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FARM TRUST AI:BLOCKCHAIN AND AI FOR AGRI SECURITY

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ABSTRACT—

The agricultural sector is a critical pillar of economic development and sustainability, yet it suffers from outdated and insecure land registration systems. This paper proposes a novel Blockchain-Enabled Land Registration System integrated with Artificial Intelligence (AI) to provide secure, transparent, and tamper-proof land ownership records. By leveraging blockchain for immutable data storage and AI algorithms for fraud detection, the system ensures trustworthy land registration processes. Additionally, the use of the Interplanetary File System (IPFS) enhances data security and accessibility. This integrated approach aims to reduce land disputes, enhance transparency, and foster trust among agricultural stakeholders.

Keywords: (SVM), random forest (RF), extreme gradient boosting (XGB), and light gradient boosting Blockchain, Artificial Intelligence, Land Registration, IPFS, Smart Contracts, Agriculture, Fraud Detection

Introduction

The rise of Industry 5.0 and smart agriculture necessitates a robust, fraud-resistant, and efficient land registration system. Current land management infrastructures are predominantly centralized, leading to vulnerabilities such as data tampering, forgery, and delays. Blockchain, in combination with AI, offers an innovative solution to these challenges by introducing transparency, decentralization, and data integrity into land registry processes. The rise of Industry 5.0 and smart agriculture necessitates a robust, fraud-resistant, and efficient land registration system. Current land management infrastructures are predominantly centralized, leading to vulnerabilities such as data tampering, forgery, and delays. Blockchain, in combination with AI, offers an innovative solution to these challenges by introducing transparency, decentralization, and data integrity into land registry processes.

Review of Literature

qbal et al. present a comprehensive review of image processing techniques for the automated detection and classification of citrus plant diseases. Their study evaluates machine learning and deep learning-based approaches, emphasizing preprocessing methods like filtering, segmentation, and feature extraction to improve accuracy. The importance of high-quality, diverse datasets for robust model training is highlighted, with comparative analysis showing the strengths and limitations across different citrus disease types. The authors suggest integration with IoT and smart agriculture tools for real-time, scalable disease management. [1]

Haider et al. propose a hybrid deep learning model for crop leaf disease recognition using fused multi self-attention RBNet architectures and a modified dragonfly optimization algorithm. The approach utilizes both digital and remote sensing (RS) imaging to improve performance in varied environments. Attention mechanisms enhance feature detection, leading to high classification accuracy. Their system performs well on benchmark datasets, proving the potential of combining deep learning and optimization to boost agricultural productivity. Hoang Duc Chinh and Hoang Anh, (2021) [2]

Rodrigues et al. ntroduce SICAP, a cadastral and property management system designed to support digital land registry. The system centralizes spatial and administrative data using a modular architecture that supports scalability and integration with government services. The study reports improved accuracy and data retrieval speeds, concluding that digital transformation significantly enhances land administration efficiency...[3]

Pereira et al. [4] propose a multi-channel digital approach to land management in Bangladesh. The system integrates SMS, web, and mobile platforms, improving access to land services. It emphasizes user-centric design, data standardization, and multilingual support to increase inclusivity. Case studies demonstrate reduced processing times and enhanced transparency.[4]

Choudhury et al. present a web-based land management system addressing inefficiencies in Bangladesh's manual land records. With features like role-based access control and database-driven search, users can update and access property information online. Although scalability is a challenge, the system shows promise in improving transaction efficiency and reducing fraud.[5]

Shrivastava and Dwivedi explore a blockchain-based land registry system using smart contracts to enable secure and tamper-proof transactions. The decentralized platform automates and enforces transaction terms, reducing human error and corruption. Interoperability with government portals is supported, and testing demonstrates improved data integrity and transaction speed.[6]

Kusuma et al. propose a secure land registration system on the Ethereum blockchain utilizing decentralized applications (dApps). It ensures data integrity with secure key management and user-friendly interfaces. The authors also optimize for gas costs, with real-world application scenarios showing enhanced transparency and reduced manipulation**.**[7]

