

AGRISURE- DECENTRALIZED LAND REGISTRY USING BLOCKCHAIN AND AI FOR SUSTAINABLE AGRICULTURE

M Divya

Department of CSE (Data Science)

CMR Technical Campus

Hyderabad, India

divyasep9@gmail.com

B Charitha

Department of CSE (Data Science)

CMR Technical Campus

Hyderabad, India

Charithabalmuri09@gmail.com

B Tejashwini

Department of CSE (Data Science)

CMR Technical Campus

Hyderabad, India

bannanorutejashwini@gmail.com

D Lokesh

Department of CSE (Data Science)

CMR Technical Campus

Hyderabad, India

lokeshdaripalli@gmail.com

Abstract-The modernization of agricultural land governance requires transparent, tamper-resistant digital systems capable of overcoming the drawbacks of traditional centralized land registries and securing them. The existing database used for land ownership and transfer can be altered by unauthorized access, leading to property disputes, fraudulent transfers, and loss of trust. To counter these challenges, this work introduces a decentralized framework named AGRISURE, which integrates technologies like blockchain, IPFS-based distributed storage, artificial intelligence-driven fraud detection, and smart contract automation. This system utilizes the Ethereum blockchain to ensure immutable record-keeping, while IPFS provides secure off-chain storage of land documents via content-based hash referencing. A deep learning model, the CNN2D model, is used for intelligent anomaly detection on the Ethereum fraud transaction datasets, outperforming the classical machine learning models such as Random Forest, Support Vector Machine (SVM), Extreme Gradient Boost (XGBoost), Logistic Regression, and LightGBM. Experimental evaluation demonstrates that the CNN2D achieves 99.52% accuracy, which indicates superior capability in identifying complex fraudulent patterns. AGRISURE is deployed as a web-based platform that enables to authenticated buyers and sellers to initiate-verify- track land transactions in real time through automated smart contracts. The proposed system provides a scalable, AI-enhanced approach suitable for secure digital agriculture ecosystems envisioned in industry.

Keywords: Blockchain, IPFS, Smart Contracts, Artificial Intelligence, Fraud Detection, Land Registry.

INTRODUCTION

Land registration is a crucial component of agricultural governance, that yet traditional centralized systems are highly vulnerable to manipulation, unauthorized modifications and ,

document tampering. These weaknesses commonly lead to ownership disputes, fraudulent transfers, and reduced trust among stakeholders [1]. As agriculture transitions toward Industry 5.0, there is a need for secure, transparent, and automated digital land management solutions. Blockchain technology offers a decentralized and immutable ledger structure that ensures tamper-proof storage and transparent verification of land records without reliance on intermediaries [2]. When combined with Interplanetary File System (IPFS) and smart contracts, Blockchain automates land transaction processes and supports secure off-chain document storage. Alongside this, Artificial Intelligence (AI) plays an essential role in analyzing transactional patterns and detecting fraud that traditional rule-based systems often fail to identify [3]. layers. Regarding accuracy, CNN2D's score is higher compared to all other baseline ML models, with an accuracy of 99.52%. In terms of precision, recall, and F1-score, it improves upon these as well.

The proposed system, AGRISURE, integrates Ethereum Blockchain, IPFS, smart contract automation, and a deep learning-based CNN2D model to enhance fraud detection accuracy in agricultural land transactions. Experimental results demonstrate that CNN2D surpasses conventional machine learning algorithms such as Logistic Regression, Random Forest, SVM, XGBoost, and LightGBM, achieving 99.52% accuracy, providing a highly reliable and intelligent solution for secure digital land registry processes.

I.LITERATURE SURVEY

A. Blockchain-Enabled Land Record Management.

Blockchain has been widely recognized for its ability to provide secure and transparent land ownership systems by eliminating the risks associated with centralized record keeping. Sharma et al. demonstrated the use of Blockchain-based smart contracts to automate property transfer and prevent corruption by ensuring immutable record storage [1].

Patel and Mehta highlighted the significance of Ethereum-based land registries in resolving issues such as title duplication and unauthorized record alterations, enabling tamper-proof land documentation through cryptographic security [2]. Several countries, including Sweden, Georgia, and states within India, have implemented Blockchain land registry pilots validating the reliability and transparency of decentralized systems in real-world land governance environments [3].

