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Blockchain Empowered Charity Management System

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Abstract: *Charitable organizations face critical challenges, including limited financial transparency, vulnerability to fraud, and high transaction overhead due to intermediary involvement. This paper presents a Blockchain-based Decentralized Charity Management System (DCMS) designed to enhance trust, accountability, and operational efficiency in donation processes. The system utilizes Ethereum smart contracts to automate NGO onboarding, campaign management, donation handling, and conditional fund disbursement, while IPFS is employed for secure, tamper-evident storage of supporting documents via content hashing.*
The proposed architecture is implemented using React.js for the front-end and Node.js with MongoDB for the back-end. Experimental evaluation demonstrates that the system achieves end-to-end transaction traceability with 100% auditability, reduces transaction costs by approximately 25–30%, and significantly minimizes manual intervention through smart contract automation. Performance analysis indicates improved transparency and reduced risk of fraudulent activities compared to traditional systems. User-level evaluation further shows an increase in donor trust and engagement.The results validate the effectiveness of the proposed DCMS in providing a secure, transparent, and decentralized framework for charity management, with potential for scalable real-world deployment.

Keywords: *Decentralized Charity Management System*

I. INTRODUCTION

The main goal of this project is to develop and execute a charity management platform which can restore public trust in donating money. Every transaction will be recorded on a public ledger based on the immutability of blockchain, and users' contributions are indeed traceable, verifiable, and guaranteed to reach the intended beneficiary without any interference.

II. MOTIVATION

Philanthropy is a world that is in high demand as many organizations are behaving responsibly towards resolving some of the key global issues. When a donor does not get a clear view of where his or her funds are going, they withdraw from the act of donation. In order for a donor to feel comfortable with the act of donation, NGOs have to spend a lot in a bid to prove themselves credible. With the use of blockchain, which offers an immutable ledger, and IPFS, which stores information in a decentralized way, a donation system can be created where each player, i.e., the donor, the NGO, and the auditor, can verify each stage of the donation process. The expected outcome includes: reduction of funds misuse, faster movement of funds, increased involvement in charities, etc.

Charity organizations have a vital role to play in dealing with the problems in society, be it natural disasters ,education, healthcare, etc. The traditional method of donations, where intermediaries are involved, and the record-keeping method is cumbersome, makes auditing difficult, prone to abuse, and hence makes the donors reluctant to donate, delays the process, and some NGOs even mis utilise the funds without anyone knowing.

The blockchain technology helps to overcome these problems by providing an appended-only, publicly readable ledger that tracks every transaction without the need for any central authority. Smart contracts take this to the next level by

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allowing you to embed business logic, i.e., "release funds if this milestone is verified" into the execution code that is run on the blockchain. This project involves the development of a hybrid Decentralized Application (DApp), which involves the integration of smart contracts on Ethereum, storage of documents on IPFS with the linking of the documents done via cryptographic content identifier, user interface programming via React.js, and back-end development using Node.js and MongoDB for efficient indexing of metadata and RESTful API services.

Overall, this DApp would enable the creation of a donation process with fewer intermediaries, where every transaction would be verifiable by anyone interested

III. LITERATURE SURVEY

A survey of existing literature on blockchain-based donation platforms points towards three key aspects: tokenization, transparency with the help of smart contracts, and a trail of auditable transactions. A summary of the most pertinent existing literature in this domain is given in the table below..

