _id is not 0 or less than total occasions...
    require(_id != 0);
    require(_id <= totalOccasions);

    // Require that ETH sent is greater than cost...
    require(msg.value >= occasions[_id].cost);

    // Require that the seat is not taken, and the seat exists...
    require(seatTaken[_id][_seat] == address(0));
    require(_seat <= occasions[_id].maxTickets);

    occasions[_id].tickets -= 1; // <-- Update ticket count

    hasBought[_id][msg.sender] = true; // <-- Update buying status
    seatTaken[_id][_seat] = msg.sender; // <-- Assign seat

    seatsTaken[_id].push(_seat); // <-- Update seats currently taken

    totalSupply++;

    _safeMint(msg.sender, totalSupply);
}
```

Figure 11: Function for Minting Tokens

In order to test the suggested plan, we put the strategy into practice using several technologies. The master records are stored on the Ethereum blockchain. In decentralized storage, smart contracts manage every transaction. Requests from users using the transfer interface. NodeJS is a serverside scripting language, Web3js is used to communicate with the client, and Solidity is a contract-oriented programming language that may be used to develop smart contracts for transactions and registration.

Performance Analysis

In-depth information about the performance review based on our trials testing the suggested structure may be found in this section. On the Ropsten test network, the following address can be monitored to obtain the record of deployed contracts: *0x0ba54510d3b95ba4173a2c4c86be27561bb36678*.

The system specification is given as follows

- Operating System : Windows 10
- RAM : 8GB
- Processor: Intel1 Core2 i7-8270U CPU @ 1.60 and 1.80 GHz

The above requirements show the details of smart contract generation transactions and user registration in the Ropstenn Ethereum Test Network. Every transaction can be examined in detail at Etherscan.

Cost Analysis

For tasks on the network to be successfully finished, participants must pay a gas fee. It needs a certain amount of gas to run each line of code written in Solidity. Computing efforts are measured in Ethereum gas units. There are two types of fees associated with carrying out an Ethereum transaction: The execution cost, which includes internal storage and contract status updates. Transaction cost, which includes both data transmission (i.e., transaction input cost) and implementation (i.e., contract deployment cost). The price and limit of gas are taken into consideration while calculating the amount of gas. Notably, when more confirmed transactions are added, the price of gas increases. The transaction fees required to carry out the main functions and execute the contract are considered.

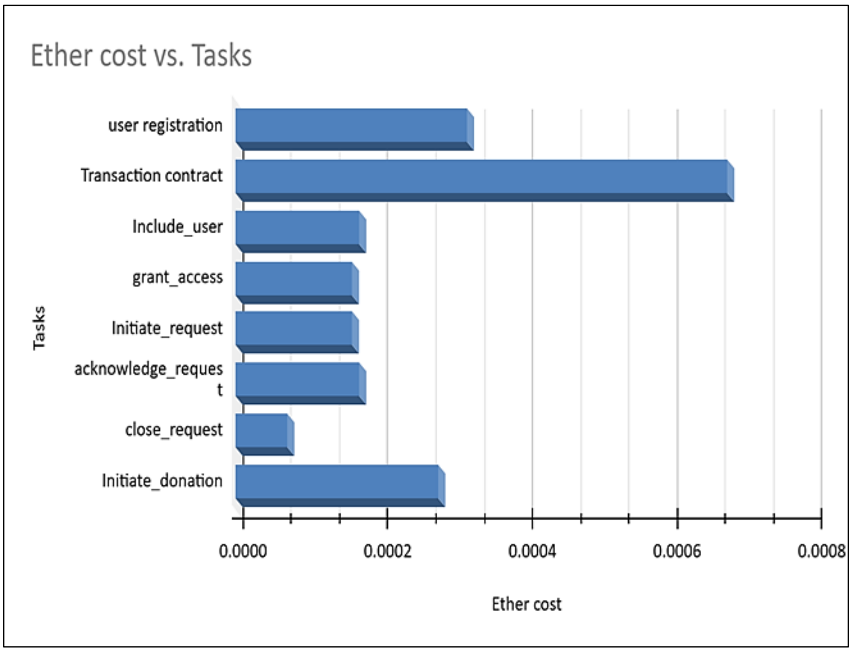

Figure 12: Cost Analysis

Processing Time

A process request time of 98 ms, a payment request time of 78 ms for the administrator, and a 51 ms mark for user contributions and approvals indicate that the platform has successfully deployed. Processing time is the amount of time (measured in milliseconds) required to process and approves a transaction. Figure 12 illustrates how long it takes to carry out the main features. The time analysis comparisons of each function are depicted in the Figure 13.

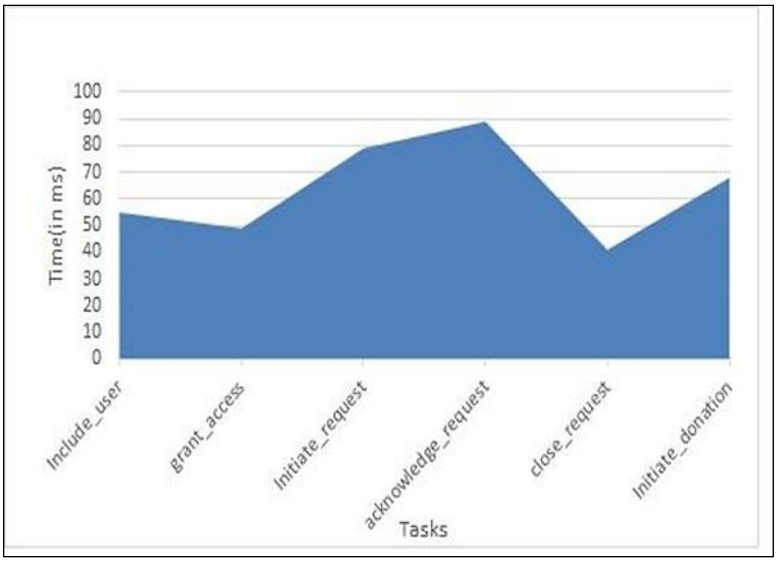

Figure 13: Time Analysis Comparison for Each Functions

Features of Blockchain Based on Donation Framework

A blockchain-based donation framework offers several distinctive characteristics that enhance transparency, security, and efficiency in charitable giving. This decentralized system provides an immutable record of all transactions, ensuring that every donation is traceable and verifiable. The distributed ledger technology at the core of blockchain creates a tamper-resistant database that is shared across a network of computers, making it extremely difficult for any single entity to alter or manipulate the records without detection. This level of transparency can significantly boost donor confidence and trust in charitable organizations. Smart contracts can be implemented to automate the distribution of funds based on predefined conditions, reducing administrative overhead and potential for human error. These self-executing contracts are programmed with specific rules and triggers, allowing for the automatic release of funds when certain criteria are met. For example, a smart contract could be set up to disburse donations to a disaster relief fund only when a verified emergency occurs, ensuring that resources are allocated promptly and