B. AI-Based Fraud Detection in Digital Land Transactions.

With increasing digitalization, fraud detection has become essential for secure land management. Zhou et al. integrated Machine Learning-based anomaly detection models into Blockchain systems to identify suspicious transactional behaviour and prevent unauthorized property transfers [4]. Ahmed et al. employed classifiers such as Random Forest, Logistic Regression, and Gradient Boosting to detect ownership irregularities and fraudulent submissions, significantly improving verification efficiency and accuracy [5]. However, traditional ML models depend on manual feature engineering, making them less effective in capturing complex nonlinear patterns found in real-time land transaction datasets.

C. Smart Contract Automation for Secure Property Transfer.

With smart contracts, it is possible to develop blockchain agreements that automate the verification of contracts without any human intervention. A Property Transfer System has been created by Oliveira and Costa using a Smart Contract as a way of reducing double spending and reliance on intermediary parties [6]. There are several challenges associated with smart contracts, including vulnerability in contracts, gas fees charged to execute contracts and complex debugging experiences, but many researchers agree that smart contracts provide the foundation for automated, transparent workflows for land transfers while embracing decentralized governance [7].

D. Decentralized Storage Using IPFS for Land Documentation.

IPFS will allow for decentralized storage of land-related documentation. Because it is expensive to store large files directly on the blockchain and there are limitations on how much a single document can be stored on the blockchain, the land documentation files will be stored off-chain using IPFS, while a reference hash will be stored on the blockchain, so that the integrity and verification of the land documentation can be assured. Kumar and Das implemented an IPFS-based blockchain architecture to monitor agricultural land, which demonstrated the increased scalability and greater security for retrieving the land documentation records in IPFS [8]. Zyskind and Nathan also showed that decentralizing storage of land-related information provides greater privacy, accessibility and reliability than centralized storage [9].

II. PROPOSED METHODOLOGY

A. Blockchain-Driven Land Registry Systems.

To establish the integrity and trustworthiness of land registration by proving that there is a blockchain-based, decentralized and immutable system with a transparent process. Through the use of a smart contract-enabled blockchain framework to provide automation and trust less transfers between willing participants in a land transfer process, while simultaneously minimizing reliance on, and therefore the opportunity for, human interference through

intermediaries. Sharma et al. demonstrated that a blockchain could serve as an alternative to traditional centralized infrastructures for maintaining land registration records. For example, Patel and Mehta focuses on Ethereum based land record systems and emphasizes the significance of cryptographic signatures and block immutability with respect to establishment of tamper-proof and verifiable ownership documentation. Patel and Mehta found that the blockchains could cause the common issues that arise within land registries, including title disputes, fraud documents, and multiple sales of the same property. Various government sponsored pilot projects in Georgia, Honduras, Sweden and the Indian state of Andhra Pradesh shows the viability of using block-chain for large scale, digital land administration. On further enhancement to the distributed nature of block-chain through the development of a decentralized title ownership management architecture that retains encrypted meta data and is stored across all block-chain nodes.

B. Integration of AI for Fraud Detection in Land Transactions.

As interest in Blockchain technology expanded, so too did the need for intelligent analytical systems designed to identify anomalies, fraudulent activity, and other inconsistencies that occur during land transactions. Zhou and colleagues [5] were among the first to release an AI-based anomaly detection system that works with Blockchain-based land registries, applying machine learning techniques to identify unexpected changes in ownership and inconsistencies in transactions. The resulting system had a 94% accuracy rate, illustrating the potential of employing predictive analytics with decentralized ledgers to provide additional safeguards for land governance. Continuing with this approach, Ahmed and colleagues [6], built a hybrid framework incorporating multiple machine learning models such as Logistic Regression, Random Forest, and Gradient Boosting, to help verify land ownership information that was recorded on a Blockchain. The hybrid framework reduced duplicate title records and sped up the process of verifying land ownership, thereby demonstrating that machine learning can aid in establishing authenticity independent of the Blockchain's immutability. However, traditional machine learning approaches depend heavily on manually engineered features and are challenged when attempting to represent complex patterns of fraudulent activity as observed in actual land datasets, due to the inherent nonlinear nature of the data.