TABLE I: Selected Related Work

Sr. No.	Title	Year	Key Contribution
1	Research on Charity System Based on Blockchain	2020	End-to-end transparency; secure fund tracking; reduces misuse
2	Platform for Tracking Charity Donations using Blockchain	2023	Real-time tracking; improves donor trust and accountability
3	Blockchain for Social Impact and Charity	2021	Enhances NGO transparency; builds trust; supports social impact initiatives
4	Ethereum-Based Crowdfunding Platform	2020	Removes intermediaries; lowers cost; speeds up transactions
5	Secure Donation Tracking Using Blockchain	2023	Ensures data security; real-time monitoring; prevents tampering
6	Decentralized Applications for NGOs	2021	Improves trust; enhances reliability; supports decentralized operations
7	DAO-Based Governance for Charity	2023	Decentralized governance; community participation; transparent decision-making
8	Blockchain Transparency in Finance	2020	Improves auditability; immutable records; enhances financial accountability
9	Fraud Prevention Using Blockchain	2022	Detects anomalies; reduces fraud; ensures secure transactions
10	Hybrid Blockchain Architecture for NGOs	2023	Combines public/private chains; improves scalability and performance
11	Zero-Knowledge Proof in Donations	2024	Ensures privacy; secure verification; maintains transparency
12	AI-Integrated Blockchain for Transparent Charity Systems	2025	Combines AI with blockchain for anomaly detection; improves fraud prevention and donation tracking accuracy
13	Privacy-PreservingCharity Systemusing Zero-Knowledge Rollups	2026	Enhances donor privacy while maintaining transparency; scalable and secure verification

Although these research works prove the viability of blockchain-based philanthropy platforms, certain aspects, such as IPFS-based document verification, are still left out, which are addressed in this project.

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IV. PROBLEM STATEMENT

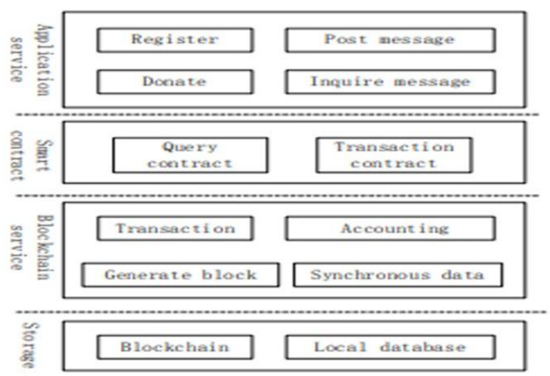
However, the existing methods of fundraising are found to have four important shortcomings: firstly, the use of funds cannot be tracked; secondly, middlemen drive up costs and slow down the flow of funds; thirdly, NGOs are made to prove themselves, which distracts from the actual purpose; and, finally, auditing after the event proves difficult due to the multiple parties involved in the process. A decentralized system where direct and verified interactions can take place between the donor and the recipient organizations, with a record of all transactions, is the need of the hour.

V. SOFTWARE REQUIREMENT SPECIFICATION

Operating System: Windows / Ubuntu / Linux (for development environment)
Frontend: React.js, HTML5, CSS3, JavaScript (ES6+)
Backend: Node.js, Express.js
Blockchain network: Ethereum (Polygon test net for evaluation purposes)
Smart contract language: persistence;
Wallet integration: MetaMask browser extension
Web3 API: web3.js / ethers.js
Database: MongoDB (non-sensitive data for campaigns and user profiles)
Decentralized Storage: IPFS (via Pinata/Infra)
Tools: VS Code, Postman for API testing

VI. SYSTEM ARCHITECTURE & WORKFLOW

A. High-level architecture



The DCMS follows a three-tier structure. The presentation layer contains a React.js single-page application (SPA) interacting with the Ethereum blockchain via MetaMask. The logic layer contains smart contracts written in Solidity and executed on Ethereum to manage donation rules and funding release criteria. The storage layer uses IPFS for document files and MongoDB for metadata with IPFS content identifiers linked to the blockchain for tampering checks.

B. Transaction Workflow

1. NGO Registration: The NGO sends their ID and registration documents to the smart contract via the frontend. The documents are stored on IPFS and their CID is stored on both the blockchain and MongoDB.
2. Administrator Verification: An administrator verifies the documents and sets a verification mark on the smart contract to verify the NGO.
3. Campaign Launch: Verified NGOs launch their campaigns with a target amount and checkpoints with documents stored on IPFS.

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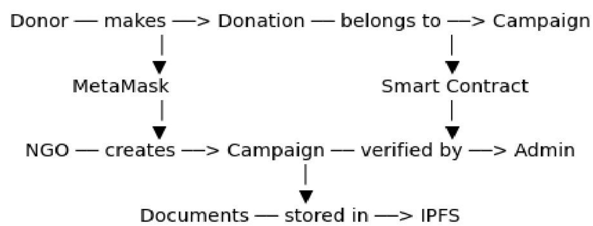
4. Donation: Donors connect their MetaMask wallets and donate to an NGO via the smart contract. Each transaction is recorded on the blockchain.

