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The Future of Farming: Farmease Blockchain-Based Solutions for Secure, Smart Agriculture

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ABSTRACT : This project focuses on building a comprehensive blockchain and AI-powered website designed to revolutionize the agricultural sector. It consists of five key modules: direct farmer-consumer communication for crop sales, a land leasing system connecting landowners and farmers, access to information on agricultural machinery for purchase or lease, AI-driven crop recommendations based on soil health, and disease-specific pesticide and fertilizer suggestions. By eliminating intermediaries and offering secure, transparent transactions, the platform ensures better profits for farmers and improved resource utilization. Additionally, the AI component enhances decision-making, promoting sustainable farming practices and higher productivity.

KEYWORDS: *Block Chain , Artificial Intelligence & Machine Learning , Support Vector Machines , Recommendation System.*

I. INTRODUCTION

The adoption of advanced technologies such as blockchain and AI offers a transformative potential for the agricultural sector. Blockchain ensures transparency and secure transactions, while AI provides data-driven insights to optimize farming practices. By combining these technologies, this project aims to bridge critical gaps in the agricultural ecosystem, enabling sustainable farming and direct farmer empowerment. The motivation behind this project stems from the pressing need to address the inefficiencies faced by farmers. By eliminating intermediaries, providing accessible tools for decision-making, and fostering a direct connection between stakeholders, this project envisions creating a more equitable and productive agricultural landscape. The goal is to not only enhance the lives of farmers but also contribute to global efforts towards sustainable agriculture.

Agriculture faces challenges like inefficient market access, lack of transparency, and resource utilization issues. This project introduces a platform that integrates blockchain for secure transactions and AI for intelligent recommendations. It facilitates direct communication, resource sharing, and data-driven farming practices, thereby enhancing productivity and profitability for farmer. Agriculture is the cornerstone of human civilization, yet it faces numerous challenges in the modern era, including inefficiencies in resource management, lack of transparency in market transactions, and limited access to modern technologies. These challenges hinder farmers from achieving optimal productivity and profitability, ultimately impacting food security and the global economy. Traditional farming practices often rely on intermediaries, leading to reduced profits for farmers. Additionally, processes like land leasing, access to agricultural machinery, and pest control lack centralized and efficient platforms. Existing solutions address these issues in soils but fail to provide an integrated approach.

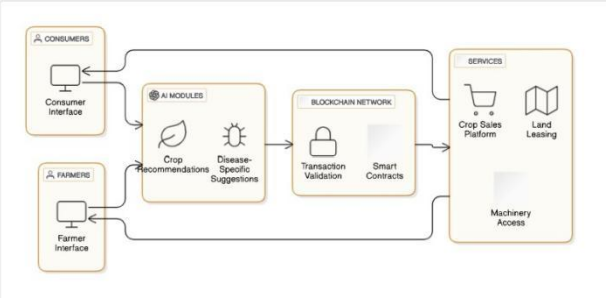

Fig:1

a) Problem Statement:

The agricultural sector faces numerous challenges that hinder the productivity and welfare of farmers. Key issues include the lack of transparent and secure systems for land leasing and machinery sharing, difficulty in assessing the next crop for cultivation, dependency on intermediaries leading to reduced profits, and limited access to personalized fertilizer recommendations. These challenges result in inefficient resource utilization, financial losses, and limited adoption of modern farming techniques.

It aims to address these issues by leveraging blockchain technology for secure and transparent transactions and AI algorithms to provide data-driven insights, empowering farmers to improve productivity and profitability.

b) Research and gaps:

- 1.challenges can be occur during the integration of blockchain and AI in the area of practical sense.

- 2.Making a multi-functional platforms scalable and easy for farmers to use is an area that hasn't been deeply explored because some farmers are not well educated.
- 3.Pest Management also fail to adapt to sudden, on-the-ground challenges like unexpected weather changes or pest infestations.
- 4. Farming conditions vary greatly from one region to another, yet many current solutions don't account for local differences in soil, climate, or crop health, limiting their usefulness to farmers in specific areas.
- 5. Developing a mobile-friendly platform with a simple design that's easy for small-scale farmers to use.