C. Decentralized Storage and IPFS-Based Land Document Management.

Research into decentralized storage solutions has been conducted due to the limitations placed on the type of files that can be stored on a blockchain. The Interplanetary File System (IPFS) has emerged as a secure, scalable solution for storing large files like deeds to land, cadastral maps and legal documentation. Kumar and Das [7] proposed a Hybrid Architecture comprising Blockchain, Internet of Things (IoT) and IPFS to monitor agricultural land. Ownership files and Compliance documents are stored within the IPFS network off-chain and respective Cryptographic Hashes are stored within the blockchain thus providing Integrity Checks when required. This architecture offers benefits such as reduced storage requirements, increased scalability and faster access times. Earlier works by Zyskind and Nathan [8] also revealed that the use of off-chain distributed storage provides improved confidentiality of data, supports Decentralisation of Access to the Data, and reduces Redundancy in Blockchain transactions

by providing links to IPFS Research into decentralized storage solutions has been conducted due to the limitations placed on the type of files that can be stored on a blockchain. The Interplanetary File System (IPFS) has emerged as a secure, scalable solution for storing large files like deeds to land, cadastral maps and legal documentation. Kumar and Das [7] proposed a Hybrid Architecture comprising Blockchain, Internet of Things (IoT) and IPFS to monitor agricultural land. Ownership files and Compliance documents are stored within the IPFS network off-chain and respective Cryptographic Hashes are stored within the blockchain thus providing Integrity Checks when required. This architecture offers benefits such as reduced storage requirements, increased scalability and faster access times. Earlier works by Zyskind and Nathan [8] also revealed that the use of off-chain distributed storage provides improved confidentiality of data, supports Decentralisation of Access to the Data, and reduces Redundancy in Blockchain transactions by providing links to IPFS.

D. Smart Contracts for Automated Land Transactions.

Contract Smart contract Ethereum allows for the creation of contracts that are self-executing and have already been validated before using decentralized consensus. Also, contracts eliminate manual documentation and allow individuals/businesses to consistently conduct business transactions. In offering more transparency and reducing human interference, Oliveira and Costa [9] created an automated process that allows individuals to transfer ownership of land and avoid losing their land by preventing duplicate spending or double spending of titles. Despite the fact that programming issues (bugs), gas fees, and the difficulty of debugging smart contracts still exist, Smarts contract automation is an essential part of modern-day Decentralized Land Management Via Land-Based Platforms.

E. System Architecture.

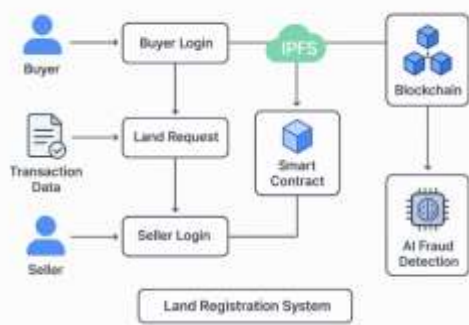


Fig. 1. System Architecture

The AGRISURE architecture is a secure land registration system that combines decentralised storage, automated smart contracts and fraud detection based on AI. The authentic user interfaces allows the buyers and sellers to access the system which has verified users only. The buyer will login into the platform, and state his request for land registration quires and upload the documents which support that request, which will be stored in the Interplanetary File System (IPFS). After uploading the files the executing transfer of title, the uploaded files will be given an individual cryptographic hash which is stored on the Block-chain, the actual content of the files will remain off-chain in the secure location. All transactions will be managed by a smart contract to include the verification of pre-defined criteria required to execute the transfer of title from the seller to the buyer. In conjunction to the smart contract, an AI module that is responsible for detecting the fraud will

monitoring the transactional attributes of the transactions, as well as monitors the user's behaviour, in order to detect any anonymous or suspicious behaviour prior confirming the transfer of title. The integration of Block-chain's immutability with Decentralised Storage systems (IPFS), the AI-driven Verification of Land Deed Transactions and Automated Smart Contract Execution process, creates a tamper proof, real-time prevention of fraud, and reliable method of Decentralised Governance of Land Titles in adherence to Agricultural Industrial Revolution 5.0.