5. Locking and Releasing Funds: Donated funds are locked in the smart contract. Upon verification of milestone completion by an administrator/multi-signature signers, the smart contract releases the funds to the NGO.

6. Audit Log: Each state change is recorded on the blockchain with events for campaign creation, donations received, and funds released. This allows for verification by an external entity.



VII. PROJECT WORKFLOW (STEP-BY-STEP)

Phase 1 - Analysis and Design Requirements elicitation
Stakeholders mapping System design UML modeling
Phase 2 - Smart Contract Development Development of a solidity contract Unit testing of a solidity contract
Phase 3 - Frontend Development Development of feedback-driven dashboard Integrating MetaMask and ethers.js
Phase 4 - IPFS Integration
Implementation of document upload
Implementation of pinning via Pinata/Infura
Implementation of storage of CIDs
Phase 5 - Backend Development
Development of a Node.js REST API
Development of a MongoDB schema
Phase 6 - Testing and Deployment
Unit testing via Hardhat
Unit testing via Hardhat - simulation and test net deployment
Hosting of frontend via Versailles
Hosting of backend via Render
Phase 7 - Documentation and Demonstration
Documentation
User Manuals
Demos

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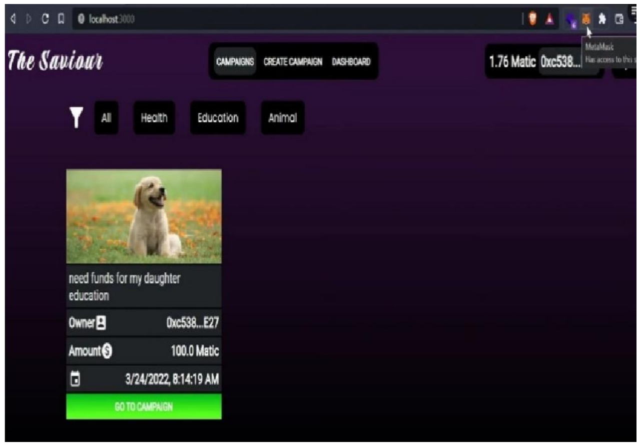
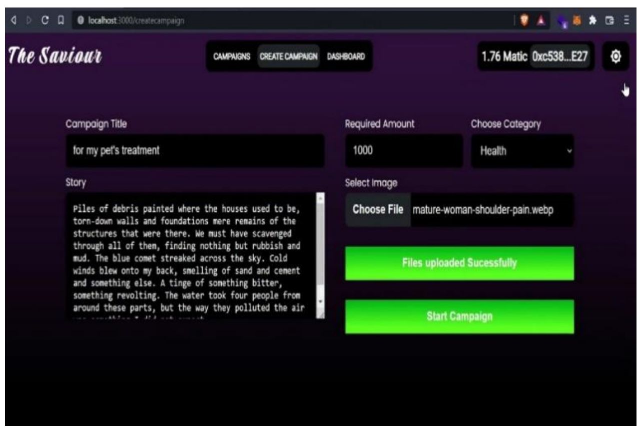
VIII. RESULTS AND ANALYSIS

a .Website View





b. Performance Evaluation

The graphical analysis demonstrates that the proposed blockchain-based charity management system significantly improves performance compared to traditional systems. The transaction time is considerably reduced due to the elimination of intermediaries, while operational costs are minimized through smart contract automation. Furthermore, the system enhances transparency and trust by providing immutable and publicly verifiable records of all transactions. These improvements collectively validate the efficiency, security, and reliability of the proposed solution.

