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Land Registry System Using Hyper-ledger Fabric Using Blockchain Technology

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Abstract*–In most of the land deals in India, the broker is still in the middle of the buyer and seller. This is the person who puts together the physical paperwork proving that a transaction did indeed take place. The sale is complete when the paperwork is entered in the register of the government office. The problem is that anyone who has access to this paper-based register can see it or change it. So records can go missing or be quietly changed, and the buyer's proof of ownership is at risk. It is still largely a paper-based rather than digital process, and therefore slow, error-prone and susceptible to corruption and fraud.***

INTRODUCTION

In most developing economies property records are kept in a single, centrally maintained ledger, which is an obvious weak link. Whoever owns that ledger essentially owns the record of who owns what. Enter an alternative model: blockchain technology. Rather than a single authority maintaining the master copy, a blockchain distributes an identical copy of the transaction history to each node participating in the network and new entries can only be added – never silently changed – once the network as a whole has consented to accept them [1]. Nakamoto's original description of the idea, published as a peer-to-peer electronic cash proposal, showed that two parties who do not know or trust each other can still transfer value directly, provided the majority of the network confirms each transaction before it is written into a block [1]. Each block contains a cryptographic fingerprint of the previous block, so to change an old entry you would have to recompute the proof for all the blocks following; this is essentially what makes the ledger tamper-resistant [2].

This property matters for an obvious reason for a land registry: ownership records are exactly the sort of data that must not be quietly rewritten. The system this paper aims to develop involves a citizen registering on the platform as either a seller or a buyer. The seller lists a property with supporting documents and once a smart contract validates the listing, a buyer is free to make an offer. When a sale is completed the deed is digitised and written into the chain as a new block, so the transaction is peer-to-peer, with no broker or clerk in the middle. Each entry is time-stamped, so later it's just a matter of reading the chain, not digging through paper files, to trace a property's ownership history. Each participating legal office holds its own cryptographically verifiable copy of the transaction as a backup [1][2].

LITERATURE SURVEY

Nolwazi N. et al. [3] define the land registry problem in terms of how a distributed ledger differs from a normal shared file: every member of the network holds a full copy of the ledger, so data can be shared across the network, but never copied out and altered independently elsewhere. Their work focuses on Hyperledger Fabric, which they argue is capable of delivering immutability, verifiability, decentralisation

and security together, saying this combination gives land records a level of transparency and audit-readiness that paper registers cannot match.

A more limited, permissioned model is used by Jagtap et al. [4]. Their design constrains participation to a fixed set of members rather than letting any node in the network participate in consensus. It maintains ledger consistency using distributed consensus algorithms and authenticates users using asymmetric cryptography. They are built using well-known Hyperledger components: peers, chaincode, a membership service provider, channels, a Fabric client and certificate authorities. The peer is authenticated against a certificate authority before being allowed to participate. This validation must have happened before the ordering service commits any change to a land asset to the ledger, and a write is only finalized when a majority of peers agree on the position in the sequence.

Dcunha et al. studied Hyperledger Fabric [5] which is an open-source permissioned platform maintained by the Linux Foundation that provides administrators fine-grained control over who can see what and is particularly suitable for enterprise-grade registries. Two mechanisms are prominent in their account: private channels, which allow a subset of participants to transact without the rest of the network knowing the details, and configurable endorsement policies, which define which organisations must sign off a transaction before it can be accepted to the chain.

Specifically in developing countries, Ali et al. [6] consider deployments and claim that a blockchain register tackles several issues at once: inconsistent data collection, weak confidentiality guarantees, and difficulty in verifying who actually owns a parcel. The ledger can hold more than just the record of the transfer so it is possible to add in information about the lending institution or insurer or source of funds behind a purchase and allow a later buyer to see the chain of previous transactions without revealing the underlying financial information to anyone not entitled to see it.

Mohanty et al. [7] evaluate a smart-contract-based registry with respect to a predefined set of criteria – decentralisation, middleman removal, scalability, security, transfer time and accountability. Each smart contract has its own address and can recognise who is calling it, so access to a given contract can be limited to the parties to whom it is actually of concern. The authors claim the system is secure precisely because land records are only released to someone with the owner's permission, even though they are distributed rather than centrally guarded.