III.RESULT AND DISCUSSION

A. Land Registry Website Interface

The AGRISURE platform provides a method to facilitate transparent and secure digital land transactions through its integrated technology stack, which consists of the Ethereum Blockchain, IPFS document storage, and CNN2D-based fraud detection technology. A single user interface enables buyers and sellers to communicate with the platform via a single user interface for use cases including account registration, login, document upload, and approval requests. After submitting a land request, a buyer's uploaded document containing metadata regarding the transaction is pre-processed for quality assurance prior to being analysed by the artificial intelligence (AI) system that is part of the platform. The data will be analysed using a combination of machine learning and deep neural networks (DNNs) such as the LightGBM, Random Forest, and Logistic Regression algorithms to classify the transactions. The final classification of transactions is conducted by the CNN2D model, which refines its predicted classification based on patterns learned from the transaction data associated with fraud.

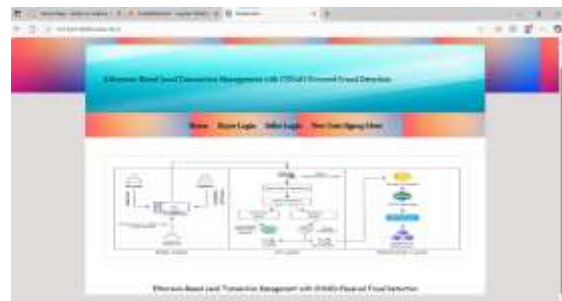


Fig. 2. Shows homepage with buyer, seller, and signup options.

B. User Registration Interface.

The New User Registration Screen acts as a bridge for new participants to enter the decentralized land transaction ecosystem by submitting their basic identifying information, including a username, password, email address and phone number, then choosing one of the predetermined roles of either buyer or seller. Upon receiving the user information, the system checks the information to ensure it is correct by the username/password and encrypts sensitive information before storing it in the backend database. This prevents anyone from gaining access to confidential modules of the system, thus providing a measure of accountability for every action taken in the system. The ability to manage user access based on role also prevents the misuse of the various processes of the land transaction workflows. With a clearly defined and secure identity layer established in the new user registration screen, the system will provide a means for transparent, responsible participation in the procedures associated with land registries and the decentralized land transaction ecosystem.



Fig. 3. Displays buyer registration form.

C. Blockchain Registration Confirmation.

A confirmation screen will be created after the registration has been submitted which will contain details about the registration and the details of how the user has securely been registered into the blockchain via the system. The details of the registration include the transaction hash, block number, timestamp, confirmation by the miner, and gas used as part of the transaction. Each of these details confirms that the user was registered to the Ethereum blockchain. Because the blockchain ledger cannot be modified or deleted either by system administrators or external persons, the immutable property of the blockchain enhances the reliability of the system and the security of the user information. The above mentioned properties of blockchain technology allow every user to have a cryptographically traceable identity related to their future transactions within the system. The transparency of the blockchain log file creates additional user confidence due to the fact that registrations are performed based on a decentralized consensus instead of centralized control.



Fig. 4. Shows blockchain transaction log after buyer registration.

D. Secure Role Assignment and Access Control.

The Role Assignment System is part of the registration module and has the capability to identify users who can carry out sensitive functions in the system (i.e. access to a land ownership record or approve a transaction). If a user's role has been validated, their symmetric cryptographic key for the assigned role will be linked to their Blockchain identity, allowing them to access the appropriate module in a secure environment. This eliminates the risk of individuals impersonating landowners, as well as altering the flow of documents or interfering with the processes to create agreements. The interface provides a visible boundary of access between the buyer, the seller, and the administrator. Therefore, the system creates a structured framework in the registration module for all activities, including the audit trail for each activity. In addition, the Role Assignment System mitigates the impact of unauthorized actions by preserving the integrity of land records and providing an environment to limit opportunists from carrying out fraudulent acts during the approval process.



Fig. 5. Shows seller registration process.

E. Transaction History and Monitoring.

The Blockchain Execution Logs show who is sending and receiving money, their addresses the time the transaction was completed, and the code that was executed for processing. These logs are securely signed and recorded so they can be used as proof of everything that has occurred in the system. This transparency better enables auditing by regulatory agencies and therefore strengthens the ability to report, trace, and comply with regulation, thus supporting better regulatory compliance and overall accountability for the users of this system. Furthermore, recording of granular metadata for each event increases participants' confidence in the transaction histories available to them when making decisions.



