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Niti Ledger - Systematic Fund Allocation and Governance Using Distributed Ledger Technology

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Abstract: NITI-Ledger introduces a blockchain-powered platform designed to improve transparency and security in the management of public funds. By leveraging Hyperledger Fabric, the system creates tamper-resistant records, allows real-time monitoring of fund disbursement, and incorporates stakeholder validation using document hashes, detailed audits, and citizen-submitted geotagged photographs. Additionally, a CRISP-DM-inspired fraud detection module enhances the capabilities of role-based dashboards for administrators, auditors, agencies, and citizens. This approach aims to increase accountability, minimize fund misuse, and build greater trust in public governance.

Index Terms **- Blockchain, Public Funds, Hyperledger Fabric, Citizen Verification.**

I. INTRODUCTION

Government fund allocation and monitoring faces a lot of persistent challenges like inefficiency, lack of transparency, and corruption. Centralized systems often fail to ensure that funds are utilized for intended cause, leading to delay of work, misuse of funds, and reduced accountability.

The NITI-Ledger help to addresses these issues by a blockchain-based decentralized platform that will provide a secure and tamper-proof records of all financial transactions by the government. This is achieved by combining smart contracts, audit trails, and citizen participation in the system which will ensure transparency, efficiency, and accountability in governance and finance.

1.1 Motivation

The motivation behind NITI-Ledger is the urgent need to restore public trust in governance where every tax payer can find out where and for what his or hers money is been utlised by the government. Current fund allocation lack real-time traceability and auditability, making them more prone to inefficiencies and corruption. By leveraging blockchain's immutability, the project aims to provide a verifiable mechanism for fund tracking and citizen participation in verification.

1.2 Problem Statement

To address the challenges in existing government fund management systems where processes are opaque, audits are delayed, and real-time traceability is absent, leading to misuse of funds , loss of public trust and unsatisfied work done by contractors.

To establish a blockchain-based solution that ensures transparency, policy-driven approvals, milestone-linked disbursements, and integration of citizen and auditor verification for enhanced accountability and efficiency.

II. LITERATURE SURVEY

Researchers have widely explored the use of blockchain for improving transparency and accountability in fund management. Studies on crowdfunding platforms, construction projects, and government tracking systems highlight blockchain's strengths in immutability and fraud prevention, but they also reveal practical issues such as scalability, user adoption, and reliance on intermediaries

Key reviewed works include:

- **Syed et al. (2025, ICICT):** In order to solve important trust issues frequently present in digital fundraising systems, Syed et al. presented a blockchain-based crowdfunding platform that uses smart contracts to ensure transaction immutability and secure fund transfers. However, their strategy was mostly restricted to the fundraising phase and lacked post-disbursal traceability, ongoing fund monitoring, and end-use verification tools. Additionally, the platform lacked strong elements that would have guaranteed transparency following the raising of funds, like milestone-based releases, multi-step audits, or the incorporation of beneficiary comments. By incorporating full-cycle fund tracking from allocation to final utilization, our approach overcomes these constraints by expanding the blockchain's function beyond initial collecting. We present features such as geotagged proof-based public engagement, multilayer verification, and real-time monitoring.
- **Nguyen-Hoang et al. (2025, IEEE Access):** Nguyen-Hoang et al. presented a blockchain-enhanced platform to solve the prevalent problems of inefficiency, lack of transparency, and data privacy in traditional fellowship management. Their solution employs an AI-driven recommendation approach to find worthy pupils, self-sustaining Identity (SSI) with Zero-Knowledge Proofs for safe, private applications, and zk-rollups to increase scalability. The platform's usage of a single blockchain, however, restricted its functionality also caused problems for customers whose assets were on other chains. Additionally, Verifiable Credentials were issued through a manual document verification procedure that may be expedited. Our method improves on this paradigm by adding cross- chain capabilities to guarantee smooth interoperability and by putting advanced automated document verification into place to increase the credentialing process's dependability and speed.
- **Sukanya et al. (2025, IJAIDR):** Sukanya et al. used blockchain technology to create a prototype for a decentralized government fund monitoring system, showing how distributed ledgers might increase accountability and transparency in public fund administration. The creation of real-time transaction records and the efficient tracking and auditing of all financial transfers were the main goals of their work. However, the suggested system was only deployed on a limited or prototype size; it lacked sophisticated capabilities like multi-step milestone verification and citizen involvement, as well as large-scale deployment and integration with other verification methods. By putting in place a scalable blockchain solution that not only preserves immutable records in real time but also facilitates widespread stakeholder engagement, fraud detection methods, third-party audits, and tangible safeguards to guarantee that money is being spent as planned, our project overcomes the constraints.
- **R. Kavade et al. (2025, IJCRT):** In their presentation of a blockchain-based dashboard for government budget allocation and tracking, R. Kavade et al. highlighted aspects including transparency, immutable transaction records, and role-based access for administrators and users. Their platform provided customers with features like automated reporting and real-time transaction monitoring, and it showcased the promise of blockchain technology for safe fund administration. However, the system's development and testing were mostly conducted in a controlled setting, and it was not thoroughly examined for scalability in the real world, performance under high loads, or interaction with intricate government operations. In order to make sure the solution is workable, reliable, and trustworthy in actual government fund management scenarios, we go beyond these limitations in our project by concentrating on large-scale implementation, optimizing for real-world transaction volumes, and adding additional verification layers (third-party audits and citizen engagement).
- **Harshavardhan et al. (2025, IJSREM):** Developed a transparent fund allocation system, though scalability and security remained concerns. A blockchain-powered fund allocation and tracking system was presented by Harshavardhan et al. the goal of improving transparency and expediting the process of government cash disbursement. Throughout the money allocation process, their system effectively included features including consolidated reporting, immutable transaction logs, and real-time dashboards, all of which increased accountability and visibility. Their study identified possible weaknesses in terms of access control and cryptographic security as well as unsolved concerns about the system's scalability—whether it could consistently handle high user or transaction volumes. By incorporating strong encryption protocols, designing for high transaction volumes, and utilising permissioned blockchain networks that have been

validated by third-party audits and citizen feedback, our project builds on their contributions by emphasizing scalability and end-to-end security, making the platform appropriate for real government deployment.

- **Song et al. (2023, IEEE SDS):** In a case study using blockchain technology for fund management in China's construction industry, Song et al. implemented milestone-based tracking methods to automate and track fund payments as building projects advanced. This demonstrated the advantages of blockchain in a particular industry setting, including real-time transparency, automated fund distribution upon project milestone accomplishments, and tamper-resistant data. Notwithstanding these developments, the solution's design and assessment were closely linked to building processes, which limited its direct relevance to larger government contexts with more intricate, multi-sectoral procedures and a range of stakeholder requirements. In order to guarantee adaptability and scalability across government domains, we build on this basis in our project by integrating flexible workflows, expanding stakeholder interaction, and generalizing blockchain-based fund monitoring for usage across a range of public governance activities.

From this review, it is evident that prior research addressed transparency but often excluded citizen participation, automated fraud detection, and nationwide scalability. NITI-Ledger attempts to bridge these gaps.