II. LITERATURE REVIEW

a) Theory Gaps:

- JAMALBEK TUSSUPOV, (2024) In this article, the author presented an analysis of formal concepts for verifying pests and diseases in crops using machine learning methods. Techniques like Logistic Regression, Vanilla CNN, and XGBoost are effectively employed to identify and classify harmful organisms and pathogens in crops.
- JOHN V. STAFFORD, ET. AL., (2024) In this article, the authors presented Farmease, a platform designed to provide crop information and disease solutions. It enables farmers to access crop data, lodge disease complaints, and stay updated on agricultural news, effectively addressing key challenges in the farming sector.
- SALONI BHAWAR, ET. AL., (2024) In this article, the authors presented a crop, fertilizer, and pesticide recommendation model using soil, image, and nutrient data. The model leverages technologies like CNNs and logistic regression to enhance soil analysis and enable early crop disease detection.
- RUCHI RANI, (2023) In this article, the author presented an analysis of the role of Artificial Intelligence in agriculture with a focus on plant diseases. The study highlights AI-based techniques such as CNNs, transfer learning, few-shot learning, and data augmentation for effective plant disease detection and advancements in agricultural practices.
- ILHAAM A. OMAR, (2023) In this article, the author presented a blockchain-based approach for crop index insurance in the agricultural supply chain. The study emphasizes the use of smart contracts to secure interactions among registered stakeholders, ensuring trust and security in the system.
- MRS. KEERTHI KETHENENI, ET. AL., (2023) In this article, the authors presented a system for crop, fertilizer, and pesticide recommendation using an ensemble method and sequential convolutional neural networks. The system provides farmers with data-driven recommendations on crop selection, organic fertilizers, and pest management, resulting in improved crop yields and reduced soil degradation.
- ARFAT AHMAD KHAN, (2022) In this article, the author presented an IoT-assisted context-aware fertilizer recommendation system. The study identified Gaussian Naive Bayes (GNB) as the most accurate machine learning model for providing effective fertilizer recommendations.
- AMANUL RAHIMAN SHAMSUDDIN ATTAR, ET. AL., (2022) In this article, the authors presented an intelligent crop and pesticide recommendation portal using machine learning and AI. The portal enables precision agriculture by optimizing crop and soil health for maximum productivity.
- SHOVON PAUL, ET. AL., (2019) In this article, the authors presented an unorthodox way of farming without intermediaries through blockchain. The platform's blockchain-based structure eliminates middlemen, empowering farmers and landowners to have greater control over their transactions while reducing costs.
- EMAN A AL-SHAHARI, ET. AL. (2017) In this article, the authors presented a system that uses Internet of Things (IoT) for plant disease detection and crop management. The system employs deep learning techniques like DenseNet-201 and RSNN for real-time monitoring and precise identification of plant diseases, helping in sustainable agriculture by improving crop management practices.

b) Literature Review

S.No	Year	Author's	Article	Key Findings
1.	2024	Jamalbek Tussupov , et. ,al	Analysis of formal concepts for verification of pests and diseases of crops using Machine learning methods.	• Logistic regression, Vanilla CNN, and XGBoost effectively identify and classify harmful organisms and pathogens in crops
2.	2024	John V. Stafford , et. ,al	Farmease – crop information and disease solution	• It enables farmers to access crop data, lodge disease complaints, and stay updated on agriculture news,

				addressing key pain points effectively.
3.	2024	Saloni Bhawar , et., al	Crop, fertilizer and pesticides recommendation model using soil, image and nutrients data	• Leveraging technologies like CNNs and logistic regression enhances soil analysis, early crop disease detection
4.	2023	Ruchi Rani , et.,al	Role of artificial intelligence in agriculture: an analysis and advancements with focus on plant diseases	• AI-based techniques, including CNNs, transfer learning, data augmentation, for plant disease detection.
5.	2023	Ilhaam A. Omar , et.,al	Blockchain-based approach for crop index Insurance in agricultural supply chain	• smart contracts to secure interactions among registered stakeholders, ensuring trust and security
6.	2023	Mrs.Keerthi Ketheneni , et.,al	Crop, fertilizer and pesticide recommendation using ensemble method and sequential convolutional neural network	• provides farmers with data-driven recommendations on crop selection, organic fertilizers, and pest management, leading to improved crop yields and reduced soil degradation.
7.	2022	Arfat Ahmad Khan , et .,al	Internet of things (iot) assisted context aware fertilizer recommendation	• Gaussian Naive Bayes (GNB) emerged as the most accurate machine learning model
8.	2022	Amanul Rahiman Shamsuddin Attar , et.,al	Intelligent crop and pesticide recommendation portal usingml and ai	• enabling precision agriculture by optimizing crop and soil health for maximum productivity.
9.	2019	Shovon Paul , et.,al	An unorthodox way of farming without intermediaries through blockchain	• The platform's blockchain-based structure removes the middlemen, giving farmers and landowners more control over their transactions and reducing costs.
10.	2017	Eman A. Al-Shahari , et.,al	Internet of things assisted plant disease detection and crop management using deep learning for sustainable agriculture.	• Techniques like DenseNet-201 and RSNN for real-time monitoring and precise identification of plant diseases