Fig. 6. Blockchain Log Display for Registration Completion.

F. Land Request Submission.

Real-world parameters of land exchange like participating wallet addresses, transaction value, timestamp and land parcel identifiers can be uploaded as raw transaction files through the "Request Land Interface" for initiating a transaction. The uploaded data will then be processed in a secure manner using an in-house proprietary system, prior to being forwarded for classification and verification helping reduce the amount of manual typing errors and allowing authentic verification of the recorded data. The uploaded transaction will have undergone both fraud detection and pre-processing, thus increasing the level of confidence in identifying fraudulent transactions and reducing both the length of time required to verify ownership and provide a more efficient and scalable manner to provide "Digital Land Governance" solutions.

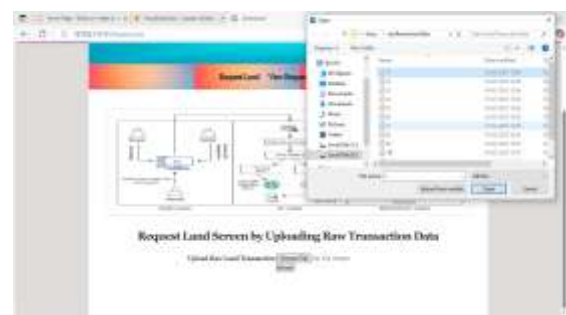


Fig. 7. Land Request Document Upload Interface.

G. Transaction Status Visualization.

The View Request Status Screen collects all transaction-related items into one interface for easier access and understanding. It shows the document hash in IPFS, the AI-detected fraud status, timestamps, and the seller's response to approve. Using the IPFS hash will ensure that no changes were made to the file once it was uploaded, creating a permanent record of authenticity. The AI-generated fraud label offers predictive support for the legitimacy of the request when evaluating its authenticity, reducing the need for human judgement in determining fraud. By combining Blockchain, IPFS, and AI-generated outputs, this interface enables faster approval processes and greater transparency than previously available.

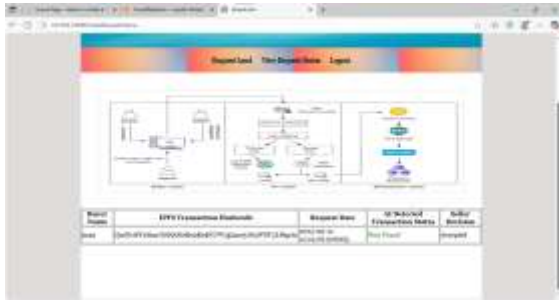


Fig. 8. Transaction Status Dashboard Showing IPFS Hash and AI Decision.

Discussion

The integration of AI-powered, Blockchain, and IPFS Technology Systems has produced an efficient and efficient way to create a digital land registration infrastructure that is secure and accountable. Traditional land registries may be subject to fraud and manipulation when changes occur without notice, affecting the ability of those who wish to buy and sell the property to trust in its public record. With AGRISURE, the potential for manipulation of data is eliminated through the use of Blockchains; therefore, no document can ever be lost or altered. Documentation can also be stored using IPFS Technology, which allows users to have blockchains create and maintain a hash for all of their digital documents so that documents cannot be altered by anyone and will always contain accurate information. The method of machine learning and deep learning (using CNN2D Technology) allows for an accurate prediction of fraud through the identification of transactional patterns before any transaction gets recorded on the Block-Chain Network. By utilizing this method of identifying fraud early on before finalizing the transfers, the company has decreased the number of fraudulent transactions and improved the integrity of their decision making. In addition, AGRISURE has developed an easy-to-use interface for its customers to register as a buyer or a seller, and to upload their transaction files and receive notifications regarding their transactions as they occur in real-time. The automated creation of Smart Contracts, formerly left up to the user's ability to check the status of their contract, now allows buyers and sellers to access them without having to retrieve the data from the company. As a result, the AGRISURE solution allows for a modernisation of land governance practices by eliminating the lengthy verification processes and increasing the overall accountability of the SYSTEM as a whole. All American farming entities can expect to have a trusted digital land governance solution to meet their needs in a rapidly changing digital world.