appropriately. The framework's peer-to-peer nature eliminates intermediaries, potentially lowering transaction costs and enabling direct connections between donors and beneficiaries. By removing the need for traditional financial intermediaries, blockchain technology can significantly reduce the fees associated with international money transfers and other financial transactions. This direct connection also allows for greater transparency in how funds are used, as donors can potentially track their contributions from the point of donation to the final beneficiary. Additionally, the use of cryptocurrencies within the blockchain ecosystem allows for borderless transactions, facilitating global giving without the constraints of traditional banking systems. This feature is particularly beneficial for international aid efforts, as it enables rapid transfer of funds to areas in need, bypassing the often slow and costly processes of traditional cross-border transactions. Cryptocurrencies can also provide a means of financial inclusion for unbanked populations, allowing them to receive aid directly through digital wallets. The inherent transparency of blockchain technology also enables real-time tracking of funds, allowing donors to monitor the impact of their contributions and enhancing accountability in the charitable sector. This level of visibility can help combat fraud and misuse of funds, as all transactions are recorded and can be audited by anyone with access to the blockchain. Real-time tracking also allows for more efficient resource allocation, as organizations can quickly identify areas of greatest need and adjust their strategies accordingly. Furthermore, blockchain-based donation systems can incorporate features such as tokenization, which allows for the creation of digital assets representing specific charitable causes or projects. These tokens can be traded or held by donors, potentially creating new models for long-term engagement and support. The technology also enables the implementation of reputation systems, where both donors and charitable organizations can build verifiable track records of their activities, fostering a more trustworthy and efficient philanthropic ecosystem. In addition to financial transactions, blockchain can be used to track the delivery and distribution of physical aid, such as food, medicine, or supplies. By creating a digital trail for these goods, organizations can ensure that aid reaches its intended recipients and reduce the risk of loss or theft along the supply chain. This enhanced traceability can lead to more effective and targeted aid distribution, ultimately improving the overall impact of charitable efforts. As the technology continues to evolve, blockchain-based donation frameworks have the potential to revolutionize the charitable sector by addressing long-standing challenges related to trust, efficiency, and global coordination. By leveraging the power of decentralized networks and cryptographic security, these systems can create a more transparent, accountable, and effective ecosystem for philanthropy, ultimately benefiting both donors and recipients alike.

Conclusion

It has been demonstrated that blockchain-based traceability solutions are quite useful in the nonprofit sector. Even though the charity sector is just as significant as the healthcare or supply chain sectors, it has, thus far, mostly been ignored when it comes to the use of blockchain technology. This is especially true for non-profit organizations. Although there are a few pertinent studies in the literature, blockchain traceability systems are yet rarely used in the actual world. The current systems for donations lack efficiency and transparency. In order for contributors to understand how their money was spent, an effective contribution system that is more transparent and capable of tracking and recording every transaction is required. The work presented suggests a more transparent, blockchain-based donation system. This article offers a dependable framework for improving the effectiveness of the pandemic donation procedure. The purpose of smart contracts is to safely send money to recipients and charitable organizations while also registering users. To guarantee money transfers and increase charity transparency, transactions can be monitored on a blockchain platform. Donors' registered cell phones receive a confirmation message along with a thorough record of all donations made in various domains. Using the Ropsten Ethereum test network in the real-time system, the framework has been implemented and assessed. The strategy is meant to cut down on time, reduce the cost of donations, and lessen the likelihood of campaign cash being misused. The suggested approach promotes increased donation during a pandemic and increases openness in donation activities. The system's performance evaluation shows promising findings about the model's dependability and the amount of time spent processing transactions.