III. PROPOSED SYSTEM AND METHODOLOGY

3.1 System Architecture

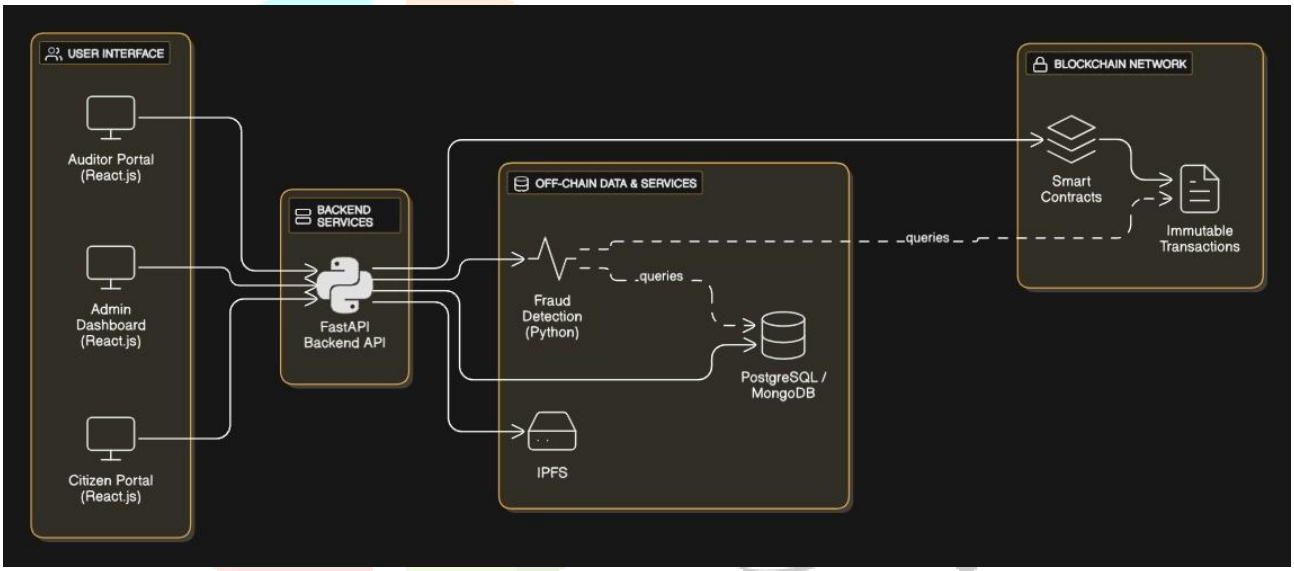

Fig. 1: NITI-Ledger System Architecture

The system consists of four major stakeholders:

- **Implementing Agencies:** These are the departments or organisations that start initiatives by putting out bids or proposals. They upload all pertinent supporting documentation and ask for the money required to carry out the project. Since they supply the first information and paperwork that starts the fund allocation process, their role is vital.
- **Administrators:** Administrators are in charge of creating the guidelines and procedures that control how funds are distributed. They oversee the entire allocation and monitoring process, reviewing and approving or rejecting financial requests. They guarantee adherence to governance requirements and effectively manage workflows with role-based dashboards.
- **Auditors:** Using cryptographic hashes to validate supplied documents, auditors confirm the legitimacy of usage certificates and invoices. In order to preserve integrity, their final audit reports assist in identifying instances of fraud or financial mismanagement. They play a crucial role in protecting public resources by having the authority to stop additional disbursements if any questionable conduct is found.
- **Citizens:** By using mobile applications to contribute geotagged images and project input, citizens actively participate. They are rewarded for their participation in exchange. By directly involving the community, this participation adds a crucial degree of openness and accountability and enables public monitoring of project development at the ground level.

Data is stored on-chain as hashes for immutability, while large files such as invoices, certificates, and photos are stored off-chain in IPFS or secure cloud repositories.