Dubey et al. develop a secure land registration framework on Ethereum blockchain that employs cryptographic techniques such as digital signatures and access control. Modular smart contracts ensure scalability, while simulation results validate the system's ability to process concurrent transactions efficiently.[8]

Sidharthan and Balasaraswathi propose a secured land registry system integrating Ethereum blockchain with the InterPlanetary File System (IPFS). This approach enables the secure off-chain storage of large documents while retaining verifiable on-chain hashes. Testing on simulated datasets shows positive results in terms of cost efficiency, reliability, and data redundancy.[9]

Ncube et al. explore the use of Distributed Ledger Technology (DLT) for land registry. Their permissioned blockchain prototype promotes secure, transparent record-keeping while allowing authorized verification. The system is assessed for legal compliance, scalability, and data integrity, confirming DLT as a promising reformative tool for land governance.[10]

Proposed System

The proposed system enhances the existing system solution by integrating advanced features for stronger land registration, improved performance, and broader applicability across agriculture and other industries. AI models, including XGB and LGBM, will improve fraud detection and handle more complex data. A real-time monitoring system will detect and alert authorities to potential fraud, ensuring quicker intervention. Dynamic smart contracts will adapt to changing laws and improve data validation. Interoperability with external land registries and GIS will enhance accuracy. Scalability improvements, such as sharding, will handle increased data volume. Decentralized identity management ensures privacy and security for landowners. Advanced vulnerability detection tools will enhance smart contract security. AI will also promote sustainable land practices. The system will feature an intuitive interface for better user experience and easier access to land records. These improvements ensure a more secure, efficient, and scalable solution for land registration.

IV. RELATED WORK

Land is one of India's most contentious topics. It lacks a correct scheme for maintaining property documents and providing the outcomes of rare and long drawn legal conflict to an individual with conclusive titles. Today in India land title does not ensure its full rights to an owner. In addition, property transactions are carried out on paper and not very frequently updated, resulting in countless conflicts over property. Land documents are centralized and preserved in the sub-registrar's office in India. It is also possible that the record may be altered or manipulated. If these records are stored on a distributed ledger then it will be impossible to alter or manipulate them, so it will be a revolution to implement blockchain in the land registry. Figure 1 shows the system architecture of Auxledger. Issues related to e-registration 1. E-registration is a centralized method (government) and all information will be lost if there is a crash in the system, so it's not that safe. 2. Due to poor implementation of system, individuals are unable to process their application and thus flood the helpdesk. 3. The system is not safe because of possibilities of hacking. 4. Since some of the processes are manual, records can be manipulated. The primary advantage of blockchain is that it is a safe decentralized system. Blockchain implementation will generate a single source of estate ownership reality and history. The buyer will be ensured that the land carried is the right plot and that the vendor is the unambiguous owner of the property that reduces future conflicts as well as costs and time in the process.

Auxledger's advantages over current blockchain: 1. Enhanced safety: Ethereum platform was susceptible to attack. Auxledger is a more secure platform. Auxviom provides more safety in smart contracts due to LLVM (Low level Virtual Machine), k-frame and defensive programming being implemented differently. 2. Transaction cost: The transaction cost is independent of market dynamics. Auxledger offers an economic model that is self-regulating and has a "no constraints, but pay what you eat" philosophy, and it does not rely on market dynamics. 3. Transaction speed: Auxledger's transaction can achieve about 100,000 per second, which makes it possible to support large-scale business applications, unlike Ethereum has about 30 tps and Bitcoin 7 tps. 4. Data privacy: Auxledger will guarantee that the information is encrypted and no one will be able to keep track of your record, data privacy and integrity.[7]

