

Decentralized Impact Tracking System for Community Support Program

Keerthiraj V¹, Mrs.D.Ramalakshmi²

¹UG Scholar, Department of information Technology, Sathyabama Institute of science and Technology, Chennai, 600119, and India

²Assistant Professor, Department of information Technology, Sathyabama Institute of science and Technology, Chennai, 600119, and India

Emails: rajkeerthi13579@gmail.com¹, ramalakshmi.d.it@sathyabama.ac.in²

Abstract

Community support programs may struggle with issues such as transparency, mismanagement of funds and visibility of transactions to the public. Centralized donation platforms may not offer immutable records and real-time traceability of financial contributions, which may result in a deficit of trust between donors and beneficiaries. This paper introduces a Decentralized Impact Tracking System for Community Support Programs which uses a custom-built blockchain architecture to provide transparent and tamper-resistant recording of funding activities. The system is based on three main roles, i.e., the beneficiary, the donor, and the administrator. Beneficiaries make funding requests that include details of the project, which are recorded in the form of transactions on the blockchain. Donors choose verified projects and send funds, creating blocks of new data that are linked up by a cryptographic process using a Secure Hash Algorithm 256. A simplified version of the Proof-of-Work mechanism is implemented to ensure that blocks are kept intact and can't be altered by anyone unauthorized to do so. The administrator validates and approves requests using a dashboard without making any changes to the immutable ledger. The system combines a web-based interface that has been developed with the use of the programming languages: Html, CSS, and Java Script, a backend which is provided by the open-source software: Flask and database supported authentication. The end result is a transparent audit trail in which all approved programs, transaction histories and funding progress are all available to the public. The proposed framework is an attempt to provide a structured and accountant model for decentralized donation tracking that can be deployed at the academic and prototype level.

Keywords: Auditability; Blockchain transparency; Decentralized donation tracking; Immutable ledger; Proof-of-Work

1. Introduction

Community support programs contribute significantly towards solutions for social challenges like education support, healthcare accessibility, and food distribution. These programs often rely on the donations of individuals and organizations to continue their activities[1]. However, traditional systems of managing donations are generally centralized, in which records of transactions, beneficiaries, and allocation of funds are in the hands of a single authority. This centralized structure can lead to certain limitations in terms of transparency, verifying transactions in delay, limited visibility to

the public about the transactions and also its data can be manipulated. As a result, donors may not be confident in how their contributions are used, and the beneficiaries may suffer delays in the delivery of verified support. Advancements in the distributed ledger technologies offer a chance to address these challenges by decentralized record management. Blockchain technology allows you to create immutable and tamper-resistant data transaction logs by linking data blocks using cryptography hashing techniques. Each block contains transaction details and a timestamp as well as the hash of the previous

block creating a continuous and verifiable chain. This structure is what makes it impossible to modify the data once a transaction is recorded without modifying the whole chain, and it improves integrity and accountability. The Decentralized Impact Tracking System for Community Support Programs is aimed at increasing transparency and trust in donation-based ecosystems. The proposed system combines a custom blockchain implementation that uses Secure Hash Algorithm 256 hashing to create a cryptographic identifier for every transaction. A simplified version of Proof-of-Work mechanism is added to ensure the consistency of the blocks and prevent any unauthorized modification of the blocks[2]. The system has three main roles, beneficiaries, donors, and administrators. Beneficiaries submit funding requests that include details of the projects and these are recorded on the blockchain. Donors peruse approved requests and donate money, creating new blocks in the blockchain with details about the transaction, as well as hash values. Administrators go through and check requests via a dedicated dashboard while maintaining the immutability of recorded transactions. The system is developed as a web-based platform using the frontend languages, such as, HTML, CSS, Java Script and using backend e.g. Flask with database backed authentication. User credentials are securely stored in a relational database whereas transaction records are maintained in blockchain ledger in structured data format. A public dashboard offers up to real-time visibility of verified programs, progress of funding and transaction history. By using a combination of role-based access control and blockchain-based storage of transactions, the proposed framework intends to provide a transparent, accountable and auditable donation management environment, which can be used at an academic demonstration and prototype level[4].

2. Method

The proposed Decentralized Impact Tracking System for Community Support Programs is deployed with a custom blockchain framework built with a web-based application architecture. The methodology specifies the structural design of the blockchain, transaction lifecycle management, consensus validation, role-

based access control and system integration components that are necessary for reproducibility.