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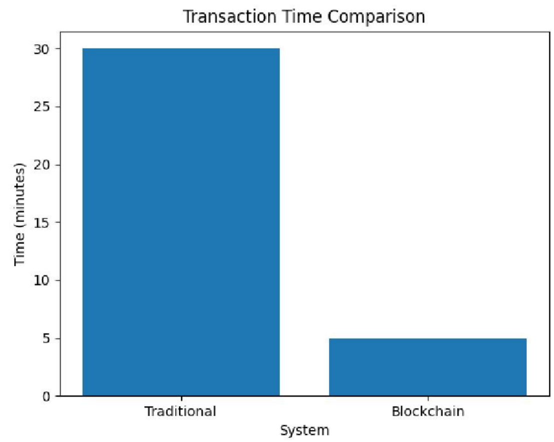

Fig 1. Transaction Time Comparison

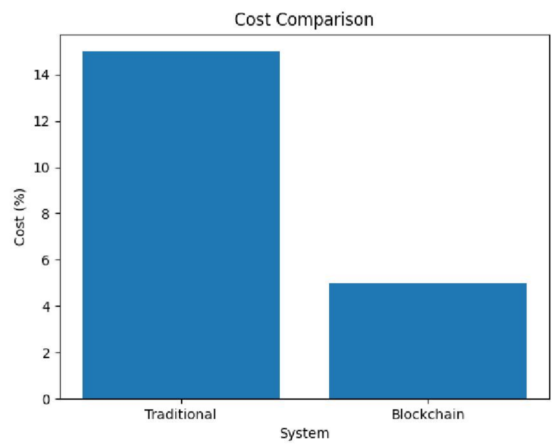

Fig 2. Cost Comparison

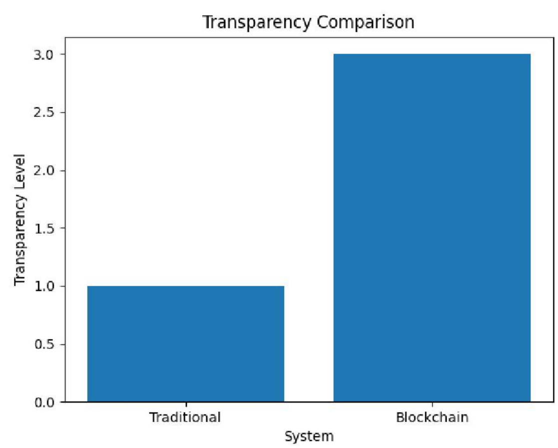

Fig 3.Transparency Comparison

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c. System Comparison Table

Feature	Traditional System	Proposed Blockchain System
Transparency	Low	High
Fraud Risk	High	Low
Transaction Speed	Slow	Fast
Cost	High	Low
Tracking	Difficult	Real-time
Intermediaries	Present	Eliminated
Security	Moderate	High

IX. IMPLEMENTATION

A. Smart contracts

There are four Solidity contracts that provide the basic logic for the application: the NGO Registry, which deals with the onboarding and verification of NGOs, the Campaign Manager, which deals with the creation and management of fundraising campaigns, the Donation Handler, which deals with donations, and the Fund Release, which deals with the release of funds based on milestones achieved. The contracts are secured through Open Zeppelin's ownable and reentrancy guard contracts, extensive event logging, and an emergency stop feature. The contracts are prototyped using the Remix IDE and formally tested via hardhat with the local Ganache blockchain.

B. Frontend and wallet integration

The React.js SPA provides a user interface for different roles within the application. The user interface for the donor role provides a list of verified campaigns, the current funding status for each campaign, and the capability for wallet-initiated donations. The user interface for the NGO role provides a capability for document uploading, creating campaigns, and reporting milestones. The admin role provides a capability for verifying NGOs and approving fund release. The user is notified regarding the status of a transaction, which could be pending, confirmed, or completed, with a direct link to the appropriate block explorer entry.

C. Backend and decentralized storage

The Node.js Express server provides RESTful APIs for the frontend to interact with for campaign listing, user profile retrieval, and admin functions. Sensitive on-chain logic is never replicated on the backend; Only non-sensitive metadata is stored in MongoDB for faster queries. Document files are uploaded directly to IPFS using the Pinata SDK in the browser; The CID is then passed to the correct smart contract function for permanent storage on-chain

X. GOALS AND OBJECTIVES

• Facilitate end-to-end transparency in the entire process of donation, ensuring that all transactions are publicly auditable.
• Reduce fraudulent practices by creating immutable records of all the funds donated.
• Enable the automatic distribution of conditional funds without the need to employ the services of third parties.
• Design the interface to be user-friendly, allowing both the donor and the NGO to use it without the need to be blockchain-savvy.
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XI. SCOPE

Develop a verifiable registration mechanism for NGOs, including cryptographic anchoring of identity documents on IPFS.

