Advances and Recent Applications of BlockChain Technologies: the Model of Blockchain Ecosystem in India

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Abstract
Blockchain technologies have been characterized by innovative applications. Several countries adopted these technologies for several purposes. India government launched a specific program for implementing them in several sectors. The paper presents a review of the main applications and related trials for adopting blockchain within the Indian country. It results an overall framework ready for implementing other innovative applications.

Keywords
Blockchain, Smart Contract, Internet Of Things,

1. Introduction

In the last years blockchain technologies have increased their interest in both from scientific and industrial sectors [1]. They have the power to completely transform citizen-business, government, and corporate interactions in ways that were unimaginable even ten years ago. Frequently associated with other technologies like artificial intelligence (AI) or the Internet of Things (IoT), the technology stands out due to its fundamental characteristics. The evolution of the electronic devices is another important building block for the market success of blockchain [2, 3, 4, 5, 6, 7]. Several are the sectors impacted by the blockchain, e.g. supply chain, eGovernment, eHealth, etc. The present paper aims to describe the national program for implementing blockchain technologies and associated trials in India. In section 2 the land registration application is described, and in section 3 the Blood Bank. The Public Distribution System (PDS), Remote Voting, and GST Chain are described in sections 4, 5, and 6. Finally, in section 7 conclusions are drawn

Blockchain can redesign the actual procedures to uncover new sources of efficiency and value, in contrast to other technologies that can provide people and other stakeholders with whole new services [1]. Given the size, diversity, and complexity of the procedures required in providing a range of public services, Indian governance faces particular difficulties. Blockchain presents special opportunities for resolving problems by enhancing governance. By permitting "self-regulation," India can make significant progress in enhancing the "Ease of Doing Business" by enabling organizations to communicate via a reliable channel and lowering their reliance on onerous regulatory scrutiny and compliance. Blockchain could make life easier by empowering citizens with qualities like accountability, decentralization, and transparency. The main applications and trials defined in India are Land registration, Blood Bank Public Distribution System (PDS), Remote Voting, GST chain [8].

2. Land Registration

In India, property ownership is proven through presumptive land titling (RoR), a chain of documents that provide evidence of title transfer over time [9]. The Revenue Department maintains land records, which are subject to state laws. The system facilitates land mutation, storing and maintaining information about land ownership, cultivators, crop growth, irrigation sources, rights, and liabilities [10]. The Record of Rights document is required for farmers to obtain government subsidies. Registration departments use independent software to upload documents, undergo approval processes, and obtain biometrics. The sale deed document is printed, and signatures are obtained for future issuance of certified copies.

2.1. Challenges

Land-related litigations, double selling, and lack of unique records are major challenges in the sector. Banks often require land as collateral for loans, and financial institutions often lack of information. Farmers must collect the necessary documents for loans and subsidies. To prevent data alteration, trust in the land records and registration systems is needed. Duplicate registration documents are often generated through tampering, and

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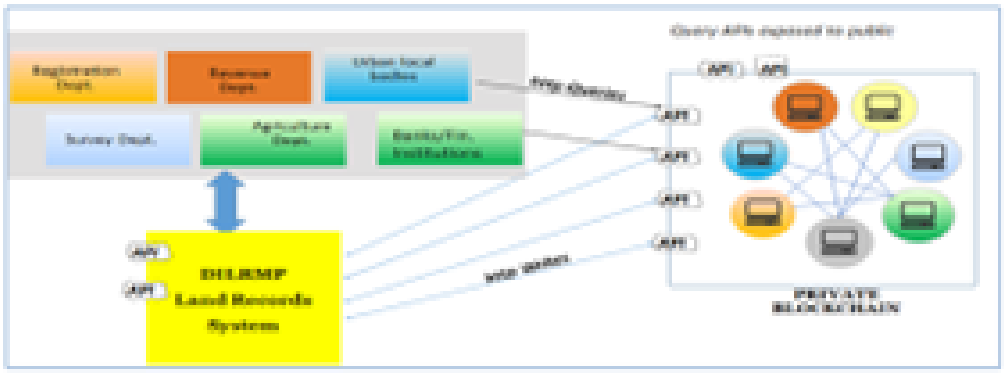

Figure 1: Land Registration.

properties are sold based on tampered records. Multiple purchasers may also keep properties under dark.

2.2. Proposed System

Land records data must be stored on the blockchain, with approval from Revenue functionaries and digital signatures. Certificates issued by the Revenue Department can be used by other agencies for verification processes. Transactions related to change of ownership, such as sale, loan, mortgage, or crop updating, require blockchain data verification. The registration department retrieves details from the blockchain to verify ownership before initiating a sale. Smart contracts can automatically initiate mutation requests, update rights and liabilities, and facilitate payment of subsidies to farmers. Eligibility can be ascertained from the blockchain for specific types of farmers.