Khan et al. [8] build directly on Ethereum which they describe as a large network of machines that act like one shared computer that can run code. Their prototype is a decentralised app, where a landowner inputs the details of a property and the asking price. A government official still plays a role in validating the listing, so the human check on registration survives even if the underlying record-keeping is no longer centralised. This combination of automated storage and a human validator, they say, creates an audit trail that is more tamper-resistant than a paper one.

In December 2021, Biswas et al. [9] argued that the biggest beneficiary of a blockchain-based registry may actually be the government itself, through better tax collection and more reliable service delivery, rather than the buyer and seller alone. They say that their system is designed to take on more registrations without redesign, and argue that the smart-contract layer stands up as the number of records scales, which they use to argue the approach is viable well beyond a small pilot.

In short, both accounts converge on two design paths: a Hyperledger Fabric route that relies on permissioned membership and channel-level privacy [3][5], and an Ethereum/smart-contract route that relies on public verifiability and self-executing agreements [6][9]. The proposed system in this paper

follows the former, since a permissioned platform fits more naturally into a state-run registry where the participants (citizens, banks and government offices) are already known and vetted.

OBJECTIVE

- Examine whether a blockchain-based land register is a realistic replacement for the existing paper-based process.
- Review the relevant literature on blockchain-based land registration to identify the approaches already in use.
- Identify gaps in the current registration system.
- Develop a system to reduce manual paperwork and increase transparency and security in land documentation.

PROPOSED SYSTEM

Even where data is digital, land registration today is fragmented across systems that do not talk to one another. It is this fragmentation that actually undermines efficiency, transparency and confidence – not the lack of digitisation itself. In this paper, we implement a small piece of the land registration workflow, scoped to the state of Maharashtra, as a way of seeing if the approach works in practice, rather than trying to overhaul the entire national system at once.

The design uses a private permissioned blockchain where only a limited set of users is allowed to participate in consensus. The consistency of the ledger is ensured using distributed consensus techniques and the identity of users is secured using asymmetric cryptography. It is the four properties of decentralisation, persistence, anonymity and auditability that do most of the work in cutting cost and improving reliability, rather than a centralised system where every observer has little choice but to trust a single authority and where opinions about that authority's integrity inevitably differ. This means that the participants are authenticating the ledger itself so all participants on the network can independently verify the current state of the system. A specifically defined group of verifying peers confirms each transition between states, not a central office [13] .

The transaction flow is taken from the standard Hyperledger Fabric pattern [14] for land records:

1) A client app sends a proposal for a transaction to a set of endorsing peers, and the endorsement policy determines how many peers need to be contacted before the client can proceed.

2) Each endorsing peer executes the proposed transaction and records the read and write sets that result and signs each.

3) The signed result returned to the client (or the client’s SDK) is the endorsed result.

4) Once enough endorsements are gathered to satisfy the policy, the transaction is submitted to the ordering service. The ordering service can accept transactions from many clients and guarantees that all peers on the network will eventually receive the transactions in the same order.

5) The ordering service groups the ordered transactions into a block and distributes that block to every peer, instructing each to append it to its local copy of the chain.