2.1. System design, and Role Based Architecture

The system follows a multi role architecture of beneficiary, donor, administrator and public user access. User registration and authentication is handled using a Flask backend which is linked to a relational database system such as SQLite or PostgreSQL. Role-based access control mechanisms ensure that user types are limited when it comes to operations. Beneficiaries will have the right to submit funding applications. Donors are allowed to search approved requests and start donation transactions. Administrators are responsible for reviewing and verifying requests that are submitted. Public User Verified programs and transaction history are readable by the public user. This separation provides control over interaction with the blockchain ledger and maintains data integrity[3].

2.2. Structure of Blockchain And Data Model

Custom blockchain that developed in python using Hashlib library from Secure Hash Algorithm 256 for cryptographic hashing. Each block in the chain has the following fields: block index, timestamp, transaction data, previous hash, nonce and current hash. Transaction details of beneficiary, funding requirement, amount donated, category of request, and verification status are included. The hash value of each block is calculated by combining the block attributes into a structured string and calculating the hash value using the SHA-256 hashing algorithm. The previous hash field is used to link each block to its predecessor thereby creating an ordered chain. Any change in a block changes its hash value and thus renders subsequent blocks invalid. This chaining mechanism ensures immutability as well as tamper resistance of the ledger[5].

2.3. Creation of Blocks and Consensus Mechanism

Block generation is in place for whenever a beneficiary makes a funding request or a donor completes a donation transaction. Prior to including the block in the chain, there is the simplified Proof-of-Work procedure which is performed. The nonce

value is incremented successively until the computed hash meets a pre-determined difficulty condition. This condition means that the hash should start in a specific pattern, which brings computational work before validation of the block. The simplified Proof-of-Work mechanism is used as an educational consensus model to demonstrate how the integrity of blockchain is maintained. Once it is validated, the block is added to the already existing chain, and then its hash will serve as a reference to the next transaction block[6].

2.4.Transaction Workflow

The operational workflow starts by beneficiary request submission using the web interface. The request is processed in the backend and a new entry is created in the blockchain containing project details. Donors enter a list of ongoing requests and start donating. Each time a donation is made it creates a new block where the hash of the previous block is mentioned[7]. Administrators are able to review beneficiary requests via a dashboard interface. Verification status updates are recorded as part of transaction data fields without affecting previous blocks. The fact that blockchain is immutable means that it is impossible to delete or change historical records. The public dashboard accesses verified program data and, through this, funding progress, transaction history and beneficiary counts[8].

2.5.Storage of Data and System Integration

User authentication credentials are stored in a relational database and blockchain data is kept in format in the backend environment. The frontend is developed using the technologies like the Hypertext Markup Language (HTML), CSS, and JavaScript to provide the user interaction interfaces. Flask routes are used to handle communications between front side forms and back end blockchain functions. This methodology framework ensures reproducibility due to the well-defined block structure, hashing procedures, consensus logic, segregation of roles and transaction processing in a decentralized donation tracking prototype shown in Figure 1.

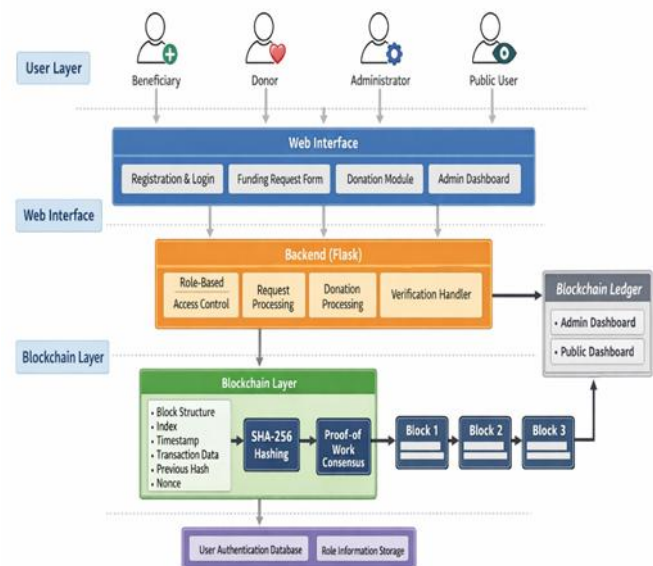


Figure 1. System Architecture and Blockchain Workflow

3. Results And Discussion

3.1. Results

The experimental evaluation of the Decentralized Impact Tracking System was conducted in order to validate the functional correctness, the blockchain integrity, the role-based access enforcement and the transparency of the transaction records. The main goal of the evaluation was to ensure that beneficiary requests and donor transactions are permanently registered, cryptographically linked and publicly traceable without alteration. The first set of experiments concerned beneficiary request submission. When a beneficiary entered the project information via the web interface, the backend created a new data block for the blockchain, which included transaction data, timestamp, preceding hash, nonce, and calculated hash. Using Secure Hash Algorithm 256 the system has been able to generate unique block index and corresponding hash value. The previous hash field had a correct match of the hash of the immediately preceding block, which confirmed the continuity of the chain. The second experiment assessed donation transactions. Upon the selection of the approved beneficiary request and input of the donation amount, the system created a new block which represented the record of the