2.3. Benefits

The proposed system aims to centralize data for faster disposal of subsidy and mutation requests, eliminate the need for trusted authorities, and ensure farmers' land ownership cannot be changed by spurious individuals. Farmers can obtain loans and update liability details in the Record of Rights, while the system also ensures that the same benefits do not reach the same farmer multiple times. The system will also provide a repository of transparent, trusted, and tamper-proof property registration documents, allowing citizens to verify ownership details and history before purchasing property.

3. Blood Bank

3.1. Objective

BlockChain Technology (BCT) has been used recently along with cloud services and AI based algorithm that are nowadays commonly implemented in the healthcare and educational systems[11, 12, 13, 14, 15, 16, 5]. Expecially BCt has been implemented also in blood bank systems ensures patient safety by verifying blood quality and expiry, excluding unsafe donors, and ensuring availability of blood among stakeholders, thereby providing trust in the system [17]. The chain allows for the assessment of blood quality, donor history, verification of blood details, maintaining sample integrity, and ensuring availability of blood from blood banks. In India, 90% of blood donations are conducted in camps, but unsafe blood can still enter testing and infect patients. Challenges include donor authentication, identification, and filtration. A centralized platform is needed for blood donors. The National AIDS Control Organization reported 2,234 HIV infections due to bad blood transfusions in the last 16 months, with over 14,000 infections in the last 7 years. Lack of a centralized donor registry and unique identification programs also contribute to the problem. Blood Chain aims to align blood donation drives with regional requirements and technological advancements by bringing all stakeholders on one platform. Blockchain technology provides a shared ledger for business transactions, providing a single point of truth and transparency. This distributed and replicated data structure allows multiple nodes to make transactional changes, ensuring asset provenance and traceability. BlockChain can be applied to any industry and ensures asset provenance and traceability. Hyperledger Sawtooth is an enterprise blockchain platform for building, deploying, and running distributed ledgers. It allows developers to code in their preferred language and separates the core system from the application domain,

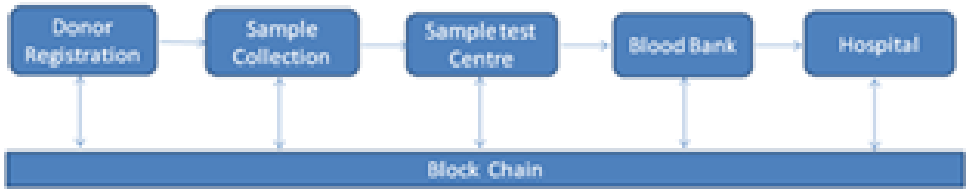

Figure 2: Blood Bank.

allowing them to specify transaction rules, permissions, and consensus algorithms. Sawtooth's use case includes BloodBank, recording transactions from donor registration to hospitals.

3.2. Supply Chain Management

Liquor manufacturers import spirits/alcohol using Blockchain-certified permits, ensuring details and quantity are available. Transactions are recorded through different levels on the Blockchain. The process involves transferring raw materials from truck to warehouse, storing data during blending, bottling, entering liquor cartons, and exiting packed liquor using Blockchain-certified permits. The manufacturing warehouse is now fully integrated with the Blockchain Network.

3.3. Distributed Ledger

Traditionally, Liquor Industry transactions involve trusted third-party entities, but this can lead to trust issues and compromised services. Current business ledgers are costly, and susceptible to misuse, tampering, and corruption. These uncertainties lead to disputes, costly refunds, and delayed reconciliations. Blockchain technology in distributed ledger systems uses a unique cryptographic signature for each record, creating a permanent record of all stakeholders' transactions in a Blockchain Network. This information is accessible to all stakeholders in the deal. The Distributed Ledger has also a strong impact on other important sectors, e.g. innovative and interoperable communication networks [18] video applications [19] or energy systems [20, 21, 22].

3.4. BlockChain Benefits for B2B & B2C

The Blockchain Network captures the entire manufacturing supply chain, allowing consumers to verify the quality of liquor directly through Batch No. and QR code on bottle labels, and buyers to verify permits without third-party trust. BlockChain technology can significantly reduce HIV rates in developing countries by using Node.js as a client application with local RDBMS SQL

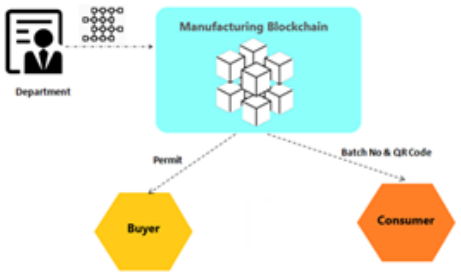

Figure 3: BlockChain Benefits for B2B & B2C.

Server 2012, sending transactions to the middle layer node.js API, and creating transactions according to SAWTOOTH at the client level.