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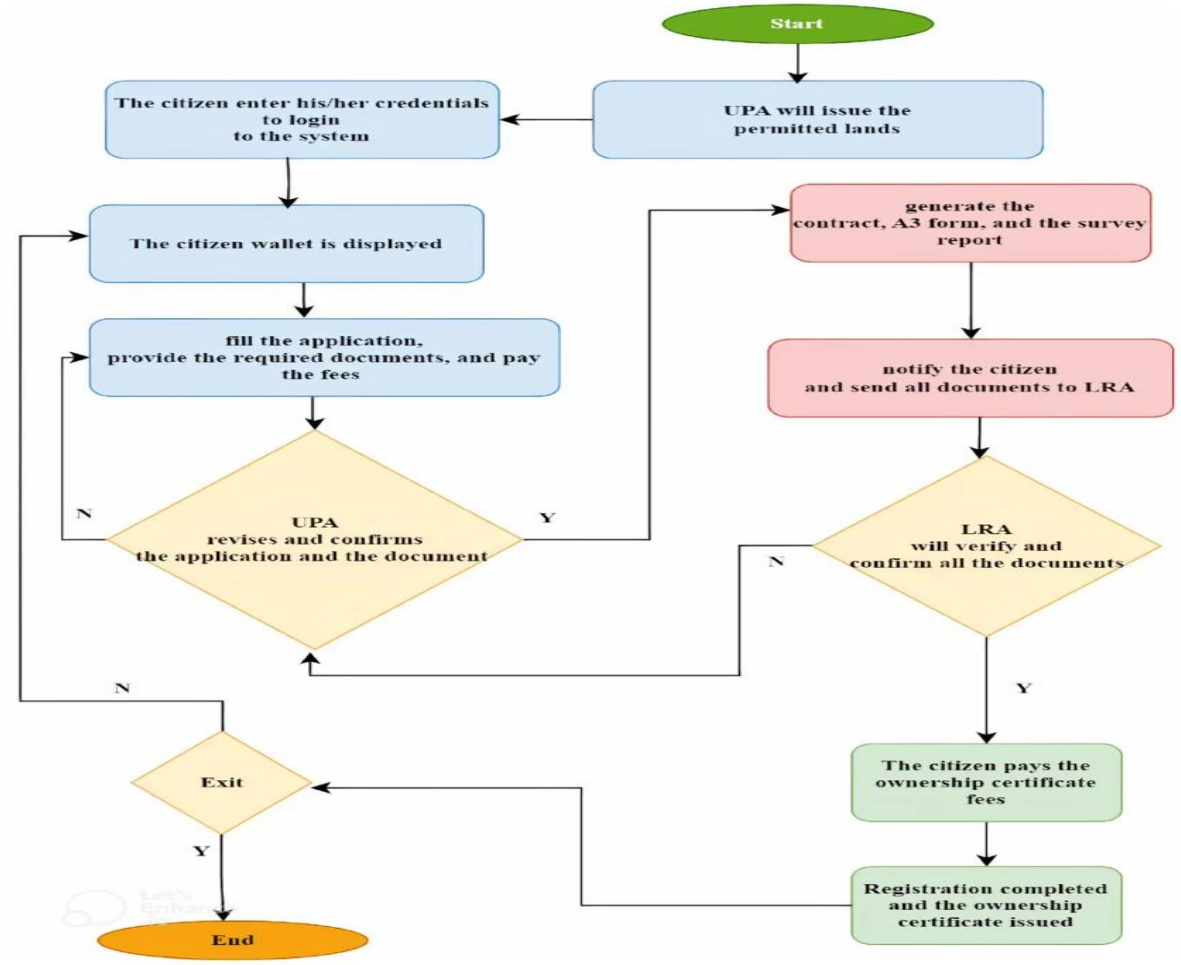
6) Then each peer verifies the block it has received. Not all of the transactions inside may have enough endorsements, so peers filter out and discard any that don't, rather than commit them.



7) When a peer has isolated the valid transactions, it commits that block and the network emits events – at the block, transaction and smart-contract level – to confirm that the update has gone through.

CONCLUSIONS

This review and proposed design come to the same conclusion that it is workable and worth pursuing to build a land record system on Hyperledger fabric. What blockchain brings to this space is efficiency, security and transparency that a paper-based or even a digitized-but-centralized register can't offer, because ownership and transaction data sits on a decentralized ledger that can't be quietly rewritten – which is precisely where most fraud, corruption and disputes in the traditional process originate. Specifically Hyperledger fabric builds on that baseline by adding a layer of scalability and configurability, allowing the system to be adapted to the needs of land authorities and other stakeholders, rather than imposing a single rigid template on every deployment. In practical terms, blockchain + Hyperledger Fabric should make property records more accurate and reliable, reduce the administrative burden and paperwork, and give all parties involved more reason to trust the process.

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