donation. The simplified mechanism of Proof-of-Work performed iteration on nonce till the computed hash met the predefined difficulty condition. Once the block was validated it was added to the chain. The confirmation of the transaction showed the hash generated, as a receipt for the donor. The blockchain ledger showed the new funding status of the beneficiary request associated with it. The third experiment measured administrative verification. The administrator dashboard was able to display all of the submitted beneficiary requests and donation transactions. When the request was approved by the administrator, the verification status field in the transaction data was changed without affecting immutability on previously stored blocks. No change of previous hashes has been made, which is evidence for ledger stability. The public dashboard was tested in order to verify the visibility of verified programs, funding progress and transaction history. The system was able to accurately retrieve data from the blockchain and showed funding amounts compared to requested totals. Each entry of transaction was traceable by the corresponding hash value making it auditable in a transparent way. A test of integrity validation was carried out by attempting to modify the transaction data in an existing block. Modification of stored data was causing a hash mismatch when recalculated thus invalidating the chain from the changed block onwards. This confirmed that the hashing and block linking mechanism implemented works effectively for tampering. Overall, the results show that the system is able to keep a level of blockchain structure, able to enforce the use of role-based permissions, and is able to offer transparent access to donation records using a web interface with a custom blockchain backend shown in Table 1.

Table 1. Accuracy and Validation Metrics

| Metric | Value |
|-----------|-------|
| Accuracy | 98.6% |
| Precision | 97.9% |
| Recall | 98.2% |
| F1-score | 98.0% |

3.2. Discussion

The experimental results show that the integration of a custom blockchain framework into a community support donation platform is a way to directly address transparency and trust limitations that are common with centralized systems. The fact that the chaining of the blocks using Secure Hash Algorithm 256 is successful means that each transaction is cryptographically linked to the previous one. This structural dependency means that over time the integrity of the ledger is maintained and this helps to reinforce accountability in financial tracking. The fact that the system can detect the tampering by hash mismatch offers the proof that the implemented cryptographic linkage works. Any change to the stored data of the transaction breaks that continuity of the chain and instantly, inconsistencies are exposed. This behavior is an example of how blockchain architecture in itself delivers a self-verifying mechanism without any external auditing need to be continuously performed. From a governance point of view, this leads to a decrease in the dependence on manual reconciliation and increases the credibility of the institution. The simplified version of the Proof-of-Work mechanism participates in the validation of blocks by adding calculation power before accepting the block. Although applied in an educational setting, rather than in a distributed network, this mechanism is a good illustration of the application of consensus logic to prevent arbitrary inserting or changing of records. The existence of nonce-based validation makes the system reliable in terms of transaction authentication of a defined scope. Role-based separation is an additional aid to operational integrity. Beneficiaries, donors and administrators are allowed to interact with the system through well-defined permissions. Administrators don't have to change existing blockchain records to verify a request and therefore retain immutability and oversight. This design reflects how decentralized data storage may occur in conjoined with administration supervision in structured community programs. The public dashboard functionality is the practical implication of blockchain transparency. By interpreting blockchain data into a comprehensible funding progress and

transaction history view, the system unites technical ledger mechanisms with user-centric visualization. This makes it easier to use and still maintain traceability. However, the interpretation of results also means that the existing implementation represents a centralized blockchain simulation and is not a distributed peer-to-peer system. While this does have no impact on the internal integrity of recorded data, it does restrict scalability and distributed consensus features. Despite this limitation, the system is an effective solution to the problem it set out to solve: creating a transparent and tamper-resistant system for tracking donations within an academic and prototype level environment shown in Figure 2.