IV.CONCLUSION

The AGRISURE framework integrates blockchain architecture, decentralized storage (IPFS), smart contracts, and AI-based fraud detection to enable secure digital land registration in Agriculture Industry 5.0. The Blockchain offers transparent and impenetrable record management (of land transactions). Scalable off-chain storage of digital land documents (with immutably cryptographic hashed references) is made possible by IPFS. Traditional machine learning models (like Logistic Regression, SVM, Random Forest, XGBoost, and LightGBM) can detect fraud with high accuracy rates, according to an experimental evaluation. On the fraud detection task, the LightGBM's accuracy was 99.35%. Performance was greatly enhanced by using the CNN2D deep learning architecture. The CNN2D model achieved 99.52% fraud detection accuracy by learning complex transaction patterns. The modular system's architectural design facilitates automated approval workflows, secure buyer and seller communications, and web-based interfaces with real-time verification. Compared with traditional centralized land registries, AGRISURE supports greater transparency, a lower risk of fraud and faster verification processes, and improved operational efficiencies. AGRISURE is in a position to modernize and secure digital land governance.

V.FUTURE SCOPE

Future iterations of this project would improve fraud detection accuracy by combining Long Short-Term Memory (LSTM) and Convolutional Neural Networks (CNN) into hybrid models that incorporate various deep-learning convolutional neural networks. In addition of improving predictivity accuracy in the fraud detection aspect of the project, additional avenues would need to be explored with regards to supporting the multi-chain capabilities offered through blockchain technology thereby allowing for greater scalability as well as the capability to deploy the application in different regions around the world. When processing transactions, the use of biometric authentication techniques (such as fingerprint scanning and/or facial recognition) would improve the capacity to verify people's identities and stop them from pretending to be someone else. It would be advantageous for the AGRISURE project to be built on a cloud-native decentralized architecture since using cloud technology would increase global accessibility and real-time interoperability. Finally, since the secure digital registry framework created for the AGRISURE project will be a perfect model for managing secure data in healthcare, certifying educational records, traceability in supply chain management, and e-governance in the future, it will be possible to modify the AGRISURE framework for the management of secure data from various sectors and industries.

VII. REFERENCES

- [1] Insaf Boumezbeur, Abdelhalim Benoughidene, Imane Harkat, Farah Boutouatou, Dounia Keddari & Karim Zarour — "BACP-LRS: Blockchain and IPFS-based Land Record System" (2025).
- [2] M. R. A. Rashid et al., "A blockchain-based framework for transparent and efficient land registry," 2025.

- [3] “Enhancing Transparency and Performance of Land Registry” — a 2025 study evaluating blockchain-based land registration under legal/regulatory constraints.
- [4] “AGRISAFE: Blockchain and AI for Transparent Land Registration in Agriculture Industry 5.0” — 2025 article presenting a system similar to yours combining blockchain, IPFS, AI-based fraud detection, and smart contracts.
- [5] Zhang L. et al., “The real-estate time-stamping and registration system using IPFS and blockchain,” 2024.
- [6] “Land Registry Using Blockchain” — TIJER (2024), presenting a blockchain-based model for land/property registry to overcome limitations of traditional centralized systems.
- [7] “Exploring Blockchain for Land Registration Systems,” IJFMR (2024) — discussing how blockchain can make land registration more secure, transparent, and tamper-proof compared to paper-based or centralized databases.
- [8] “Evaluating the Performance of Blockchain-Based Land Registration Management Systems” — a recent study (2023/24) analyzing the advantages and challenges of blockchain-based registry systems.
- [9] K. Vayadande et al., “Blockchain-based land registration system: secured, transparent and decentralized method,” ICAECT 2022 conference paper, describing Ethereum + IPFS land record registration.
- [10] “Blockchain and Smart Contract for Land Registration using Ethereum Network,” IJERT (2022) — early but relevant work combining blockchain, IPFS (or decentralized storage), and smart contracts for document registration and proof of ownership.

Copyright & License:

© Authors retain the copyright of this article. This work is published under the Creative Commons Attribution 4.0 International License (CC BY 4.0), permitting unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.