III. METHODOLOGY

a) Objectives:

- We use SHA-256 hashing algorithm for ensuring data integrity by generating unique hash for document.
- In this we are using the ECDSA for verifying authencity of land ownership, AES for protecting sensitive data ,consensus algorithm for verified nodes can add records.
- Our app is used by the farmers who are suffering with land leasing problems, suggestions for crop fertilizers.
- In this land owners and land tenants can login and can get the details of lands for leasing .

b) USED Methodology:

The Farmease project leverages blockchain and AI technologies to revolutionize agriculture through a user-friendly app.

we're creating a future where farming is more connected, efficient, and sustainable

Farmease is an innovative app that leverages blockchain and AI to connect farmers directly with consumers, facilitating the sale of crops without intermediaries. It also streamlines land leasing, provides access to modern machinery, offers smart crop recommendations, and delivers targeted pesticide and fertilizer information.

This comprehensive platform aims to empower farmers and promote sustainable agricultural practices.

It consists of five modules aimed at creating a secure, smart, and efficient farming ecosystem.

Direct Communication

- Farmers can connect directly with consumers to sell crops without intermediaries. They can list their crops and set prices, allowing for transparent transactions.

Land Leasing System

- This module helps urban farmers lease land from rural owners. It includes separate logins for landowners and farmers, facilitating easy communication and information sharing about available plots.

Access to Modern Machinery

- Farmers can discover the latest agricultural machinery for purchase or lease, along with local suppliers, enhancing operational efficiency.

Crop Recommendations

- AI-driven recommendations help farmers choose optimal crops based on soil nutrient needs, promoting better crop rotation and soil health.

Pesticides and Fertilizers Information

- Farmers can search for crop diseases and receive tailored recommendations for effective pesticides and fertilizers, supporting sustainable farming practices.

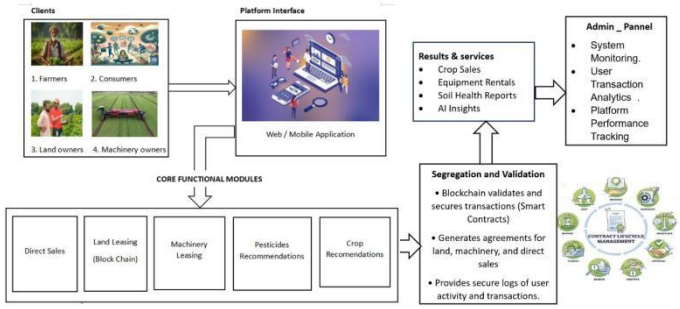

Fig:2

Hashing Algorithms (e.g., SHA-256):

- Ensures data integrity by generating a unique hash for each transaction or document.
- Any tampering with the land papers will change the hash, making alterations detectable.

Digital Signatures (e.g., ECDSA - Elliptic Curve Digital Signature Algorithm):

- Verifies the authenticity of land ownership.
- Ensures that only authorized individuals can sign or validate documents.

Encryption Algorithms (e.g., AES - Advanced Encryption Standard):

- Protects sensitive data by encrypting the land papers, ensuring only authorized parties can access them.

Consensus Algorithms (e.g., Proof of Authority or Proof of Stake):

- Ensures only verified farmers can add records about land ownership to the blockchain.

Machine Learning Algorithms:

- **Linear Regression**: Used for price prediction by analyzing historical trends and market data.
- **Decision Trees**: Helps recommend suitable crops based on soil conditions and nutrient levels.
- **Random Forest**: Enhances soil health prediction by combining multiple decision trees for accurate results.
- **K-Nearest Neighbors (KNN)**: Matches similar soil-crop data to suggest appropriate crops for rotation.

Geolocation and GIS Algorithms:

- Integrates real-time location data to find nearby resources (e.g., machinery suppliers) and assist in navigation.