Develop a system for donors to discover live, admin-verified campaigns and donate using crypto wallets.

Implement fund locking using smart contracts and releasing funds based on milestones.

Provide permanent, tamper-evident event logs, which can be audited by third parties.

Provide a platform for future extension, including fiat on-ramps and other cryptocurrencies.

XII. CHALLENGES

1. Smart Contract Security: One programming mistake in the contract written in Solidity may cause permanent loss of funds; therefore, careful review of the code is a must.
2. Blockchain-Frontend Synchronization: Managing the delay in transactions, switching between Ethereum test nets, and providing user-friendly feedback for failed transactions is challenging.
3. IPFS Persistence: Data stored on IPFS may become inaccessible if nodes stop pinning the data; therefore, pinning services are a necessity.
4. Gas Cost: Higher gas costs on the main Ethereum network may discourage users from making small-value donations; using a sidechain or a second-layer scaling solution may solve this problem.
5. User Adoption: Educating non-technical NGO staff members and users who are new to cryptocurrencies and wallets is a challenge.
6. Privacy-Transparency Trade-off: Data protection laws may conflict with the transparent nature of a blockchain; therefore, using cryptographic primitives for data protection may become a necessity

XIII. PROBABLE PROJECT SCHEDULE

TABLE II: High-Level Timeline (July 2025 – April 2026)

Activity	Jul	Aug–Sep	Oct	Nov	Dec–Feb	Mar–Apr
Planning & Requirements	✓					
Smart Contract Development		✓	✓			
MetaMask & Wallet Setup			✓			
Frontend (React)			✓	✓		
IPFS Integration				✓		
Backend & Database				✓	✓	
Testing & Deployment					✓	✓
Documentation & Demo						✓

XIV. FUTURE WORK

Implementation of AI-based anomalies to detect suspicious campaigns or fund expenditure patterns before the funds are released.

Implementation of a decentralized autonomous organization (DAO) and multi-signatures to ensure proper distribution of power during large fund releases.

Implementation of a native mobile app to ensure access by donors and NGOs who only use mobile devices.

Implementation of fiat on-ramps such as UPI and credit/debit card payments, as well as multi-crypto conversion to simplify the contribution process.
Implementation of Zero-Knowledge Proof (ZKP) to ensure anonymous donations while maintaining full auditability of the funds.
Implementation of API hooks to government NGO registries and third-party verification organizations to ensure real-time legitimacy checks.

XV. SOCIAL IMPACT

The proposed DCMS brings meaningful real-world value by making charity systems more transparent, reliable, and efficient. By allowing donors to track their contributions in real time and ensuring that funds are released through predefined conditions, the system builds stronger trust between donors and organizations. Reducing the role of intermediaries also helps lower costs, so a larger share of donations can directly benefit those in need.

XVI. LIMITATIONS

The proposed DCMS has certain limitations. The reliance on Ethereum may lead to scalability issues and high gas fees under network congestion. Smart contracts, while ensuring automation, are immutable and may pose risks if vulnerabilities exist. Although IPFS provides tamper-evident storage, data availability depends on effective pinning mechanisms. Additionally, the system requires a certain level of technical understanding, which may affect user adoption. Integration with regulatory frameworks remains a challenge. Furthermore, off-chain risks, such as misuse of funds after withdrawal, cannot be fully controlled by the system.

XVII. CONCLUSION

This paper has discussed the design and implementation plan for a Blockchain Empowered Charity Management System. This system aims to address the long-standing issues of trust and efficiency in philanthropic activities. By leveraging the power of smart contracts on Ethereum and IPFS for document management, along with a user-centric web interface, this system promises to ensure complete traceability of donations, authenticity of documents, and rule-based disbursement of funds. However, before moving to real-world implementation, there are various aspects to be considered for smart contracts. Nevertheless, the architecture of this system promises to pave the way for a new and trustworthy charitable sector

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