3.2 Methodology

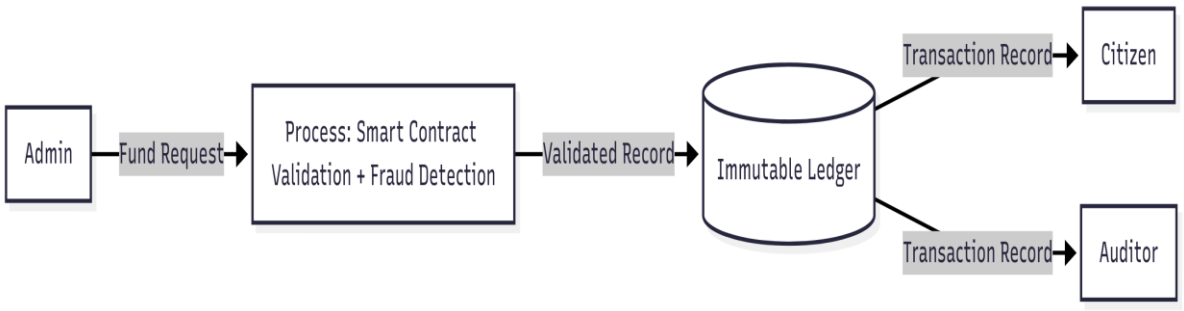

Fig. 2: Data Flow Diagram

- **Smart Contracts (Chain-code):** Automate fund release based on project milestones and policy rules.
- **Fraud Detection:** A CRISP-DM-based workflow which will analyze the invoices, geotagged evidence, and citizen feedback to detect anomalies.
- **Citizen Engagement:** Public dashboards allow citizens to view ongoing projects, upload verification photos, and flag inconsistencies.
- **Audit Trail:** Every action—whether approval, rejection, or fund disbursal—is recorded immutably, simplifying future audits.

3.3 State-Machine Diagram:

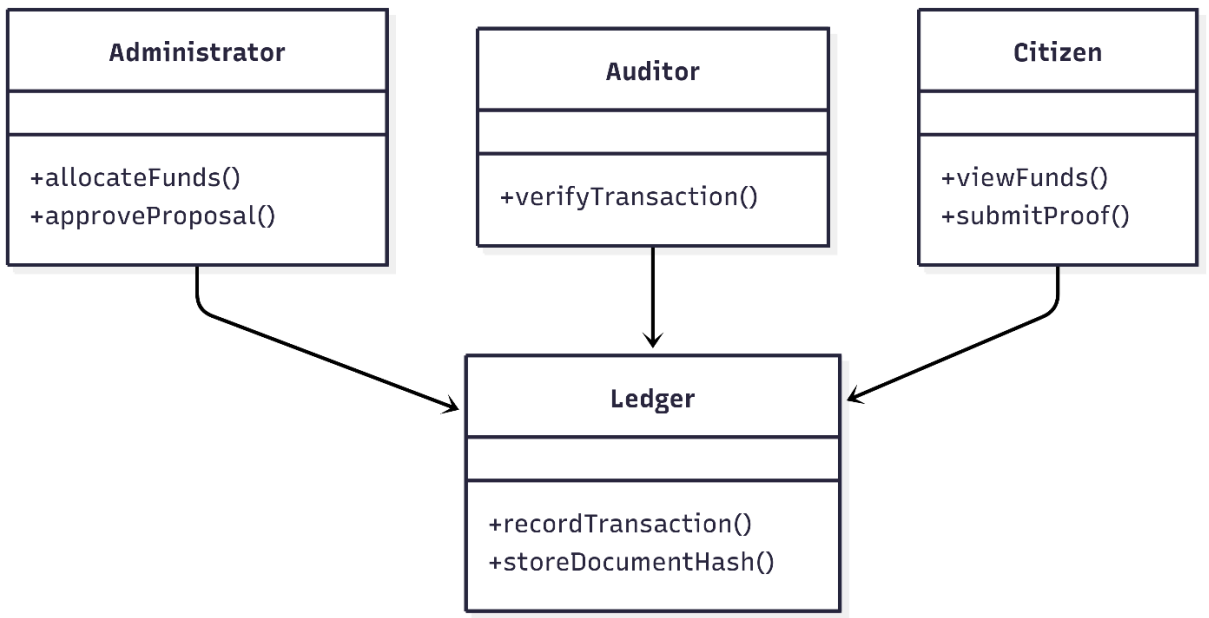

Fig. 3: State Machine Diagram

Roles and Functions of the System:

- **Administrator:** This position represents the controlling power of the system. Administrators can release capital and approve projects filed by implementing agencies with the help of the +allocateFunds() and +approveProposal() functions, which make sure that all activities follow defined governance procedures.
- **Auditor:** The auditor maintains financial integrity. Cryptographically verifying the legitimacy of financial papers is their main function, +verifyTransaction(). This position is essential for stopping fraud and has the power to halt payments in the event that anomalies are found.
- **Citizen:** The citizen role is what propels public accountability. Financial flows are directly transparent thanks to the +viewFunds() function. More actively, people may provide on-the-ground validation, such geotagged photos, to confirm that projects are indeed moving forward using the +submitProof() function.
- **Ledger:** Serving as the primary, unchangeable database, the Ledger is at the heart of this ecosystem. Its +recordTransaction() and +storeDocumentHash() functions are essential for establishing an audit trail of all financial transactions and document authentications that is both permanent and impenetrable.