Conclusion

Farmease aims to empower farmers, streamline agricultural processes, and foster a sustainable ecosystem by integrating these essential modules into one user-friendly platform.

IV. RESULTS & DISCUSSIONS

Crop Recommendation:

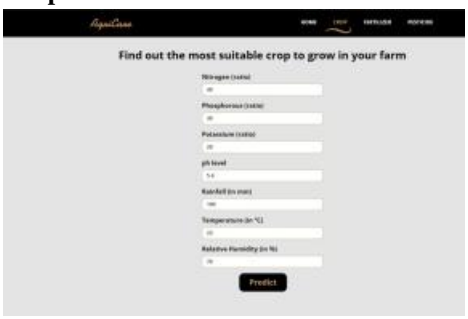

Fig:3

In our application,we provide the farmers with a template,where the farmer needs to fill the details regarding the soil,for the crop recommendation such as humidity,temperature,phosphorous,pH.So that the farmers will be Recommended with the crops that would suit their lands.

Fig:4

Here, the farmer has given the information as Nitrogen , Phosphorous , potassium , ph level , rainfall,temperature , relative humidity , all those details are analysed and the soil has the most features where the mangoes can be grown with more productivity.

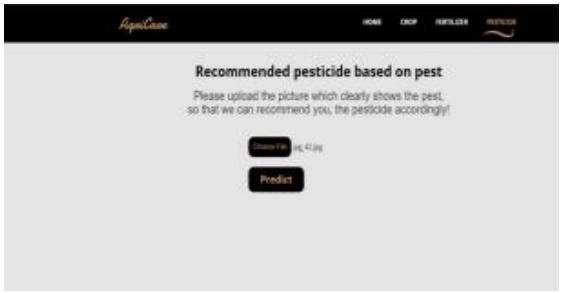

Fig:5

In our module ,we provide the farmers with a template,where the farmers needs to upload the image of the pest regarding the crop .So that the farmers will be Recommended with the Pesticides to be used that would suit their crops.

Fig:6

As a result ,when an image is uploaded of a leaf or pest ,then the pesticide is recommended which is suitable for soil and the plant .

Fertilizer Recommendation:

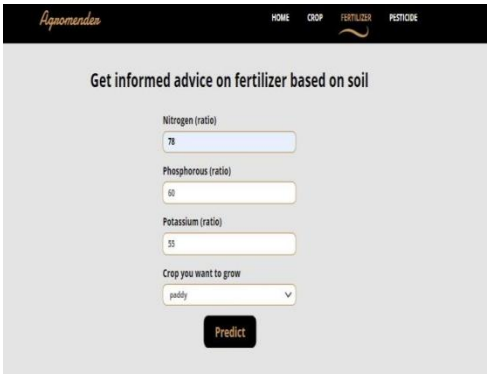

Fig:7

In this module ,for getting an advice on fertilizer farmer has to provide information as Nitrogen ,
phosphorous ,potassium ,and the crop name .

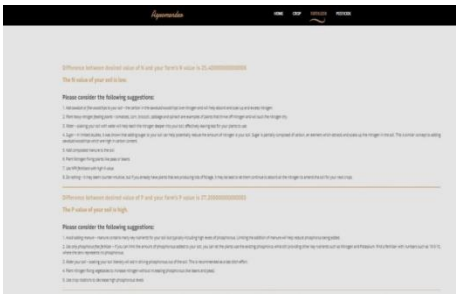

Fig:8

Based on the given information , farmers will get the detailed advice on fertilizers to be used based on the soil.

V. CONCLUSION

The Future of Farming project offers a comprehensive solution to enhance agricultural productivity and efficiency by leveraging blockchain technology and AI algorithms. Blockchain ensures farmers land documents safely stored and cannot be changed without permission. This gives farmers control over their own information . The AI system is used to predict the crop and fertilizers for the crop by uses advance models like CNNs. Blockchain helps ensure that these predictions are accurate and that the AI system's decisions can be trusted. Smart contracts can also automate the tasks land leasing process.By using techniques like SHA-256 for generating unique hash for every document, ECDSA for verify authority of ownership, AES algorithm encrypt document before uploading to blockchain, consensus algorithms for validate transactions, smart contracts for automate tasks for land leasing module. By using supervised , unsupervised , deep learning algorithms for predicting the crop and fertilizers.In the future we are going to extend this for collab with laboratories and conducting land fertility tests and providing more features to solve various agricultural problems.

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