Future Work

Future research on blockchain-based donation frameworks could explore several promising avenues to enhance their functionality, efficiency, and impact. One key area is improving scalability to handle larger transaction volumes while maintaining low fees and fast processing times. This could involve implementing layer-2 solutions, such as sidechains or state channels, or exploring alternative consensus mechanisms that offer higher throughput without compromising security or decentralization. Integrating smart contracts with decentralized finance (DeFi) protocols could enable more sophisticated fundraising mechanisms and automated fund distribution. For instance, charitable organizations could leverage yield farming strategies to generate additional returns on donated funds, or implement token-based governance systems to allow donors to participate in decision-making processes. Programmable escrow services could ensure that funds are only released when predefined milestones or conditions are met, increasing accountability and donor confidence. Enhanced privacy features, such as zero-knowledge proofs, could be implemented to protect donor identities while ensuring transparency of fund allocation. This would address concerns about personal information exposure while maintaining the auditability of transactions. Confidential transaction techniques could also be explored to obscure donation amounts while still allowing for aggregate statistics to be computed. Interoperability between different blockchain networks could facilitate cross-border donations and expand the reach of charitable initiatives. This could involve developing cross-chain bridges or adopting standards for blockchain interoperability, enabling seamless transfers of funds and data across various platforms. Such advancements would allow donors to contribute using their preferred cryptocurrencies and enable charitable organizations to operate across multiple blockchain ecosystems. Developing user-friendly interfaces and mobile applications would make blockchain-based donation platforms more accessible to a wider audience. This could include creating intuitive wallet interfaces, implementing social login options, and designing educational resources to help users understand the benefits and mechanics of blockchain-based donations. Gamification elements could also be incorporated to engage donors and incentivize regular contributions. Research into governance models for decentralized charitable organizations could help establish best practices for community-driven philanthropy in the blockchain era. This might involve exploring different voting mechanisms, reputation systems, and incentive structures to ensure fair and efficient decision-making. Additionally, investigating ways to balance decentralization with regulatory compliance and legal frameworks would be crucial for the widespread adoption of blockchain-based charitable platforms. Furthermore, integrating blockchain donation systems with traditional financial infrastructure could create hybrid models that combine the benefits of both worlds. This could involve developing solutions for seamless fiat-to-crypto conversions, partnering with established payment processors, and creating bridges between blockchain-based platforms and existing donor management systems used by non-profit organizations. Lastly, research into the environmental impact of blockchain-based donation systems and potential solutions for minimizing their carbon footprint would be valuable. This could include exploring energy-efficient consensus mechanisms, offsetting strategies, or leveraging renewable energy sources to power blockchain networks dedicated to charitable causes.

Abbreviations

BECP: Blockchain Enabled Charity Process Framework, POA: Proof of Authority, POS: Proof of Stake, POW: Proof of Work.

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Author Contributions

All authors contributed to the study conception and design.

Conflict of Interests

The authors declare that they have no competing interests.

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