4. PUBLIC DISTRIBUTION SYSTEM (PDS)

The public distribution system (PDS) distributes subsidized ration to cardholders monthly. However, it lacks accountability throughout the supply chain, leading to leakages. Blockchain technology can help manage this by integrating the entire supply chain, from procurement to disbursement [23].

4.1. Process Flow

Farmers cultivate food grains, which are procured by the government under minimum support price (MSP). Millers collect and hull the grain, which is then distributed to state godowns, block godowns, and fair price shops for beneficiary distribution. Government agencies register millers, and farmers deposit produce and receive payment based on quantity supplied. Millers process and transport the commodities to storage points.

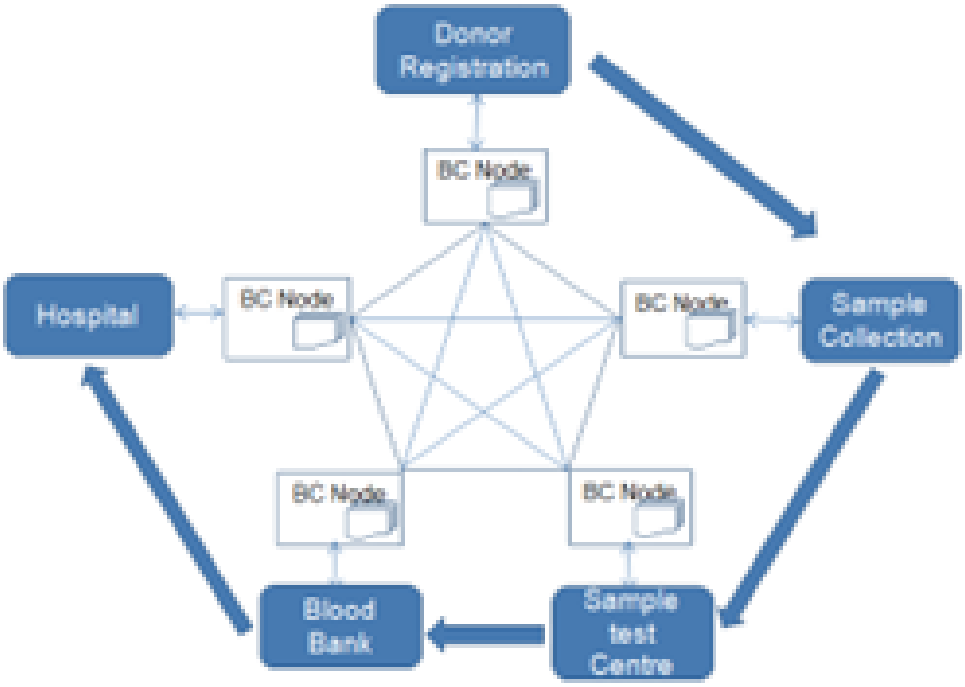

Figure 4: Blood Bank procedures.

4.2. Role of BlockChain

Blockchain technology can eliminate payment delays for farmers based on miller procurement. It ensures non-repudiation of transactions, sealing data provenance. The decentralized distributed ledger allows stakeholders to make decisions based on local data. Payments can start immediately without waiting for miller hulling, making each transaction non-time critical. This eliminates the need for a public chain with transporters. It can be very useful in the case of multimedia and video applications.

4.3. Current status of POC

The POC application for PDS is a Python web application with three stakeholders: miller, farmer, and admin user. It interacts with blockchain node and RDBMS, covering PDS procurement processes. Registration modules write registration details to blockchain and database, while data updating modules read and update data.

5. REMOTE VOTING

The remote voting system, a Blockchain-based distributed system, allows migrants and in-service voters to cast their votes from their work, saving time and money, and boosting voter turnout. The system securely stores remote vote details on a Blockchain, allowing returning officers to download encrypted votes for counting on the day of counting [17].

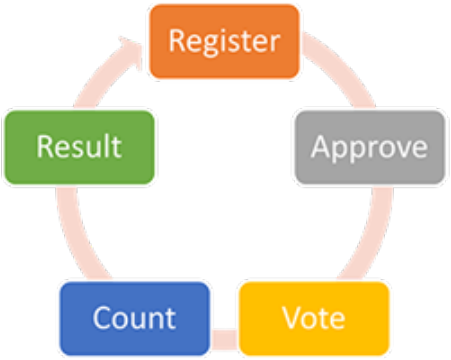

Figure 5: Remote voting procedure.

6. GST CHAIN

The Central Board of Secondary Education has implemented a GST Chain using BlockChain Technology to record transactions and maintain tax liabilities, ensuring transparency and accountability in GST management.

7. Conclusions

Scientific communities and several companies are interested in implementing blockchain technology in different market sectors, including supply chains, e-government, e-health, and automotive. The India country has already implanted different applications. From the review presented in this paper a very important framework to be used for developing and implementing other innovative applications. Future works are focused on them.

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