3.3 Minimum Viable Product:

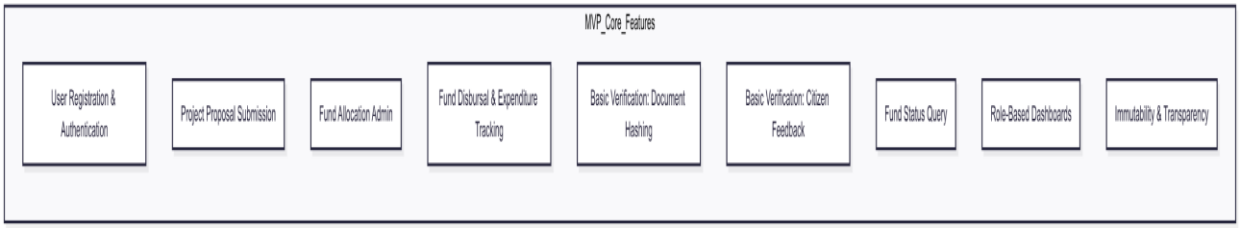

Fig. 4: MVP Diagram

Access and Administration:

- **User Registration & Authentication**: This serves as the secure gateway, ensuring that only verified individuals with assigned roles can access the platform.
- **Fund Allocation Admin**: A dedicated administrative function for overseeing and approving the release of funds based on submitted proposals.
- **Role-Based Dashboards**: To streamline user experience, the system will present a tailored interface for each role (e.g., administrator, citizen), showing only relevant data and actions.

Project and Fund Lifecycle:

- **Project Proposal Submission**: The initial step where implementing agencies can formally submit their projects and request the necessary funding.
- **Fund Disbursal & Expenditure Tracking**: This component provides a clear financial audit trail, monitoring the flow of money from allocation to on-the-ground spending.
- **Fund Status Query**: A public-facing feature that allows any user to look up the status of funds for a project, promoting direct transparency.

Verification and Trust:

- **Basic Verification (Document Hashing):** To guarantee document integrity, the system will create and store cryptographic hashes (unique digital fingerprints) of all uploaded files. This makes them tamper-proof.
- **Basic Verification (Citizen Feedback)**: A crucial accountability loop where the public can submit feedback or evidence related to a project's progress.
- **Immutability & Transparency:** This is not just a feature but the core principle underpinning the entire system. By leveraging blockchain, all recorded transactions and data are permanent and cannot be altered, forming the basis of trust.