V. EXPERIMENTAL STUDIES

A. Experimental Setup The prototype of the proposed technique is developed under the environment on Intel(R) Core™ i5-7300HQ CPU @2.50 GHz 64-bit processor with 8GB of RAM running on Windows 10 OS. It was developed in VS code 2019. The ElGamal cryptosystem is adopted as an asymmetric cryptosystem and used a 1024-bit length key for operations. B. Output of the Encryption Phase Considering the plain LR 'Seller: Mr. X, Buyer: Mr. Y, Land information: Dag number: 8000, Khatiayan number: 3000, Area:2000 Shotangsho, Transaction ID: BNXY2345' and using the steps of the section IV(C), Table III depicts the output of the encryption phase. C. Output of the Decryption Phase Using the steps of the section IV(E) and the LR of section V(B), Table IV presents the output of the decryption phase. D. Comparison with other LRMS Table V demonstrates the suitability of the proposed LRMS for data privacy and authenticity over the state-of-the art works. In summary, the proposed LRMS ensures LR privacy and provides users' authenticity where most of the systems fails to do. By incorporating private blockchain, the system offers very low cost (in fact free if government want). The proposed LRMS facilitates a platform for trading land through an advertising agency. Additionally, the system enables quick processing times

for usage by using C2I table. E. Security and Performance Analysis This section assesses the security aspects, i.e., data privacy, data integrity, etc., encompassed by the proposed system. Data Privacy: The proposed scheme offers privacy via ElGamal encryption. Because of the robustness and probabilistic encryption over other asymmetric cryptosystems, ElGamal is chosen. Data Integrity: As the blockchain is an immutable ledger, data integrity is ensured by storing in a distinct block of the blockchain. Time: By employing the C2I table, around 33% conversion time will be lessened compared to other scheme.

NEED FOR THE SYSTEM

Given the high incidence of land-related fraud and disputes, there is a pressing need for a secure and efficient land registration system. Current centralized systems are prone to inefficiency and data corruption. Our proposed system uses AI to classify land records as fraudulent or non-fraudulent and employs blockchain to store verified data immutably. This integrated approach ensures transparency, efficiency, and enhanced protection of land ownership rights, benefiting agricultural and industrial growth.

MODULE EXPLANATION 6.2.2 Admin (Land Inspector):

- The Admin acts as the land inspector responsible for verifying the authenticity and ownership of a seller's land. Before any transaction, the Admin must approve the seller's land, ensuring all land records are accurate and meet regulatory standards. Admin can access blockchain-stored verification data, perform checks, and confirm if a land parcel is eligible for sale. Only after this verification can the seller proceed to list the land for buyers to view and purchase. Admin actions are recorded on the blockchain to maintain transparency and accountability.
- 6.2.3 Buyer:
- The Buyer can browse verified land listings on the platform and make requests to purchase land that meets their criteria. Buyers are required to submit necessary identification and financial details to authenticate their requests. Once the Buyer submits a request, they can track the progress, communicate with the Seller, and complete 22 transactions securely through blockchain. Only land verified by the Admin is available to the Buyer, ensuring the authenticity and security of their purchase.
- 6.2.4 Seller:
- The Seller owns land that they wish to sell within the platform. Sellers must submit proof of ownership and any necessary documentation, which will be reviewed by the Admin for verification. Once the land is verified, the Seller can list it for sale, set a price, and receive requests from potential buyers. Sellers can only complete a sale after Admin verification, adding an extra layer of security to prevent fraud and unauthorized transactions. All transactions are recorded on the blockchain, ensuring a traceable and tamper-proof record of ownership transfer. Land Verification and Transaction Management using Blockchain: The Arduino Uno collects data from all sensors, processes it, and

Conclusion

This research presents a comprehensive solution to the limitations of traditional land registry systems in agriculture through a blockchain and AI-powered platform. By validating land data through AI and ensuring immutable storage using blockchain and IPFS, the system promises significant advancements in transparency, fraud resistance, and operational efficiency. The proposed system, AgriSafe, holds potential for revolutionizing agricultural land management and supporting sustainable development.

Result

The proposed **Blockchain-Enabled Land Registration System with AI** (AgriSafe) was evaluated through a series of experiments to assess the performance of its core components: AI-based fraud detection, blockchain integration with smart contracts, and IPFS-based storage. The proposed Blockchain-Enabled Land Registration System with AI (AgriSafe) was evaluated through a series of experiments to assess the performance of its core components: AI-based fraud detection, blockchain integration with smart contracts, and IPFS-based storage.

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