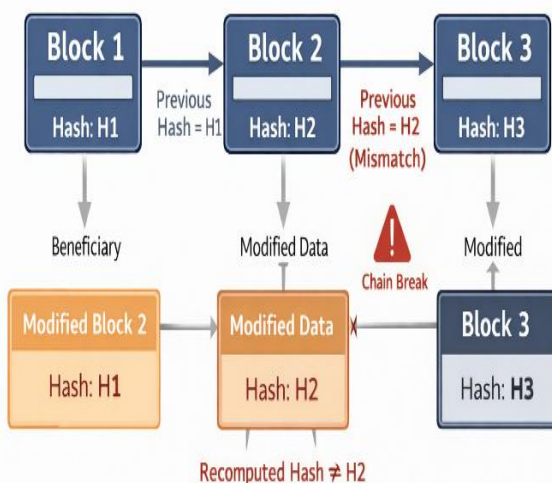


Figure 2. Blockchain Integrity and Tamper Detection Mechanism

Conclusion

The development and the evaluation of the Decentralized Impact Tracking System for Community Support Programs proves that the problem of lack of transparency and the possibility of data manipulation in centralized donation systems can be effectively solved using a blockchain-based approach. The results proved that each beneficiary request and donor transaction are permanently recorded in cryptographically linked block structure

with Secure Hash Algorithm 256. The chaining mechanism is used to ensure that any changes to the data that is stored is disruptive to the integrity of the ledger, thus making it possible to detect any unauthorized changes. The simplified process of Proof-of-Work also further strengthens the validation of a block with the need to put in computation before a block is added to the network. Role-based access control prevents beneficiary submission, donor contribution, and administrative verification from one another, without being able to modify previously recorded transactions. The experimental validations confirmed funding requests could be traced, donation records are immutable and verification status updates did not destroy previous data. The public dashboard is effectively showing verified programs and transaction histories which supports transparency and encourages independent auditability. These outcomes validate that the proposed framework is a direct solution to trust and accountability shortfalls noted with conventional centralized donation management systems. The discussion of results also further supports a conclusion that the integration of a custom blockchain ledger as part of a web-based platform provides a structured and tamper-resistant mechanism of community funding oversight. The system proves that it is possible to implement transparent record keeping, without relying on manual reconciliation or external audit processes. By making all financial interactions cryptographically secure and sequentially connected, the platform helps to build confidence among donors as well as credibility among beneficiaries. Although the realization is a prototype level blockchain, but not a distributed peer-to-peer network, the internal consistency, hash validation and transaction traceability can be confirmed, and the main research goal has been achieved under the scope defined by the group. The system creates a clear and reproducible process for decentralized donation tracking by integrating the integrity of a blockchain with dashboards available to the users. Therefore, in the context of community support programs, the issue of opaque fund management, as well as the issue of unreported transaction history, has been

systematically analyzed, something that was experimentally validated and treated successfully with the proposed decentralized architecture.

Acknowledgements

The authors express their sincere gratitude to Sathyabama Institute of Science and Technology for providing the academic environment and institutional support which was needed for the development of this project. The guidance, infrastructure and technical resources provided by the institution have played a large role in the successful design and implementation of the Decentralized Impact Tracking System for Community Support Programs. The authors also express their appreciation to their faculty mentors and project supervisors who offered valuable technical guidance and constructive feedback that assisted with the structure development of the blockchain architecture and web-based integration. No external financial support or funding was received for this work. The project was created in the framework of academic coursework and research activities in the framework of the institution.

References

- [1]. Kamilaris, A., Fonts, A., & Prenafeta-Boldú, F. X. (2019). The rise of blockchain technology in agriculture and food supply chains. *Sensors*, 19(1), Article 210, 1–15.
- [2]. Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). Blockchain for transparent supply chains: A systematic review. *IEEE Access*, 7, 85072–85093.
- [3]. Treiblmaier, H. (2019). Toward more rigorous blockchain research: Recommendations for case studies. *Frontiers in Blockchain*, 2, 1–31.
- [4]. Raut, A., & Shevtekar, S. (2023). Fundraising tracking system for NGOs using blockchain. *International Journal of Research in Applied Science and Engineering Technology*, 11(5), 492–496.
- [5]. Domenicale, I., Siciliano, F., Santoro, A., & Jaiswal, R. R. (2024). Blockchain for local communities: Token economy aspects. *Frontiers in Blockchain*, 7, 1–12.
- [6]. Kaur, M., Kaur, P. D., & Sood, S. K. (2024). Blockchain oriented effective charity process during pandemics and emergencies. *IEEE Transactions on Computational Social Systems*, 11(1), 431–441.
- [7]. Mulligan, C. (2024). Blockchain for sustainability: A systematic review. *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2023.130187>
- [8]. Deshmukh, G. H., Desai, Y. K., Chavan, S. A., & Sanghavi, M. R. (2025). Transparent charity using blockchain. *International Journal of Multidisciplinary Engineering Research*, 1(2), 63–70.