3.3 Component Diagram:

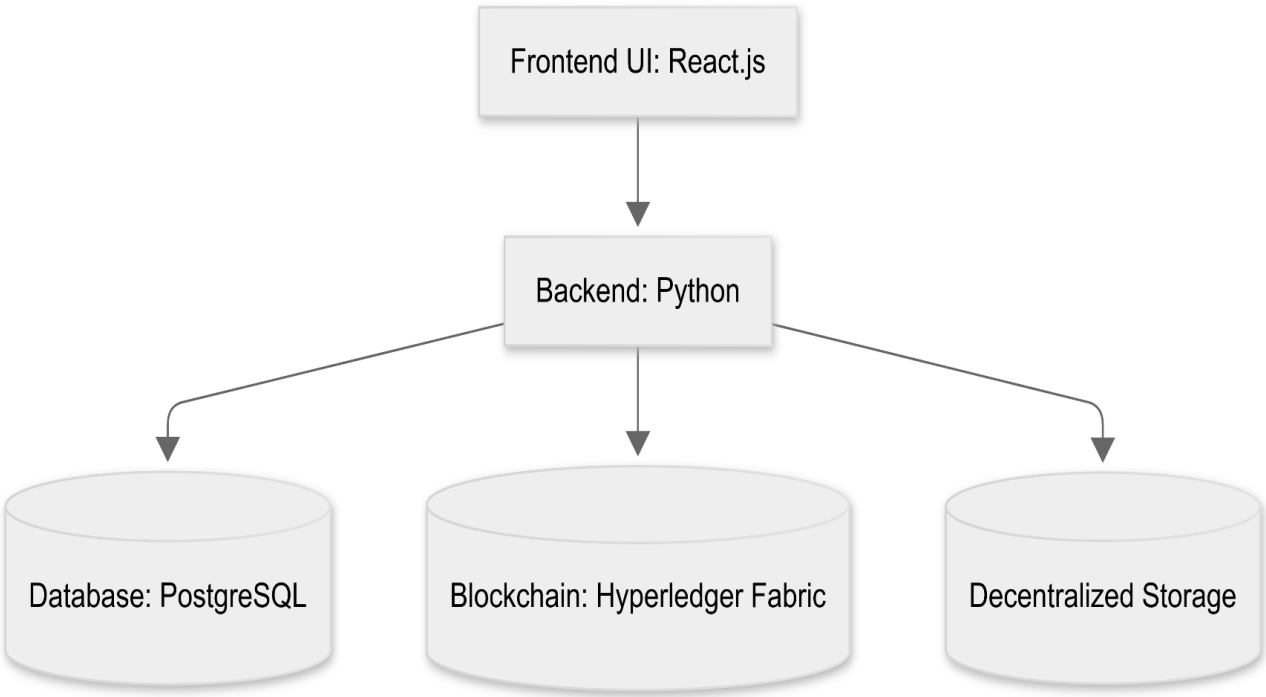

Fig. 5: Component Architecture

Unit Overview:

- **Frontend UI (React.js):** This is the user-facing layer of the application. Built with React.js, it provides a dynamic and responsive interface for all stakeholders—administrators, auditors, and citizens—to interact with the system's features. All user actions originate here before being sent to the backend for processing.
- **Database (PostgreSQL):** For conventional data needs, the system relies on a PostgreSQL database. This relational database is likely used to store structured application data such as user profiles, roles, and project details that require frequent updates and complex queries.
- **Blockchain (Hyperledger Fabric):** The core of the system's trust and immutability is the Hyperledger Fabric blockchain. The backend interacts with this layer to record critical transactions, such as fund allocations and document verifications. Storing these events on a distributed ledger ensures they are permanent and tamper-proof.
- **Decentralized Storage:** To handle large files like invoices, certificates, and citizen-submitted photos, the system utilizes a decentralized storage solution (such as IPFS). The backend coordinates storing these files off chain while recording their cryptographic hashes on the blockchain, creating a secure and efficient link between the asset and its proof of existence.

IV. COMPARSION WITH EXISTING SYSTEMS

Traditional government fund management systems are much more likely to inefficiencies and misuse of funds. They lack transparency, rely heavily on manual audits, and do not allow real-time monitoring.

By contrast, **NITI-Ledger provides**:

- Immutable fund records through blockchain network.
- Automated milestone-linked disbursements via smart contracts.
- Transparent dashboards accessible to administrators, auditors, and citizens.
- Citizen-driven verification using geotagged submissions.
- Faster, more reliable auditing with reduced manual intervention.

This combination directly addresses the gaps found in existing systems.

V. APPLICATIONS

- **Government Schemes:** Track disbursement and execution of funds in healthcare, education, infrastructure etc.
- **Public Sector Enterprises:** Improve accountability in large-scale development projects.
- **NGOs and Non-Profits:** Provide transparency in donations by keeping everything on record and grant utilization.
- **Municipal Governance:** Monitor local projects such as roads, sanitation and local development in areas.
- **Research and Education**: Track academic grants and project funding with verifiable audit.
- **Crowdfunding Platforms**: Ensure the donor's trust through blockchain-based transparent system.

VI. CONCLUSION

NITI-Ledger demonstrates how effective use blockchain can reshape the public fund management by ensuring that resources are allocated and utilized responsibly and transparently where penny can be tracked of the tax payers. Through immutable records, automated fund release, and citizen participation, the system enhances both efficiency and accountability

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